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RICHARD RATHBUN,

*Assistant Secretary, Smithsonian Institution, in
charge of the United States National Museum.*

MARCH 12, 1917.

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¹ Date of publication.

KNOWLTON, F. H. A Lower Jurassic flora from the Upper Matanuska Valley, Alaska. No. 2158. December 16, 1916 ¹	Page. 451-460
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- PIERCE, W. DWIGHT. Studies of weevils (Rhynchophora) with descriptions of new genera and species. No. 2159. December 16, 1916¹ Page. 461-473
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- TOWNSEND, CHARLES H. T. New genera and species of Muscoid flies. No. 2152. October 28, 1916¹ 299-323
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DESCRIPTIONS OF NEW LEPIDOPTERA
FROM MEXICO

BY

HARRISON G. DYAR

Custodian of Lepidoptera, United States National Museum

No. 2139.—From the Proceedings of the United States National Museum,
Vol. 51, pages 1-37

Published October 16, 1916



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By HARRISON G. DYAR,

Custodian of Lepidoptera, United States National Museum.

This is the fifth paper describing new species of Lepidoptera from Mexico.¹ The Museum is indebted, as before, to Messrs. Roberto Müller and William Schaus for the material, also to Mr. B. Preston Clark for many fine things from a fresh region, and for one species to Mr. W. D. Kearfott.

The present paper comprises 111 new species, 3 new subspecies, 7 new genera, reference to the synonymy of one previously known species and one synoptic table.

Superfamily PAPILIONOIDEA.

Family RIODINIDAE.

Genus *CARIA* Hübner.

CARIA RABATTA, new species.

Wings with fulvous ground showing, the veins smoky-lined; basal, medial and terminal areas smoky, making the ground spotted; five lines of black spots across the wing between the veins, the fourth row becoming elongate, the fifth submarginal and round; a few leaden blue scales in the black marks, especially on the discal cross-vein and fourth row. Hind wing similar, with a line of leaden scales marginally beyond the last row of spots. Beneath dark fulvous, the inner area of both wings fuscous; black spots distinct and marked with metallic leaden, the basal rows somewhat confused. Expanse, 24 mm.

Type.—No. 18824, U.S.N.M.; Sierra de Guerrero, Mexico, November, 1913 (R. Müller).

IPIDECLA, new genus.

In Stichel's Table:² SC dreiästig; SC 1 weit vom Zellende ausgehend, mit C nicht verbunden.

¹The fourth paper is in the Proceedings United States National Museum, No. 2045, vol. 47, 1914, pp. 365-409, where references to earlier papers are given.

²Gen. Ins., fasc. 112A, 1910, p. 14.

Fore wing with vein 2 from near middle of cell; 3 and 4 approximate at lower angle; cell closed; 5 from middle of cross-vein; 6 at apex of cell; 7 and 8 absent; 9, 10, 11, free on the cell. Hind wing with the cell open; 5 from the middle of the obsolete cross-vein; 6 and 7 from the apex of the cell; 8 curved at base widely separate. Palpi with the second joint oblique; third porrect, lanceolate.

Type of the genus.—*Ipedecla miadora*, new species.

IPEDECLA MIADORA, new species.

Above gray-black, the basal half of fore wing and all of hind wing washed with blue-gray. Below bluish gray, veins of hind wing black; a patch at costa, base of hind wing and smaller one on fore wing bright orange. Expanse, 22 mm.

Type.—Female, No. 18825, U.S.N.M.; Sierra de Guerrero, Mexico, July, 1913 (R. Müller).

Family LYCAENIDAE.

Genus THECLA Fabricius.

THECLA ARINDELA RINDE, new subspecies.

Fore wing black; a broad metallic greenish blue area over the lower half of the cell to inner margin, extending outward roundedly to near tornus. Hind wing of the same blue, with a black border, broadest at the apex and running along the inner margin; a black line along the lower half of the margin with long scales at the anal angle; tail of vein 2 long, white-tipped. Beneath dull ash gray, slightly brownish; on fore wing a single band from costa to vein 2, blackish, white-edged without; a little irregular; on hind wing, faint dark specks subbasally above cell; outer line broken into segments, that between veins 4–5 outward, between 2–3 much outward, but continues thence to the inner margin, in-angled at veins 1–2; a subterminal silvery powdered band; a black spot at tornus and small submarginal red, black-centered ocellus between veins 2–3; a marginal black and white line. Expanse, 34 mm.

Type.—No. 19251, U.S.N.M.; Sierra de Guerrero, Mexico, December, 1910 (R. Müller).

THECLA SYNCELLUS SIERRAE, new subspecies.

Light blue above, fore wing blackish along costa, margin and broadly apically. Hind wing with the veins dark and the margin very narrowly so; black submarginal spots between veins 1c–2, 2–3; a black terminal line; tails black with white tips, the one at the end of vein 2 long. Below pale gray; fore wing with slightly oblique line from costa to vein 2, gray within, whitish without. Hind wing with an outer irregular, similarly colored line, the segment between veins

3-4, retracted, forming a blunt W on veins 1c and a submarginal gray line with whitish shadings; a bluish spot at anal angle preceded by white and a spot between veins 2-3. Expanse, 29 mm.

Type.—No. 19252, U.S.N.M.; Sierra de Guerrero, Mexico, January, 1913 (R. Müller).

THECLA SYVIX, new species.

Fore wing black; shaded with deep blue below cell nearly to margin; a large black stigma in the cell with a fainter area of raised scales beyond it toward costa. Hind wing black at costa, overspread with bright blue below; long tail at vein 2 white-tipped; an area of long scales at anal angle. Below, blackish gray; fore wing with a white band from costa to vein 2, then angled inward across submedian space; margin washed with white especially on costa half. Hind wing with a central white band that becomes expanded and triplicate across the end of the cell, curved below vein 2 and dislocated twice, but not forming a W. Margin broadly shaded with whitish, relieving small dark submarginal dots above; a red spot with black pupil between veins 2-3 rather far from margin. A small double red spot at anal angle; a marginal black line relieved by white at anal angle. Expanse, 27 mm.

Type.—Male, No. 19253, U.S.N.M.; Presidio, Mexico, December, 1913 (R. Müller).

THECLA MINNILES, new species.

Black, inner area of fore wing and all of hind wing except inner margin dull dark blue. Hind wing without tails. Below bright green; fore wing broadly gray along the inner area. Hind wing with an outer central line, black within, white without, broken into irregular curved segments, most retracted between veins 3-4 and 1c-2; a very faint white line at end of cell; a submarginal red spot between veins 2-3 and one at anal angle, each preceded by a black line, that at anal angle with some white also. Expanse, 20 mm.

Type.—No. 19254, U.S.N.M.; Sierra de Guerrero, Mexico, July, 1913 (R. Müller).

Family HESPERIIDAE.

Genus EUDAMUS Swainson.

EUDAMUS HYSTER, new species.

Bronzy brown; fore wing with yellow-hyaline spots; one in cell, a large one between veins 2-3, both square and indented, a small one below vein 2, these three in a line; a small one between veins 3-4 and a costo-subapical row of minute confluent dots. Hind wing with short rounded anal prolongation. Below, fore wing with spots repeated, the ground diversified with pale lilaceous especially submar-

ginally. Hind wing with a somewhat diffuse white line from costa to above anal angle, inclosing near its outer border brown spots of the ground, also between veins 5-6 and 7-8. Expanse, 40 mm.

Type.—No. 19255, U.S.N.M.; Sierra de Guerrero, Mexico, July, 1913 (R. Müller).

Genus THORYBES Scudder.

THORYBES PAUCIPUNCTA, new species.

Brownish black, the costal fold containing pale brownish scales; white dots small, punctiform; one in cell, one above vein 2 and costo-subapical row of three. Fringe of hind wing white except at apex. Below, hind wing dusted with gray with two submacular darker curved bands, stopping at anal area. Expanse, 38 mm.

Type.—Male, No. 19256, U.S.N.M.; Sierra de Guerrero, Mexico, July, 1913 (R. Müller).

Genus AMBLYSCIRTES Scudder.

AMBLYSCIRTES CATAHORMA, new species.

Brown-black, a little bronzy; an oblique black stigma from lower end of cell, to vein 1; nine small yellowish white spots, one in end of cell, one above vein 1, above vein 2, between veins 3-4, two farther out beyond end of cell and three costo-subapical. Hind wing with five small spots in a curved row beyond middle and a faint one in end of cell; fringe whitish. Below, fore wing with costa yellow for two-thirds, center of wing blackish, the rest olivaceous brownish. Hind wing olivaceous brownish, the spots repeated, white, and somewhat enlarged. Expanse, 30 mm.

Type.—Male, No. 19257, U.S.N.M.; Sierra de Guerrero, Mexico, July, 1913 (R. Müller).

Superfamily SATURNOIDEA.

Family SATURNIIDAE.

Genus HYLESIA Hübner.

HYLESIA OMEVA, new species.

Thorax dark brownish, abdomen banded with ocher tufts; wings pinkish gray; fore wing with two lines, brown, bordered with pinkish inwardly, straight, the outer a little incurved; discal mark a dark brown, somewhat annular shade; subterminal line faint, pale, ex-curved below and dentate on vein 2. Hind wing with discal ocellus, dull rosy with broad black ring, thinner on the inner side; an outer straight dark brown line; a submarginal broad gray shade, indented at vein 2 and submedian fold. Expanse, 48 mm.

Type.—Male, No. 19258, U.S.N.M.; Zacualpan, Mexico, January, 1914 (R. Müller).

Superfamily BOMBYCOIDEA.

Family SYNTOMIDAE.

Genus CHROSTOSOMA Hübner.

CHROSTOSOMA TABASCENSIS, new species.

Black; a crimson spot at base of patagia and a quadrate one at base of abdomen dorsally. Beneath, pectus and base of legs washed with sordid white; venter also white, the terminal segments apically black. Fore wing hyaline, veins and margins narrowly black, the apex more broadly so. Hind wing with vein 3 from 2 near margin, hyaline, veins black, the margin suffused with black. Expanse, 22 mm.

Type.—Male, No. 18826, U.S.N.M.; Teapa, Tabasco, Mexico, January, 1914 (R. Müller).

Genus ERIPHIODES Kirby.

ERIPHIODES FASTIDIOSA, new species.

Near *tractipennis* Butler, from which it differs in having no white at base of palpi; a white subdorsal spot on second segment of abdomen above the sublateral row, and white streaks along the anal area of hind wing below, showing less distinctly above; no red on back of head above, but lateral patches in the neck. Slightly smaller than *tractipennis*. Expanse, 37 mm.

Type.—Male, No. 18827, U.S.N.M.; Juan Vinas, Costa Rica, November, 1906 (W. Schaus); allotype, female, presidio, Mexico, November, 1913 (R. Müller); paratype, male, Los Amates, Guatemala, February 9, 1905.

Family LITHOSIIDAE.

Genus TALARA Walker.

TALARA SYNNEPHELA, new species.

Fore wing gray-white, a clouded black patch above anal angle; a slight shading subcostally. Hind wing and abdomen blackish. Hind wing with veins 3-4 stalked. Expanse, 14 mm.

Type.—Male, No. 18828, U.S.N.M.; Teapa, Tabasco, Mexico, September, 1913 (R. Müller).

GRUCIA, new genus.

Fore wing with vein 2 near middle of cell, 3 from its end, 4-5 stalked, 6 from the apex, 7-9 stalked, 10, 11 on cell, 11 joining 12 at the tip. Hind wing with vein 2 near middle of cell, 3-4 stalked, 5 absent, 6-7 stalked, 8 anastomosing with the cell at basal third. Palpi short, hairy, not reaching beyond the tongue. Male antennae prismatically biserrate, ciliate.

Type of the genus.—*Grucia monacheicauda*, new species.

Near *Gnamptonychia* Hampson, but without accessory cell.

GRUCIA MONACHEICAUDA, new species.

Dark slaty gray, the hind wing a little paler; anal tuft ocher. Expanse, 37 mm.

Type.—Male, No. 18829, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Genus CLEMENSIA Packard.

CLEMENSIA HOLOCERNA, new species.

Brown, a dark brown patch on costa before apex; lines indicated by ill-defined brown markings, the subterminal the most distinct, pale, and forming a whitish edge to the costal patch. Hind wing fuscus; anal tuft gray. Expanse, 13 mm.

Type.—Female, No. 19259, U.S.N.M.; Teapa, Tabasco, Mexico, March, 1914 (R. Müller).

Near *C. cernitis* Druce, but browner, the costa more strongly bent before apex, forming a slight prominence.

Family ARCTIIDAE.

Genus HEMIHYLEA Hampson.

HEMIHYLEA NIMBIPICTA, new species.

Thorax brown; abdomen rosy red dorsally. Fore wing shaded with black, in the male solidly, except three dorsal dull clay-colored patches on costa and a pink dash along middle of inner margin; in the female the bands faintly cross the wing and the terminal space is relieved by dully clay color at its inner portion. Hind wing rosy pink with gray brown along costa only. Expanse male, 59 mm.; female, 64 mm.

Type.—Male, allotype, female, No. 18830, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

HEMIHYLEA EUORNITHIA, new species.

Thorax brown; abdomen rosy red dorsally. Fore wing pale buff, semihyaline except on costa and margin; four broad, waved, smoky black bands, more or less interrupted across the disk, sub-basal, inner, median and outer; a mark on costa and inner margin representing subterminal band, leaving a wide clear subterminal space; termen broadly brown, with inner edge dentate on the veins. Hind wing hyaline, margin narrowly gray, inner margin broadly pink. Expanse, 49–54 mm.

Type.—Male, No. 18831, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark);

paratype, male, No. 18831a, U.S.N.M.; Guerrero, Mexico (through J. Doll).

Nearest to *H. daraba* Druce.

HEMIHYALEA RHODA Druce.

Phaegoptera rhoda DRUCE, Ann. Mag. Nat. Hist., ser. 6, vol. 3, 1894, p. 173.

Hemihyalea fuscescens ROTHSCHILD, Nov. Zool., vol. 16, 1909, p. 277.

I identify this form by the descriptions of Druce and Hampson, since the figure in the *Biologia Centrali-Americana* (pl. 74, fig. 17) is apparently misleading and indistinguishable from *daraba* Druce, except for the brown thorax, which varies. True *rhoda* (= *fuscescens* Rothschild) is distinguishable from *daraba* by being gray-brown, without any pure ochre, which appears at the bases of the wings and in the bands of *daraba*, even of the more hyaline variations. The determinations in the collection before me are much mixed.

HEMIHYALEA RHODA HIDALGONIS, new subspecies.

Differs from *rhoda* in having the pale bands slightly marked on both costa and inner margin, faintly traceable across wing. In *rhoda* the bands are occasionally marked on the costa but not on the inner margin.

Type.—Male, No. 18832, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Genus CALIDOTA Dyar.

CALIDOTA CLARCANA, new species.

Similar to *C. divina* Schaus; smaller, the pale markings on fore wing forming a series of small irregularly connected spots, those of subterminal line forming spots similar to the other lines, not diffused; wings uniformly darkened over the spotted ground, not in dark shades beyond the lines only as in *C. divina*. Hind wing spotted, the pale ground being crossed by mesial, outer and marginal pale gray bands, dentate, the outer two sometimes fused, but never the even border of *divina*, in which the mesial band is absent. Expanse, 47 mm.

Type.—Male, No. 18833, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Named in honor of Mr. Clark, who presented this and much other valuable material to the National Museum.

MANNINA, new genus.

Fore wing with vein 2 before the middle of the cell, 3 long before the end of the cell, 4—5 from the end of the cell, 6 shortly stalked, 9 from 10 anastomosing with 8 to form an accessory cell, 11 on the cell. Hind wing with vein 2 from the middle of the cell, 3 before

the end, 4-5 shortly stalked, 6-7 stalked, 8 anastomosing with the cell for over the basal third. Palpi reaching the front.

Type of the genus.—*Mannina hagnoleuca*, new species.

Falls with *Phryganopteryx* Saalmüller in the table, but the palpi are shorter and hairy below, while vein 7 of fore wings arises beyond 9.

MANNINA HAGNOLEUCA, new species.

Head, legs, venter of abdomen and anal tuft dark ocher; tibiae and tarsi black. Thorax and fore wing silvery white; a black costal edge on basal third; a dot on vein 1 beyond base; a row of dots at outer third parallel to outer margin, on the veins, heavy toward the inner margin, becoming weaker toward costa. Hind wing dull white with faint discal dot by transparency. Below, fore wing shaded with blackish except costa and inner margin; hind wing with discal dot and outer gray broken band. Expanse, 44 mm.

Type.—Female, No. 18834, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Genus TURUPTIANA Walker.

TURUPTIANA PANOEZYS, new species.

Creamy white, marked with black; broad stripe on collar, patagia and center of thorax; abdomen gray black. Fore wing with the veins and broad bands on discal and submedian folds creamy white, the rest black; the black forms a band on costa, broken at the origin of vein 8; a dash in upper part of cell; bands between veins from apex to vein 2, the one between veins 5-6 broken; a wedge-shaped spot below the cell; a streak above and below vein 1, not reaching the base. Hind wing creamy white with a few faint dark specks near the margin. Expanse, 34 mm.

Type.—Male, No. 18835, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

METACRISIODES, new genus.

Characters of *Metacrisia* Hampson, but head and thorax with much longer hair; vein 8 of hind wing arising before middle of cell, long and distinct and attaining costa; a high tuft of hair on vertex of head.

Type of the genus.—*Metacrisiodes pua*, new species.

METACRISIODES PUA, new species.

Antennae lengthily bipectinate, testaceous; thorax and abdomen soft mouse-gray. Fore wing mouse-gray, but in oblique light with an ocher cast. Hind wing darker gray. Below as hind wing above. Expanse, 45 mm.

Type.—Male, No. 18836, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Family NOCTUIDAE.

Subfamily AGROTINAE.

Genus AGROTIS Ochsenheimer.

AGROTIS ROSIFUNDA, new species.

Rosy brown; fore wing with terminal space broad, contrastingly plain; basal and median spaces filled with marks; subbasal half line double, black, dentate on subcostal; a black half ring in cell; inner line of four black cusps, preceded by a straight line and another segment before that below cell; claviform full, orbicular large, a little obliquo, reniform large, a little pointed inward on median vein, all three marks black-ringed and concentrically rosy brown within; outer line black, excurved over cell, denticulate on the veins, with a distant inner rosy brown duplication and followed outwardly by whitish, then a purple shade; a deep red patch on costa, not reaching apex; a narrow terminal brown band. Hind wing pale grayish straw-color, dull rosy on margin. Expanse, 40 mm.

Type.—Female, No. 18837, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Allied to *Agrotis oblata* Morrison.

Genus EUXOA Hübner.

EUXOA TETRATOPIS, new species.

Male antennae minutely ciliate. Fore wing lilaceous gray, over-spread with black in basal space, beyond inner line and in cell between the stigmata and in terminal space; costa broadly pale on basal half; stigmata large, full, pale; inner line pale, toothed on subcostal, outbent below vein 1, followed by the black, nearly filled claviform; orbicular indistinctly open to the pale costa; outer line angled on subcostal, strongly outbent, then regularly curved, double, the inner segment throwing dentations along the veins across the outer segment; subterminal line forming a dark triangle on costa, waved, dark; terminal space dark except at apex. Hind wing pale fuscous, veins and discal mark darker. Expanse, 37 mm.

Type.—Male, No. 18838, U.S.N.M.; Guerrero Mill, Hidalgo Mexico 9,000 feet (Mann and Skewes, through B. Preston Clark).

Genus EPISILIA Hübner.

EPISILIA PYRSOGRAMMA, new species.

Reddish gray with olivaceous cast; collar black on posterior half. Fore wing with the lines broad, pale, defined by faint darker edges, straight, the outer gently excurved above; costa, inner margin, fringe, a streak on submedian fold, dash in base of cell and centers of orbicular and reniform dull fiery orange; a square black spot between the stigmata is the only conspicuous mark; subterminal

line brown, macular. Hind wing tinged with fuscous, disk pale, fringe touched with dull fiery orange. Expanse, 44 mm.

Type.—Female, No. 18839, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Genus TRICHORTHOSIA Grote.

TRICHORTHOSIA ASELENOGRAPTA, new species.

Costa clayey grayish; a stripe of the same color below the cell, running out to subtermen along vein 2 and joining the costal stripe beyond cell; a velvety black wedge-shaped mark filling cell except at base; a short basal dash; a stripe along submedian fold beyond base to subtermen; a patch before subterminal line, with dentations along the median nervules; subterminal line straight, pale, followed by brown; termen slate gray with small black dots; fringe and inner margin purple gray. Hind wing fuscous, with dark discal point; termen narrowly dark; fringe paler. Expanse, 30 mm.

Type.—Female, No. 18840, U.S.N.M.; Guerrero Mill, Hidalgo Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

TRICHORTHOSIA CLARCANA, new species.

Ocherous gray; veins, especially the median, streaked with dark smoky; a dot for orbicular; reniform a white dot at origin of veins 3-5, partly surrounded by black; subterminal line straight, white, preceded by smoky; terminal space very narrow, with minute black dots. Hind wing fuscous with dark discal dot and pale line in base of fringe. Expanse, 30 mm.

Type.—Male, No. 18841, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Named in honor of Mr. B. Preston Clark, the donor.

Subfamily CUCULLIINAE.

Genus EUMICHTIS Hübner.

EUMICHTIS CHLOROSTICTA, new species.

Dark purplish gray, collar and spots on patagia and metathorax green. Fore wing with many green spots and black patches; basal space with a green line and spot; inner line fine, black, coarsely waved, followed by a black patch below cell; cell with alternating green and black, the stigmata large, green, but diffused and without bordering lines; outer line black, excurved above, finely dentate, followed by some green; subterminal line blotched, forming a patch above tornus, with an oblique green line within it; terminal dots black. Hind wing whitish at base, with dark veins and discal spot; an outer wavy dark line, beyond which the margin is blackish. Expanse, 36 mm.

Type.—Male, No. 18842, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Genus BRYOMIMA Staudinger.

BRYOMIMA CONTINENTIS, new species.

Fore wing red-brown, lighter, more ochreous on the inner half; lines black, slender; inner line strongly dentate-angled, a tooth above margin joined by a bar to outer line, a tooth on submedian fold, narrowly reaching outer line, lost in cell, a mark on costa; veins black lines; outer line regularly finely dentate, curved; the black vein lines stop just before the margin; a row of pale dots in base of fringe; reniform a white blotch on each side of the black discal cross vein. Hind wing whitish, veins dark; a discal spot and faint outer line; termen narrowly fuscous. Expanse, 29 mm.

Type.—Male, No. 18843, U.S.N.M.; Zacualpan, Mexico, August, 1913 (R. Müller).

Resembles *Amiana continens* Henry Edwards.

BRYOMIMA OZIPHONA, new species.

Dark reddish brown, shaded with blackish; basal space dark; inner line obscured; reniform white, narrow, with slender black central line; outer line black, angled on vein 4; termen broadly brown, without subterminal line. Hind wing dark fuscous, paler over the disk; discal mark, veins, and terminal line darker. Expanse, 29 mm.

Type.—Female, No. 18844, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Subfamily HADENINAE.

Genus MISELIA Hübner.

MISELIA DIMA, new species.

Fore wing dark lilacine gray, almost blackish; lines converging below, making the median space narrow, black-filled to submedian; a basal black bar to one-third of wing and a short one on submedian beyond outer line; orbicular and reniform large, pale, double-ringed but not contrasted; lines slender, black, the inner oblique, the outer excurved above; a dark triangular shade on costa beyond outer line; subterminal line obsolete. Hind wing white, stained with fuscous on apex and veins, especially on vein 2 outwardly. Expanse, 25 mm.

Type.—Male, No. 19260, U.S.N.M.; Zacualpan, Mexico, March, 1914 (R. Müller).

Genus HYDROECIODES Hampson.**HYDROECIODES PEXINELLA, new species.**

Male antennae bipectinate. Fore wing dark brown, showing red in the stigmata and subterminal space; lines dark brown; subbasal curved; inner bent subcostally and on median vein, but nearly straight, cutting the large, red, oval claviform in two; orbicular circular, red, brown-edged; mesial line strongly excurved, angled on vein 3 below reniform; reniform red, four white dots within, the first at the inner lower angle and a faint one at inner upper angle; outer line far out, excurved, denticulate, closely followed by the similar subterminal, the space below red, divided into spots by the veins; veins narrowly black, as is terminal line. Hind wing dark fuscus. Expanse, 29 mm.

Type.—Male, No. 18845, U.S.N.M.; Zacualpan, Mexico, August, 1913 (R. Müller).

Near *H. pexa* Schaus, but smaller, the male genitalia less prominent and small, the reddish spots in subterminal space narrower.

HYDROECIODES RUXIS, new species.

Male antennae bipectinate. Dark brown, without red tint in the stigmata; subbasal line curved; inner line bent at right angles on median vein; claviform and round orbicular slightly pale; median line bent at reniform; reniform with a white semicircular spot and two dots on lower side; outer line excurved, denticulate on the veins; subterminal space broad, slightly pale; subterminal line broadly irregular, bent in at veins 2 and 5. Hind wing dark fuscous; abdomen blackish dorsally, anal segment dull ocherous. Expanse, 28 mm.

Type.—Male, No. 18846, U.S.N.M.; Zacualpan, Mexico, September, 1913 (R. Müller).

HYDROECIODES CIRRAMELA, new species.

Fore wing reddish ocher, the outer half suffused with purplish; lines slender, the inner of three arcs, the outer lost in the purple shading; orbicular round, distinct, clear reddish; reniform quadrate, clear reddish, with five little white dots on the outer border and one in the lower inner angle; some reddish flecks along costa and three minute white specks toward apex; subterminal line showing reddish on upper half. Hind wing dark fuscous, veins darker; costal half faintly reddish. Expanse, 30 mm.

Type.—Male, No. 19261, U.S.N.M.; Zacualpan, Mexico, January, 1914 (R. Müller).

Genus *ERIOPYGA* Guenée.*ERIOPYGA RHODOHORIA*, new species.

Fore wing lilaceous, shaded with blackish in broad, ill-defined bands between the lines; lines brown, slender, single; subbasal curved; inner far out, outwardly oblique, a little excurved in its central third; outer line far in, excurved over the reniform, the lower segment straight; orbicular and reniform of the ground color, outlined in brown, the reniform with a black patch in the lower half; subterminal line smooth, slightly curved, less so than the margin, brown, followed by a narrow but distinct pink area, the most conspicuous marking on the wing; fringe dark. Hind wing blackish fuscous, the fringe pinkish. Expanse, 26 mm.

Type.—Female, No. 18847, U.S.N.M.; Zacualpan, Mexico, October, 1913 (R. Müller).

ERIOPYGA DESIOTA, new species.

Dark blackish purple; a dash in base of cell, outlines of orbicular and reniform and terminal space dull bronze; lines blackish, obscure; inner line of three arcs, outwardly oblique, single; outer line incurved above, dentate on the veins, obscurely doubled; orbicular round, reniform kidney-shaped, with a faint mesial shade below it. Hind wing fuscous brown, pale on the disk; veins and small discal spot darker. Expanse, 36 mm.

Type.—Female, No. 18848, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Allied to *E. crista* Walker, the male with the same large anal tuft.

ERIOPYGA TEBOTA, new species.

Blackish lilaceous; outlines of orbicular and reniform and terminal space dull bronze; lines black, clearly written; inner of three coarse arcs, joining a linear claviform; outer strongly dentate; orbicular round, reniform kidney-shaped, outlined in black; subterminal line of small sagitate marks, excurved subcostally and more slightly at discal area. Hind wing dark fuscous, disk pale. A large bushy anal tuft, as in *E. crista* Walker. Expanse, 42 mm.

Type.—Male, No. 18849, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

ERIOPYGA COMPLEXENS, new species.

Male without marked secondary sexual structures. Lilaceous reddish brown, the lines pale, clayey; orbicular a little oblique, reniform large, both dark-filled in pale rings; a reddish shade through the cell and on costa beyond outer line; lines simple, the outer pointed subcostally; a double row of dots beyond the outer line on veins 1-6; subterminal line pale, with a marked subcostal angle,

else straight; terminal space darkened, with a row of black terminal dots edged with lighter within; fringe dark reddish; general aspect of markings powdery and diversified. Hind wing blackish powdered, with a slight warm brown tint; fringe more reddish. Anal tuft light. Expanse, 31 mm.

Type.—Male, No. 18850, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Peston Clark).

ERIOPYGA REA, new species.

Male without marked secondary sexual characters. Pinkish brown, powdered with blackish; lines obscure; a dark shade near base, through center of wing and terminally; orbicular round, pale; reniform dark-filled, reddish above, blackish below, pale-edged; inner line marked by some black dots; outer line only slightly ex-curved, marked by black dots outwardly; subterminal line pale, smooth, bent in a little at veins 4-5 and slightly so subcostally. Hind wing pale fuscous, darker outwardly and on veins; fringe pale. Expanse, 27 mm.

Type.—Male, No. 18851, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

ERIOPYGA SIMPLEX, new species.

Warm purplish, powdery, the costa light reddish; stigmata and terminal space dark; lines faint, pale, simple, the outer ex-curved above; reniform moderate; orbicular small, dark, pale edged; subterminal line pale, conspicuous, smooth, evenly and regularly curved, parallel to the exterior margin. Hind wing dark fuscous; discal dot a little darker. Expanse, 28 mm.

Type.—Female, No. 18852, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

ERIOPYGA RUBIFER, new species.

Male without secondary sexual characters. Light pinkish, clear, with little irroration; claviform, orbicular and reniform covered by large rust-red stains; inner line black, double, broken, and powdery, forming two dots on vein 1; outer line broken, visible only below, followed by two series of black dots on the veins; sub-terminal line regular and even, parallel to the margin, fiery reddish, edged with brown; terminal space brown-shaded; terminal dots and fringe dark, the dots preceded by red cusps that form a dentate line. Hind wing blackish fuscous, veins and discal dot darker; ringe purple. Expanse, 30 mm.

Type.—Male, No. 18853, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

ERIOPYGA UMBRIFER, new species.

Male without secondary sexual characters. Apex of fore wing square, light ochereous; a broad brown-black shade below cell from near base to subterminal line, spreading up nearly to costa beyond cell, covering reniform; a narrow similar shade on termen; lines and spots obsolete except a row of dots on costa and the outer line of reniform, which is dark-filled and cut across by a pale ray; cell pale, with oblique boundary of the dark shade cutting across its end. Hind wing pale on costa; rest of wing overspread with dark fuscous; discal dot blackish. Expanse, 30 mm.

Type.—Male, No. 18854, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

ERIOPYGA MILIO, new species.

Light clayey grayish, shaded with blackish along costa, median shade and terminal space; lines blackish, the inner of three arcs; outer line dentate, the tips of dentations forming dots and obscurely doubled; orbicular lost; reniform black-filled, pale ringed, the ring on the upper half only and emphasized as light dots on discal fold; subterminal line faint, pale, irregular, near the margin; costa black-spotted, with three light dashes toward apex. Hind wing pale, apex, veins and terminal line fuscous; fringe pale. Expanse, 32 mm.

Type.—Male, No. 18855, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

ERIOPYGA NISIO, new species.

Clayey grayish, much overspread with blackish; costa to subtermen and over cell blackish; inner line of three slight arcs, pale, black-edged; orbicular round, pale with black edge and slight dark center; reniform moderate, pale and black ringed, black-filled, the lower edge open, with a white dot on each side above discal vein; outer line pale with a black edge, dentate on the veins and obscurely dotted black and white, incurved above reniform and sharply bent on costa; three pale dots on costa subapically; subterminal line pale, narrow, preceded by black cuneiform shades, large at veins 4–5, incised subapically, leaving a pale apical patch; termen blackish with pale dots in fringe. Hind wing dark fuscous; discal dot dark; fringe pale. Expanse, 27 mm.

Type.—Female, No. 18856, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

ERIOPYGA RATELUSIA, new species.

Dark gray, faintly violaceous; a broad median black shade runs into the reniform, which is solidly black-filled, then angled slightly on submedian fold; black shades following the subterminal line

subcostally and between veins 2-4; basal space marked with black; ordinary lines slender, black, dentate, obscure, the outer followed by white points on the veins, angled at subcostal and moderately drawn in; subterminal line vague, irregular; orbicular fragmentary, obscure. Hind wing dark fuscous. Expanse, 29 mm.

Type.—Female, No. 19262, U.S.N.M.; Zacualpan, Mexico, May, 1914 (R. Müller).

Genus NEPHELISTIS Hampson.

NEPHELISTIS OOMAE, new species.

Fore wing dark brown, nearly black; median space black-filled between the lines and stigmata, but not contrasted on account of the general dark color; lines double, slightly violaceous filled, oblique, approximated on inner margin, the outer curved over reniform and slightly dentate; orbicular and reniform large, similar, slightly violaceous, the reniform with a white speck outwardly; subterminal line faint, irregular. Hind wing fuscous, paler at base; a discal spot and curved mesial line. Expanse, 26 mm.

Type.—Male, No. 18857, U.S.N.M.; Zacualpan, Mexico, August, 1910 (R. Müller).

Subfamily ACRONYCTINAE.

Genus HOMOLAGOA Barnes and McDunnough.

HOMOLAGOA TRITOGRAMMA, new species.

White, palpi black; abdomen broadly banded with black dorsally. Fore wing with a black dot near base of costa, inner row of three, mesial row of three above median vein, followed by a line from vein 2 to inner margin. Hind wing lightly dusted with black outwardly and a faint mesial line. Below, fore wing heavily dusted with black except along inner margin. Hind wing white with large black discal spot, mark on outer third of costa and slight dusting outwardly. Expanse, 24 mm.

Type.—Male, No. 18858, U.S.N.M.; Sierra de Guerrero, Mexico, July, 1913 (R. Müller).

Nearly allied to *H. grotelliformis* Barnes and McDunnough.¹ Barnes and McDunnough place the genus in the Erastrinae, but I have preferred the Acronyctinae on general habitus, especially as some of the species of *Antapлага* show vein 5 of hind wing about as well developed as in *Homolagoa* and in much the same position.

¹ Can. Ent., vol. 44, 1912, p. 92.

Genus *ACHATIA* Hübner.*ACHATIA DOGMATICA*, new species.

Warm brown, the base, except center of base to reniform, and outer line shaded with blackish; a quadrate black patch on costa beyond outer line; a thick black dash on submedian fold from outer line to margin; inner line curved, arcuate below vein 1; clavi-form black-outlined; orbicular oblique, rather large, of the ground color with black rim; reniform pale, large, dissolved in a pale area, a lunate black patch within; outer line excurved above, sharply dentate, obscurely double; subterminal line lost except for a trace; slight terminal black streaks between the veins, especially at veins 3-4. Hind wing pale at base, fuscous outwardly with faint discal dot and outer line. Expanse, 38 mm.

Type.—Female, No. 18859, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Allied to *A. lacruma* Schaus.

CHALCAMISTIS, new genus.

Proboscis aborted, small; palpi obliquely porrect, the second joint with dense hair below, spreading hair above; front smooth; eyes large, round; thorax clothed with hair-like scales, the pro- and metathorax with spreading crests, patagia crested; abdomen with dorsal crest at base only. Fore wing with areole present; hind wing with vein 5 slightly below middle of discocellulars, only a little weakened. Male antennae simple.

Type of the genus.—*Chalcamistis autoplusia*, new species.

CHALCAMISTIS AUTOPLUSIA, new species.

Fore wing purple-brown, light purplish in a band beyond outer line; median space bright bronze, irrorate with dark; lines slender, brown, single, approaching each other on inner margin, the inner angled centrally, the outer slightly fluxuous; subterminal line angled, brown, fine, inconspicuous; orbicular and reniform bright bronzy, the latter followed by a black cloud. Hind wing lustrous fuscous, slightly bronzy. Expanse, 28 mm.

Type.—Male, No. 18860, U.S.N.M.; Zacualpan, Mexico, August, 1913 (R. Müller).

Subfamily ERASTRIINAE.

Genus *CERATHOSIA* Smith.*CERATHOSIA* (?) *OPISTHOCHRA*, new species.

Fore wing light rosy gray; a brown-gray outer shade-band, produced in two blunt teeth opposite cell. Hind wing orange ocher. Expanse, 11 mm.

Type.—Female, No. 19263, U.S.N.M.; Tehuacan, Mexico, September, 1913 (R. Müller).

The forelegs are missing in the specimen, so that the generic reference is tentative.

Genus ARAEOPTERA Hampson.

ARAEOPTERA VILHELMINA, new species.

Both wings with two marginal excavations; white, fore wing with very faint, slender, inner, median and outer lines, shown by black dots on costa; a black discal dot; subterminal shade blackish, broad, interrupted subapically and at vein 5; a row of black dots on costa toward apex; a terminal black line in the marginal excavations. Hind wing with similar markings, but much reduced; small discal dot, faint half line on inner margin, subterminal brown shade and short black line next anal angle. Expanse, 11 mm.

Type.—Female, No. 19264, U.S.N.M.; Teapa, Tabasco, Mexico, February, 1914 (R. Müller).

Genus COBUBATHA Walker.

COBUBATHA IPILLA, new species.

Smooth gray; median band broad, dark brown, edged with a white line; inner line erect, outer a little oblique above and angled slightly on submedian fold; a gray shade beyond outer line; discal dot small, black, just beyond the outer line; subterminal line blackish, irregularly wavy, indentate subcostally and discally and angled on submedian fold. Hind wing pale fuscous. Expanse, 16 mm.

Type.—Female, No. 19265, U.S.N.M.; Cuernavaca, Mexico, May, 1914 (R. Muller).

Near *C. hippotes* Druce, but with a distinct subterminal line.

COBUBATHA MUNNA, new species.

Fore wing with the basal half whitish gray, outer half silver gray; in the light basal part three gray shades start on the costa, and there is a brown band from inner margin to median vein, close to and parallel with the black line limiting the basal pale area; this line slender, black, dislocated where it crosses the position of the obsolete orbicular, angled on submedian and oblique below; in the dark outer part a slender, black outer line is strongly produced over cell, inclosing traces of the reniform; subterminal line faint, dark, waved, with a dark shade and black patches next costa. Hind wing pale, darker on margin. Expanse, 15 mm.

Type.—Male, No. 19266, U.S.N.M.; Teapa, Tabasco, Mexico, March, 1914 (R. Müller).

Close to *C. damozela* Dyar.

Subfamily MOMINAE.

Genus CHARADRA Walker.

CHARADRA PATAFEX, new species.

Fore wing rather more pointed than in *C. pata* Druce, costa straighter. Dark, with glaucous tint, especially in the lighter areas below orbicular and reniform and beyond subterminal line; inner line black, single, dentate on subcostal and submedian; orbicular black-ringed, with concentric brown inner ring; reniform large, dissolved in its pale glaucous area; outer line lost; a line runs from inner side of reniform to submedian, to a white speck at point of inner line; subterminal line black, strong at costa and margin, dentate and irregular, followed by glaucous whitish. Hind wing yellow, the outer half gray with straight edge; a darker spot before tornus. Expanse, 44 mm.

Type.—Male, No. 18861, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

CHARADRA OLIGARCHIA, new species.

Fore wing washed with dark brown to end of cell, terminating abruptly; rest of wing glaucous gray; inner line black, dentate subcostally and submedianly, touching orbicular; a purplish area over orbicular to the black linear claviform, above which is a whitish speck; orbicular itself elongate, large, open below, black-ringed, with brown center; reniform in a white space, diffused, its center brown, narrow, upright; outer line slender, dentate, running far in along subcostal, inbent on submedian; subterminal line brown, strong on costa and margin, wavy, followed by white; submarginal brown streaks subapically. Hind wing yellow, the outer half gray with straight edge. Expanse, 42 mm.

Type.—Male, No. 18862, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Subfamily NOCTUINAE.

Genus COENIPETA Hübner.

COENIPETA ENDOPOLIA, new species.

Fore wing black, from base to a line obliquely across middle, with broad tooth on vein 1 and small one on vein 2; another triangular black patch on costa subapically, reaching down to vein 3; area over reniform to tornus pale brown; margins darker; outer line fine, dark, wavy, far out; a subterminal row of black cusps. Hind wing brown with two outer, finely dentate, black lines; termen darkly shaded; subterminal markings as on fore wing. Expanse, 37 mm.

Type.—Male, No. 19267, U.S.N.M.; Sierra de Guerrero, Mexico, July, 1913 (R. Müller).

Genus BANIANA Walker.**BANIANA LODEBER, new species.**

Fore wing ochreous gray; inner line black, thick, broken into three segments, the costal one farther out; a black spot in cell just beyond; discal dot double, dark; outer line black, distinct, inwardly dentate on discal and submedian folds, followed by a deep purplish brown shade to the dentate subterminal line; termen of same light color as base of wing, with a fine wavy line in base of fringe; hind wing fuscous, becoming blackish outwardly. Collar dark brown; disk of thorax light. Expanse, 24 mm.

Type.—Female, No. 19268, U.S.N.M.; Teapa, Tabasco, Mexico, February, 1914 (R. Müller).

Genus PLEONECTYPTERA Grote.**PLEONECTYPTERA CONSOLATA, new species.**

Fore wing purplish gray; lines oblique, parallel; inner line faint, running from inner margin to across median vein, where it ends; outer line distinct, yellow, edged with dark brown without, straight from outer third of inner margin to costa before apex. Hind wing grayer and less smoothly colored than fore wing. Expanse, 33 mm.

Type.—Female, No. 19269, U.S.N.M.; Zacualpan, Mexico, October, 1913 (R. Müller).

Subfamily HYPENINAE.**Genus METALECTRA Hübner.****METALECTRA VIRIDESCENS, new species.**

Luteous clay-color, faded from glaucous green, a little of which still shows toward apex; marks powdery, black; inner line double, slender, obsolete above; median line double, broad, dentate on vein 1, crossing the lunate reniform; outer line double, dentate, powdery, the outer segment shaded; subterminal line irregularly shaded, blotched below middle of margin and at tornus; a row of terminal dashes. Hind wing with the lines blotched and obscured by extensive costal powdery patches that reach down across the cell. Expanse, 16 mm.

Type.—Female, No. 18863, U.S.N.M.; Teapa, Tabasco, Mexico, January, 1913, "Raupe auf Piltz" (W. Gugelmann, through R. Müller).

METALECTRA VIVIDIFER, new species.

Light purplish gray, shaded with rosy in patches in subterminal space; base of fore wing black-shaded, followed by a point of a claviform, rosy filled; median band broad, black, touching the curved reniform and fusing it to costa; outer line slender, incurved opposite

cell; terminal black shading, interrupted at veins 2-5. Hind wing blackish along costa, apex and a little at tornus; a broad, black median band and an outer line, looped out on disk. Expanse, 21 mm.

Type.—Male, No. 18864, U.S.N.M.; Sierra de Guerrero, Mexico, July, 1913 (R. Müller).

Family NOTODONTIDAE.

Genus NAGIDUSA Walker.

NAGIDUSA MYCOMBA, new species.

Glaucous gray, the abdomen blackish; fore wing irrorate with black, the subterminal line of large diffused spots between the veins; discal spot large; lines double, indistinct; inner line a little oblique, wavy; outer line similar, with dark clouds beyond cell and below vein 2; veins across terminal space black. Hind wing pale fuscous, irrorate; a pale mesial line shown on costa and tornus. Expanse, 42 mm.

Type.—Male, No. 18865, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Genus PSILACRON Felder.

PSILACRON HIDALGOA, new species.

Dark gray, slightly greenish, finely irrorate with black; discal mark lunate, black, stained with brown; a white patch on costa above; lines obscure, dark; inner line faintly double, dentate; outer line double and dentate; a straight row of small subterminal dashes between the veins, rather far from the margin. Hind wing whitish; costa and inner margin gray, cut by the remains of a pale outer band. Expanse, 46 mm.

Type.—Male, No. 18866, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

The type and another dwarf male have vein 7 stalked, and fall in *Psilacron*; three other males and one female have vein 7 from the end of the accessory cell and fall in *Heterocampa*. I think the latter genus will prove more acceptable, though I leave it in *Psilacron* for the present, as Mr. Schaus labeled a specimen with the above name and has sent specimens out under it.

Genus SCHIZURA Doubleday.

SCHIZURA TOMAEA, new species.

Near *S. deba* Druce (= *concinna* Smith and Abbot) and *semirufescens* Walker (*eximia* Grote), but not like *perangulata* Henry Edwards.

Fore wing rather narrow and emarginate at anal angle; yellowish through the middle, costa gray, inner margin violet reddish; discal dot small, round, black; costa with black streaks and dots on outer

half; median shade-line indicated; subterminal line also, faint, ochereous tinted, becoming black streaks above tornus and close to margin; purple inner area a little streaked; a slight black dash at base on submedian. Hind wing whitish over the disk with diffused, rather broad, gray border, forming a spot at anal angle. Expanse, 31 mm.

Type.—Male, No. 19270, U.S.N.M.; Zacualpan, Mexico, May, 1914 (R. Müller).

RIBALDIA, new genus.

Male antennae lengthily bipectinate, the tips simple; fore wing with a small tuft on middle of inner margin; vein 5 below apex of cell, accessory cell narrow, vein 6 from its middle, 7 and 10 from its end, 8-9 stalked; hind wing with vein 5 slightly above the middle of the cross-vein, 6-7 shortly stalked, 8 close to 7 to near end of cell.

Type of the genus.—*Ribaldia amatame*, new species.

RIBALDIA AMATAME, new species.

Tan-brown, finely irrorate with dark brown, the median space dark brown, with small elliptical discal spot of pale tan; lines brown, the inner a little irregular, the outer dentate on the veins; a subterminal row of diffuse blackish spots. Hind wing pale, whitish, costa and margins powdered with blackish, forming a darker spot at tornus; fringe pinkish. Expanse, 39 mm.

Type.—Male, No. 18867, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

SCEVESIA, new genus.

Male antennae plumose; palpi upturned, densely hairy in front, the third joint porrect and lying on the frontal hairs; legs hairy. Fore wing with vein 5 from below apex of cell, 6 very shortly stalked, 7-10 stalked, 11 on the cell; no accessory cell. Hind wing with vein 5 absent, 8 diverging from cell before middle.

Type of the genus.—*Scevesia broidricci*, new species.

Named for Mr. Herbert H. Skewes, one of the collectors for Mr. B. Preston Clark.

SCEVESIA BROIDRICCI, new species.

Collar clay-color and brown; disk of thorax dark gray; abdomen slaty gray with dark gray hairs at base. Fore wing rather dark gray; discal mark full, lunate, white, edged with black; subterminal row of small black dots between the veins parallel to outer margin and near it; some black blotches on basal half of wing, partly denuded in the specimen; outer line lost. Hind wing fuscous gray. Expanse, 47 mm.

Type.—Male, No. 18868, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Named for Mr. J. H. Broidrick, who assisted Messrs. Mann and Skewes in collecting.

Genus DATANA Walker.

DATANA HOLOPORPHYRA, new species.

Purplish, irrorate with brown; terminal space broad, pale, the margin touched with bluish; apical line depressed from apex, running to vein 4; lines weak, purple-brown, inner and outer moderate, the space between darkened, the median line obscure; outer line excurved gently in the center between veins 2-6; discal dot obscure, with some light bluish scales. Hind wing dark, purplish brown over a light color, the dark dusting dense, nearly complete. Expanse, 49 mm.

Type.—Male, No. 18869, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Family GEOMETRIDAE.

Genus TEPHRINA Guenée.

TEPHRINA CALIPOSIS, new species.

Light brownish, shaded and irrorate with purplish; lines nearly straight; inner slender; mesial running close to discal dot, which is round, black, followed by a purple shade; outer line slightly bent above, followed by a purple shade; a subterminal row of black dots between the veins; a terminal row of small dots. Hind wing clearer, more distinctly irrorate; inner line through the discal dot; outer line fused to a short purple shade; terminal dots as on fore wing. Expanse, 30 mm.

Type.—Female, No. 18870, U.S.N.M.; Zacualpan, Mexico, September, 1913 (R. Müller).

TEPHRINA CALLIOPE, new species.

Ground color almost white, a little grayish; densely brown-irrorate, the veins rather strongly lined; lines rusty brown, distinct, without purple shades, nearly straight, the mesial line cutting the upper end of cross-vein; outer line slightly flexuous; a terminal brown line. Hind wing with mesial line through the discal dot; outer line joined to a series of short rays along the veins; terminal line as on fore wing. Expanse, 27 mm.

Type.—Male, No. 18871, U.S.N.M.; Zacualpan, Mexico, May, 1913 (R. Müller).

Genus MACARIA Curtis.**MACARIA DA**, new species.

Dark gray; lines black, the inner broad to median vein and a spot on costa; outer straight to vein 6, broken and a dash of costa; discal spot annular and a spot on costa. Hind wing with faint subbasal and mesial lines and a small discal dot; also a faint, dentate, submarginal shade. Expanse, 19 mm.

Type.—Male, No. 19271, U.S.N.M.; Teapa, Tabasco, Mexico, January, 1914 (R. Müller).

Near *M. infimata* Guenée, but the outer line is straight.

Genus CYMATOPHORA Hübner.**CYMATOPHORA SUDELLA**, new species.

Grayish straw-color; inner line purplish, faint, blunt on subcostal; outer line showing a spot on costa, faint below, slender, nearly straight; a costal mark from subterminal line. Hind wing with a single line beyond the middle, fainter toward the inner margin. Below, fore wing gray, costa and hind wings strigose on a pale ground; a common extra-mesial dark line. Expanse, 25 mm.

Type.—Male, No. 19272, U.S.N.M.; Tehuacan, Mexico, June, 1913 (R. Müller).

CYMATOPHORA SPECIFICA, new species.

Light whitish straw-color; inner line brown, slender, bent a little on subcostal; outer line only a little beyond middle of wing, brown, excurved a little over cell and followed by a brown shade, diffused outward, but absent next the costal; a broad, subterminal black costal bar, diffused inward. Hind wing slightly more straw-color than fore wing, with a faint brown extra-mesial line. Expanse, 23 mm.

Type.—Male, No. 19273, U.S.N.M.; Tehuacan, Mexico, September, 1913 (R. Müller).

Genus MELINODES Herrich-Schäffer.**MELINODES IOBARRIS**, new species.

Densely irrorate with red over a pale straw-color ground; a purplish brown band along costa; inner line broad, purplish brown; outer line bent out at veins 3-5; followed by a broad brown band that sends a bar to margin centrally; discal dot a point. Hind wing with the line more strongly outbent centrally, its border narrower, but equally joined to margin by a bar. Head brown in front, the vertex yellow with red scales. Expanse, 27 mm.

Type.—Female, No. 18872, U.S.N.M.; Orizaba, Mexico, February, 1907 (R. Müller).

Genus CASBIA Walker.**CASBIA ALTERARIA, new species.**

Similar to *C. nicetaria* Guenée or *C. cermala* Druce, but the lines straight; inner and outer lines slender, straight; discal dot a point, preceded by a faint mesial line; basal and terminal areas darker, less violaceous than median space. Hind wing similar, the curved outline followed by a darker terminal space; discal dot a white point. Expanse, 27 mm.

Type.—Male, No. 18873, U.S.N.M.; Teapa, Tabasco, Mexico, February, 1913 (R. Müller).

Genus APICIA Guenée.**APICIA PORRIGARIA, new species.**

Male.—Fore wing dark, almost solidly mottled with brown; inner line curved, a little angled on median vein, brown, followed by a narrow, pale yellowish area; discal point black; outer line sharply angled subcostally, followed by a pale yellowish space that becomes broad below. Hind wing lighter, with pale yellow on costal half and beyond mesial line; lines straight, shortly beyond the discal dot, fading out toward costa. Expanse, 21 mm.

Female.—Darker, being without the pale yellowish areas, though the yellow lightening on costal half of hind wing persists. Expanse, 21–25 mm.

Type.—Male, allotype, female, No. 18874, U.S.N.M.; Zacualpan, Mexico, June, 1913 (R. Müller).

APICIA ANADIS, new species.

Yellow, slightly olivaceous, obsoletely irrorate; discal dot black; lines brownish, the inner bent on median vein, the outer running to vein 8, then angled, but not reaching costa, followed by a faint lighter area; two small dark spots in the upper part of terminal space. Hind wing with discal dot and single line, terminating before costa. Expanse, 32 mm.

Type.—Male, No. 18875, U.S.N.M.; Zacualpan, Mexico, July, 1913 (R. Müller).

Near *A. myandaria* Walker, but paler yellow, the costal dashes absent, the spots in the terminal space higher up. Lighter than any male *vibicaria* Cramer before me and without the dark ground of that species.

APICIA COMMOTA, new species.

Ground color straw yellowish, thickly mottled with purple patches, nearly solidly filling the terminal space; inner line brownish, bent on median vein, but curved, not angled; outer bent subcostally, well below costa and running to it distinctly; discal dot black; a dark clouding above anal angle. Hind wing with single mesial line, gently

curved, olive brown with a narrow following light area; mottlings finely strigose, heavier subterminally. Expanse, 29 mm.

Type.—Male, No. 18876, U.S.N.M.; Sierra de Guerrero, Mexico, July, 1913 (R. Müller).

APICIA VOLCANICA, new species.

Slaty gray, finely powdered with whitish outwardly; inner line bent at right angles on median vein, pale yellow, with narrow brown outer edge; discal dot black, with a trace of brown median line on costa above it; outer line straight, angled subcostally, reaching costa, brown, a brown radiation within, and a very distinct broad, pale yellow band without, ending at the subcostal angle; terminal space dark, in spite of the white powdering. Hind wing gray on inner area and margin, costal half or more of wing whitish; discal dot black; a short mesial line, less than half the wing, brown, with pale yellow beyond. Expanse, 30 mm.

Type.—Male, No. 18877, U.S.N.M.; Popocatepetl Park, Mexico, 8–10,000 feet, July, 1906 (W. Schaus).

Differs from all the species of the *vibicaria* group by the uncolored costal half of the hind wing.

APICIA YSSONE, new species.

Nearly solidly dark grayish, somewhat olivaceous within the outer line; inner line lost; discal point dark; outer line distinct, narrow, pale straw color, the line itself olivaceous brown, angled well below costa. Hind wing with a single line, curved in the middle, like the line on forewing; basal field olive gray as on fore wing; outer field slaty gray. Below, without lines, pale yellowish with faint, pale irrorations. Expanse, 28 mm.

Type.—Male, No. 18878, U.S.N.M.; Zacualpan, Mexico, September, 1910 (R. Müller).

APICIA MESENERICA, new species.

Olivaceous gray, washed with whitish shades; costa touched with brownish; lines appearing pale from the narrow, distinct edges, themselves olive brown; inner line bent at right angles on median vein; outer straight to costa without angle; terminal space mottled, a gray band rising from tornus to about middle, edged with pale without. Hind wing yellowish, like the paler parts of forewing; a gray half band from the margin, fading out toward costa; a mark from tornus as on forewing. Below immaculate yellowish. Expanse, 29 mm.

Type.—Male, No. 18879, U.S.N.M.; Cuernavaca, Mexico, May, 1911 (R. Müller).

Genus METANEMA Guenée.**METANEMA MARILACTA, new species.**

Both wings with a single point on the margin, not prominently scalloped. Pale straw-color or brownish with sparse, dark strigae; fore wing with two distant, straight, nearly parallel, brown lines; traces of subterminal line; a dark line on terminal edge; discal dot a point. Hind wing with a single straight line and traces of submarginal one. Expanse, 40 mm.

Type.—Female, No. 18880, U.S.N.M.; Zacualpan, Mexico, September, 1913 (R. Müller).

Genus CALLOPSIODES Warren.**CALLOPSIODES THINBALLA, new species.**

Fore wing with the margins scalloped, hind wings slightly irregular. Dark greenish brown, the veins brown to the outer line, where they are emphasized by white points; discal cross-vein white, with a tooth at vein 5 like Greek letter epsilon, in black; lines black, rather broad, a little clouded, the inner curved and waved; outer itself slender, projected at an angle above vein 4, preceded within by a broader duplication; terminal field mottled with yellowish in sagittate markings. Hind wing blackish, a little pale toward base; a faint, dark outer line, showing an angle opposite cell; a small light mark at tornus. Expanse, 35 mm.

Type.—Male, No. 18881, U.S.N.M.; Zacualpan, Mexico, October, 1913 (R. Müller).

Genus THERINA Hübner.**THERINA BLANDARIA, new species.**

Translucent, faintly brownish tinged. Fore wing with two faint lines, the inner a little curved, the outer slightly dotted on the veins; discal dot small, round. Hind wing with a single line. Wings faintly mottled with dark. Expanse, 26 mm.

Type.—Male, No. 18882, U.S.N.M.; Popocatepetl Park, Mexico, July, 1906 (W. Schaus).

Genus SELENIA Hübner.**SELENIA GIAVOR, new species.**

Fore wing lilaceous brown, finely irrorate with dark brown, that forms a shade before the line; no inner line; outer line pale yellowish, indented a little below middle, slightly recurved only at costa; a dark discal spot. Hind wing pale, a little yellowish, darker at anal angle; discal dot small. Expanse, 30 mm.

Type.—Male, No. 18883, U.S.N.M.; Popocatepetl Park, Mexico, June, 1906 (W. Schaus).

SELENIA AGATHA, new species.

Fore wing pale, faintly lilacine, finely powdered with dark brown, forming a narrow shade before the outer line; inner line very faint and narrow; discal dot small; outer line pale, slightly yellowish, diffused outwardly, the brown inner border slightly dentate on the veins; a trace of a dark subterminal line. Hind wing lighter, faintly straw-color, powdered with brown, especially about the margin and anal area; a trace of mesial line toward inner margin. Expanse, 27 mm.

Type.—Female, No. 18884, U.S.N.M.; Esperanza, Puebla, Mexico, April, 1911 (R. Müller).

Genus HETEROLOCHA Lederer.**HETEROLOCHA PARATHESA, new species.**

Yellow straw-color, mottled with ocher; discal dot round, dark brown; a few dark specks indicating outer line, which is inbent opposite cell. Hind wing with a discal dot and black specks indicating a mark on inner margin beyond middle. Expanse, 26 mm.

Type.—Male, No. 18885, U.S.N.M.; Zacualpan, Mexico, June, 1913 (R. Müller).

This is not improbably an immaculate form of *Spododes auranti-color* Dyar.

HETEROLOCHA AUTHADES, new species.

Brownish straw-color, with raised shining scales, finely brown-irrorate; lines slender, brown; inner line evenly curved; outer line inbent at disk and incurved below middle; discal dot oval, blackish. Hind wing with strong mesial line, excurved centrally; small blackish discal dot and faint, irregular outer line. Expanse, 25 mm.

Type.—Male, No. 18886, U.S.N.M.; Zacualpan, Mexico, May, 1913 (R. Müller).

Near *H. tomisa* Schaus, but the lines paler, the outer line much farther from the margin.

Genus LOBOPOLA Warren.**LOBOPOLA PLICATA, new species.**

Blackish, finely and coarsely mottled, both wings alike, the lines nearly lost in the general dark color; discal dot black on fore wing, white on hind wing; outer line of fore wing and mesial of hind wing coarsely sinuate; subterminal line of fore wing indicated by pale scales, of hind wing dark, sinuate. Beneath, pale brown, the fold on inner margin of hind wing streaked with blackish. Expanse, 22 mm.

Type.—Male, No. 18887, U.S.N.M.; Tehuacan, Mexico, August, 1913 (R. Müller).

Genus HYMENOMIMA Warren.**HYMENOMIMA DOGNINANA, new species.**

Gray, irrorate with black; a black spot on costa at inner line and before discal dot; inner line black, faint and powdery; traces of mesial line by dot at origin of vein 2 and a dash across vein 1; outer line distinct, strongly denticulate on the veins, scarcely excurved above; subterminal line powdery, irregularly flexuous; terminal dark spots between the veins. Hind wing with inner half line; discal dot small; mesial line like outer of fore wing and followed by a distant brown duplication; subterminal and terminal as on fore wing. Expanse, 34 mm.

Type.—Male, No. 18888, U.S.N.M.; Misantra, Vera Cruz, Mexico, August, 1910 (R. Müller).

Mr. Paul Dognin kindly examined the specimen and labeled it "nearest to *Hymenomima subnigrata* Warren."

Genus NESALCIS Warren.**NESALCIS NEBETTA, new species.**

Gray, powdered with black; inner line narrow, crenulate, indistinct, preceded by dull violaceous; an olive cloud on discal cross-vein; outer line black, dentate on the veins, followed by olivaceous patches on the veins; subterminal line pale, crenulate, near the margin; black terminal lunules in the excavations between the veins. Hind wing similar, without inner line, but with a small linear, black, discal spot. Expanse, 37 mm.

Type.—Male, No. 18889, U.S.N.M.; Cuernavaca, Mexico, June, 1906 (W. Schaus).

Close to *N. laeca* Schaus from Costa Rica, but larger, with darker ground color and less bright spots beyond the lines.

Genus AMPHIDASYS Treitschke.**AMPHIDASYS ANTENNATISSIMA, new species.**

Male antennae very heavy, long, strongly bipectinate. Fore wing square and broad; hind wing deeply crenulate on the margin. Dark brown, irrorate and shaded with black; fore wing with inner line strongly curved, preceded by a black shade below median vein; mesial line distinct, curved above, oblique below, crossing a small white discal dot; outer line produced centrally and dentate on veins 3 and 4; followed by a broad ochreous lightening that runs obliquely toward apex; terminal black spots between the veins. Hind wing similar; no inner line, the mesial crossing the discal dot; outer followed by a purplish black shade that fills in even to the ends of the dentations, then the lightening as on fore wing; traces of powdery whitish subterminal line. Expanse, 50 mm.

Type.—Male, No. 18890, U.S.N.M.; Cuernavaca, Mexico, June, 1912 (R. Müller).

Genus CAENOCHARIS Hulst.

CAENOCHARIS RHADINARIA, new species.

Fore wing elongate, apex sharp, outer margin oblique, stained with ochreous centrally (discolored?) and with blackish along inner margin, with very illy defined central shades; discal dot small; no lines. Hind wing whitish, suffused with gray on margin; a dark terminal line. Expanse, 40 mm.

Type.—Female, No. 19274, U.S.N.M.; Cuernavaca, Mexico, May, 1914 (R. Müller).

Genus EXELIS Guenée.

EXELIS MUNDARIA, new species.

Slightly yellowish gray; fore wing with inner line curved below costa and oblique, dark gray, irregular, faint; discal dot whitish in a distinct oval, black shaded annulus; outer line far from margin, oblique, denticulate, weak between the denticulations, submacular; faint traces of a dark, parallel, subterminal line. Hind wing yellowish toward costa with two lines as on fore wing; no subterminal line. Expanse, 28 mm.

Type.—Male, No. 18891, U.S.N.M.; Zacualpan, Mexico, May, 1913 (R. Müller).

Genus EOIS Hübner.

EOIS PANEREMA, new species.

Very dark gray, blackish, but with an overtint of gray; lines blackish, inner curved; mesial denticulate, beyond the black discal dot; outer dentate, submacular, followed by a narrow yellowish lightening; terminal area dark, divided evenly, the outer half grayish; a row of terminal black dashes; fringe with black interline. Hind wing similar, without inner line. Expanse, 17 mm.

Type.—Male, No. 18892, U.S.N.M.; Mexico City, Mexico, June, 1913 (R. Müller).

Similar to *E. cocaria* Schaus, but darker, the lines less contrasted, the outer line followed by a light area.

Genus CNEMODES Guenée.

CNEMODES MACULIMARGO, new species.

Reddish brown suffused over dark clay-color; lines blackish; inner line of two dashes; outer line obscure, reddish, excurved over cell; discal dot large, round, black; subterminal line nearly parallel to margin, of closely placed dashes; a row of large, round, black spots in terminal space, largest opposite disk and at tornus. Hind wing similar, discal dot occluded, narrow; subterminal line and spots as on fore wing. Expanse, 23 mm.

Type.—Male, No. 19275, U.S.N.M.; Mexico City, Mexico, April, 1914 (R. Müller).

Genus EUACIDALIA Packard.

EUACIDALIA NITIPENNIS, new species.

Fore wing uniform dark gray, a little bronzy, showing faintly a discal mark and straight outer line. Hind wing dark, the two emarginations of the outer edge distinct but not scalloped; a black inconspicuous terminal line on both wings. Expanse, 17 mm.

Type.—No. 18893, U.S.N.M.; Sierra de Guerrero, Mexico, July, 1913 (R. Müller).

Allied to *E. orbélia* Druce, but much darker and uniform in color.

Genus EUSTROMA Hübner.

EUSTROMA PHYLACA, new species.

Fore wing pale straw-yellow with brown lines; a brown shade on outer margin, obscuring the outer ones; a narrow, curved, subbasal line; inner line slender, curved, forming a point in the cell; median series of three lines, the inner of them straight from costa to median vein, bent at right angles and straight to vein 1, then bent again and straight to margin; the other two lines in general parallel but fainter, less rigid and somewhat suffused together; outer series of three lines, of which the outermost is the strongest, zigzag, but less angled than the median series, becoming crenulate below and even forming rings with the outermost line of the median series below the cell. Hind wing pale straw-color with two half lines on inner area; anal angle stained with brown. Expanse, 31 mm.

Type.—Male, No. 18894, U.S.N.M.; Zacualpan, Mexico, October, 1913 (R. Müller).

Genus CHLOROPTERYX Hulst.

CHLOROPTERYX JALAPATA, new species.

Thinly scaled, dull green over pale gray; lines greenish, a trace of white edge to the outer only; a discal dot on hind wing; outer margin produced. Expanse, 18 mm.

Type.—Male, No. 19276, U.S.N.M.; Coatepec, Mexico, May, 1914 (R. Müller).

Without distinct white areas as in *productaria* Herrich-Schäffer and *clemens* Warren; uniformly clouded like *albidata* Warren and *obvidaria* Schaus, but uniformly greenish, not white.

Genus COENOCALPE Hübner.**COENOCALPE AGAPETICA, new species.**

Fore wing pulverulent red-brown upon rusty yellowish, showing two parallel, curved, broad shades of the paler color. Beneath, the hind wings are powdered with red-brown and show a faint, darker, diffusely powdered mesial band. Expanse, 28 mm.

Type.—Female, No. 18895, U.S.N.M.; Zacualpan, Mexico, June, 1913 (R. Müller).

Genus ANAPALTA Warren.**ANAPALTA BAPTOPENNIS, new species.**

Fore wing reddish gray, especially rosy along outer margin; apex shaded broadly with dark brown, black along margin and a broad submarginal band, which becomes obsolete below the dark apex and reappears, narrower at tornus; base dark gray to just beyond the inner band, which is broad and blackish; discal mark faint, the median area broad and unmarked; outer line curved, narrow, broken and dotted below. Hind wing reddish gray, with faint, small, discal dot and dark terminal line. Expanse, 23 mm.

Type.—Female, No. 18896, U.S.N.M.; Zacualpan, Mexico, July, 1913 (R. Müller).

Somewhat resembles *A. immixta* Dognin from Colombia.

Genus PSALIODES Guenée.**PSALIODES EUPLANETA, new species.**

Fore wing olive yellowish, shaded with brown through median space and more faintly outwardly; base narrowly black, limited by a white, wavy line; a narrow median black band, coarsely sinuous, edged with white, attenuated in its bend at median vein, the white edgings in part black-edged; a black patch at apex with a point directed toward cell. Hind wing grayish, with faint discal dot and half line on inner margin. Expanse, 19 mm.

Type.—Female, No. 18897, U.S.N.M.; Zacualpan, Mexico, July, 1913 (R. Müller).

PSALIODES MONAPO, new species.

Dark reddish brown; basal area brown-black, limited by a broken white line; median band broad, brown-black, broadly sinuous centrally, edged with powdery white; a dark patch on outer margin at apex, edged above by a faint, white line, which proceeds downward, broadly sinuous, as a subterminal line. Hind wing dark gray with discal dot and faint shaded half line. Expanse, 22 mm.

Type.—Female, No. 18898 U.S.N.M.; Zacualpan, Mexico, October, 1913 (R. Müller).

Allied to *P. crispa* Druce.

Superfamily TINEOIDEA.

Family NOLIDAE.

Genus ROESELIA Hübner.

ROESELIA CLARCIANA, new species.

Fore wing light gray, more whitish at base and above cell; a black patch on costa at base widening triangularly; a black median shade, covering orbicular and half of reniform, widening in an arc to outer line, thence wide but fainter to inner margin; outer half of reniform white, without border; outer line excurved over cell, double throughout except immediately at costa; subterminal line dark, shaded, irregular, followed by whitish; a row of black dashes around apex and outer margin. Hind wing pale gray, lighter on costa. Expanse, 29 mm.

Type.—Female, No. 19277, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes, gift of B. Preston Clark).

Named in honor of Mr. B. Preston Clark.

Family COCHLIDIIDAE.

Genus EUCLEA Hübner.

EUCLEA IMMUNDARA, new species.

Ground color light, many scales erect, the dark brown ones predominating only at base; a pale mustard-yellow patch at apex and beyond the median half line; fringe pale below vein 3, except a dark tuft at tornus; half line silver, raised, an angle on submedian vein and on vein 1, concave between; subapical scale-dots on veins 6 and 10 and a streak between 7-9; veins dark brown outwardly; discal dot erect, dark brown. Hind wing brown with pale mustard-yellow fringe, tipped with brown at anal angle. Expanse, 23 mm.

Type.—Male, No. 18899, U.S.N.M.; Teapa, Tabasco, Mexico, November, 1913 (R. Müller).

The species of *Euclea* most nearly allied to this one may be separated as follows:

Fore wing with a pale ray along vein 1, the subbasal silver marking not crossing it.

Line on vein 1 silvery; subbasal line oblique, not, or slightly, dentate.

subspecies *trichathdota* Dyar. (*distrahens* Dyar.)

Line on vein 1 at most pale; subbasal line toothed.

Subbasal line uniform as to submedian fold, forming similar marks above and below it.

Subbasal line epsilon-shaped, forming full arcs, the upper sometimes running out along vein 2.....*diversa* Druce.

Subbasal line cusp-shaped, the arcs abbreviated above and below.

cuspostriga Dyar.

Subbasal line looped, a tooth on submedian and deep sinus below, the arm above reduced to a line.

Dark brown; pale purplish patch on disk small or obsolete; discal spot not contrasted.....*buscki* Dyar.

Less dark; pale purplish patch on disk distinct, triangular; discal dot round, contrasted.....*baranda* Schaus.

Fore wing with subbasal silver line crossing vein 1.

Wing rough-scaled; a yellow patch at apex and beyond subbasal line.

immundara Dyar.

Wing smoothly dark-scaled; a straight line from subapical mark to vein 2 inclosing discal purplish patch.

Subbasal silver line outwardly arcuate across vein 1, no tooth.

retroversa Dyar.

Subbasal line angled on vein 1, forming a shallow cusp above and below it.....*vericruz* Dyar.

E. agchistropa Dognin and *E. lamora* Dognin belong to this group, but I have only figures of them and can not place them satisfactorily. *E. poasica* Dyar has so nearly lost the silvery marks that I can not decide to which group it is nearest. It is not likely to be confused, however.

Family DALCERIDAE.

Genus ANACRAGA Dyar.

ANACRAGA GUGELMANNI, new species.

Fore wing orange, the termen narrowly yellow; a large gray discal patch running down centrally to near inner margin, lightened with reddish in the center of the wing. Hind wing orange, with yellow edge. Expanse, 11 mm.

Type.—Male, No. 19278, U.S.N.M.; Teapa, Tabasco, Mexico, March, 1914 (R. Müller).

Near *A. mesoa* Druce, smaller, the dark patch of fore wing smaller and paler and pale-centered.

Named in honor of Mr. W. Gugelmann, Mr. Müller's collector in Teapa.

Family THYRIDIDAE.

Genus DYSODIA Clemens.

DYSODIA HYPOTHYRIS, new species.

Body rather slender, wings broad; discal cross-vein practically obsolete on both wings. Black, slightly bronzy; some square, yellowish, reticulated spots along costa and centrally below cell of fore wing, in a dark-centered median band on hind wing; a large white-hyaline discal spot on each wing, that of fore wing oval, of hind wing rounded quadrate, emarginate without. Beneath violaceous, discal spots repeated; fore wing with two black bands and scattered strigae. Expanse, 15 mm.

Type.—Male, No. 18900, U.S.N.M.; Sierra de Guerrero, Mexico, July, 1913 (R. Müller).

Family PSYCHIDAE.

Genus CHALIA Moore.

CHALIA ZACUALPANIA, new species.

Fore wing with 11 veins, veins 4-5 from a point, 6 below apex of cell, 7-9 stalked, 9 and 10 on cell. Hind wing with 7 veins, a bar between vein 8 and cell inclosing a large basal cell. Wings gray, thinly scaled. Expanse, 22 mm.

Type.—Male, No. 19279, U.S.N.M.; Zacualpan, Mexico, March, 1914 (R. Müller).

Nearest *C. viciasia* Schaus, much larger and less transparent.

Family PYRALIDAE.

Subfamily PYRAUSTINAE.

Genus MEGASTES Guenée.

MEGASTES ROMULA, new species.

Dark gray-brown; fore wing of this color to near outer line, lightened by a yellow-brown suffusion in lower part of median space and outer part of basal area; inner line curved, brown, angled on vein 1; two quadrate white spots in cell; two little spots at each side of base of vein 2; outer line excurved from costa to vein 2, then looped up to end of cell, again oblique to margin, preceded by large white spots between the veins above the loop, followed by smaller ones below it; outer area largely white, a dark-brown patch on margin between veins 4-7 and one rising from before tornus, shaded outwardly and joined to the other patch by a shaded, cusp-shaped subterminal line. Hind wing with large brown discal spot and dash from it to tornus; two outer lines, quadrately scalloped on the veins, the inner joined along vein 2 to the dash, the outer lost at vein 2. Expanse, 46 mm.

Type.—Male, No. 18901, U.S.N.M.; Zacualpan, Mexico, January, 1912 (R. Müller); paratype No. 18901a, from the same locality and source, January, 1914.

Close to *M. brunnetalis* Dyar, but of a different color and the terminal markings more open.

Genus ISCHNURGES Lederer.

ISCHNURGES MICROCHROIA, new species.

Fore wing pale yellow, marked with pink; a stripe along costal edge to the distinct dark reniform; outer and subterminal powdery lines, slightly curved and parallel to margin, the terminal space sparsely powdered, thicker toward apex. Hind wing straw-whitish. End of abdomen tinged with pink. Expanse, 22 mm.

Type.—Female, No. 19280, U.S.N.M.; Guerrero Mill, Hidalgo, Mexico, 9,000 feet (Mann and Skewes; gift of B. Preston Clark).

Genus **BOEOTARCHA** Meyrick.

BOEOTARCHA LITHOCYMALIS, new species.

Fore wing silvery white, marked with dark grayish brown; costa and inner margin narrowly dark, termen more broadly so, widening to anal angle; basal space dark; a large spot in cell and one below across submedian space; a large spot at end of cell fused to costa; outer line slender, brown, dentate on the veins, curved above, retreating across submedian space. Hind wing subhyaline whitish, termen narrowly brown. Expanse, 18 mm.

Type.—Male, No. 19281, U.S.N.M.; Teapa, Tabasco, Mexico, February, 1914 (R. Müller).

Subfamily **CRAMBINAE**.

Genus **CRAMBUS** Fabricius.

CRAMBUS CHALCOSTOMUS, new species.

Fore wing white, tinged with yellowish and densely powdered with black atoms, showing clear white only in cell and a ray on basal half of submedian fold; discal spot black; cell bordered internally with black; short black rays between veins 2-5; termen narrowly yellow, with subterminal row of leaden dots and terminal row of black ones; fringe metallic silvery. Hind wing gray, with pale fringe. Expanse, 27 mm.

Type.—Male, No. 19282, U.S.N.M.; Esperanza, Mexico, April, 1911 (R. Müller).

Kindly compared with material in the British Museum by Mr. William Schaus.

CRAMBUS HARPIPTERUS, new species.

Fore wing light brownish, indistinctly streaked on the veins, darker along costa and lighter toward inner margin; a broad white subcostal band edged with brown, narrowing submarginally and only narrowly and diffusely reaching the outer margin; outer line curved, white, edged with brown within, marked by a little white before and beyond at costa; a terminal brown-black line. Hind wing whitish, smoky grayish on costal third. Expanse, 22 mm.

Type.—Male, No. 18902, U.S.N.M.; Real del Monte, Hidalgo, Mexico (Van Ostrand through W. D. Kearfott). A series of thirty-seven in all from this locality and six from Tehuacan, Puebla, Mexico, October, 1910 (R. Müller).

Male antennae slightly thickened and flattened. Fore wing with vein 7 given off farther from the apex than 9; 11 anastomosing with

12; hind wing with veins 4-5 stalked. Fore wing with the apex strongly falcate, pointed.

A specimen was determined by Mr. Schaus as *Crambus nergaellus* Druce; but I recognize as *nergaellus* specimens from Popocatepetl Park, Mexico, in which the white stripe runs through uniformly to margin and there is no outer line. In these vein 11 does not anastomose with 12, but is curved and approximate to it.

Genus IESTA Dyar.

IESTA ADULCIA, new species.

Fore wing pale straw-color, with two outer, oblique, wavy, pale brown lines, converging a little toward costa and somewhat suffused along the veins; small discal dot and terminal dots black. Hind wing whitish. Expanse, 16 mm.

Type.—Female, No. 19283, U.S.N.M.; Teapa, Tabasco, Mexico, January, 1914 (R. Müller).

IESTA MOROBE, new species.

Fore wing pale, with brown shades along costa, mesially, and at tornus; lines remote from margin, parallel, blackish, curved, the inner lost in the central brown shade; a blackish, apical, triangular spot; terminal dots small, black. Hind wing whitish. Expanse, 21 mm.

Type.—Female, No. 19284, U.S.N.M.; Teapa, Tabasco, Mexico, February, 1914 (R. Müller).

Subfamily EPIPASCHIINAE.

Genus JOCARA Walker.

JOCARA BAN, new species.

Base glaucous gray, median space brown, terminal space violaceous, all but the latter irrorated with coarse black scales; lines far out, pale, with fine double blackish borders; inner with a black ray to base along submedian fold; outer excurved centrally and dentate; lower third of basal space violaceous blackish; discal spot large, black; a black shade line beyond it, dividing the median space; a terminal row of black dashes. Hind wing pale grayish over disk, apex and outer margin shaded with fuscous; a pale submarginal line, retreating at apex, with a black patch before and beyond it on submedian. Expanse, 27 mm.

Type.—Female, No. 19285, U.S.N.M.; Teapa, Tabasco, Mexico, December, 1913 (R. Müller).



DESCRIPTIONS OF MISCELLANEOUS NORTH
AMERICAN CHALCIDOID HYMENOPTERA
OF THE FAMILY EULOPHIDAE

BY

A. A. GIRAULT

Of the Bureau of Entomology, United States Department of Agriculture

No. 2140.—From the Proceedings of the United States National Museum,
Vol. 51, pages 39-52

Published October 16, 1916



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DESCRIPTIONS OF MISCELLANEOUS NORTH AMERICAN
CHALCIDOID HYMENOPTERA OF THE FAMILY EULO-
PHIDAE.

BY A. A. GIRAULT,

Of the Bureau of Entomology, United States Department of Agriculture.

The following descriptions are based on specimens in the United States National Museum and were made with a Zeiss binocular microscope, having the highest magnification.

RHICNOPELTOMYIA MARYLANDENSIS, new species.

Female.—Length, 1.50 mm. Abdomen acuminate.

Differs from *bicincta* (Ashmead) in being smaller and more slender, the body is dark green, the two transverse marks on the fore wing are shorter and fainter, the distal one from stigmal vein distinctly not reaching the middle of the wing, the proximal one still shorter; the postmarginal vein is longer, also the marginal fringes of the fore wings (but not long by far); funicle 1 is somewhat shorter. Postmarginal vein over twice the length of the stigmal. Legs (except the caudal coxa above at base) and proximal half of scape, brownish yellow. Propodeum short, glabrous, noncarinate. Parapsidal furrows complete. Thorax scaly. Mandibles 6-dentate, three lateral teeth large, others minute.

From one female on a tag in the United States National Museum, labeled "Bladensburg, Maryland, June 16."

Type.—Cat. No. 19582, U.S.N.M., the above specimen and a slide bearing a pair of wings and the head.

RHICNOPELTOMYIA ACHRYSOCHAROIDES, new species.

Female.—Length, 1.10 mm. Like species of *Achrysocharis*. Ring-joints minute.

Dark metallic green, the legs white excepting the coxae, the caudal femur dusky above at proximal two-thirds. Forewings with a large, distinct fuscous spot from the stigmal vein, narrower at caudal half, deeper at cephalic half. Scape white, dusky at cephalic third (or a little more above); pedicel black; rest of antennae yellowish, the distal club joint dusky, not much longer than its distinct terminal spine which is conical and somewhat longer than wide. Club 2 longest,

slightly longer than the two funicle joints which are subequal, each a third longer than wide and a little longer than the pedicel. Mandibles tridentate, tooth 3 smallest, 1 and 2 acute, subequal. Body shiny, the scaly sculpture delicate and inconspicuous. Propodeum plane. Postmarginal vein shorter than the stigmal. Parapsidal furrows complete, sutured cephalad only.

From one female captured by sweeping in the forest, District of Columbia, May 10, 1915.

Type.—Cat. No. 19583, U.S.N.M., the female on a tag, the head on a slide.

RHICNOPELTOMYIA SCUTELLATA, new species.

Female.—Length, 2 mm. Rather stout.

Dark purplish black, the wings hyaline, the venation yellow, the stigmal vein dusky. Trochanters, knees, tibiae, tarsi, and scutellum white, the median line of the scutellum broadly concolorous, this line broadening gradually distad, spreading around the apex narrowly, thus mushroom-shaped; the disto-lateral bristle is a little separated from this line and are the only two bristles present on the scutellum, the latter with a very short median groove at base. Parapsidal furrows far cephalad only. Abdomen stout, subglobular. Body very finely scaly, the propodeum plane, subglabrous. Postmarginal vein slightly shorter than the stigmal, the marginal much longer than the broken submarginal. Cephalic tibial spur not forming a strigil. Third ring-joint largest. Pedicel subequal to club 2; club 3 conical, four times longer than its short, distinct terminal spine, subequal to funicle 2; funicle 1 two-thirds longer than wide, somewhat longer than the pedicel. Mandibles with three large, acute teeth, the third smallest; dusky, red at tip.

From one female on a tag captured by sweeping in the forest, District of Columbia, May 10, 1915.

Type.—Cat. No. 19584, U.S.N.M., the above specimen, the head on a slide.

RHICNOPELTOMYIA VIRIDISCUTELLUM, new species.

Female.—Length, 2.05 mm.

Canary yellow, the wings hyaline, the venation yellow; ocellar area, a large quadrate area on cephalic scutum (cephalic third or somewhat more but not reaching the abbreviated parapsidal furrows), scutellum, postscutellum, axillae lightly meso-cephalad, meson of propodeum not very broadly, a marginal spot on abdomen at base and three moderate cross stripes on middle abdomen, the first at apex of proximal fourth, the third somewhat distad of the middle, all three thickened at the meson and there more or less confluent, dark metallic green. Tip of ovipositor valves black. Body finely scaly. Postmarginal vein somewhat longer than the stigmal. Propodeum noncarinate.

Mandibles tridentate, the face of the inner tooth concaved and feebly serrate. Club with its terminal nipple over half the length of club 3, which is shortest, club 2 longest, subequal to funicle 2, which is longer than wide. Funicle 1 nearly twice longer than wide, barely longer than the pedicel. Antennae dusky, the scape yellow. First ring-joint largest. Scutellum with 2 bristles (distad of center).

Described from a female, forest, May 18, 1915. District of Columbia.

Type.—Cat. No. 19585, U.S.N.M., the female on a tag, the head on a slide.

ACHYSOCHARELLA AMERICANA, new species.

Female.—Length, 1 mm.

Differs from *acuminaticornis* Girault in being less robust, the legs are white (including all coxæ), the general coloration is dark metallic green, the wings are hyaline throughout, the stigmal and postmarginal veins are somewhat longer, the scaly sculpture of the thorax fainter, the thorax more shiny. The joints of the funicle and club are distinctly shorter, funicles 1-2 only about three-fourths longer than wide, the club joints a little shorter. Mandibles with three acute teeth. Scape white, rest of antennae black. Hairs on flagellum shorter. Compared with type of the named species. Flagellum with the club distinct, less acuminate. Abdomen sessile.

From one female, forest, May 18, 1915, Washington, District of Columbia.

Type.—Cat. No. 19586, U.S.N.M., the female on a tag, the head on a slide.

CHRYSOCHAROMYIA OCCIDENTALIS, new species.

Female.—Length, 1.50 mm.

Shining, bright metallic green, the legs white except the coxæ; scape white except rather broadly at apex. Body very delicately scaly, the face more coarsely so. Propodeum nearly glabrous. Venation dusky yellow, the wings hyaline. Pedicel slightly longer than wide, subequal in length to funicle 3; ring-joint 3 abruptly shortest (in relation to the funicle), distinctly wider than long, its apical margin oblique; funicles 1-2 subequal, longest, each somewhat longer than thick; club 1 slightly shorter than funicle 3; terminal nipple of the club distinct. Antennae with short pubescence. Third ring-joint very large, colored and clothed like the funicle. Habitus of *Achysocharis*. Postmarginal vein elongate, the stigmal about a third of its length, distinctly longer than wide, yet short. Marginal vein about twice the length of the submarginal. Abdomen subpetiolate, propodeum noncarinate. Parapsidal furrows cephalad only, short. Axillae only slightly advanced. Cheeks very short.

Described from one female on a tag in the United States National Museum, "Sonoma Co., Calif."

Type.—Cat. No. 19590, U.S.N.M., the above specimen, the antennae on a slide.

ACHRYSOCHAROIDES TITIANI, new species.

Female.—Length, 1.10 mm.

Dark metallic blue green, the wings hyaline, the legs white except the coxae. Venation yellow, the postmarginal vein subequal to the stigmal. Coarsely scaly, the meson of scutellum broadly glabrous, the propodeum subglabrous. A round fovea at meson, base of propodeum. Parapasidal furrows complete but sutured only at cephalic third, the rest an impression. Propodeum noncarinate, nearly of uniform length. Two large bristles on the scutellum. Scape white. Pedicel somewhat longer than wide, slightly shorter than either of the three funicle joints which are distinctly longer than wide. Club 1 subequal to the pedicel. Second club joint as long as the first, with a distinct terminal spine. Two outer teeth of mandibles of equal length, acute, the third very short.

From one female labeled "*Chrysocharis oscinidis* Ashmead. Indiana, 1311."

Type.—Cat. No. 19591, U.S.N.M., the above specimen on a slide.

ACHYSOCHARIS KANSENSIS, new species.

Female.—Length, 1 mm.

Dark metallic green, the wings hyaline except a very small amount of staining just against the apex of the stigmal vein, the venation dusky yellowish. Legs white except coxae and middle and hind femora. Proximal two-thirds of scape white. Mandibles tridentate, the inner tooth smaller by far. Pedicel subequal to funicle 2 which is subequal to club 2; club 1 slightly wider than long. Third club joint with a distinct terminal spine. Postmarginal vein nearly as long as the stigmal. Scutellum uniformly sculptured. Propodeum distinct, shorter than in *A. titiani*. Parapasidal furrows deeper all the way up (from caudad) than in *titiani* and the abdomen more distinctly sculptured. Caudal tibiae just below knee slightly dusky. Sculptured as in *titiani* and the propodeum similar but shorter.

Described from one female in the United States National Museum, labeled "*Chrysocharis oscinidis* Ashm. Riley Co., Kansas, Marlatt, August."

Type.—Cat. No. 19592, U.S.N.M., the specimen on a slide in fragments.

PSEUDIGLYPHOMYIA FLAVIFACIES, new species.

Female.—Length, 2 mm.

Bright golden yellow, the wings hyaline, the venation yellow, the apex of the ovipositor black, the body marked as follows with dark metallic green: Upper two-thirds of occiput, ocellar area, meson of pronotum broadly, cephalic half of scutum, scutellum, propodeum, a not broad stripe across abdomen with a distinct rectangular mesal projection, thorax just latered of distal scutellum, metapleura and four cross-stripes on abdomen at middle, all broadly, suffusedly joined along the meson, the first at proximal fourth or more, the fourth obliqued on each side from the meson, at about distal three-fourths; proventer cephalad and between the coxae, postscutellum, mesopleurum caudad of the tegulae, mesoventer, metaventer, and most of hind coxae. Stripes of abdomen continued over the venter. Postmarginal vein not quite so long as the stigmal. Propodeum scaly, with a median carina and no others. Scape metallic green and the pedicel above except at apex; the latter subequal in length to funicle 1 which is somewhat longer than wide, funicle 2 quadrate. Mandibles 7- and 8-dentate. Hind tibial spurs not seen.

Agrees in pattern with *americana* but the stripes on the abdomen in that species are consolidated (or there is one broad stripe), the postscutellum is not metallic nor the meson of pronotum nor the mesopleurum and so on.

Described from two females on a minutien mount in the United States National Museum, labeled "25^{0a}, Los Angeles Co., California."

Types.—Cat. No. 19593, U.S.N.M., the above specimens and a slide with the head.

This species is doubtless congeneric with *Cirrospilus flavicinctus* Riley.

STENOMESIOIDEA, new genus.

Female.—Belongs to the Ophelinini. Head normal, the antennæ inserted a little below the middle of the face, 10-jointed, with two ring and club joints. Pronotum conical but not long. Parapsidal furrows complete, not reaching the pronotum. Axillae not advanced. Scutellum simple, with a groove dorso-laterad, *laterad* of the two bristles on each side. Propodeum with median and lateral carinae, the latter at base for some distance a sulcus. Abdomen sessile, the second segment occupying about a fourth of the surface. Marginal vein long, a little shorter than the submarginal, about twice the length of the elongate stigmal, which is somewhat shorter than the postmarginal. No true grooves on scutellum.

Genotype.—*Stenomessioidea mellea*, new species.

STENOMESIOIDEA MELLEA, new species.

Female.—Length, 2.50 mm.

Uniformly golden yellow, the funicle and club black, the venation yellow, the forewing stained yellow from base out to the end of the venation. Funicle 1 much the longest, nearly twice longer than wide, 4 barely longer than wide, subequal to club 1; club 2 conical and longer than 1, acute, without a terminal nipple. Pedicel not quite as long as funicle 4. Body with delicate scaly sculpture.

Type.—Cat. No. 12735, U.S.N.M., two females on tags (forewing, caudal tibiae, and an antenna on a slide). These specimens are labeled "*Stenomesioidea mellea* Ashm.," an undescribed species, and "3436°.26/784."

SYMPIESOMORPHELLEUS NIGRICEPS, new species.

Female.—Belongs to the Ophelinini and in my table to the Australian genera runs to *Sympiesomorphelleus* but the club is apparently 3-jointed, the third joint nipple-like yet not articulated. Axillae not advanced.

Length, 2.50 mm.

Deep orange yellow, the head, antennae, prothorax, scutum, parapsides except laterad, axillae except caudal and lateral margins, margins of abdomen very narrowly and a median stripe down dorsum of abdomen commencing a little out from base, gradually narrowing to apex, black. Tip of ovipositor valves black. The very long-sagittate mesal marking on abdomen is connected narrowly with the base. Head finely scaly (except the middle of the face), the thorax more coarsely so (except the scutellum, postscutellum, and propodeum, which are glabrous, the abdomen slightly scaly). Propodeum with a delicate median carina and no others, the spiracles small. Pedicel a little longer than wide at apex, shorter than funicle 4, which is a little longer than wide; funicle 1 nearly twice longer than wide; club 1 slightly shorter than funicle 4; club 2 shorter, the apparent 3 very small. Venation as in *Stenomesioidea* but the marginal vein distinctly longer

From one female in the United States National Museum labeled "College Station, Texas. September, Banks."

Type.—Cat. No. 19594, U.S.N.M., the female on a tag; the hind tibiae, forewing, and an antenna on a slide.

The grooves on the scutellum are just within the two bristles on each side.

Genus CIRROSPILOIDEUS Ashmead.

The hind tibiae bear two rather long, slender spurs, so the genus belongs to the Ophelinini and is the same as my *Sympiesomorphelleus*. The mandibles of the genotype are 8-dentate. The terminal

nipple of the club is not articulated. Propodeum with a median carina and a curved lateral one. Abdomen rather slender, its segment 2 somewhat over a fourth the length of the surface. Parapsidal furrows and axillae as in the preceding species.

PSEUDIGLYPHOMYIA (CIRROSPILUS) FLAVICINCTUS (Riley).

This species is the same as *Cirrospilus flavimaculata* Ashmead. There are specimens in the United States National Museum from Algonquin, Illinois (Nason), and from Washington, District of Columbia. The caudal femur is concolorous.

Propodeum without lateral carinae. Postmarginal vein somewhat shorter than the stigmal. Types compared.

PSEUDIGLYPHOMYIA CINCTITHORAX, new species.

Female.—Length, 1.50 mm.

Differs from *flavicinctus* Riley in that the yellow on the little less than distal half of the distal scutum is complete—that is, crosses the entire dorsal thorax (the parapsides with only their lateral and cephalic margins metallic dark blue or concolorous); the caudal femur is golden yellow (thus but the caudal coxa is concolorous) and also the head (except cheeks below the eyes, ocellar area and occiput, the latter except around the mouth and dorso-laterad at each eye). Thorax scaly, the propodeum and postscutellum smoother. Venation yellow. Scape metallic except at apex, the pedicel so at base above broadly. Funicle 1 subequal to the pedicel, somewhat longer than wide, 2 quadrate. Club with a small terminal nipple. Postmarginal vein slightly shorter than the stigmal. Mandibles 5-dentate. Compared with type of *flavicinctus*.

Described from a single female captured at Algonquin, Illinois, September 20, 1895 (Nason).

Type.—Cat. No. 19602, U.S.N.M., the female on a tag, the head, a hind tibia and a forewing on a slide.

PSEUDIGLYPHOMYIA PULCHRA, new species.

Female.—Like *americana* but wholly lemon yellow, the legs wholly so and the metallic blue green markings differ as follows: The upper occiput more narrowly green, the pronotum all green, the area of the cephalic half of the scutum is semicircular, the stripe across base of abdomen is absent, while the broad abdominal stripe is farther distad, distinctly closer to the tip than to the base and excised only proximo-laterad, so that there is at meson an obtuse projection from the proximal margin. Also the sides of the thorax caudad of the tegulae and proximal half of caudal coxae are metallic blue. The broad band of the abdomen crosses the venter. Mandibles 5-dentate.

Described from one female labeled "from *Bucculatrix* species. February 9, 1908. *Cirrospilus flavicinctus* Riley." United States.

Type.—Cat. No. 19603, U.S.N.M., the specimen on a tag, the head, hind tibiae and a forewing on a slide.

LEUCODESMIA NIGRIVENTRIS, new species.

Female.—Twice the size of the genotype, varying as follows: Abdomen black (not yellow with the apical margin of each segment black), the substigmal spot of the forewing black and much larger, longer than the stigmal vein (faint and very small in the typical form), the mandibles are 7-dentate (6-dentate in the other), the silvery band on the face is a little narrower (across near ventral ends of the eyes and continuous), the propodeum blacker and the hind coxae are black. General color orange yellow (in *typica* honey yellow). Scutellum with four bristles which are laterad of the grooves. Median carina of propodeum paired, no others. Compared with types of genotype.

Described from four females in the United States National Museum labeled "Madison, Fla., X.14, 1914. Parasite of *Pyroderces rileyi* Wals. Cotton. W. D. Pierce."

Type.—Cat. No. 19604, U.S.N.M., the above specimens plus a slide with forewing, head, and hind tibia (and same of *L. typica* Howard but not types). Three of the females are paratypes.

In this genus the third joint of the club is nipplelike, the small hind tibial spurs double, two ring-joints, the first very short. The vertex is more or less elevated in dry specimens. The genotype has a delicate, paired median carina on the propodeum and no others, the propodeum glabrous. Body scaly.

CLOSTROCERUS UTAHENSIS CALIFORNICUS, new variety.

Female.—Length, 1 mm.

Differs from typical *utahensis* Crawford in having the proximal or third stripe of the forewing present in the shape of a large triangular area from the caudal margin, its base or broad end distad and its pointed end extended along the caudal margin to base and distad to the second stripe; it extends cephalad nearly to cephalic margin. In the typical form it is present only all along the caudal margin. Mandibles tridentate in both. Also, here the distal stripe of the forewing is broader than the second (the other way round in the typical form).

From two females on tags "Berkeley, Calif. May 29, 1911. P. H. Timberlake."

Type.—Cat. No. 19605, U.S.N.M., the above specimens (= type and paratype), and slide with pair of wings and head of a paratype typical form.

CLOSTERO CERUS UTAHENSIS CINCINNATUS, new variety.

Male.—Length, 0.70 mm. Differs from the typical form in having the second stripe of the forewing very broad and the basal infumation is somewhat as in *californicus*. Also from both in having the body more shiny, the sculpture more delicate. Mandibles tridentate.

From a female on a tag, "Par. on a Cynipid, J. U. Lloyd, Cincinnati, Ohio, July 1, '95. 463°2."

Type.—Cat. No. 19606, U.S.N.M., the above specimen, and the head and pair of wings on a slide.

HEMIPTARSENOIDEUS AMERICANUS, new species.

Female.—Length, 1.75 mm. Differs from *semialbiclavus* in having the stigmal vein over a third the length of the marginal.

Dark metallic green, the antennal club silvery white, the following parts fulvous: The abdominal petiole and a large V-shaped area dorsad, its apex at base and each arm extending to about middle; proximal two-thirds of abdominal venter except the lateral margins narrowly; the legs except the cephalic concolorous coxae, the ends and middle of the sides narrowly of cephalic femora and the white tarsi; scape and pedicel (lighter). Distal tarsal joint dusky; also more or less of the hind tibia. Funicle black. Forewings lightly smoky from base of the marginal vein distad to the apex, the infuscation more or less irregular. Funicle subcompressed, 1 two and one-half times longer than wide, 2 and 3 subequal, but 3 stouter, each longer than 1; 4 as stout as 3, subequal to the club, shorter than 1, distinctly longer than the pedicel and a third shorter than 3. Club 1 distinctly longer than 2. Antennae inserted in the middle of the face, the club with a short terminal spine. Mandibles 5-dentate. Head and thorax scaly punctate, the propodeum more coarsely, with a delicate, nearly complete, long median carina and one irregular lateral one (composed of several crooked rugae). Spiracle minute, round, cephalad. Middle femur above metallic. Postmarginal vein a third or more longer than the slender stigmal. Abdominal petiole very short. Segment 2 of the abdomen longest, occupying about a fourth of the surface, the abdomen flat above, keeled beneath. Axillae advanced half way into the scutum. Propodeum long.

From a female captured in the forest, District of Columbia, May 11, 1915.

Type.—Cat. No. 19624, U.S.N.M., the above specimen on a tag, the head and forewing and the hind tibia on a slide.

A somewhat similar species occurs in Australia.

TETRASTICHOMYIA, new genus (*Tetrastichini*).

No groove on scutum; one groove (the lateral) on scutellum. Four ring-joints, the third very short, three funicle and club joints. Pedicel and funicle 1 subelongate.

Genotype.—*Miotropis clisiocampae* Ashmead.

PSEUDIGLYPHOMYIA AMERICANA, new species.

Female.—Length, 1.60 mm.

Legs and abdomen golden yellow, the head and thorax sanguineous, the wings hyaline, the venation yellow. Variegated with dark metallic green as follows: Ocellar area, upper fourth of occiput, cephalic apex of pronotum, cephalic half of scutum, the area frustum-shaped (narrowing caudad, thus leaving the lateral margin more and more) its caudal margin incised obtusely at meson; caudal margin of pronotum rather narrowly, scutellum, propodeum (and the thorax dorsad just laterad of postscutellum and distal scutellum), a moderate stripe across base of abdomen, its caudal margin with a broad obtuse projection at meson, a very broad stripe across beyond middle of the abdomen (equal to over one-third the surface) its margin deeply excavated proximo-laterad at lateral margin and less deeply from lateral margin a little before its caudal end, which is as far from the apex of the abdomen as the proximal margin is from the green stripe at base. Tip of ovipositor valves black. Middle tibia with a rather broad cinctus just below the knee for some little distance. Propodeum with a median carina and no others, the thorax scaly. Scutellum with four bristles which are just laterad of the grooves. Antennae dusky yellow; funicle 1 somewhat longer than wide, 2 a little shorter, subequal in length to the pedicel. Nipple of club short, distinct; mandibles 5-dentate. A spot laterad at base of the hind coxae. That portion of the broad stripe of abdomen proximad of the latero-caudal excision passes over the venter.

Described from one female labeled "*Cirrospilus flavicinctus* Riley. 1729, Ohio."

Type.—Cat. No. 19625, U.S.N.M., the above specimen on a tag, the head, forewing and hind tibiae on a slide.

ENTEDON OCCIDENTALIS, new species.

Female.—Length, 3.50 mm. Robust.

Like *E. bigeloviae* Ashmead but much more robust, the post-marginal vein is slightly shorter than the stigmal, which is longer than wide, the club lacks the small terminal spine or it is a mere tubercle; funicle 1 is distinctly longer than the pedicel, two and one-half times longer than wide, longer than the club. The abdominal segments after 3 are scaly and 2 is not quite a fourth the length of

the abdomen. There is a foveolate groove along each side of the median carina of the propodeum and a boomerang shaped carina over the spiracle. The propodeum and hind coxae are more coarsely sculptured. Occipital margin of the vertex finely scaly, more finely so than the occiput. Hind tibial spur thick and of tolerable length. Types compared.

Described from one female labeled "*Entedon bigeloviae* Ashmead. Type, Dalles, Oregon"; three labeled "Los Angeles, California. April. Coquillett"; and three labeled "Wasatch, Utah, June 27."

Type.—Cat. No. 19626, U.S.N.M., two females on tags, and a slide bearing a hind leg and an antenna (Los Angeles).

In this species the cheeks at the ventral ends of the eyes have a broad path, which is differentiated by being scaly, not punctate (narrower and less distinct in *bigeloviae*).

EPRHOPALOTUS, new genus.

Female.—Belongs to the Entedonini. Head large, the antennae 9-jointed with two large ring-joints, the club 3-jointed and with a long terminal spine. Marginal vein nearly twice the length of the submarginal, the stigmal long but somewhat shorter than the subelongate postmarginal vein. Segment 2 of the abdomen a little longer than 3, occupying about a fifth of the surface. Pronotum not visible from above. Parapsidal furrows as in *Secodella*. Abdomen sessile. Axillae advanced half way cephalad of the scutellum, the latter large, larger than the scutum. Propodeum short at the meson, there with three carinae with sulci between them, all of the three forked at base in a small way; also a larger, very delicate, shadowy carina somewhat laterad of these; no true lateral carina but a spiracular sulcus which is complete, running disto-laterad. Hind tibial spur not especially large.

Genotype.—*Ephrhopalotus purpureithorax*, new species.

EPRHOPALOTUS PURPUREITHORAX, new species.

Female.—Length, 1.75 mm.

Metallic purple, the propodeum, abdomen and legs blue-green. Wings hyaline. Scape, tibiae and tarsi white. Venation yellow. Middle tibiae concolorous for proximal half. Knees white. Vertex scaly, also the thorax, the scutum and parapsides more coarsely than the axillae and scutellum, on the scutum the lines partly raised. Propodeum glabrous, scaly toward the spiracle and laterad. Abdomen scaly, glabrous at immediate base. Scape dusky above and at distal half, long and slender. Pedicel a half longer than wide at apex, longer than either funicle joint; 2 of the funicle a little longer than 1, a little longer than wide. Terminal spine of club as long as

club 3 which is smallest of the club. Club 2 slightly longer than wide. Forewings naked from proximal third of marginal vein to base, broad. A line of small setae along near caudal margin, opposite the break of the submarginal vein (about 10 setae).

Described from one female on a tag labeled "371°. Par. of *Cynips* from gall of *Cecidomyia quercus-pilulae*. Issued March 24, 1879." United States.

Type.—Cat. No. 19627, U.S.N.M., the above specimen, the fore wing and antennae on a slide.

ACHRYSOCHARELLA ACUMINATICORNIS, new species.

Female.—Length, 1.50 mm.

Dark metallic purple, the propodeum and abdomen dark metallic green, the wings hyaline, their venation except the dusky stigmal vein and the legs except the dusky metallic femora, reddish yellow. Scape reddish yellow, dusky toward tip. A very slight stain from the apex of the stigmal vein. Postmarginal vein distinctly somewhat longer than the stigmal. Abdomen with a very short petiole. Body finely scaly reticulate. Propodeum of moderate shortness, noncarinate. Parapsidal furrows complete but sutured only cephalad. Flagellum with numerous long, non-whorled, single hairs, the pedicel somewhat longer than wide, shorter than the following joints; funicles 1–2 subequal, clubs 1–2 each slightly shorter, club 3 still shorter, terminating in a rather long point. Funicle 1 about two and a half times longer than wide, the flagellar joints elongate.

Described from one female in the United States National Museum collection captured at Washington, District of Columbia, June 23.

Type.—Cat. No. 19628, U.S.N.M., the female on a tag plus a slide bearing the antennae.

PARDIAULOMELLA IBSENI, new species.

Female.—Length, 1.80 mm.

Dark metallic blue, the trochanters, knees, tibiae, tarsi, and scape white, the venation pale, the wings hyaline. Head finely scaly, the thorax more finely so, the lines raised but not very coarse, the areas small. Propodeum with a glabrous median carina and no others, no sulci, of moderate length, scaly punctate, the spiracle round, cephalad, not small. Abdomen finely scaly. Axillae much advanced. Scutellum with four bristles. Antennae inserted below the middle of the face, cylindrical, 11-jointed with two short ring-joints, the club 3-jointed, the third joint small, nipple-like, itself ending in a short, stout terminal spine. Pedicel barely longer than wide, two-thirds the length of funicle 1 which is longest, widening distad, somewhat longer than wide, 2 a little wider than long, 3 and 4 subequal, each distinctly wider than long. Club 1 subequal to funicle 2; club short,

ovate, about half the length of the funicle. Mandibles 10-dentate. Marginal vein slightly longer than the submarginal, over thrice the length of the stigmal, the latter much shorter than the postmarginal which is not quite half the length of the marginal. Hind tibial spurs double. Pronotum transverse-linear; scutellum simple.

The apparent male is smaller with the flagellum brown, the legs white except the caudal tibiae and middle and caudal femora (another specimen bore legs colored as in the female). The scape is compressed and widened below, the second ring-joint very short, the third club joint larger and with a terminal spine yet acute. The first three funicle joints each bear a long branch from the same side at base. Mandibles about 7-dentate. The two male forms differed considerably in the details of the antennae and I do not like to connect either one definitely as yet to this species. The mandibles were 5-dentate in the form colored unlike the female. There is a white stripe across the abdomen just out from base and the parapsidal furrows are complete yet obscure.

Described from two females and several males reared from larvae of *Desmia funeralis*, Fairfax County, Virginia, June 6 (J. F. Strauss).

Types.—Cat. No. 19629, U.S.N.M., two females on a tag; the head, the hind tibiae, and the antennae on a slide.

This species is somewhat similar to the female of *Cratotechus larvarum* Linnaeus (Thomson), which has the minute third joint of the club tubular and the first ring-joint very short; but in *larvarum* there are only three funicle joints. There are in the United States National Museum three specimens labeled as being this species, apparently in Thomson's handwriting, two females labeled "Silvestri, Italy, October 7, 1902"—and another which bears the specific label and is localized at Blankenburg, Thuringia. I doubt the identity of these very much excepting the third). Two females in the same collection, labeled *Cratotechus unguularis* Thomson, had the antennae 10-jointed, with three funicle and club joints and the third club joint large and distinct. In this species *ungularis* the hind tibial spurs are double, an incidented observation here. The specimens were labeled "Blankenburg, Thur. ♀." *Cratotechus smerinthi* Ashmead, female, has antennae like *ungularis*, that is as to segmentation. Type examined. The club is somewhat enlarged, the first ring-joint much shorter than the second; the third club joint terminates in no distinct spine, but its apex is nipped a little. The funicle is 3-jointed in *Trichogramma (Cratotechus) orgyiae* (Fitch) which appears correctly placed now.

The species is dedicated to Henrik Ibsen.

In the genotype of *Dimmockia* the mandibles are large, broadly truncate at apex, 10-dentate, the antennae are brownish, the pedicel

longer, funicle 2 quadrate and 3 or 4 not as wide as in *ibseni*; the club has an apparent small, obtuse nipple-like third joint, but this is not articulated as in *ibseni* and *per se* does not bear a terminal spine. *Dimmockia* bears two ring-joints, the antennae 10-jointed, with two club and four funicle joints. The head is stouter (longer from occiput to face) than with *ibseni*, but the latter is very similar to the *Dimmockia* both in color and structure. The latter bears two hind tibial spurs.

Orig.

SOME DIPTERA (MICRODON) FROM NESTS OF ANTS

BY

T. D. A. COCKERELL AND HAZEL ANDREWS

Of the University of Colorado, Boulder

No. 2141.—From the Proceedings of the United States National Museum,
Vol. 51, pages 53-56

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Of the University of Colorado, Boulder.

An excellent summary of our knowledge of the biology of the syrphid genus *Microdon* has been given by Dr. W. M. Wheeler,¹ while the taxonomy of the North American species has been fully discussed by Dr. S. W. Williston.² A new species from Colorado was reported by Cockerell many years ago,³ but was not described. W. A. Snow⁴ described a new species from the male as *Microdon megalogaster*; in the Aldrich catalogue this is said to be from Colorado, but no locality is cited by Snow, and evidently he did not know where the specimen came from. Snow's paper is mainly on Syrphidae from Colorado, but he says in his prefatory note that the material discussed is "chiefly" from the Colorado collection, implying that part of it is from another source. Doubt is also thrown upon the locality "Colorado" by the fact that Townsend described as *M. bombiformis* what appears to be the female of the same species from Virginia, while Johnson reports the species from New Jersey and Pennsylvania. It may be stated that a specimen from Pecos, New Mexico (W. P. Cockerell), was referred to Snow's species by Coquillett; this is in the United States National Museum, and Mr. Knab informs us that it is a female of our *M. coloradensis*. Wheeler gives good reasons for thinking that all the records of the breeding of *Microdon* in the United States refer to a single species, *M. tristis* Loew. The junior author of this paper was fortunate in breeding two species from larvae found in nests of *Formica* in Colorado in the spring of 1915. Upon examination, it seems that one of these is undescribed while the exact position of the other seems somewhat uncertain, so they are characterized herewith.

MICRODON COLORADENSIS, new species.

Male.—Robust; length (not including antennae), 14 mm.; width of abdomen about 6.75 mm.; length of wing 9.6 mm. Head black,

¹ Journ. New York Ent. Soc., vol. 16, 1908, pp. 202-213.

² Bull. 31, U. S. Nat. Museum, 1886, pp. 3-13.

³ Trans. Amer. Ent. Soc., vol. 20, 1893, p. 368.

⁴ Kansas University Quarterly, vol. 1, 1893, p. 34.

clothed with brassy yellow pile; front broad, inner orbits parallel; distance from ocelli to antennae much less than least distance between the eyes; ocelli approximate; antennae black, the first joint slightly shorter than the two following together, second joint about (or slightly over) half as long as third; third joint considerably shorter than first, pointed at tip; thorax black, with obscure purplish and green tints, the dorsum clothed with fox-red pile; scutellum short, rounded, transverse but projecting, not emarginate, its pile longer and brighter red than that on mesothorax; abdomen short, broad, black, pile long on margins of segments, reddish yellow, abundant on first and second segments, especially at sides, and on apical margin of

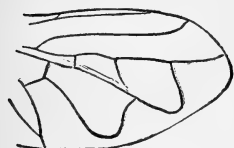


FIG. 1.—MICRODON COLORADENSIS.
WING OF MALE.

third; legs black, femora and tibiae clothed with reddish yellow pile; hind basitarsi not as long as remaining joints together, the whole hind tarsi thick, but the basitarsi not especially so; wings pale gray, veins blackish; vein forming outer side of discal cell strongly curved, finally directed upward forming an obtuse angle on outer side with vein bounding first posterior cell; distance

on upper side of first posterior cell from base to stump less than from stump to end; halteres cream color.

Female.—A little larger, width of abdomen over 7 mm.; differs from male in having the pile on head and thorax whitish yellow; pile on abdomen forming a broad pale yellowish shining band on hind margin of first segment, but black on sides of that segment anteriorly; on the other segments thin and black, with a few pale hairs on lateral hind margins of third segment.

Pupa.—Of the usual form and reddish color; length 10.5–12.5 mm., width 7.5 mm., height 5.5 mm.; easily distinguished from those of *M. tristis* and varieties by the absence of raised lines or other distinct sculpture; the surface is uneven, with small and obscure pustuliform elevations, arranged more or less in longitudinal rows. The posterior tubercle is relatively long and narrow, its length conspicuously greater than its apical breadth, whereas in *tristis*, variety, it is broad and short, its length much less than the apical breadth.

Egg.—Long-oval, white, about 1.75 mm. long, the surface regularly and densely beset with protuberances, giving a coarsely granular appearance under a lens.

Type.—Cat. No. 19727, U. S. Nat. Mus.

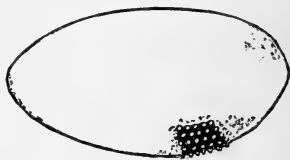


FIG. 2.—MICRODON COLORADENSIS. EGG.

Habitat.—Boulder, Colorado. Two of the soft, slug-like larvae were found in a nest of *Formica fusca argentea* Wheeler, April 13, 1915, at the foot of Flagstaff Hill, Boulder. They were placed in a glass jar with soil and some of the ants, and a third larva, found later, was added. On April 15, one of the larvae became a pupa. On May 14, two male flies hatched, and two days later a female appeared. On June 8 a female was caught at Pulpit Rock, Boulder. The type is a male. This is a large robust species, the sexes with quite differently colored hair, but both having the front broad. It is much larger than *M. tristis*, and differently colored. The size suggests *M. megalogaster* (*bombiformis*), but the color is different, and the front of the male is not narrowed in the middle, while the second antennal-joint is much more than a third the length of third. It is larger than *M. xanthopilis* Townsend, from California, and quite differently colored; in *xanthopilis* the hair is entirely brassy yellow (more orange in the male), without black.

MICRODON TRISTIS, subspecies.

Female.—Robust; length (not including antennae), 12 mm.; width of abdomen, 6 mm.; length of wing, 9 mm.; general color, black, with shining pale hair; antennae, black; front broad, but narrower than face; scutellum with a pair of small tubercles, hidden by hair; penultimate segment of abdomen at sides nearly or quite as long as the two preceding together. Head black, clothed with glittering very pale yellowish pile; eyes bare; transverse groove of front shallow, above it the integument is purplish black, while behind the eyes it is very faintly greenish; antennae elongate, first joint longer than third, second more than a third length of third, but not nearly half; thorax purplish-black, with rosy or coppery tints on disk, thinly clothed with hair like that of head; abdomen black, with extremely faint greenish tints; glistening pale hair on lateral margins of segments, covering dorsal surface of first segment, hind margin of second (broadened in middle), and forming a very broad band, widely interrupted in middle, along posterior marginal area of third, apical part of abdomen with scattered pale hair; the apparently bare parts of abdomen have thin black hair; legs black, with pale hair, orange on inner side of tarsi; hind tarsi thickened; wings dilute cinereous, pale reddish basally and in costal region, outer veins bordered by dusky clouds; outer corners of first posterior and discal cells broadly rounded, that of first posterior minutely appendiculate, but discal not; angle formed on outer side by first posterior and discal cells a little greater than a right angle; stump in first posterior cell before middle.

Male.—Superficially exactly like female, with the same colors, except that first abdominal segment is more distinctly green; front strongly narrowed above, the transverse groove, at the narrowest

point, strong; hair band on apical part of second abdominal segment interrupted; apical region with much pale glistening hair; first posterior cell not appendiculate; hind tarsi thick, but basitarsi hardly broader than next joint.

Pupa.—Length 12 mm., width 8, height 5 (female), or length 10.5 mm., width 7, height 4.5 (male). Surface sculpture essentially as in *M. tristis*, figured by Wheeler, except that the space between the mid-most longitudinal raised lines is fully equal to those between these lines and the next, instead of being much less. Color deep red-brown.

Habitat.—Boulder, Colorado. This is almost certainly the new species recorded from Wet Mountain Valley in 1893. A pupa was found at Boulder a few years ago, but being isolated from its proper environment gave only a crippled male fly, whose wings did not expand. Pupae were found May 1, 1915, in a nest of *Formica rufa aggerans* Wheeler, at Boulder. They were kept in a jar with the ants, and on May 23 a fly of each sex emerged. The specimens described are in the United States National Museum.

This is certainly allied to *M. tristis* Loew, but is considerably larger, with the first antennal joint entirely black, the outer angle formed by the first posterior and discal cells larger, thorax above with coppery and brassy (not green or bluish) tints. The dark tibiae and tarsi, and the absence of black pile on the front, show that this is neither *M. tristis ruficrus* Williston nor *M. tristis cothurnatus* Bigot. The last antennal joint is flattened at end, so that it appears obtuse in one view and acute in another. It is probable that it represents a western subspecies of *M. tristis*.¹

¹ Since the above was put in type, Mr. Chas. W. Johnson has published an article in *Psyche*, vol. 23, June, 1916, p. 75, in which he reviews the subject of *M. tristis* and *cothurnatus*. According to the interpretation there given, one Colorado species falls with *M. cothurnatus*, which is distinct from *tristis*.



ON THE GEOGRAPHICAL FORMS OF THE PHILIP-
PINE ELEGANT TITMOUSE, PARDALIPARUS ELE-
GANS (LESSON), WITH DESCRIPTIONS
OF THREE NEW SUBSPECIES

BY

EDGAR ALEXANDER MEARNES

Associate in Zoology, United States National Museum

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ON THE GEOGRAPHICAL FORMS OF THE PHILIPPINE
ELEGANT TITMOUSE, *PARDALIPARUS ELEGANS*
(LESSON), WITH DESCRIPTIONS OF THREE NEW
SUBSPECIES.

By EDGAR ALEXANDER MEARNs,

Associate in Zoology, United States National Museum.

As a whole, including its subspecies, *Pardaliparus elegans* ranges from the islands of Tawi Tawi and Sulu, south of the Sulu Sea, north through the middle Philippine Islands to the Babuyan Islands (Calayan and Camiguin, north of Luzon), or, approximately, from the 5th to the 20th degree of north latitude and from the 120th to the 127th degree of east longitude. It has not been recorded from the eastern islands, Samar, Leyte, Bohol, and the Dinagat group; and west of the Sulu Sea, on the islands of Palawan and Balabac, it is replaced by a distinct species, *Pardaliparus amabilis* (Sharpe), which has no yellow band on the side of the head and neck, which are entirely black.

The species *Pardaliparus elegans* was described by Lesson in the year 1831. Subsequently three additional forms of it, *mindanensis*, *albescens*, and *edithæ*, were described by Mearns and McGregor; of these, the last two were considered as full species until Hellmayr¹ placed them in their true relation as subspecies of *Pardaliparus elegans*. In the present paper three additional subspecies are described as follows:

PARDALIPARUS ELEGANS PANAYENSIS, new subspecies.

PANAY TITMOUSE.

Parus elegans STEERE, List Birds and Mamm. Steere Expedition, 1890, p. 21 (part; Panay).—WORCESTER and BOURNS, Proc. U. S. Nat. Mus., vol. 20, 1898, p. 560 (part; Panay).

Pardaliparus elegans MCGREGOR and WORCESTER, Hand-list Birds Philippine Islands, 1906, p. 94 (part; Panay).—MCGREGOR, Manual of Philippine Birds, 1909, p. 605 (part; Panay).

Type-specimen.—Adult male, Cat. No. 233639, U.S.N.M.; collected on the Island of Panay, Philippine Islands, November 14, 1890, by D. C. Worcester and F. S. Bourns. (Original number, 1395.)

¹Genera Avium, pt. 18, 1911, pp. 15, 16, and 32.

Subspecific characters.—Most closely related to *Pardaliparus elegans albescens* (McGregor), with which it agrees in the clear yellow color of the under parts, sides of head, and nuchal patch, but differs in having less black on the upper back and the back and rump overwashed with pale greenish gray instead of white. In *panayensis* the scapulars are almost as heavily blotched with white terminal spots as in *albescens*, and the white terminal spotting of the wing-coverts, tertiaries, secondaries, and inner primaries have about the same extent. The white spots on the middle portion of the outer webs of the four outer rectrices are smaller in *panayensis*, as are also the apical white spots.

Measurements of type (adult male).—Wing, 64; tail, 39; culmen, 9 (about; extreme tip gone); tarsus, 17.

PARDALIPARUS ELEGANS GUIMARASENSIS, new subspecies.

GUIMARAS TITMOUSE.

Parus elegans STEERE, List Birds and Mamm. Steere Expedition, 1890, p. 21 (part; Guimaras).—WORCESTER and BOURNS, Proc. U. S. Nat. Mus., vol. 20, 1898, p. 560 (part; Guimaras).

Pardaliparus elegans MCGREGOR and WORCESTER, Hand-List Birds Philippine Islands, 1906, p. 94 (part; Guimaras).—MCGREGOR, Manual of Philippine Birds, 1909, p. 605 (part; Guimaras).

Type-specimen.—Adult (?) female, Cat. No. 161448, U.S.N.M.; collected on the Island of Guimaras, Philippine Islands, December 28, 1887, by D. C. Worcester. (No original number.)

Subspecific characters.—Most closely related to *Pardaliparus elegans mindanensis* Mearns, from which it differs principally in being of duller coloration, with less black on the upper back, and with the back, scapulars, and rump dull yellowish gray, with a tendency to pale yellowish central or apical spots to the feathers of the mantle, and a greenish wash on the rump. As in *mindanensis*, the white wing-spots are washed with yellow. The under parts, sides of head and neck, and the elongated nuchal patch are slightly deeper yellow than in *panayensis*.

Measurements of type (adult female).—Wing, 63; tail, 38; culmen, 10; tarsus, 16.

Remarks.—Possibly the type-specimen is subadult, although it has the black on head and throat and was killed late in the month of December.

PARDALIPARUS ELEGANS SULUENSIS, new subspecies.

SULU TITMOUSE.

Parus elegans GUILLEMAED, Proc. Zool. Soc. London, 1885, p. 264 (Sulu).—WORCESTER and BOURNS, Proc. U. S. Nat. Mus., vol. 20, 1898, p. 560 (part; Sulu).

Pardaliparus elegans MCGREGOR and WORCESTER, Hand-List Birds Philippine Islands, 1906, p. 94 (part; Sulu).—MCGREGOR, Manual of Philippine Birds, 1909, p. 605 (part; Sulu).

Type-specimen.—Adult male, Cat. No. 233279, U.S.N.M.; collected on the Island of Sulu, Philippine Islands, September 9, 1891, by D. C. Worcester and F. S. Bourns. (Original number, 1387.)

Subspecific characters.—This form is closest to *Pardaliparus elegans guimarasensis* and *P. e. mindanensis*. The upper parts are more distinctly greenish than in any other form of *P. elegans*. The yellow parts (chest, abdomen, crissum, sides of head and neck, and nuchal patch) are a trifle paler and more greenish yellow than in *mindanensis* and *guimarasensis*, and the feathers of the mantle have pale yellowish green central or apical spots, suggesting the pattern of *P. e. albescens*; but the scapulars are unspotted grayish green. The white or whitish wing-spots are of medium size and very faintly washed with yellow.

Measurements of type (adult male).—Wing, 61; tail, 35; culmen, 9.5; tarsus, 16.

The known forms of *Pardaliparus elegans* now stand as follows:

PARDALIPARUS ELEGANS ELEGANS (Lesson).

ELEGANT TITMOUSE.

Parus elegans LESSON, Traite d'Ornith., 1831, p. 456 (no locality; the type is from the Philippines; compare Pucheran, Rev. Mag. Zool. (2), vol. 6, 1854, p. 68).

Parus quadrivittatus LAFRESNAYE, Rev. Zool., vol. 3, 1840, p. 129 ("in Manila aut in India").

Geographical range.—Islands of Luzon and Mindoro.

PARDALIPARUS ELEGANS MINDANENSIS Mearns.

MINDANAO TITMOUSE.

Pardaliparus elegans mindanensis MEARNS, Proc. Biol. Soc. Washington, vol. 18, 1905, p. 8 (Mount Apo, Mindanao, Philippine Islands).

Geographical range.—Island of Mindanao.

PARDALIPARUS ELEGANS ALBESCENS (McGregor).

WHITE-BACKED TITMOUSE.

Pardaliparus albescens MCGREGOR, Philippine Journ. Sci., vol. 2, 1907, p. 293 (Ticao Island).

Geographical range.—Islands of Ticao, Masbate, Cebu, and Negros.

PARDALIPARUS ELEGANS EDITHÆ (McGregor).

EDITH'S TITMOUSE.

Pardaliparus edithæ MCGREGOR, Philippine Journ. Sci., vol. 2, 1907, p. 294
(Calayan Island, Babuyan Group).

Geographical range.—Islands of Calayan and Camiguin.

PARDALIPARUS ELEGANS PANAYENSIS Mearns.

PANAY TITMOUSE.

Pardaliparus elegans panayensis MEARNS, Proc. U. S. Nat. Mus., vol. 51,
1916, p. 57 (Panay, Philippine Islands).

Geographical range.—Island of Panay.

PARDALIPARUS ELEGANS GUIMARASENSIS Mearns.

GUIMARAS TITMOUSE.

Pardaliparus elegans guimarasensis MEARNS, Proc. U. S. Nat. Mus., vol. 51,
1916, p. 58 (Guimaras, Philippine Islands).

Geographical range.—Island of Guimaras.

PARDALIPARUS ELEGANS SULUENSIS Mearns.

SULU TITMOUSE.

Pardaliparus elegans suluensis MEARNS, Proc. U. S. Nat. Mus., vol. 51,
1916, p. 59 (Sulu, Philippine Islands).

Geographical range.—Island of Sulu, Philippine Islands.¹

The forms enumerated above may be identified by means of the following

KEY TO THE SUBSPECIES OF *PARDALIPARUS ELEGANS* (LESSON).

- a¹**.—Larger (wing, 68 millimeters or over; culmen, more than 11 millimeters).
Sides of head and neck white, faintly tinged with pale yellowish. White
apical spots on median and greater wing-coverts much restricted. Under
parts pale greenish yellow.....*Pardaliparus elegans edithæ*.
- a²**.—Smaller (wing usually less than 68 millimeters; culmen under 11 milli-
meters). Sides of head and neck bright yellow. Light apical spots on
median and greater upper wing-coverts large. Under parts brighter
yellow.
- b¹**.—Mantle mostly white, with very little olive-green or black.
Pardaliparus elegans albescens.
- b²**.—Mantle mostly dark.
- c¹**.—Upper sides of neck and upper back solidly black, surrounding the
yellow nuchal patch.
- d¹**.—Bill larger; apical spots on upper wing-coverts and rectrices nearly
pure white; underneath, the black confined to chin and throat.
Pardaliparus elegans elegans.

¹ A form of *Pardaliparus elegans* was collected by Messrs. Bourns and Worcester on the islands of Tawi Tawi and Bongao. Possibly this may prove to be identical with the Sulu form, but I have not examined these specimens.

*d*².—Bill smaller; apical spots on upper wing-coverts and rectrices pale yellow; underneath, black of throat continued on to the chest.

Pardaliparus elegans mindanensis.

*c*².—Upper back not solidly black, but interrupted by pale spots or washing.

*d*¹.—Back and rump greenish gray; wing-spots large.

Pardaliparus elegans panayensis.

*d*².—Back and rump olive-greenish; wing-spots smaller.

*e*¹.—Upper back olive-greenish, spotted with black.

Pardaliparus elegans suluensis.

*e*².—Upper back dull yellow, spotted with black.

Pardaliparus elegans guimarasensis.

Adults appear in perfect and unworn plumage in December and January, when the white spots of the wings and tail are of full size and unworn by attrition; during the months of April and May many individuals show considerable reduction in the size of the white spots; and, in June, July, and August, some of the spots have entirely disappeared from long wearing and consequent reduction in the size of the feathers.

Young birds, in first plumage, were obtained from April to November, on Luzon Island. In April and the early summer months the young have the mantle unspotted greenish gray. By November these young birds, although lacking any black on the head or throat, are beginning to acquire, while molting, some large pure white spots on the wings and narrow yellowish white ones on the lower mantle.

Young of this species, when in their first plumage, have no black on the head; those having black heads are marked adult in the following table, although a few of them are doubtless subadult. The measurements presented were taken by Miss Celestine B. Hodges.

Record and measurements of specimens contained in the United States National Museum.

PAIRDALIPARUS ELEGANS ELEGANS (LESSON).

National Museum number.	Original number.	Locality.	Sex and age.	Date.	Wing.	Tail.	Culmen.	Tarsus.	Collector.	Remarks.
189970	451	Marivales, Bataan, Philippine Islands.	Male, adult.	Feb. 18, 1902	mm. 66	mm. 41	mm. 10.5	mm. 17	R. C. McGregor and A. Celestino.	Iris and bill black; feet and nails plumbeous.
190272	12860	do.	do.	Aug. 4, 1903	65	39.5	10.5	17.5	E. A. Mearns.	
233282	1399	Quisao, Luzon, Philippine Islands.	do.	Oct. 14, 1890	67	43.5	10		D. C. Worcester.	
189971	2384	Irisan, Benguet, Luzon, Philippine Islands.	do.	Apr. 20, 1903	64.5	38	9	17.5	R. C. McGregor and A. Celestino.	Bill black, blue at base; legs and nails lead blue; iris, dark brown.
189973	2603	do.	do.	May 13, 1903	66.5	40	10.5	17.5	do.	
211597		Baguio, Benguet, Luzon, Philippine Islands.	do.	Mar. 13, 1908	67	42	9	17.5	Paul Bartsch.	
211598		do.	do.	do.	65	41.5	9	17.5	do.	
211599		do.	do.	do.	66	39	9.5	17	do.	
200647	13778	do.	do.	Dec. 5, 1905	68.5	45.5	10	18.5	E. A. Mearns.	
200649	13791	do.	do.	Dec. 7, 1905	68	42.5	9	17.5	do.	
200651	13800	do.	do.	Dec. 8, 1905	67.5	42.5	9.5	17.5	do.	
200652	13801	do.	do.	Dec. 9, 1905	67	42	9	18	do.	
210867	14599	Baguio, 5,000 feet, Benguet, Luzon, Philippine Islands.	do.	Dec. 26, 1906	70	43	10	18	do.	
210868	14609	do.	do.	Dec. 27, 1906	66	39.5	9	17.5	do.	
210869	14610	do.	do.	do.	66	40.5	10	17.5	do.	
210870	14670	do.	do.	Jan. 3, 1907	65	38.5	9	18	do.	
210871	14671	do.	do.	do.	66.5	40	10	18	do.	
210872	14672	do.	do.	do.	66.5	39	9.5	17.5	do.	
210873	14673	do.	do.	do.	67.5	41.5	9.5	18.5	do.	
210877	15075	do.	do.	Apr. 8, 1907	63	42	10	18.5	do.	
210878	15076	do.	do.	do.	67	40	10	17.5	do.	
210880	15093	do.	do.	Apr. 9, 1907	66	41	10.5	17.5	do.	
208414	15123	do.	do.	Apr. 28, 1907	66	39	10.5	17.5	do.	
208415	15173	do.	do.	May 17, 1907	68.5	42.5	10.5	17	do.	
208416	15276	do.	do.	July 5, 1907	66	40.5	10	17	do.	
208418	15288	do.	do.	July 7, 1907	66	41	10.5	17.5	do.	
208421	15308	do.	do.	July 11, 1907	64	42	10	18	do.	
208426	15420	Haight's-in-the-oaks, 7,000 feet, near Paoyay, Benguet, Luzon, Philippine Islands.	do.	July 27, 1907	68	40.5			do.	
210876	14996	Nagpartian, Ilocos Norte, Luzon, Philippine Islands.	do.	Mar. 2, 1907	65	41	10	17.5	do.	
210865	14469	Mangyan clearing, left side of Alag River, 2,500 feet, Mindoro, Philippine Islands.	do.	Nov. 11, 1906	64	38	10	18.5	do.	

210866	14517	Junction of Alag and Bolton rivers, Mindoro, Philippine Islands.	do. do. do.	Dec. 1, 1906	65	40	10.5	17.5	do.
208413	15115	Baguio, Benguet, Luzon, Philippine Islands.	Male, immature.	Apr. 23, 1907	do.	do.	do.	do.	do.
208420	15290	do	do.	July 7, 1907	do.	do.	do.	do.	do.
208422	15340	do	do.	July 18, 1907	do.	do.	do.	do.	do.
208423	15341	do	do.	do.	do.	do.	do.	do.	do.
208424	15362	Haight's-in-the-oaks, 7,000 feet, near Paoy, Benguet, Luzon, Philippine Islands.	do.	July 21, 1907	do.	do.	do.	do.	do.
210864	14460	Mangyan clearing, left side of Alag River, 2,500 feet, Mindoro, Philippine Islands.	do.	Nov. 9, 1906	do.	do.	do.	do.	do.
190273	12861	Marivales, Luzon, Philippine Islands.	Female, adult.	Aug. 4, 1903	63	37.5	10.5	17.5	do.
189672	2581	Irisan, Benguet, Luzon, Philippine Islands.	do.	May 12, 1903	60.5	39	9.5	16.5	R. C. McGregor and A. Celestino.
189674	2604	do	do.	May 13, 1903	61	37.5	10.5	16.5	do.
189675	2751	do	do.	May 27, 1903	62.5	39	10.5	16	do.
211602	do.	Near Sablayan, Benguet, Luzon, Philippine Islands.	do.	Mar. 15, 1908	63	38	do.	17	Paul Bartsch.
200648	13792	Baguio, 5,000 feet, Benguet, Luzon, Philippine Islands.	do.	Dec. 7, 1905	63	39	10	17.5	E. A. Mearns.
200650	13799	do	do.	Dec. 8, 1905	65	39	9	17	do.
210874	14674	do	do.	Jan. 3, 1907	64	41	9	16.5	do.
210875	14675	do	do.	do.	64.5	38.5	9	17	do.
211600	do.	do	do.	Mar. 13, 1908	65	39	9.5	17	Paul Bartsch.
211601	15077	do	do.	do.	63	37.5	9.5	18	do.
210879	15078	do	do.	Apr. 8, 1907	62	38.5	10	16.5	E. A. Mearns.
202389	15078	do	do.	do.	64	39.5	9	16.5	do.
202374	15091	do	do.	Apr. 9, 1907	62	38	10.5	17.5	do.
208412	15114	do	do.	Apr. 23, 1907	63	36	10	16.5	do.
208419	15289	do	do.	July 7, 1907	63.5	38.5	10	17	do.
208417	15277	Baguio, Benguet, Luzon, Philippine Islands.	Female, immature.	July 5, 1907	do.	do.	do.	do.	do.
208425	15363	Haight's-in-the-oaks, 7,000 feet, near Paoy, Benguet, Luzon, Philippine Islands.	do.	July 21, 1907	do.	do.	do.	do.	do.
208427	15424	do	do.	July 28, 1907	do.	do.	do.	do.	do.

Record and measurements of specimens contained in the United States Naonal Museum—Continued.

PARDALIPARUS ELEGANS EDITHÆ (MCGREGOR).

National Museum number.	Original Museum number.	Locality.	Sex and age.	Date.	Wing.	Tail.	Culmen.	Tarsus.	Collector.	Remarks.
211085	3620	Calayan, Philippine Islands.....	Male, adult.	Oct. 13, 1903	68	42.5	12	18.5	R. C. McGregor and A. Celestino.	
211086	3549	.....do.....	Female, adult.	Oct. 9, 1903	68	41	11.5	18	.....do.....	
211084	6611	Camiguin, Philippine Islands.....	Female, immature.	July 1, 1907	66	39	11	18	.....do.....	

PARDALIPARUS ELEGANS ALBESCENS (MCGREGOR).

233275	1378	Palanoc, Masbate, Philippine Islands.....	Male, adult.	Nov. 20, 1892	65	39	10	16.5	D. C. Worcester and F. S. Bourns.	
233276	1381	Toledo, Cebu, Philippine Islands.....	.....do.....	June 18, 1892	65	38	10	17	.....do.....	
233277	1382	.....do.....	.....do.....	June 14, 1891	64	39	10	18	.....do.....	
233281	1398	Bais, Negros, Philippine Islands.....	.....do.....	Jan. 20, 1891	66	41	9.5	17	.....do.....	
161447	.....	Cebu, Philippine Islands.....	Female, adult.	Mar. 17, 1888	60.5	36	10	17	D. C. Worcester.....	Iris light brown.

PARDALIPARUS ELEGANS PANAYENSIS MEARNS.

233280	1304	Panay, Philippine Islands.....	Male, adult.	Nov. 12, 1890	64	39	9	17	D. C. Worcester and F. S. Bourns.	
233639	1395	.....do.....	.....do.....	Nov. 14, 1890	64	39	.....	17	.....do.....	Type.

PARDALIPARUS ELEGANS GUIMARASENSIS MEARNS.

161448	Guimaras, Philippine Islands.....	Female, adult.	Dec. 28, 1887	63	38	10	16	D. C. Worcester.....	Type.
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PARDALIPARUS ELEGANS MINDANENSIS MEARNS.

192267	13580	Mount Apo, 6,200 feet, Mindanao, Philippine Islands.	Male, adult.	June 25, 1904	67	41	9.5	16.0	F. A. Mearns.	Type.
192268	13581	Mount Apo, 6,000 feet, Mindanao, Philippine Islands.	do.	June 25, 1904	62	36	8.5	16.5	do.	Bogobo name: Kah-too-ree-may.
192269	13662	Mount Apo, 6,200 feet, Mindanao, Philippine Islands.	do.	July 8, 1904	66	38	9.5	16.5	do.	Do.
210863	14115	Catagan, 1,100 feet, Mindanao, Philippine Islands.	Female, adult.	May 12, 1906	60	33	10	15.5	do.	Do.

PARDALIPARUS ELEGANS SULUENSIS MEARNS.

233278	1386	Sulu (Jolo), Philippine Islands.	Male, adult.	Sept. 17, 1891	58	33	9	16.5	D. C. Worcester and F. S. Bourne.	Type.
233279	1387	do.	do.	Sept. 9, 1891	61	35	9.5	16	do.	
233640	1391	do.	Female, adult.	Sept. 22, 1891	59	33	9	16	do.	

REPORT ON ARACHNIDA COLLECTED BY MESSRS.
CURRIE, CAUDELL, AND DYAR IN
BRITISH COLUMBIA

BY

NATHAN BANKS

Of the Bureau of Entomology, United States Department of Agriculture

No. 2143.—From the Proceedings of the United States National Museum,
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REPORT ON ARACHNIDA COLLECTED BY MESSRS. CURRIE, CAUDELL, AND DYAR IN BRITISH COLUMBIA.

BY NATHAN BANKS,

Of the Bureau of Entomology, United States Department of Agriculture.

The Arachnida collected by Messrs. Rolla P. Currie, A. N. Caudell, and H. G. Dyar on their trip to British Columbia in 1903 have been determined except for a few mostly immature forms. Although containing no new species, the collection is of considerable interest as indicating the nature of the spider fauna of that region, and the material is a valuable addition to the United States National Museum collection of Arachnida.

Order ARANEIDA.

Family DRASSIDÆ.

DRASSODES ROBUSTUS Emerton.

An immature specimen from Kaslo.

ZELOTES ATRA Hentz.

One female from Ainsworth, July 11 (Currie).

POECILOCHROA MONTANA Emerton.

Kaslo (Currie), young; Kaslo, June 17 and 26 (Currie).

Family CLUBIONIDÆ.

CLUBIONA PACIFICA Banks.

One female from Kaslo, June 30 (Currie); Kaslo, June 15 and 23 (Currie); one female, Bear Lake, July 29 (Caudell); Kaslo Creek, June 18 (Currie); Ainsworth, July 11 (Caudell).

GAYENNA PACIFICA Banks.

One male, Kaslo, July 2 (Currie); female from Mirror Lake, Aug. 3 (Caudell); Ainsworth, July 10 (Currie).

PHRUROLITHUS PUGNATUS Emerton.

Kaslo, July 8 (Currie), 1 pair.

Family AGELENIDAE.

AGELENA CALIFORNICA Banks.

One specimen from Kaslo.

Family DICTYNIDAE.

DICTYNA SUBLATA Hentz.

Kaslo, July 16 (Currie).

DICTYNA, species.

One female, of a species allied to *D. foliata*, from Kaslo, July.

AMAUROBIUS PICTUS Simon.

Kaslo, June 29 (Caudell).

Family ULOBORIDAE.

HYPTIOTES CAVATUS Hentz.

One from Frye Creek, July 23 (Currie); Kaslo, Aug. 4 (Currie).

Family THERIDIIDAE.

THERIDIUM PLACENS Keyserling.

Kaslo, June 23 and 29, July 2 (Currie); Powder Creek, June 26 (Currie); Ainsworth, July 10 (Currie).

THERIDIUM DIFFERENS Emerton.

Kaslo, July 8 (Caudell); June 23 and 24, July 2 (Currie).

THERIDIUM MURARIUM Emerton.

Kaslo, July 8 (Caudell), June 23 (Currie).

THERIDULA SPHAERULA Hentz.

Kaslo, June 11 (Currie).

DIPOENA TIBIALIS Banks.

Kaslo, July 3 and 8 (Caudell); July 18 and 24 (Currie); Frye Creek, July 23 (Currie); Powder Creek, opposite Kaslo, July 15 (Caudell), June 26 (Currie).

EURYOPIS FUNEBRIS Hentz.

Kaslo, July 8 (Caudell), June 15 (Currie).

STEATODA BOREALIS Hentz.

One from Kaslo, June 21 (Cockle).

Family LINYPHIIDAE.

LINYPHIA PHRYGIANA Koch.

Kaslo, July 3 (Caudell), June 24 (Currie); Frye Creek, July 23 (Currie); South Fork of Kaslo Creek, Aug. 11 (Currie); top of mountain north of Bear Lake, July 29 (Currie); Kokanee Mountain, in snow of glacier, 9,000 feet, Aug. 10 (Caudell); Ainsworth, July 10 (Currie); Kaslo Creek, June 18 (Currie).

LINYPHIA MARGINATA Koch.

Kaslo, June 29 and 30 (Caudell), June 15, 23, and 26, July 2 and 4 (Currie); Powder Creek, June 26 (Currie).

LINYPHIA COMMUNIS Hentz.

Kaslo, July 7 (Currie).

LEPTYPHANTES NEBULOSA Sundeval.

Kaslo, July 4 (Currie).

LEPTYPHANTES, species.

One male from top of mountain north of Bear Lake, July 29 (Currie).

Family TETRAGNATHIDAE.

TETRAGNATHA EXTENSA Linnaeus.

Lardo, July 7 (Dyar); Kaslo, June, July (Currie); Kaslo Creek, June 18 (Currie); Ainsworth, July 10 (Currie); Powder Creek, June 26 (Currie).

TETRAGNATHA LABORIOSA Hentz.

Kaslo, June and July; Kaslo Creek, June 18 (Currie); Bear Lake, July 20 (Currie).

Family EPEIRIDAE.

EPEIRA ANGULATA Clerck.

One female from Ainsworth, July 10 (Currie).

EPEIRA TRIFOLIUM Hentz.

Kaslo, June 26 (Currie), male.

EPEIRA FOLIATA Koch.

One from Kaslo, July 13 (Caudell).

EPEIRA PATAGIATA Clerck.

Many specimens from Kaslo, June, July, and August (Currie and Caudell); Powder Creek, opposite Kaslo (Caudell); Kaslo, July 23, with cocoon in leaf (Caudell), June 23 (Currie), July 3 (Caudell).

EPEIRA NORDMANNI Thorell.

South Fork of Kaslo Creek, August 9 (Caudell); Kaslo Creek, June 18 (Currie), not quite adult.

EPEIRA GEMMA McCook.

Kaslo, August 14, male, August 16, female (Caudell); Frye Creek, July 23 (Currie); Kaslo, July 13 (Currie), July 20 (Caudell), July 25 (Cockle).

EPEIRA DISPLICATA Hentz.

Kaslo, June 23 and July 2 (Currie), July 16 (Caudell, Currie); top of mountain north of Bear Lake, July 29 (Currie); Ainsworth, July 10 (Currie), July 11 (Caudell); Kaslo Creek, June 18 (Currie); Bear Lake, July 20 (Currie); Powder Creek, June 26 (Currie).

CYCLOSA CONICA Pallas.

Kaslo, June 13 and 24, July 2 and 4 (Currie), July 8 (Caudell); Ten Mile, June 30 (Currie); Kaslo Creek, June 18 (Currie); Powder Creek, June 26 (Currie).

Family **THOMISIDAE**.**XYSTICUS MONTANENSIS** Keyserling.

Kaslo, July 16 (Caudell).

XYSTICUS DISCURSANS Keyserling.

One female, Kaslo, July 16 (Caudell).

XYSTICUS FORMOSUS Banks.

Half-grown specimen from Kaslo, June 24 (Currie); Powder Creek, June 26 (Currie).

CORIARACHNE VERSICOLOR Keyserling.

Kaslo, June, July, July 2 (Currie).

MISUMENA VATIA Clerck.

Kaslo, June, July (Currie, Caudell); Kaslo Creek, June; Bear Lake, July 29 (Caudell); Ainsworth, July 10 (Currie).

THANATUS RUBICUNDUS Keyserling.

Shawnigan Lake, Vancouver Island, August 31 (Dyar).

TIBELLUS OBLONGUS Walckenaer.

Kaslo, June 11, 17, and 23, July 2 and 17 (Currie), July 23 (Caudell); Powder Creek, June 26 (Currie).

PHILODROMUS SPECTABILIS Keyserling.

Kaslo, July 2 (Currie); Powder Creek (Currie).

PHILODROMUS AUREOLUS Walckenaer.

Kaslo, July 4 and 18 (Currie), July 16 (Caudell); Powder Creek, July 15 (Caudell).

PHILODROMUS LENTIGINOSUS Keyserling.

One female from top of mountain north of Bear Lake, July 29 (Currie); Kaslo, July 18 (Currie); Kokanee Mountain, on snow of glacier, 9,000 feet, August 10 (Currie, Caudell).

Family LYCOSIDAE.

LYCOSA PRATENSIS Emerton.

Kaslo, one specimen, June 26 (Currie).

PARDOSA GLACIALIS Thorell.

Top of mountain north of Bear Lake, July 29 (Currie); Bear Lake, July 28, 6,500 feet (Caudell).

PARDOSA GROENLANDICA Thorell.

Kaslo, June 13 and 24, July 4, and Aug. 1 (Currie), June 26 (Caudell); Mirror Lake, Kaslo, Aug. 3 (Currie); Kokanee Mountain, in snow on glacier, 9,000 feet, Aug. 10 (Caudell, Currie); Powder Creek, June 26 (Currie); Ten Mile, June 30 (Currie).

PARDOSA UNCATA Thorell.

From top of mountain north of Bear Lake, July 29 (Currie); Kaslo, June 17 and 23 (Caudell).

Family OXYOPIDAE.

OXYOPES RUFIPES Banks.

Kaslo, June 11, 20, and 23, July 2 (Currie), July 13 and Aug. 5 (Caudell); Frye Creek, July 23 (Currie); Powder Creek, June 26 (Currie).

Family ATTIDAE.

PHIDIPPUS JOHNSONI Peckham.

Kaslo, June 15 and 26, Aug. 5 (Currie), June 7 (Dyar), June 20 and Aug. 5 (Caudell).

DENDRYPHANTES MILITARIS Hentz.

Kaslo, July 13 (Caudell), June 23 and July 23 (Currie); Powder Creek, opposite Kaslo, July 15 (Caudell).

DENDRYPHANTES OCTAVUS Hentz.

Common at Kaslo, June, July.

ATTUS PALUSTRIS Peckham.

Two females from Kaslo, June (Currie).

PELLENES FALCATA Clerck.

Kaslo, June 17 and 23, July 7 (Currie), July 16 and Aug. 5 (Caudell); Ainsworth, July 10 (Currie); Powder Creek, June 26 (Currie).

Order PHALANGIDA.

LIQBUNUM EXILIPES Wood.

Several specimens from Kaslo and Frye Creek, from June 13 to July 23. These specimens have shorter legs than those from California.

HOMOLOPHUS BICEPS Thorell.

Many specimens taken from the middle of June till August 4, some at sugar. It is evidently the most common "daddy-long-legs" of the region.

Order ACARINA.

RHYNCHOLOPHUS GRACILIPES Banks.

Top of mountain north of Bear Lake, July 29 (Currie); Kaslo, June 13 (Currie); two specimens.

TROMBIDIUM, species.

Mirror Lake, Kaslo, Aug. 3 (Currie); one specimen of a rather elongate species.

DERMACENTOR VENUSTUS Banks.

Kaslo, June 26 (Currie).

Order PSEUDOSCORPIONIDA.

IDEORONCUS OBSCURUS Banks.

Two from Kaslo, July 8 (Currie).

NEW BRACHIOPODS OF THE GENUS SPIRIFER
FROM THE SILURIAN OF MAINE

BY

HENRY SHALER WILLIAMS

Of Cornell University, Ithaca, New York

No. 2144.—From the Proceedings of the United States National Museum,
Vol. 51, pages 73-80, with Plate 1

Published December 16, 1916



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NEW BRACHIOPODS OF THE GENUS SPIRIFER FROM THE SILURIAN OF MAINE.

BY HENRY SHALER WILLIAMS,
Of Cornell University, Ithaca, New York.

The species described in the following paper are particularly interesting because of the relations they bear to well-known Silurian forms while retaining a distinctive distribution of their specific characters not heretofore observed.

The fauna with which they are associated indicates a closer relationship to the Wenlock-Ludlow formations of Great Britain than to the Niagara of the interior of the American Continent.

Their source is the Edmunds formation of Washington County, Maine.

SPIRIFER (?DELTHYRIS) TRECOTTI Williams.

Plate 1, figs. 1-9, 11, 20, 22-23, 25.

1828, cf. *Delthyris elevata* DALMAN Vet. Acad. Handlingar fur 1827, p. 120, pl. 3, fig. 3.

1867, cf. *Spirifera elevata* Dalman, DAVIDSON, British Silurian Brachiopoda, pt. 7, No. 2, p. 95, pl. 10, figs. 8, 9, and 11.

In external appearance the adult shells of this species resemble Davidson's figures of "*Spirifera elevata* Dalman" shown on his plate 10, figures 8, 9, and 11 in British Silurian Brachiopoda.

It is necessary to examine critically his definition in order to discover the points of difference. The following portions of Davidson's description of "*Spirifera elevata* Dalman" may be used as they were written in defining the form here under consideration:

Transversely rhomboidal, hinge line nearly (----(a)----) as long as the width of the shell, cardinal angles (----(b)----) rounded. Dorsal valve less convex than the opposite one with (----(c)----) simple ribs, which are divided by a mesialfold, equaling in width the adjoining two ribs, moderately elevated and grooved along the middle. Ventral valve much arched and gibbous; beak incurved; mesial sinus as wide as the fold of the opposite valve and margined by a strong rounded rib or ridge on each side; ----four---- ribs on either side of the sinus. Surface of both valves regularly crossed by numerous slightly

projecting lines, as well as by delicate longitudinal and transverse striæ. Area triangular (----(d)----), fissure (----(e)----). Specimens vary much in size (----).¹

The omissions marked by dotted lines above, are parts of the description which do not apply to *S. trescottii*. The differentiating characters are therefore found in the following particulars: (a) The hinge line does not quite reach the full width of the shell in our specimens. (b) The cardinal angles are rounded or slightly angular. (c) The plications on the brachial valve vary with size of the shell, additional plications making their appearance at the cardinal angles with development of the shell. The smallest specimen in evidence (see pl. 1, figs. 2 and 4) is 5 millimeters wide and shows one plication each side the median fold of nearly the size of the fold, and a second one faintly expressed outside the first. The cardinal extremities are broadly rounded, presenting the form of *Spirifer crispus*, var. *simplex* Hall. A specimen about 7 mm. wide (H. S. W. Cat. No. 1429.2) shows three plications each side the fold and the fold is distinctly broader than the first plication; the extremities are rounded. Specimens 8 or 9 mm. wide have the extremities slightly angular and four plications (and in one specimen a faint fifth) are seen each side the fold. Larger specimens, up to the largest seen (17 mm. wide), show only four well defined and faintly a fifth plication each side the fold. The fold in the smaller as in the larger specimens shows the "groove along the middle" described by Davidson as characteristic of *S. elevata* Dalman. The pedicle valve shows but four well-defined plications each side the sinus which, at the front of the larger specimens, is quite broad, equaling the distance from first to third plication. The small pedicle valves differ from *S. crispus* in the high, strong, and overarching beak, and a specimen 6 mm. wide, a mold of the interior of a pedicle valve, shows a distinct septum as in adult specimens. (d) The triangular area of the pedicle valve is not broad but is undefined, as shown by Whitfield in figures of *Spirifer crispus* and *S. vanuxemi*², and slopes gradually off into the sides of the shell without any sharp angle defining its limits. Specimens showing this character are molds of the interior, and it is therefore possible that the limits are more sharply defined exteriorly as expressed by Davidson's figures. (e) The fissure (delthyrium) is narrow and high (see pl. 1, fig. 20), and no case of a pair of deltidial plates has been discovered on our specimens. Davidson mentions them in his description, but none of his figures show them.

The dental plates of the pedicle valve are thin and elongate. In small as well as large specimens there is a thin, deep median septum reaching halfway from beak to front. The surface is covered by

¹ Brit. Sil. Brac., p. 95.

² Pal. New York, vol. 8, pt. 2, pl. 36, figs. 2 and 11.

regular fine lamellose lines fringed at their outer edges by fine interrupted radial lines. Molds of the interior of some brachial valves show a faint linear depression (elevated line in shell) in the umbonal portion of the mold.

From the above description it will be seen that the shell closely resembles Davidson's narrower forms of *S. elevata* Dalman.

Formation.—Edmunds formation (Silurian).

Locality.—Northeast corner of Crowe Neck, Trescott Township, Washington County, Maine.

Cotypes.—Cat No. 61451, U.S.N.M.

Remarks.—It is known that specimens identified as *Delthyris elevata* Dalman possess a median septum in the pedicle valve which has led to the adoption of that species as the type of the genus *Delthyris*.¹ It is not established, however, either that Dalman recognized that character in his descriptions or that the type-specimens possessed this distinction.

Lindstrom, in his description of the species from Gotland,² makes no mention of the median septum. (The writer is indebted to Mr. Hermanson, of Cornell University, for the translation of this description.) The discovery in the Edmunds formation of Maine of the two species here defined (which externally are very close to the form called *Delthyris elevata* Dalman from Gotland and *Spirifera elevata* Dalman of Davidson from the Wenlock of England, but differ from each other by the possession of a well-defined median septum in one, i. e. *Sp. trescotti*, and its absence in the other, i. e. *Sp. cobscooki*, leaves us in doubt as to the validity of the generic characters of *Delthyris* Dalman.

Davidson's conception of the species, as above quoted, appears to be based upon external characters, and we note no mention of a median septum in his description or figures.

Wenjukow,³ in citing the species from the Silurian of Podolia, seems to base the identification upon external characters alone.

In all these definitions of the species *Delthyris* (or *Spirifera*) *elevata* Dalman the groove along the middle of the fold of the brachial valve is noted as one of the specific characters.

In the various specimens here under investigation it is noted that those forms in which the fold of the brachial valve is grooved (viz, *Spirifer cobscooki*) have no median septum in the pedicle valve and those forms possessing the median septum have no groove along the middle of the brachial fold. While it does not necessarily follow that the combination of characters expressed by species in Maine should be the same as in species of the same approximate age in Got-

¹ Schuchert. Syn. Amer. Foss. Brach., Bull. U. S. Geol. Surv., No. 87, 1897, p. 206.

² Ofersigt. Kgl. Vet. Akad. Forhandlingar, 1860, p. 359-360.

³ Wenjukow, T., Die Fauna der Silurischen Ablagerungen des Gouvernements Podolien, 1899, p. 129, pl. 11, figs. 3, 4, and 5.

land, England, and Podolia the validity of the establishment of the genus *Delthyris* upon Dalman's species *D. elevata* will rest upon the proving that that species combines in the same shell the median septum of the pedicle valve with the groove along the middle of the fold of the brachial valve.

SPIRIFER COBSCOOKI Williams.

Plate 1, figs. 10, 12, 21, 24.

1905. *Spirifer octocostatus* Hall, WILLIAMS, U. S. Geol. Surv., Prof. Paper No. 35, pp. 22, 23.

Cf. *Delthyris elevata* DALMAN.

A spirifer of the general form of *Delthyris elevata* Dalman with high area, overarching beak, four plications each side the fold of the brachial valve which is indented by a median groove extending from beak to front. The interior of the pedicle valve has no median septum.

The original specimens were identified in 1905 with *Spirifer octocostatus* Hall,¹ by Williams and probably by Shaler, as the name is given in his list of 1886,² though the specimens are not labeled. But they differ from that species both in the absence of a median septum in the pedicle valve and by the presence of the groove along the top of the brachial fold. The species attains a larger size than *Spirifer trescottii* Williams from the same formation, and the surface markings are similar. The possession of a strongly developed median septum, however, distinguishes *S. trescottii* from this species.

The type-specimen of *S. cobscooki*, represented on plate 1 by figure 21, shows a cardinal view in mold of the two valves in conjunction. The dimension of this specimen across the cardinal area is 19 mm., the height from center to center of the two valves at the beaks is 14 mm., the width of the delthyrium at the cardinal base 5 mm. Four complete plications are in evidence each side the sinus of the pedicle valve; where the area meets the outer surface of the pedicle valve the angle is rounded. Another specimen (pl. 1, fig. 10), a mold of the interior of a pedicle valve, shows the sinus to the tip of the beak and without trace of the median septum. Still another specimen (pl. 1, fig. 12), a mold of the interior of the brachial valve, shows the groove on the fold extending from beak to front. The surface sculpture consists of fine concentric lamellose lines, fringed at their edges by fine interrupted longitudinal lines. The figure (pl. 1, fig. 24) illustrating this character was photographed from a gutta-percha mold of the specimen, which is a mold of the exterior and only imperfectly exhibits the interrupted lines at edges of the concentric lamellae.

¹ Prof. Paper No. 35, U. S. Geol. Surv., 1895, pp. 22-23.

² Amer. Journ. Sci., ser. 3, vol. 32, p. 58.

The two species together (*S. trescottii* and *S. cobscookii*) fairly well represent the characters generally ascribed to Dalman's species *Delthyris elevata*, but the first, with a median septum in the pedicle valve, lacks the groove in middle of the brachial fold, and the second, having the groove, lacks the median septum. Until further light is thrown on the matter the three species may be regarded as distinct though very closely related.

Formation.—Edmunds formation of the Silurian.

Locality.—South of Bells Mountain, on west shore of Cobscook River, Edmunds Township, Washington County, Maine.

Holotype and paratypes.—Cat. No. 61452, U.S.N.M.

SPIRIFER EDMUNDSI Williams.

Plate 1, figs. 13, 14, 15.

1905. *Spirifer cf. perlamellosus* Hall, WILLIAMS, Prof. Paper U. S. Geol. Surv. No. 35, pp. 22, 23.

Specimens described under the name *Spirifer edmundsi* differ from *S. cobscookii* in the following particulars: They are larger in size, have a greater number of plications (6 and 7 instead of 4 and 5, respectively, on each side of the brachial and pedicle valves), a lower area, and more angular cardinal extremities. The two species agree in lacking a median septum in the pedicle valve and in possessing a groove in the middle of the brachial fold.

Spirifer edmundsi closely resembles some figures of Hall's species *S. perlamellosus*, as will be seen upon comparing our figures 13, 14, 15 on plate 1 with Hall's figures on plate 26.¹

The type-specimen (pl. 1, fig. 13) was about 28 mm. from tip to tip of cardinal margin. The corner on the left is broken off in the specimen. Hall's figure 1*g* of *S. perlamellosus* measures 27 mm., and the several figures given on his plate 26 vary from 10 to 45 mm.

The cardinal extremities of our specimen are closely similar to those of Hall's figure 1*n*. The plications on right side of figure 13 are 7; those on Hall's figure 1*n* are 6 on left and 5 on right side.

The brachial valve (pl. 1, fig. 14) shows 6 plications on the right of the fold; Hall's figure 1*p* shows 6 plications each side the median fold. The surface markings are similar in the two species. The area is flat and extended as in Hall's figure 1*m*.

Spirifer edmundsi differs from *S. perlamellosus* in the possession of a well-defined groove along the middle of the brachial fold from beak to front of the shell and in the absence of any trace of median septum in the pedicle valve, which is present in *S. perlamellosus*.

Formation.—Edmunds formation of the Silurian.

Locality.—South of Bells Mountain, on the west shore of Cobscook River, Edmunds Township, Washington County, Maine.

¹ Paleontology of New York, vol. 3, pl. 26.

Holotype and paratypes.—Cat. No. 51453, U.S.N.M.

Remarks.—In the list of species given by N. S. Shaler as from the Orange Bay section and from locality on the west side of Orange or Whiting Bay, about half a mile south of Balls Mill,¹ the species *Spirifer perlamellosus* Hall is cited. The writer had occasion to examine the collections made by Shaler and, although the specimens were not labeled, recognized specimens which closely resembled Hall's species. These were reported in a revised list of the collection under the name *Spirifer* cf. *perlamellosus* Hall.² The specimens so identified and others obtained in course of preparation of the Eastport Folio are here described under the specific name *Spirifer edmundsi* Williams.

SPIRIFER (cf. CYRTINA) LUBECENSIS Williams.

Plate 1, figs. 16-19, 26-28.

Shell cyrtiniform, pedicle valve, plicated with high, nearly flat and erect cardinal area. Fold and sinus wide at front. A pedicle valve $2\frac{1}{2}$ cm. wide measures $1\frac{1}{2}$ cm. from beak to front. A brachial valve of about the same width is about 12 mm. from beak to front.

Teeth plates of pedicle valve thin, extend one-third way to front, and a median septum cuts the sinus to three-quarters way to the front in a mold of the interior. Beak sharp and angular; area, high and triangular, flat and slightly overarching at the tip. Edge of area nearly straight and rounded at junction with the sides. Median sinus shallow, broadening toward front, and produced toward opposite valve; plications, counting the outer edge of the sinus as one, seven each side the center. Delthyrium narrow and apparently uncovered.

The brachial valve is gently curved from beak to front, fold prominent and separated from the plications by a furrow stronger than the furrows between the plications; a shallow groove cuts the middle of the fold.

The surface is badly preserved in all specimens, though faint evidence of lamellose concentric lines is seen on some. It is not possible from the specimens to determine whether or not there was punctate structure. The general form and the septum suggest that it may belong to the genus *Cyrtina*.

The form varies considerably, which is probably the result of distortion through movement in the rock mass after fossilization.

Formation and locality.—Black limestone at station 6.52.6B, believed to belong in the Edmunds formation, Lubec Township, Washington County, Maine.

Cotypes.—Cat. No. 61454, U.S.N.M.

¹ Amer. Journ. Sci., ser. 3, vol. 32, 1886, p. 52.

² Prof. Paper No. 35, U. S. Geol. Surv., 1905, pp. 22-23.

EXPLANATION OF PLATE 1.

All the figures are natural size except figures 2 and 24 magnified 2 diameters, and figure 9 magnified 3 diameters.

Spirifer trescotti Williams.

- FIG. 1. Mold of the interior of a mature pedicle valve showing the plications, dental plates, and median septum.
- FIG. 2. An immature specimen of the brachial valve, enlarged two diameters (shown natural size on lower left hand corner of fig. 4). This specimen shows resemblance to *Spirifer crispus* Hisinger.
- FIG. 3. Mold of the interior of a mature pedicle valve.
- FIG. 4. Molds of the interior of the beak portion of a mature pedicle valve and of an immature brachial valve. (See fig. 2.) The pedicle valve shows the dental plates and median septum.
- FIG. 5. A small specimen showing the brachial valve and hinge area of the pedicle valve drawn from a gutta-percha impression. The beak of the pedicle valve is less developed than in mature shells.
- FIG. 6. Mold of the interior of a pedicle valve not fully mature. The center of view is higher up on the umbonal portion of the shell than for figure 1, causing the shell to appear shorter from beak to front than normal.
- FIG. 7. Mold of the exterior of a pedicle valve showing the rounded plications crossed by fine concentric lines.
- FIGS. 8 and 11. Two views of mold of the interior of a brachial valve showing the number and form of the plications, the rounded median fold, and the form of the hinge border.
- FIG. 9. Mold of the interior of a small brachial valve magnified three diameters.
- FIG. 20. Interior cardinal view of a pedicle valve, showing the triangular area rounded off at sides, the narrow delthyrium, and the edge of the median septum where the beak is broken off.
- FIG. 22. End view of same specimen as figure 20.
- FIG. 23. Another view of same specimen, showing plications and contour of the pedicle valve.
- FIG. 25. A slightly crushed brachial valve.

Formation.—Edmunds formation of the Silurian.

Locality.—Northeast corner of Crowe Necke, Trescott township, Washington County, Maine.

Spirifer cobscooki Williams.

- FIG. 10. Mold of the interior of a pedicle valve of ordinary size, showing the five well-developed plications, each side the sinus, the absence of a median septum and the short development of the dental plates.
- FIG. 12. Mold of the interior of a mature brachial valve, showing the plications and the well-developed furrow in the middle of the fold and extending from beak to front.
- FIG. 21. Cardinal view of a specimen, showing both valves, the high over-arching area and beak, the triangular delthyrium, absence of a median septum in pedicle valve, and trace of the furrow along the top of the brachial fold.

FIG. 24. Mold of the exterior of a piece of a brachial valve enlarged two diameters to show the fine concentric lines crossing the plications and the distinct median furrow on the fold.

Formation.—Edmunds formation of the Silurian.

Locality.—West shore of Cobscook River, about half a mile south of Bells Mountain, Edmunds township, Washington County, Maine.

Spirifer edmundsi Williams.

FIG. 13. Mold of the exterior of a pedicle valve. The drawing was made from an impression of the opposite side of same specimen represented by figure 15 and shows the plications more in number than in *S. cobscooki* (see fig. 10).

FIG. 14. Mold of the interior of a brachial valve, showing the plications and furrow along the top of the fold.

FIG. 15. Mold of the interior of same specimen represented by figure 13, showing the relatively low area and the absence of a median septum.

Formation.—Edmunds formation of the Silurian.

Locality.—West shore of Cobscook River, about half a mile south of Bells Mountain, Edmunds township, Washington County, Maine.

Spirifer lubecensis Williams.

FIG. 16. An end view of a pedicle valve, showing the high, pointed beak and nearly straight cardinal area.

FIG. 17. Mold of the interior of a pedicle valve, showing the plications, the broad shallow median sinus, and the angular beak with its nearly straight sides. Another view of same specimens as figure 1.

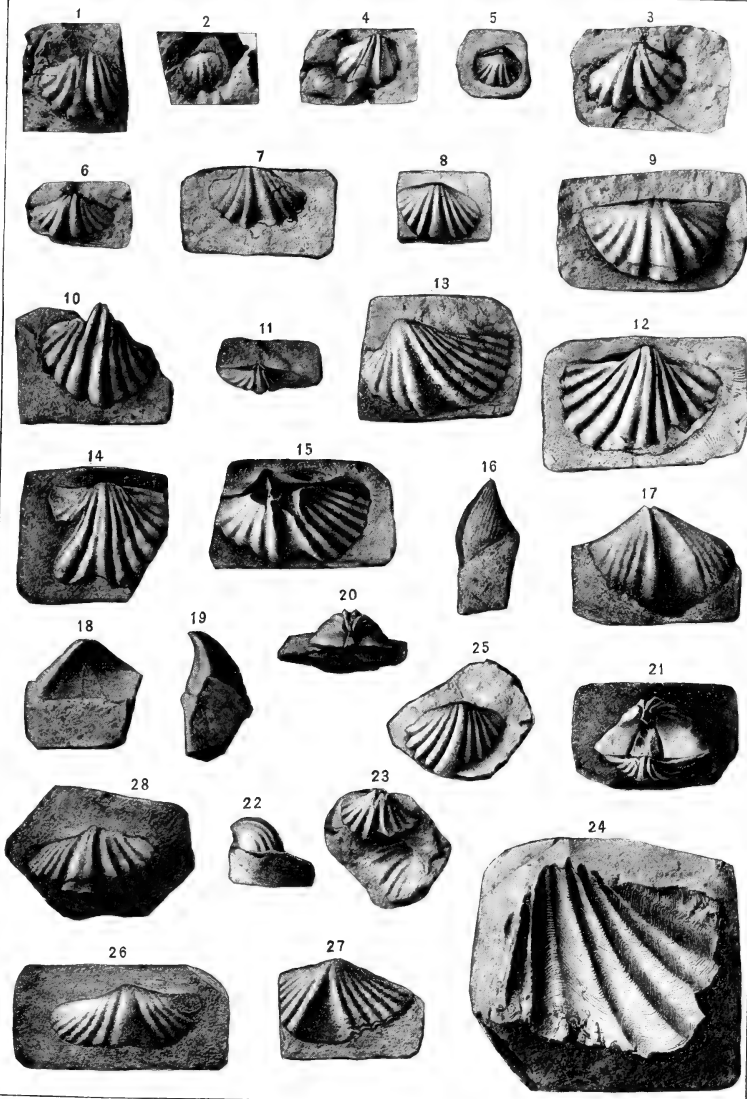
FIGS. 18 and 19. Two views of another specimen, showing the cardinal area, delthyrium, and slightly overarched beak.

FIGS. 26 and 28. Two specimens of brachial valves, both of them imperfect and distorted by crushing of rock after they were imbedded.

FIG. 27. The exterior surface of a pedicle valve, faintly exhibiting surface sculpture of concentric lamellose lines.

Formation.—Edmunds formation of the Silurian.

Locality.—Lubec township, Washington County, Maine.



NEW BRACHIOPODS FROM THE SILURIAN OF MAINE.

FOR EXPLANATION OF PLATE SEE PAGES 79 AND 80.

NOTES ON ALUNITE, PSILOMELANITE,
AND TITANITE

BY

EDGAR T. WHERRY

Assistant Curator, Division of Mineralogy and Petrology

No. 2145.—From the Proceedings of the United States National Museum,
Vol. 51, pages 81-88

Published October 16, 1916



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A PHOSPHATE-BEARING ALUNITE FROM TEXAS.

The material herein described was sent to the United States National Museum for examination and report by Mr. L. F. Christian, of Lockhart, Texas, the locality being given as "Gonzales County, Texas" (U.S.N.M. Cat. No. 88252). As preliminary examination showed it to possess somewhat unusual composition and properties, it was studied in detail. It has the following properties:

PHYSICAL PROPERTIES.

Color: White with very slight yellowish hue; also shows superficial brown stains of iron rust.

Luster: Dull, like chalk.

Structure: Compact (cryptocrystalline); fracture subconchoidal.

Hardness: $1\frac{1}{2}$.

Density: 2.67.

Optical properties: Under the microscope seen to consist chiefly of a fine crystalline aggregate, with occasional grains up to .02 mm. in diameter; colorless; mean refractive index $1.580 \pm .005$; double refraction .005.

CRYSTALLOGRAPHIC PROPERTIES

Indeterminate.

CHEMICAL PROPERTIES.

Qualitative tests: Before the blowpipe gives reactions for Al, K, Na, SO_3 , and H_2O ; in HCl slightly soluble, the solution giving faint reactions for Al and SO_3 ; after ignition, H_2O extracts K_2SO_4 .

Quantitative composition: A sample was submitted to Dr. J. E. Whitfield, of Booth, Garrett, and Blair, of Philadelphia, who reported as follows (column 1):

Constituents.	1	2	3	4	5	6
	Analysis.	Kalio-alunite.	Natro-alunite.	Kalio-hitchcockite.	Natro-hitchcockite.	Clay (Cimolite.)
K ₂ O.....	6.39	5.81		.43		.15
Na ₂ O.....	2.81		2.56		.19	.06
H ₂ O.....	15.20	6.63	4.43	.68	.44	3.02
Al ₂ O ₃	36.31	18.87	12.62	1.45	.93	2.44
Fe ₂ O ₃.....	.34					.34
SO ₃	32.89	19.70	13.19			
P ₂ O ₅	2.20			1.34	.86	
SiO ₂	3.95					3.95
	100.09	51.01	32.80	3.90	2.42	9.96

The mineral composition, given in columns 2 to 6 inclusive, was obtained as follows: The sulphur trioxide found was first calculated to alunite, $R_2O \cdot 6H_2O \cdot 3Al_2O_3 \cdot 4SO_3$, or $R_2 [Al(OH)_2]_6 (SO_4)_4$, the R_2O comprising $K_2O : Na_2O =$ approximately 3:2. (Columns 2 and 3.) The names for the end members are derived according to the standard rule advocated by the writer elsewhere, of assigning a group name (in this case *alunite*) to the isomorphous series as a whole and naming the (theoretical) end-members by chemical prefixes. The potassium (kalium) end-member thus becomes kalio-alunite, the sodium (natrium) one natro-alunite; the latter name is indeed already in use, having been proposed by Hillebrand and Penfield in 1902.¹

The phosphoric oxide was then assigned in a corresponding way to a molecule with HPO_3 replacing the SO_4 of alunite, $R_2O \cdot 8H_2O \cdot 3Al_2O_3 \cdot 2P_2O_5$, or $R_2H_4 [Al(OH)_2]_6 (PO_3)_4$, the same ratio of $K : Na$ being used. That this is the most probable form in which the phosphoric oxide found in alunite and related minerals is present was pointed out by Schaller.² Although the potassium and sodium salts of this radical are so far known only as isomorphous replacements in sulphates such as alunite, they may some day be discovered as independent minerals, and should be assigned names. As pointed out by Schaller, goyazite (hamlinite) is probably a strontium salt, gorceixite a barium salt, plumbogummite (hitchcockite) a lead salt, and florencite a cerium salt of the same radical. If these are all members of one isomorphous series, then all but one of the names are superfluous; one must be selected to apply to the series as a whole. Among them, plumbogummite has priority, having been introduced by De Laumont and Berzelius in 1819, which would make gummite

¹ Amer. Journ. Sci., ser. 4, vol. 14, 1902, p. 220.

² Journ. Wash. Acad. Sci., vol. 1, 1911, p. 112; Amer. Journ. Sci., ser. 4, vol. 32, 1911, p. 359; U. S. Geol. Surv. Bull. 509, 1912, p. 70.

the proper name for the series. Unfortunately, however, the name gummite (Dana, 1868), a contraction of uranogummite (Breithaupt, 1847), has been applied to a hydrous oxide of uranium of totally different composition and relationships. Furthermore, the members of the series under discussion are not characteristically gum like, so that the name gummite is not an appropriate one for it. Hitchcockite is next in point of date, having been proposed by Shepard in 1856. It is therefore recommended that the isomorphous series of the general formula $R'_2O.8H_2O.3Al_2O_3.2P_2O_5$, or $R'_2H_4[Al(OH)_2]_6(PO_3)_4$, with $R'=K, Na, \frac{1}{2}Ca, \frac{1}{2}Sr, \frac{1}{2}Ba, \frac{1}{2}Pb, \frac{1}{3}Ce$, etc., be named the hitchcockite group. The names goyazite and hamlinite could then be discarded in favor of strontiohitchcockite, gorceixite or bariohitchcockite, and so on; the salts containing the phosphoric oxide in alunite would be kaliohitchcockite and natrohitchcockite.

After the constituents of the alunites and hitchcockites are subtracted, there remain all the Fe_2O_3 and SiO_2 , together with a little K_2O , Na_2O , H_2O , and Al_2O_3 (Column 6). The first is undoubtedly present as a stain, and may be disregarded; the others are probably united in clay-like substances. The ratio of $Al_2O_3:SiO_2=1:3$ approximately, which would indicate a clay of the cimolite group.

It is therefore concluded that the alunite from Texas consists of about 51 per cent kalioalunite, 33 natroalunite, 4 of a potassium aluminium phosphate for which the name kaliohitchcockite is suggested, and 2 of the corresponding sodium compound, natrohitchcockite, admixed with some 10 per cent of a clay (cimolite).

SODIUM-BEARING ALUNITES FROM CALIFORNIA.

Another lot of alunite was received from Mr. Charles Muck of California, the locality being stated as a prospect pit in the Funeral Range Mountains, near Death Valley, California (U.S.N.M. Cat. No. 87529). It is similar to the preceding in certain respects, but differs in the presence of a considerable excess of sodium over potassium, as brought out in the description, which follows.

PHYSICAL PROPERTIES.

Color: White; specimens from near the surface stained red by iron oxides.

Luster: Dull, like chalk.

Structure: Compact (cryptocrystalline); fracture subconchoidal.

Hardness: $2\frac{1}{2}$ (material from 60 feet beneath surface); $3\frac{1}{2}$ (that from near the surface of the ground).

Density: 2.63.

Optical properties: Under the microscope, appears as confused minutely crystalline aggregates; colorless; mean refractive index $1.585 \pm .005$; double refraction .01.

CRYSTALLOGRAPHIC PROPERTIES.

Indeterminate.

CHEMICAL PROPERTIES.

Qualitative tests: Before the blowpipe gives reactions for Al, Na, SO_3 , and H_2O ; in HCl slightly soluble, the solution giving faint reactions for Al and SO_3 ; after ignition, H_2O extracts Na_2SO_4 .

Quantitative composition: Through the kindness of Prof. F. W. Clarke, chief chemist, two analyses of this material were made in the laboratory of the United States Geological Survey by R. K. Bailey. The material from near the surface gave the results in column 1, that from a depth of 60 feet those in column 5, below:

Constituents.	1	2	3	4	5	6	7	8
	Analysis (surface).	Natroalunite.	Kalioalunite.	Remainder.	Analysis (depth).	Natroalunite.	Kalioalunite.	Remainder.
Na_2O	5.27	4.29	.....	.98	6.83	4.42	.....	2.41
K_2O	3.05	.....	2.49	.56	1.04	.....	.67	.37
H_2O	14.87	7.42	2.84	4.61	17.60	7.64	.77	9.19
Al_2O_3	39.02	21.17	8.07	9.78	38.46	21.79	2.18	14.49
SO_3	30.52	22.10	8.42	.....	25.03	22.75	2.28	.....
SiO_2	7.46	.....	.....	7.46	10.27	.....	.....	10.27
Totals....	100.19	54.98	21.82	23.39	99.23	56.60	5.90	36.73

In the determination of the mineral compositions, the sulphur trioxide was first calculated to alunite, with Na:K in the first=approximately 5:2; in the second 9:1. The remainder contains in both cases Al_2O_3 : SiO_2 =about 4:5, which indicates a clay belonging to the allophanite group; the alkalies left over may be adsorbed in this clay, or may be present in combination in a feldspar or other silicate, but the microscope fails to yield definite evidence on this point.

The specimens from California contain thus over 50 per cent of natroalunite, with small amounts of kalioalunite and a rather large amount of impurities.

A LITHIUM-BEARING PSILOMELANITE FROM TENNESSEE.

A manganese dioxide, forming a coating on vein quartz, sent to the United States National Museum for examination and report by Mr. J. B. Lawson, of Sevierville, Tennessee (U.S.N.M. Cat. No. 87371), has proved to be so unusual in composition (approaching the variety which has been called lithiophorite), as to be worth special description. Mr. Lawson states that it occurs "loose in the soil in the vicinity of the proposed Appalachian Park." Its properties are as follows:

PHYSICAL PROPERTIES.

Color: Black with slight bluish hue; streak brownish-black.
 Luster: Dull-submetallic; more brilliant against surfaces of quartz;
 opaque.
 Structure: The several types exhibited by colloid minerals—botry-
 oidal, globular, compact, and dendritic; fracture uneven.
 Hardness: Varying from 3 to $5\frac{1}{2}$.
 Density: Varying from 4.20 to 4.30.
 Optical properties: Indeterminate.

CRYSTALLOGRAPHIC PROPERTIES.

Indeterminate.

CHEMICAL PROPERTIES.

Qualitative tests: Before the blowpipe gives reactions for Mn and Li
 (flame red!). Soluble in HCl, with evolution of Cl; solution gives
 reactions for Mn, Fe, Al, Co, and SiO₂ and traces of other elements.
 Quantitative composition: The most homogeneous material obtain-
 able from the specimens was submitted to Dr. J. E. Whitfield, of
 Booth, Garrett, and Blair, who obtained the results given below
 (with the exception of the Li₂O, which was determined by the
 writer, using the spectroscopic method):

Constituents.	Analysis.	Constituents.	Analysis.
H ₂ O.....	11.40	Al ₂ O ₃	7.83
Li ₂ O.....	.35	Fe ₂ O ₃	2.20
Na ₂ O.....	1.20	MnO ₂	56.54
K ₂ O.....	.44	SiO ₂	7.68
CaO.....	Trace.	P ₂ O ₅.....	.49
BaO.....	3.12	SO ₃.....	.89
MnO.....	5.84		
CoO.....	1.76	Total.....	100.06
NiO.....	.32		

The results of analysis of psilomelanites (the termination *ite* is added for uniformity) have been previously interpreted in various ways. Rammelsberg¹ regarded the barium, manganous manganese, etc., as united with manganic manganese to form manganites, of the formula M'' (MnO₃)''. Laspeyres² considered that these elements are present as basic manganates, M''₂O(MnO₄)'', and his view was adopted by Dana.³ In the light of colloid-chemistry the mineral might be interpreted as colloidal manganese dioxide containing adsorbed substances.

¹ Handwörterbuch chem. Theils Mineralogie, 1841.

² Journ. prakt. Chem., vol. 13, 1876, pp. 1 and 215.

³ System of Mineralogy, 1892, p. 257.

The bearing on this question of certain relations between constituents may be pointed out here. If the SO_3 and P_2O_5 found in the present specimen be regarded as united with BaO , the amount of the latter necessary would be 3.27 per cent, while 3.12 per cent was found. This essential agreement may be an accident, but the known stability of BaSO_4 and $\text{Ba}_3(\text{PO}_4)_2$ suggests the possibility that these compounds are actually present. The ratio of the Al_2O_3 to SiO_2 found is roughly 1:2, indicating that these constituents may be united as a clay of the halloysite group. The Fe_2O_3 may well be combined with some of the H_2O to form limonite. But there remains about 10 per cent of oxides the condition of which is not so clear. Of these, Li_2O , Na_2O , and K_2O should be soluble in water, yet water fails to extract them from the mineral, so they must be held in some peculiar way. They can not be in the form of manganates (Laspeyres-Dana theory), for their manganates prepared artificially are soluble in water to green solutions. No definite manganites of these elements have ever been obtained artificially. By exclusion, therefore, it would seem that the only form in which these oxides (and, correspondingly, the MnO , CoO , and NiO) can be present is as gels, united by adsorption to the MnO_2 gel, which makes up the bulk of the material. Accordingly, no "mineral composition" is to be derived for psilomelanite, but it is to be regarded as composed essentially of adsorption products of the various oxides.

TITANITE OF UNUSUAL HABIT.

A yellowish-brown radiated-acicular mineral imbedded in datolite was discovered in 1913 in the northernmost quarry of the group situated on the east side of the Delaware River, 2 miles north of Lambertville, New Jersey, by Mr. Oscar Streland, of Philadelphia, and submitted to the writer for identification. Qualitative chemical and optical examination showed it to have the general features of titanite, but as this mineral had never before been observed in acicular form further investigation seemed desirable. Mr. Streland and Mr. Henry Munson, of Philadelphia, kindly presented several small specimens to the Museum (Cat. No. 59206), and of these all but one were broken up for examination. As the specific gravity of titanite ($3.50 \pm .10$) is much higher than that of datolite ($2.95 \pm .06$) mercuric potassium iodide solution of specific gravity 3.20 was used to separate them, and about 0.8 gram of the unknown mineral obtained, which proved to be quite homogeneous under the microscope, containing only minute amounts of datolite adhering to a few of the yellow grains, and of ilmenite, a mineral sparingly associated.

The mineral has the following properties:

PHYSICAL PROPERTIES.

Color: Varying from cream (Ridgway's 19'f, yellowish orange yellow with 45 per cent white, broken with 32 per cent neutral gray) to Dresden brown (17'k, orange yellow with 70.5 per cent black, broken with 58 per cent gray).

Luster: Subadamantine; subtransparent.

Structure: Columnar to acicular, and radiated; maximum length of needles observed 2 cm.; diameter 0.1 to 1 mm. Needles somewhat fractured.

Hardness: 5.

Density: 3.52.

Optical properties: Under the microscope colorless; with crossed nicols shows large, variable extinction angle; in convergent light biaxial. Mean index of refraction 1.89.

CRYSTALLOGRAPHIC PROPERTIES.

System: Indeterminate.

Habit: Long prismatic; no definite terminations observed; prism angle $66^{\circ} 30'$.

Cleavage: Prismatic, imperfect.

CHEMICAL PROPERTIES.

Qualitative tests: Before the blowpipe gives reactions for Ca, Ti, Fe, and Si. Insoluble in HCl, but after fusion with Na_2CO_3 dissolves, yielding reactions for Ca, Fe, Ti, and Si.

Analysis, made on 0.75 gram purified as above described; J. E. Whitfield, analyst:

Constituents.	1	2	3	4	5
CaO.....	27.32	25.42	1.90	.3389	1.15
Fe ₂ O ₃	6.32	.....	6.32	.3958	1.35
TiO ₂	36.40	36.40	.....	.....	.....
SiO ₂	29.16	27.39	1.77	.2935	1.00
P ₂ O ₅.....	.42	.....	.....	.....	.....
	99.62	89.21	10.41	.....	.....

1. Results of analysis.

2. The percentages of the constituents corresponding to 36.40 per cent TiO₂ in the form of titanite, Ca'' (TiO)''(SiO₄)''''; amount of latter represented, 89.21 per cent.

3. Remainder left after subtracting 2 from 1.

4 and 5. Ratios of 3. (Disregarding the P₂O₅, the rôle of which is entirely unknown.)

The ratios of column 4 are as near a definite ratio (1:1:1) as could be expected considering the small amount of material used for analysis; and they indicate that in this occurrence, at least, the iron present in titanite is in the form $\text{Ca}''(\text{Fe}'''\text{O})'_2(\text{SiO}_4)''''$, or $\text{CaFe}_2\text{SiO}_6$, a compound presumably isomorphous with $\text{Ca}(\text{TiO})\text{SiO}_4$, as yet unknown in the pure state.

The mineral thus agrees in every essential respect with titanite, being unusual in containing a rather large percentage of ferric oxide, and in possessing an acicular form.

SOME AMERICAN FOSSIL INSECTS

BY

T. D. A. COCKERELL

Of the University of Colorado, Boulder

No. 2146.—From the Proceedings of the United States National Museum,
Vol. 51, pages 89–106, with Plate 2 .

Published October 16, 1916



Washington
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SOME AMERICAN FOSSIL INSECTS.

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The insects described in this paper range in age from the Coal Measures to the Miocene. Perhaps the most interesting is a new species of *Dolophilus*, the first insect to be described from American amber. Second in interest is *Hypoderma ascarides* (Scudder), represented by larvae and pupae, which are sufficiently numerous and well preserved to leave no doubt that they belong to the Oestridae, and were parasitic on some mammal. Two Coleopterous elytra represent a new Eocene locality for fossil insects in North Park, Colorado. A gall on narrow-leaved cottonwood from Florissant appears to have been made by a beetle of the genus *Saperda*.

The majority of the Florissant insects described were received through Mr. F. H. Ward, of Rochester, New York, who obtained them from Mr. G. W. Wilson of Florissant, whose ranch had previously yielded many new species of fossils. It is a pleasure to record a new genus from the Mazon Creek Carboniferous, collected by Mr. L. E. Daniels, who has done so much to increase our knowledge of the Carboniferous land fauna. The insects not indicated as being in the National Museum and in the museum of the University of Colorado.

DIPTERA.

PLECIA WOODRUFFI, new species (Bibionidae).

Wing 7 mm. long, 2.75 broad. Costal region suffusedly dusky. A relatively broad-winged species of ordinary type, somewhat remarkable because the anterior cross vein is shorter than the distance from its lower end to the basal corner of the second posterior cell. Second posterior cell on upper side about 2.8 mm. long; submarginal cell about 1.9 mm. long; outer side of anal cell not much elbowed.

Green River Eocene, east side of Evacuation Creek, near Ute Station, Utah (E. G. Woodruff). The species is represented by a single wing, on the underside of a rather thick slab of shale on which are many larvae of *Hypoderma ascarides*. This species is smaller than

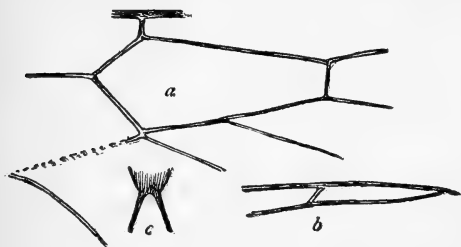
P. dejecta Scudder, from Green River, Wyoming, and differs in details of the venation. It appears to be quite distinct from the other species described by Scudder, and from the many Canadian forms described by Handlirsch.

Holotype.—Cat. No. 61455, U.S.N.M.

PSILOCEPHALA SCUDDERI Cockerell (Therevidae).

Plate 2, fig. 5.

A figure is given of a specimen collected by Mr. George N. Rohwer at Station 14, in the Miocene shales at Florissant, Colorado. The following description was made from this specimen: Length about 11.5 mm., of which 7.75 mm. is abdomen; black, the abdominal sutures broadly colorless; legs entirely dark; face not hairy; basal joint of antennae with large bristles at end, as in modern *Psilocephala*; wings very short, about 6.5 mm. long, dusky, the apical region paler. The following wing measurements are in microns: Submarginal cell on margin, 1,310; length of second submarginal cell, 2,240; first basal cell on submarginal, 1,250; submarginal on first posterior, 1,216; first posterior on discal cell, 1,184; first posterior on wing-margin, 592; second posterior on discal, 208, and on wing-margin, 560; third posterior on discal, 368; width of anal at broadest part, 560. This specimen is in United States National Museum. Cat. No. 61456.



OXYCERA ROHWERI,
new species (Stratiomyidae).

FIG. 1.—*OXYCERA ROHWERI*. *a*, DISCAL CELL AND ADJACENT PARTS. *b*, SECOND SUBMARGINAL CELL. *c*, SCUTELLAR SPINES.

Length probably about 8 mm.; black, the abdomen extremely broad, about 4 mm. wide, without light markings, its dorsal surface with very fine and short rather close dark hair; wings about 6.25 mm. long, width near base about 2.35 mm., fuliginous, the stigmatic spot small. Cubital vein forked, the second submarginal cell long; discal cell very long; veins from discal cell reaching wing margin; anal cell very broad, closed. Scutellar spines long, close together.

The following measurements are in microns: Length of second submarginal cell, 608; discal cell on first basal, 224, on second basal, 256, on first posterior, 752; width of anal cell about middle, 720; end of anal cell to wing-margin, 336; second posterior cell on wing-margin, 560; third posterior cell on wing-margin, 640; fourth pos-

terior cell on wing-margin, 960; fifth posterior cell on wing-margin, 1,120.

Miocene shales of Florissant, Colorado, Station 14 (George N. Rohwer). The abdomen is like that of *Pachygaster maculicornis* Hine (determined by Malloch), which I collected on the campus of the University of Colorado, Boulder, on June 30. The venation differs from *Pachygaster*, and agrees better with that of *Oxycera*, of the section having the cubital vein forked. The insect is peculiar for the very long discal cell, and the veins leaving it dark and distinct to the wing-margin; in these respects it is more primitive than the living species of *Oxycera* of which I have any knowledge.

HYPODERMA ASCARIDES (Scudder).

Plate 2, figs. 4, 6, 7.

Musca ascarides SCUDDER, Tertiary Insects of North America, 1890, p. 551.

Larva large and robust, fully 30 mm. long and 8 broad, formed as in the modern *H. lineata*, each segment with a transverse row of tubercles beset by minute bristles, the lateral tubercles inclined to be prominent, as in *H. bovis*. Pupa about 11 mm. long and 6 broad, very dark, with strong lateral spinuliferous tubercles marking the segments. The details are best shown by the figures; *a*, caudal end of larva, with spiracles and tracheal tubes; *b*, three segments of middle of larva, showing spinuliferous areas; *c*, lateral projecting spinuliferous area of a larva beginning to contract; *d*, spinuliferous areas of another larva; *e*, mandibles of larva; *f*, lateral spinuliferous projections of semipupa; *g*, contracted and hardened pupa.

Green River Eocene, east side of Evacuation Creek, near Ute Station, Uintah Railway, eastern Utah (E. G. Woodruff).

Plesiotypes.—Cat. No. 61457, U.S.N.M.

The specimens are very numerous, in all stages between the freshly dropped larva and the hardened pupa. Considering their age, they probably represent an extinct genus of Oestridae, which appears to differ from *Hypoderma* by the prominent lateral tubercles of the pupa, more after the manner of *Cephalomyia*. In the absence of the adult fly, however, it seems undesirable to remove the species from *Hypoderma*.

Scudder¹ remarks that the specimens of *Musca ascarides* "so closely resembles the larvae of bot flies that I could scarcely persuade myself that they did not belong to the Oestridae. The appendages of the skin, however, are much more delicate than is usual in Oestridae, and are uniformly distributed over the surface or are altogether absent." The more complete material now before me shows that the spinules or minute bristles are not uniformly distributed over the skin, but are

¹ Tertiary Insects of North America, 1890, p. 551.

arranged in patches as in the Oestridae. In some specimens, owing to the two surfaces being preserved on a single plane, the surface appears to be more completely covered than it actually was in life. The structures are not more delicate than in some Oestridae. Scudder also remarks that it is difficult to understand how such masses of Oestrid larvae could accumulate at one place. This, however, is quite possible if they infested gregarious animals, though we must agree that the infestation seems to have been remarkably heavy.

Scudder's species came from the Chagrin Valley, White River, Colorado. This locality is certainly Eocene, but perhaps not contemporaneous with the Green River beds of Wyoming. The present material is assigned to the Green River, following the indication of the label. Since the above was written a large quantity of material containing *H. ascarides* has come to hand, collected at Hay Gulch, Colorado (D. E. Winchester and others, U. S. Geological Survey). The precise locality is southeast quarter of section 36, township 1 N., range 96 W.

EMPIS PERDITA, new species (Empididae).

Length 7.5 mm.; wing almost 7 mm. long, the apical and costapical region faintly dusky; structure quite normal for the genus.



FIG. 2.—*EMPIS PERDITA*. a, END OF THIRD VEIN. b, END OF FIRST BASAL CELL.

Hind femora 3 mm. long, not incrassate, thinly clothed with black bristles, but with a longitudinal bare band; anterior femora 2 mm. long.

The following measurements are in microns: Height of head, about 990; length of proboscis, about 1680; length of antennae (excluding style), about 640. Venation essentially as in *Empis trigramma*, the nervure separating the first basal cell from discal strongly arched, longer than the anterior cross-vein. Measurements in microns: End of second vein from end of upper branch of third, 225; first basal cell on first submarginal, 320; discal on second posterior, 176; discal on third posterior, 512; discal on second basal, 288; lower side of second basal beyond tip of anal, 384.

Miocene shales of Florissant, Colorado; received from Mr. L. E. Daniels, who obtained it from Mr. J. C. Carr. Easily known from the previously described species of *Empis* from Florissant by its much larger size.

In the original account of *Empis florissantana* Cockerell¹ the figure of the discal cell is upside down.

¹ Proc. Acad. Nat. Sci. Phila., 1914, p. 646.

PROTOLOMATIA RECURRENS, new species (Bombyliidæ).

Length, about 10 mm.; wing, 6.2 mm.; head, thorax, dorsal surface, and apical part of abdomen black or dark brown, the abdomen colorless at the sutures; wings hyaline; legs pale reddish. Thorax dorsally bare; antennae moderately long, proboscis much shorter than (vertical) length of head. Anterior cross-vein slightly oblique, not at all approximately in a straight line with lower branch of fourth vein, as it is in *Lomatia lateralis*. Second vein strongly recurved at end, in the manner of *Alepidophora pealei*, but second and third posterior cells essentially parallel-sided, wholly unlike those of *Alepidophora*; anterior cross-vein considerably beyond middle of discal cell; four posterior cells, all open, but first contracted apically; anal cell open; second submarginal cell squarely truncate at base, with an appendicular nervure directed basad from the corner.



FIG. 3.—PROTOLOMATIA RECURRENS. APEX OF WING.

The following measurements are in microns:

First submarginal cell on wing-margin.....	784
First posterior cell on wing-margin.....	160
Second posterior on wing-margin.....	800
Third posterior on wing-margin.....	800
Fourth posterior on wing-margin.....	1,280
Anal cell on wing-margin.....	160
Praefurca.....	496
First basal cell on first submarginal.....	1,440
First posterior on first submarginal.....	976
First posterior on second submarginal.....	1,456
Discal on second basal.....	128
Discal on first basal.....	1,200
Discal on first posterior.....	752
Discal on fourth posterior.....	912
Second basal on fourth posterior.....	160

The discal cell is long, and its outer margin shows a very strong double curve.

Miocene shales of Florissant (Geo. W. Wilson).

Holotype.—Cat. No. 61990, U.S.N.M.

Differs from the type of the genus by having the second vein recurrent, as in *Alepidophora*, and also in many lesser details. It runs in my key to *Alepidophora*.¹

¹Bull. Amer. Mus. Nat. Hist., vol. 23, pp. 229-235.

PROTEPACMUS, new genus (Bombyliidae).

Allied to *Alepidophora*, but wings much longer and with three submarginal cells; abdomen elongated but rather broad, the sides with rather long, pale reddish stiff hairs. Face prominent; antennae apparently ordinary; proboscis not elongated; hind femora not hairy, but with a row of stout bristles; hind tibiae without hairs or bristles on inner side, but with stout bristles (about 480 microns apart); costa with short bristles; præfurca short; end of second vein directed upward, ascending vertically to the costa; upper branch of third vein also directed upward to the costa, its terminal part parallel with second vein; base of upper apical submarginal cell for basad of base of the cell below it, the second vein very slightly bent at basal corner, the bounding vein below weak; base of lower apical submarginal cell sharply truncate; discal cell very long, the discal cross-vein far beyond its middle; four posterior cells, all open on margin, the second extremely widely open; anal cell narrowly open at end.

In my key¹ this runs to 34. It is certainly close to *Cyllenia*, agreeing in most details of the venation, but the shape of the second posterior cell is quite unlike that of *Cyllenia* or *Tomomyza*. There is also evident affinity with the Californian *Exepacmus*, but that is a more hairy insect, and the venation differs in detail.

PROTEPACMUS SETOSUS, new species.

Length 10.5 mm.; wings a little over 8 mm., hyaline, veins pale ferruginous; head and thorax dark brown (probably black in life); abdomen somewhat paler, the sutures not conspicuously pallid; abdomen elongated, but rather broad, its length 7 mm., width near base 3.5 mm. The discal cross-vein is only slightly oblique. The following measurements are in microns:

Width of upper apical submarginal cell	
near end.....	320.
First posterior cell on first submarginal...	1120.
First posterior on lower apical submarginal	1376.
First posterior on wing-margin.....	224.
First posterior on second discal.....	720 (Same in <i>Alepidophora pealei</i>).
First posterior on second posterior.....	1632.
Discal cell on first basal.....	2320 (1872 in <i>Alepidophora pealei</i>).
Discal on second basal.....	480.
Discal on second posterior.....	320.
Second posterior on wing-margin.....	1520.
Second posterior on third posterior.....	800.
Third posterior on wing-margin.....	608.
Fourth posterior on second basal.....	208.
Anal cell on fourth posterior.....	1600.
Anal on wing-margin	208.

Miocene shales of Florissant (Geo. W. Wilson).

Holotype.—Cat. No. 61991, U.S.N.M.

¹ Bull. Amer. Mus. Nat. Hist., vol. 33.

PACHYSOMITES, new genus (Ortalididae).

A genus of the subfamily Richardiinae, running in Williston's tables¹ exactly to *Epipletea*, but the shape of the discal cell is entirely different, its apical margin being long and very oblique, undulating and forming a gentle double curve, an exaggeration of the condition found in *Oedopa*; in addition, the first vein extends far toward the end of the wing, reaching the costa at an extremely acute angle, in the manner of the Syrphid genus *Chilosia*; the submarginal cell is constricted in the subapical region, but expands toward the margin, as in *Richardia*, except that the constriction is more pronounced; the first posterior cell is very broad apically, its width even greater than length of oblique end of discal cell; the anterior cross-vein, which is somewhat oblique and gently arched outward, is far before the middle of discal cell. The second basal cell is very narrow, and the anal is retracted, its lower angle a very wide one, as in *Richardia*. Robust; femora unarmed and not incrassate; wings with no conspicuous markings; ovipositor short.

PACHYSOMITES INERMIS, new species.

Length 8.3 mm.; very robust; thorax black; dorsally bare; legs dark brown, unarmed, femora not incrassate; abdomen thick, about 3.8 mm. long, dark reddish, with an appearance of longitudinal banding which seems to be due only to the condition of preservation; ovipositor short and thick, about 1 mm. long. Wings about 5.5 mm. long, hyaline, without bands or spots, except a dark cloud above end of first vein, such as occurs in *Euxesta* and *Pseudeuxesta*. The following measurements are in microns:

Marginal cell on costa, about.....	1040
(It is impossible to be exact, as the first vein grades gradually into costa at end.)	
Submarginal cell on wing-margin, not allowing for curve.....	770
(The costa is thickened and minutely bristly, the thickened part extending as far as end of third vein.)	
Diameter of submarginal in middle of constriction.....	288
Diameter of submarginal cell where expanded, basad of constriction.....	464
Submarginal cell on first basal.....	1056
Length of anterior cross-vein.....	352
First posterior cell on wing-margin, not allowing for curve.....	1280
Fourth vein beyond discal cell, about.....	720
Oblique apical side of discal cell.....	1120
Discal cell on first posterior.....	1712

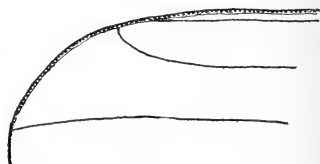


FIG 4.—PACHYSOMITES INERMIS. APEX OF WING.

¹ N. Amer. Diptera, third edition.

Discal cell on first basal.....	656
Discal cell on second basal.....	50
Oblique apical side of anal.....	240

Miocene shales of Florissant (Geo. W. Wilson).

Holotype.—Cat. No. 61992, U.S.N.M.

TABANUS MERYCHIPPI, new species (Tabanidae).

Length 13 mm., abdomen 5.5 mm. broad; anterior wing 10 mm. long. Size and appearance of *T. lasiophthalmus* Macquart. (from Garrison, New York), but eyes not hairy; apical (small-jointed) portion of antennæ more conical, broadened basally instead of cylindrical; distance between eyes a little less (about 0.8 mm. instead of 1 mm.). Spots on wings placed exactly as in *lasiophthalmus* (with the addition of slight dusky suffusion at ends of second and upper branch of third veins), and the abdomen also has a rather obscure dark median band. Comparing the venation with that of *lasiophthalmus*, the discal cell is narrower basally, the fourth posterior cell is contracted apically (its width at margin of wing 384 microns, but at lower apical corner of discal cell 640), and first posterior cell is narrower (its width near apex 480 microns). Miocene shales of Florissant; (Geo. W. Wilson).

Holotype.—Cat. No. 61993, U.S.N.M. Easily known from the previously described species of *Tabanus* from Florissant by the smaller size and spotted wings.

CHILOSIA SEPULTULA, new species (Syrphidae).

Length about 8.5 mm., width of thorax about 3.5 mm.; wings 8 mm. long. Head and thorax dark; abdomen pale, thinly hairy, with black or very dark narrow sutural bands; no longitudinal band. Costa thick, with two rows of minute bristles, as in *C. miocenica*. Apical angle of first posterior cell more acute than in *C. miocenica*.

The following measurements are in microns; the corresponding measurements of *C. miocenica* are given within parentheses:

Width (depth) of marginal cell 800 from end.....	352	(272)
Length of first posterior cell from lower basal corner to upper apical corner.....	4,000	(4,080)
Submarginal cell on first basal (not allowing for curve).....	1,200	(1,280)
First basal on second posterior.....	830	(1,090)
Second basal on second posterior.....	270	(320)
Second basal on third posterior.....	304	(256)

Holotype.—Cat. No. 61994, U.S.N.M.

The type is from the Miocene shales of Florissant (Geo. W. Wilson).

The smaller specimen, assigned to *C. miocenica*¹ and collected by Mr. Rohwer, belongs to this species.

¹ Bull. Amer. Mus. Nat. Hist., vol. 26, 1909, p. 72.

SCIARA FLORISSANTENSIS, new species (Mycetophilidae).

Male.—Length 4.5 mm., wing 3.6 mm.; veins not setose, venation much like that of *S. abdita* Johannsen, with a long R_1 ; dark brown, legs dark, wings hyaline; first two antennal joints short and broad, the following ones cylindrical, longer than broad, the third and fourth each about 96 microns long and 76 broad; claspers formed about as in *S. cucumeris* Johannsen, the apical part slender. The following measurements are in microns:

Radius before branching	1,280
R_1 beyond branching (apparent cross-vein)	960
Distance on margin between ends of branches of radius, about	1,250
Lower branch of radius beyond cross-vein	2,080
R-M cross-vein	384
Media before R-M cross-vein	960

The delicate fork of media is wholly obliterated, but the subcosta is distinct and well developed, though colorless.

Miocene shales of Florissant (Geo. W. Wilson).

Holotype.—Cat. No. 61995, U.S.N.M.

CORDYLURA (s. lat.) EXHUMATA, new species (Cordyluridae).

Length, about 6.5 mm.; abdomen, about 2.8 mm.; wing, 6.7 mm.; hind tarsus, about 2.5 mm.; hind tibia about the same; hind femur a trifle longer. Thorax, 3 mm. long, robust, dark, probably black in life; abdomen and legs paler; abdomen short, formed as usual in the family; wings dusky hyaline, not spotted, veins partly dark. Antennal arista long-plumose; auxiliary vein present, but very delicate; none of the veins bristly; costa with a row of minute dark spinules, not longer than diameter of costal vein (this row is single and is not accompanied by delicate bristles, as it is in *Scatophaga*); venation normal for the family; first vein ending about 2.5 mm. from base and 4.2 mm. from apex of wing; end of discal cell about 4.6 mm. from base of wing; first posterior cell about 0.8 mm. wide (deep). Legs minutely hairy, without any long spines or bristles; femora with dark spinules beneath, only at all large or conspicuous toward apex; tibiae spined at apex; tarsi with dark spinules beneath. Discal cell on first posterior, 2,000 microns.

Miocene shales of Florissant (Geo. W. Wilson).

Holotype.—Cat. No. 61996, U.S.N.M.

The insect has the appearance of a *Scatophaga*, but lacks the strong armature of the legs seen in that genus. It is not a *Cordylura*, as that genus is now restricted, but it is impossible to see all the characters used to separate the genera in this family, so I do not attempt to refer it to any genus of Becker's classification.

Heer has described a *Cordylura vetusta* from the Miocene of Croatia, but, judging from his figure, it does not belong to the Cordyluridae.

CHIRONOMUS SCUDDERIELLUS, new species (Chironomidae).

Male.—Length, 6.7 mm.; head and thorax dark, legs ferruginous, abdomen pale; antennae long-plumose, as usual in the genus; wings obliterated (as in all Florissant Chironomidae); genitalia as usual in the genus, the claspers stout. The following measurements are in microns: Distance between eyes, about 320; width of abdomen near base, 880; length of anterior femur, about 1,440; and its tibia the same.

Miocene shales of Florissant (Geo. W. Wilson).

Holotype.—Cat. No. 61997, U.S.N.M.

Scudder long ago noted the presence of Chironomidae in the Florissant shales, but the specimens have been too poorly preserved to describe. The present specimen has all the characters of genuine *Chironomus*, and, as the genitalia can be figured, it may deserve a name.

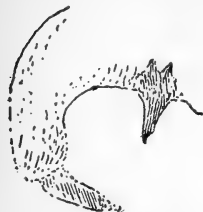


FIG. 5.—CHIRONOMUS SCUDDERIELLUS. GENITALIA.

LEPIDOPTERA.

TORTRIX (?) DESTRUCTUS, new species (Tortricidae).

Length, about 8.3 mm.; thorax robust, abdomen tapering; antennae reddish, immaculate, about 4.5 mm. long, slender, the apical part curled to form the greater part of a circle; legs hairy or scaly; anterior wings about 8.3 mm. long, outer margin about 3.5 mm., lower margin about 7.3 mm., costal border little convex, apical corner obtuse (apex not at all falcate), outer margin forming only a little less than a right angle with costa and nearly straight; anterior wings apparently more or less longitudinally streaked and with a broad but rather obscure submarginal band, failing or diffused in the costapical region.

Miocene shales of Florissant (Geo. W. Wilson).

Holotype.—Cat. No. 61998, U.S.N.M.

Much smaller than *T. florissantana* Cockerell. The generic reference is, of course, uncertain.

TRICHOPTERA.

DOLOPHILUS (?) PRAEMISSUS, new species.

Anterior wing about 5.6 mm. long, a little over 2 mm. wide; thinly hairy; apical portion subcuneate, but apex blunt. Thorax about 2 mm. long. Part of a long antenna, and a leg showing a large spur of the usual type, can be seen. All five apical forks present in anterior wing; discoidal cell long-cuneate, closed at apex; no darkened pterostigma, but a cross vein between R_1 and subcosta; anal cell

obtuse at end, scarcely or not open. The following measurements are in microns:

Cross vein connecting R_1 with Sc. basad of (vertical) level of base of first fork.....	400
Base of discal cell to base of first apical fork (separation of R_2 from R_3).....	960
R_3 from its separation from R_2 to end.....	1,760
R_4 from its separation from R_3 to end.....	2,208
Base of second apical fork basad of level of base of third fork.....	560
Base of fourth apical fork basad of level of base of third fork.....	400
M_1 from its separation from M_2 to end.....	1,840
M_3 from its separation from M_4 to end.....	1,760
Base of fourth apical fork apicad of level of base of fifth fork.....	1,120
Cu_1 from its separation from Cu_2 to end.....	2,320
End of anal cell apicad of level of base of fifth fork.....	480

In amber from the Eutau formation (Upper Cretaceous; Em-scherien), Coffee Bluff, Hardin County, Tennessee (Bruce Wade).

The specimen was very kindly forwarded by Prof. Edward W. Berry. It is of extraordinary interest, as being the first insect to be described from American amber. If any considerable insect fauna can be found in Cretaceous amber, it will undoubtedly throw much light on many obscure problems connected with the origin of the modern families and genera. *Dolophilus* Mc-

Lachlan (Philopotamidae) has four species in Prussian amber, of Oligocene age. The present insect is too close to such forms as *D. aequalis* Hagen to be generically separated, so far as the visible characters show. Ulmer remarks that as regards venation *Dolophilus* is extremely like *Phylocentropus* (Polycentropidae), and I was indeed in doubt whether to refer the present species to the latter genus. The discoidal cell in *Phylocentropus* is shorter, and on the whole our species seems rather to belong with *Dolophilus*. According to Ulmer's phylogenetic scheme, the Philopotamidae are more primitive than the Polycentropidae. It is also noteworthy that of the four living species of *Dolophilus* three are European and one is Australian.

Thus we may say that our Cretaceous fossil is of a very modern type, but it would be more correct to put the matter another way and say that the living *Dolophilus* is a remnant of a very ancient group. It is, in fact, closely related to the Necrotauliidae of the European Lias.

Type.—Cat. No. 62001, U.S.N.M.



FIG. 6.—*DOLOPHILUS PRAEMISUS*. ANTERIOR WING.

PROTORTHOPTERA.

DANIELSIELLA, new genus.

Body essentially as in *Spaniodera*, the mesothorax large, with a considerable portion anterior to insertion of wings; prothorax elongated, though not excessively so; abdomen long; hind legs not fitted for jumping, the femur and tibia like those of *Ischnoneura*. Wings shaped as in *Spaniodera*; subcosta not obscured; radius simple, its apical part hardly separated from costal margin; radial sector very stout, arising far toward base of wing, having two oblique branches above near end, and four branches below, the fourth curved; media with three very oblique branches below; cubitus and anals not observed. The above refers to the anterior wing; the radial sector of posterior wing has three branches below, but the last is nearly in a line with the stem, so that the continuation of the latter rather resembles an upper branch.

DANIELSIELLA PRISCULA, new species.

Anterior wing about 24 mm. long, of which 20 mm. is preserved; diameter of mesothorax slightly over 4 mm.; diameter of prothorax near middle about

2.25 mm. Body and legs are preserved intense black, the middle of the thorax apparently paler, with a black band across mesothorax; wings

disky, the radial sector blackened and conspicuous on both wings, the other veins pallid.

Mazon Creek, Illinois, in a nodule of Carboniferous (Pennsylvania)

age. (L. E. Daniels.)

Holotype.—Cat. No. 62000, U.S.N.M.

The interpretation of the venation has been difficult, and may possibly be erroneous. The media is almost exactly like the cubitus of *Dieconeura mazona*, as figured by Handlirsch. Below the stem of the radial sector it is possible to detect a very faint line, shown in the figure, which could conceivably represent a more or less rudimentary media, essentially as in *Gyrophlebia longicollis* Handlirsch. The character of the radial sector, with two very distinct branches above, appears to exclude the insect from *Dieconeura* and *Gyrophlebia*. On the other hand, both radial sector and media present a good deal of resemblance to those of *Ischnoneura oustaleti* Brongniart, from the Carboniferous of Commeny; and a mere simplification of this type gives us the Permian *Liomopterum* and *Lepium* of

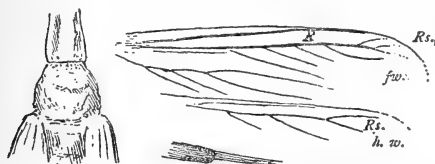


FIG. 7.—DANIELSIELLA PRISCULA. fw, FRONT WING. hw, HIND WING. R, RADIUS. Rs, RADIAL SECTOR.

Sellards. The distinction between the Spanioderidae, Geraridae, and Ischnoneuridae becomes more difficult with the discovery of additional types. The Spanioderidae have few branches to the radial sector, and many to the cubitus; in the Geraridae the radial sector has many branches, and the cubitus is more or less reduced. *Ischnoneura* has four branches to the radial sector, and four (five?) to the cubitus; it thus falls between the other two families. The general structure of the body and legs seems to be about the same in all. *Danielsiella* may be referred to the Geraridae, but perhaps the correct solution would be to recognize a single family Geraridae (Gerarina Scudder, Geraridae Handlirsch), with subfamilies Gerarinae, Spanioderinae (Spanioderidae Handlirsch) and Ischnoneurinae (Ischnoneuridae Handlirsch).

It may be convenient to adopt a formula for the venation. The number of primary branches may be expressed by a figure, and if these again branch a second figure may be added, and a third for tertiary branchlets. According to this method the formula for the radial sector, media and cubitus of *Spaniodera ambulans* Handlirsch will be:

Anterior wing. Rs. 3. 1. M. 3. 1. Cu. 5.

Hind wing. Rs. 2. M. 1. Cu. 5.

If necessary, distinction can be made between upper and lower branches, by using the form of a fraction; thus *Danielsiella* has Rs. $\frac{2}{3}$, M. 3. It is not always easy to distinguish the main stem from an upper branch (though in *Danielsiella* there is no doubt), and the anterior wing of *Spaniodera ambulans* should perhaps be interpreted as having Rs. 2. 1. 1.

ODONATA.

LITHRAGION (?) OPTIMUM, new species.

Length, about 51 mm., the thorax about 9 mm.; thorax and abdomen with black markings; mesepisternal plates with a broad black band covering most of the surface and a narrow band along inferior margin, with a narrow pale stripe, curved mesad posteriorly, between the two dark portions; mesepimeron with a broad black band, invaded below near the anterior end by an oblique pale stripe; abdominal segments in lateral view showing a pair of stripes, one dorsal and one subdorsal, failing anteriorly on the middle segments, but the subdorsal stripes shorter, with the anterior end pointed; ventral side of abdomen dusky; legs slender, hind femora about 7 mm. long; tibiae very slender, with the usual bristles, hind tibiae 6 mm. long; wings 36 mm. long and about 7.5 wide, dusky, the apical margin suffusedly darker; nodus 11.5 mm. from base of wing; two antenodal cross-veins, in the usual position; quadrilateral with

upper side much longer than apical side; several double cells beyond stigma. Miocene shales of Florissant; from the collection of Mr. L. E. Daniels. It formerly belonged to Mr. J. C. Carr, who does not recollect who collected it. The specimen has unfortunately been broken, probably at the time of its discovery, and the stigma and

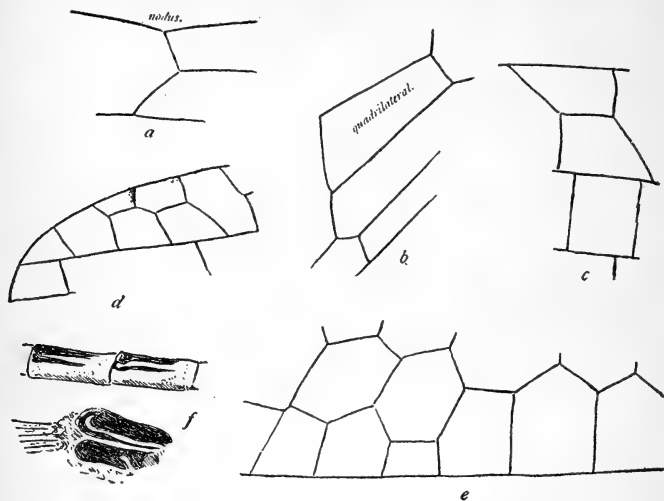


FIG. 8.—LITHAGRION OPTIMUM. *a, b*, DETAILS OF VENATION. *c, d*, CELLS OF REGION JUST BEYOND STIGMA. *e*, CELLS OF LOWER MARGIN OF WING. *f*, THORAX AND MIDDLE ABDOMINAL SEGMENTS.

middle region of the wing is missing. What is left agrees with *Lithagrion*; the species will be readily known by the large size and dusky (though translucent) wings.

HYMENOPTERA.

AULACITES, new genus (Evaniidæ).

A genus of Aulacinae, related to *Aulacus*, but with the first recurrent nervure joining the second submarginal cell; only two well-defined submarginal cells, the second transversocubital being evanescent, though leaving traces showing where it should be. Anterior part of thorax transversely striate.

Type.—*Aulacites secundus*, new species.

AULACITES SECUNDUS, new species.

Head and thorax black, wings clear. Thorax 5.5 mm. long; anterior wing 9.5 mm. long (that of *A. bradleyi* 11 mm.). Close to *Aulacites bradleyi* (*Aulacus bradleyi* Brues), but on comparison with

the type of that species apparently distinct, the thorax being much more strongly transversely grooved, the first discoidal cell longer in proportion to its height, and various other details of the venation different. The following comparative measurements in microns will bring out the differences (*s.*=*secundus*; *b.*=*bradleyi*): First submarginal cell on basal nervure, *s.* 720, *b.* 672; first *s. m.* on marginal, *s.* 480, *b.* 576; first *s. m.* on second *s. m.*, *s.* 1152, *b.* 1280; first discoidal cell on basal nervure, *s.* 480, *b.* 608; first discoidal on third discoidal, *s.* 720, *b.* 800; apical side of third discoidal, *s.* 720, *b.* 736.

Miocene shales of Florissant, station 14 (University of Colorado Expedition).

Holotype.—Cat. No. 61458, U.S.N.M.

I have been a little in doubt whether to consider this a distinct species or only a variety, but it seems to be sufficiently distinct. The

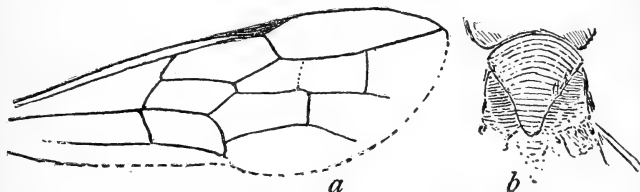


FIG. 9.—AULACITES SECUNDUS. *a*, ANTERIOR WING. *b*, ANTERIOR PART OF THORAX.

remoteness of the basal nervure from the stigma suggests affinity with *Pristaulacus* and *Interaulacus*, rather than with *Aulacinus*. The claws can not be seen.

HEMICHROA EOPHILA, Cockerell (Tenthredinidae).

A new specimen is 10 mm. long; anterior wing 7.3 mm.; width of thorax very little over 2 mm. The following measurements of the anterior wing, in microns, show some variation from the original type, but do not appear to indicate a distinct species:

Transverse-costal nervure basad of upper end of basal, about.....	320
Length of basal nervure (of which 800 is beyond the bend).....	960
Length of first submarginal cell.....	368
Length of (oblique) outer side of third submarginal cell.....	690
Upper side of third submarginal cell.....	912
Third submarginal on first marginal.....	560
Lower side of third submarginal.....	1, 150
Length of second transverso-cubital.....	336
Upper side of second discoidal.....	850
Lower end of basal nervure basad of transverso-medial.....	770
Upper side of third discoidal.....	880
Third discoidal on first discoidal.....	592
Third discoidal on second discoidal.....	480
Lower side of third discoidal.....	1, 250
Outer (apical) side of third discoidal.....	800
End of second recurrent nervure basad of second transverso-cubital.....	160

Contracted (linear) part of lanceolate cell.....	960
End of contracted part of lanceolate cell to lower end of transverso-medial nervure.....	1,150

Miocene shales of Florissant (Geo. W. Wilson). Should this be separated from the original *H. eophila*, the specimen collected by Wickham at the Wilson Ranch would go with it.

ERIOCAMPOIDES MICRARCHE, new species (Tenthredinidae).

Length, 6.5 mm.; anterior wings, about 5.5 mm.; mesothorax pale, other parts of thorax darker; abdomen pale, with the apical third fuscous, the extreme base also dusky; antennae with all the joints visible, except the two short (basal) ones, the joints measuring as follows in microns: (3.) 432, (4.) 240, (5.) 240, (6.) 208, (7.) 160, (8.) 160, (9.) 192. The last two antennal joints look, at first sight, like a single one; the others are more distinct, as usual in the group. The venation agrees well with *Eriocampoides*, as figured by MacGillivray.¹ The transverse-costal nervure is rather more basad, the third submarginal cell has its side on first marginal longer than on second, and the transverso-medial nervure has its upper end well beyond the middle of the first discoidal cell (as in *Phyllotoma*); the first discoidal cell is widened basally, its two sides being far from parallel, and the basal nervure is straight, not bent near its lower end. The hind wing is like that of *E. aethiops* in all essential features, but the median cell is more produced and very narrow at the apex.

The following measurements of the anterior wing are in microns:

Transverse-costal nervure basad of upper end of basal, about.....	640
Narrow upper side of first discoidal cell.....	208
Length of basal nervure.....	750
Lower end of basal nervure to transverso-medial.....	750
First discoidal on second submarginal.....	256
First discoidal on second discoidal.....	416
Lower side of second discoidal.....	770
Length of first submarginal cell.....	320
Apical side of second submarginal cell.....	208
Third submarginal on first marginal.....	560
Third submarginal on second marginal.....	544
Third discoidal on second submarginal.....	640
Third discoidal on third submarginal.....	400
Third discoidal on first discoidal.....	400
Third discoidal on second discoidal.....	480
Lower side of third discoidal.....	912
Apical side of third discoidal.....	592

Miocene shales of Florissant (Geo. W. Wilson).

Holotype.—Cat. No. 61999, U.S.N.M.

Very much smaller than *E. revelatus* Cockerell, already known from Florissant.

COLEOPTERA.

SAPERDA LESQUEREUXI, new species (Cerambycidae).

Plate 2, fig. 1.

Gall on small branch of *Populus lesquereuxi* Cockerell, fusiform, about 13 mm. long and 6.5 broad, exactly like the galls of the living *S. moesta* Le Conte.

Miocene shales of Florissant (University of Colorado Expedition).

CALANDRITES HINDSI, new species.

Plate 2, fig. 3.

Elytron 8 mm. long, 2.8 broad; as preserved ferruginous; base truncate; inner basal angle obliquely truncate, apparently indicating a rather large scutellum; inner (lower) margin concave; apex obtuse; 10 rows of punctures, all except those nearest the margin coarse; second and third rows (counting from inner side) meeting eighth and ninth at an angle near apex; fourth and fifth rows close together, joining in the subapical region, but not forming an angle; sixth and seventh rows free below, cut off by the obliquely ascending eighth; second row with about 34 punctures; fourth with about 25.

In Eocene rock, southeast corner of North Park, Colorado (N. E. Hinds), University of Colorado Museum 5799. Scudder described *Calandrites* as follows: "Elytra, which seem from their elongate form and the character of their markings to be not far removed from the much smaller species of the old genus *Calandra*, though it is certainly possible that they may belong in a very different group. They both belong to rather large species, and agree in having 10 punctured striae." The present species is considerably larger than either of Scudder's but by its coarse punctures comes closest to *C. defessus*. The large size readily distinguishes our insect from all other known American Eocene Calandridae.

OPHRYASTITES HENDERSONI, new species.

Plate 2, fig. 2.

Elytron 5.5 mm. long, 2.35 broad; as preserved blackish; convex, outer margin strongly convex; apex angular; nine deep striae, without any distinct punctures. In Eocene rock, southeast corner of North Park, Colorado (N. E. Hinds), University of Colorado Museum 5799. It is given the name of Prof. J. Henderson, curator of the university museum, well known for his writings on Colorado paleontology and zoology. This agrees well with Scudder's blanket genus *Ophryastites*, but is distinguished by the very convex outer margin and the lack of distinct punctures.

The strata furnishing this and the last species are of somewhat uncertain age, but probably either Fort Union or Wasatch. The locality is in Arapahoe (or Muddy) Pass.

EXPLANATION OF PLATE 2.

FIG. 1. Gall of *Saperda lesquereuxi*, new species.

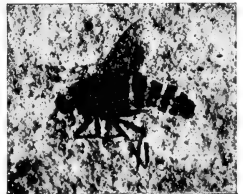
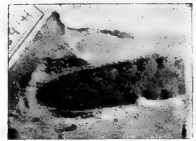
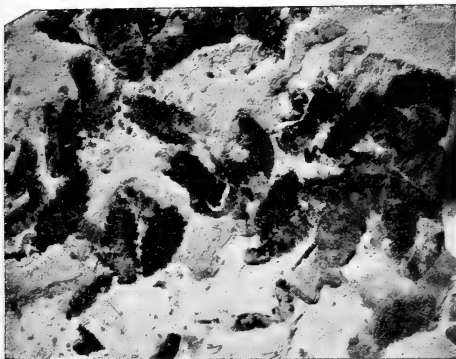
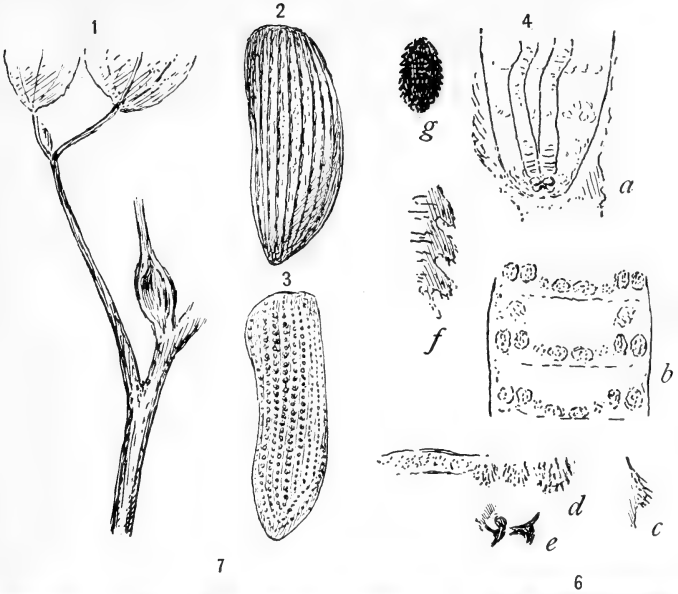
2. *Ophryastites hendersoni*, new species.

3. *Calandrites hindsii*, new species.

4. *Hypoderma ascarides* (Scudder). Larva and pupa. *a*, Caudal end of larva, with spiracles and tracheal tubes; *b*, three segments of middle of larva, showing spinuliferous areas; *c*, lateral projecting spinuliferous area of a larva beginning to contract; *d*, spinuliferous areas of another larva; *e*, mandibles of larva; *f*, lateral spinuliferous projections of semipupa; *g*, contracted and hardened pupa.

5. *Psilocephala scudderii* Cockerell.

6, 7. *Hypoderma ascarides* (Scudder). A single example and a slab with numerous specimens (natural size).



SOME AMERICAN FOSSIL INSECTS.
FOR EXPLANATION OF PLATE SEE PAGE 106.

DESCRIPTIONS OF TWO EXTINCT MAMMALS OF
THE ORDER XENARTHRA FROM THE
PLEISTOCENE OF TEXAS

BY

OLIVER P. HAY

Research Associate of the Carnegie Institution of Washington

No. 2147.—From the Proceedings of the United States National Museum,
Vol. 51, pages 107-123, with Plates 3-7

Published October 28, 1916



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ORDER XENARTHRA FROM THE PLEISTOCENE OF
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Research Associate of the Carnegie Institution of Washington.

Few of the many remarkable animals of the Pleistocene epoch in North America are more interesting than are those which have been known as Edentata, but which now are more properly called Xenarthra. Our interest in them is due in part to their usually large size and their strange forms and habits; in part to the fact that their presence furnishes evidence that about the beginning of the Pleistocene or earlier, there was a sufficiently free communication between the two American continents, that many South American genera of animals migrated into North America and other genera passed from the latter continent into the more southern. On the plains bordering on the Gulf of Mexico and those stretching northward from Texas, the overgrown and unwieldy South American Xenarthra met more highly organized forms, many themselves immigrants from Asia, and in the contest with them suffered extinction.

GLYPTODON PETALIFERUS Cope.

Plates 3-5.

In the United States National Museum there are considerable parts of a glyptodon which the writer is permitted to describe. It has the catalogue number 6071. This specimen was found in 1908 by Mr. O. S. Shelton near Wolfe City, Hunt County, Tex. This place is in the northeast corner of the State and its position is approximately latitude $33^{\circ} 16'$ and longitude $96^{\circ} 3'$. In a letter written November 18, 1908, Mr. Shelton stated that the remains had been found along the banks of Middle Sulphur Creek, at a depth of about 9 feet from the surface. The bones lay on a bed of gravel and were overlain with clay. Where the enveloping matrix is present it consists of fine clay.

The specimen presents considerable parts of the skull, most of the anterior half of the vertebral column, six caudal vertebræ, considerable parts of the limbs, a fragment of the scapula, a few fragments of the pelvis, and a considerable number of the osseous plates which made up the carapace and sheath of the tail. Undoubtedly much more of the skeleton was present and might have been saved had it been exhumed by a practiced hand.

Professor Cope based the species *Glyptodon petaliferus*¹ on one-half of a single dermal plate which had been found in Nueces County, Texas. This fragment was figured in 1889,² showing the object two-thirds the natural size. The diameter was given by Cope in his original description as 45 mm.; that of the central area as 17 mm., the thickness as 15 mm. Where the type is now is not known.

Of the carapace and tail sheath of the Wolfe City specimen there are present about 80 plates. Although these constitute but a small part of the whole, there are enough to show the various forms which these plates assumed. In diameter they vary from 35 mm. to 50 mm. There were some, no doubt, which were smaller and others larger than those which are preserved. In Cope's specimen the central area had a diameter equal to three-eighths of that of the plate. In the animal here described the diameter of the central areas of the plates varies from the relative length given by Cope up to seven-tenths or more of the diameter of the plate. In some cases the central area occupies practically the whole area of the plate. In thickness they vary from 14 mm. or less up to 42 mm. As to the external sculpture, there appears to be nothing shown in Cope's description and figure that can not be found on the plates at hand.

Brief explanations may be given of the elements which are represented on plate 5. Figure 1 shows a bone of the carapace in which the central area is large. The greatest diameter of the plate is 52.5 mm.; that of the central area, 31 mm. At the upper border the thickness is 29 mm.; on the lower 44 mm. The lower surface is rough and uneven as if the plate had been attached by ligaments to some other bone. The greatest diameter of the plate represented by figure 2 is 53 mm. It will be seen that the central area is relatively small. The thickness is 16 mm. The plate of figure 3 has as its greatest diameter, at the outer surface, 50 mm. The central disk comprises nearly the whole of the surface of the plate. The greatest thickness is 22 mm. The diameter of the plate of figure 4 is 44 mm.; that of the central area, 17 mm.; the thickness, 17 mm. The plate shown by figure 5 has as the diameter of its sculptured surface 47 mm.; the thickness is 17 mm.

¹ Amer. Nat., vol. 22, 1888, p. 345.

² Idem, vol. 23, p. 662, fig. 2.

Figures 7, 8, and 9 represent plates which evidently belonged to the anterior border of the carapace, that surrounding the neck. Similar plates are shown by Burmeister.¹ Figures 7 and 9 present views of the inferior surfaces. These are very convex from front to rear and they terminate in an obtusely rounded free border. The free border of figure 7 is toward the right hand; that of figure 9 toward the left. The bone of figure 7 has a thickness of 26 mm.; that of figure 9 a thickness of 23 mm. Figure 8 gives a view of the outer surface; the free border is directed downward. The bone is 28 mm. thick.

Figures 6, 10, and 11 give views of plates which belonged on the tail.² From a rather thin front border, about 10 mm., these bones thicken backward and end in a relatively acute point. At this point the bone of figure 10 is 23 mm. thick; that of figure 11, 34 mm. The bone of figure 6 belonged to one of the rings which alternated with the rings composed of such bones as those of figures 10 and 11. The upper half of the figure, which represents the hinder half of the bone, was evidently overlapped by such a bone as that of figure 10, while the lower border joined the front edge of another bone similar to figure 10. The convex pitted outer surface is shown in the lower half of figure 6. The bone is 16 mm. thick.

Another plate belonging to the tail, or possibly to the borders of the carapace, and resembling that of figure 11, has a thickness of 32 mm. at the proximal border and of 42 mm. near the hinder border.

In the second volume of the Transactions of the Wagner Free Institute of Science (p. 25) Dr. Joseph Leidy called attention to some carapacial plates of a glyptodon which had been sent to him from Peace Creek, Florida. One of these bones is illustrated on his plate 4, figure 9; another on plate 6, figure 1. The latter presents a radiating striation which is not seen on any of the plates from Texas. The figure on his plate 4 suggests strongly some of the Texan bones, but the pitting appears to be coarser. It is impossible to say whether or not the Floridan specimens belong to *G. petaliferus*. Among the bones of the latter species are none which resemble those of Leidy's figures 11 and 12 of his plate 5.

From the fragments of the lower jaw no information of importance has been obtained.

The length of the upper tooth line was 165 mm. These upper teeth were much curved, in such a way that the outer face is concave, the inner one convex. At the same time they are directed outward as they ascend. The outer faces of the second teeth would have been 55 mm. apart at the grinding surface, about 90 mm. at the middle of their height, and about 100 mm. at the upper ends. The fourth tooth

¹ Anales Mus. Pub., Buenos Aires, vol. 2, pl. 41, fig. 4.

² Idem, pls. 37-40.

(pl. 3, figs. 2, 3) may be compared with that of Burmeister's figure.¹ This has a length of 26 mm. and a width of 18 mm. across the middle lobe. In *G. petaliferus* the corresponding measurements are 22.5 mm. and 15.5 mm., the longitudinal measurements being taken at the middle of the width. The height of this tooth is 70 mm. in a straight line. In *G. asper* the axis of each of the lobes is at right angles with the axis of the grinding surface; in *G. petaliferus* the axis of the anterior lobe is turned pretty strongly forward at its inner end; that of the second lobe less so; while that of the hinder lobe is turned somewhat backward. In *G. asper* the second tooth is slightly narrower than the fourth, 13 mm. at the middle lobe.

The skull is badly injured, but important parts remain. The axial bones and the occipital region are gone. The roof and lateral walls of the brain case are present, extending forward to about the rear of the orbit. Between this fragment and that presenting the front of the skull an interval is missing. Superiorly the upper surface of the face is present from a line joining the middle of the orbits, to the nasal opening, except a strip on the left side. The palate (pl. 3, fig. 2) is represented on one side or the other along its whole length. Three upper teeth are present. Parts of the facial portions of each maxilla are preserved; likewise a part of the left zygomatic arch. Parts of both lower jaws are present, including a portion of each ascending ramus and one condyle and a portion of each horizontal ramus, with one tooth. The bones of the skull have united so completely that no sutures are visible.

The parietal region (pl. 3, fig. 1) is convex from side to side. The surface is uneven and pierced by openings for blood vessels. The width, where least, just behind the orbits, is 95 mm. The width just above the opening of the ear was close to 104 mm. This fragment shows that the roof over the front of the brain and that just behind and between the orbits was occupied by large sinuses. The length of the cavity for the brain, including the olfactory lobe, was close to 100 mm., the width 60 mm.

The width of the skull taken at the lower border of the lachrymal opening is 148 mm. The height of the upper surface of the face, midway between the orbits, above the midline of the palate is 105 mm.

The length of the palate (pl. 3, fig. 2), measured from the front of the premaxilæ to the hinder nares, was close to 200 mm. The width at the third tooth is 38 mm.; at the hindermost one, 26 mm. The palate is rough and is pierced by many small and about six large foramina. It differs from that of Burmeister's *G. asper*¹ in being narrower and in being more contracted between the hinder teeth. In the species just mentioned the width is equal to 0.22 of the length; in *G. petaliferus*, to only 0.19 of the length.

¹ Anales Mus. Pub., Buenos Aires, vol. 2, pl. 27, fig. 1.

In *G. petaliferus* the second tooth (pl. 3, figs. 2, 4) is different from the fourth. Its length is 20 mm., its width only 9 mm. The outer ends of all the lobes are much reduced. It resembles considerably the first tooth of *G. asper*. The first tooth is missing in the Texas species, but the inner wall of the socket is present. From this it is evident that the lobes were much reduced on the inner side also. It is pretty certain that this tooth was thin and simple in construction, but the length of its grinding surface nearly equaled that of the second tooth.

The lower teeth were nearly straight, as shown by the one present and by the sockets in the fragments of the lower jaw. The one present (pl. 3, fig. 5) had a height of 75 mm., a length of 21 mm. on the grinding surface, and a width of 12.5 mm. on the middle lobe. The tooth present, belonging on the right side, is placed opposite the front border of the ascending ramus and is probably the sixth in the series. There were at least two others behind it. In *G. asper*, as figured by Burmeister, the grinding surface of this tooth has a length of 21 mm. and a width of 16 mm. across the middle lobe. In *G. petaliferus* the length is 21 mm., the width 13 mm. In the tooth of this species the axes of the lobes are little turned from a perpendicular to the longitudinal axis; in *G. asper* they are much more strongly deflected.

In all the teeth, upper and lower, the central core of vasodentine which sends lateral branches into the lobes undergoes secondary divisions there, as in *G. asper*.

The atlas is missing. In the glyptodonts the axis and the succeeding three or four cervicals are consolidated into one mass. Usually in the genus *Glyptodon* the mass includes the sixth cervical, but from Burmeister's description¹ it seems that in two species it is sometimes free and sometimes confluent. In the specimen at hand the sixth was evidently free and is missing from the collection. The consolidated second to fifth vertebræ (pl. 3, fig. 6) are injured somewhat; especially, the transverse processes are gone. The mass resembles much that of the forms figured by Burmeister. From the outside of one lateral articular surface for the atlas to that of the other is 80 mm. Hence the bone is smaller than any of those figured on the plate just cited. The distance from the outer side of one postzygapophysis to that of the other of the fifth vertebra is likewise 80 mm. The height of the neural spine above the floor of the neural canal is 63 mm.

Judging from the character of the surfaces by which the sixth cervical was united with the seventh, there was not much motion between them.

¹ *Anales Mus. Pub., Buenos Aires, vol. 2, p. 296, pl. 29.*

As usual in the glyptodonts, the seventh cervical is united solidly with the first and second dorsals. The width of the mass (pl. 3, fig. 7) near the rear is 150 mm. That of *G. asper*¹ appears to have been about 180 mm. wide behind and wider still in front. This mass, as figured and described by Burmeister, had along each border two rather deep notches and three processes. These are not seen in the specimen before us. On each side is an irregular surface, with several small facets for union with the head of the first rib. The motion here was evidently unimportant. The surface on each side for the second rib indicates more liberal movement. On each side below are two large openings for nerves. These divide each into two canals, one opening out on the upper surface of the mass, the other on the lower. The superior openings are much larger than those of Burmeister's figures. At the rear of the mass the postzygapophysial surfaces of the two sides coalesce under the spine. On each lateral process is a surface for union with corresponding surface on the front of the third dorsal.

The third dorsal and the succeeding ones, up to and including the twelfth are, in the glyptodonts, consolidated into a single mass in which the individual vertebræ can be distinguished only by the foramina for nerves and the facets for the ribs. In *G. petaliferus* the floor of the spinal canal is in places less than a millimeter in thickness: in the last dorsal, however, 5 mm. thick. The dorsal spines are greatly reduced and coalesced into a median ridge of small and irregular height. In the series, as preserved, on the assumption that there were twelve, there is missing most of the sixth and of the seventh dorsals and a part of the eleventh. The front of the third dorsal presents, superiorly (pl. 3, fig. 8) a crescentic zygapophysial surface for the second dorsal; also on each side a semicylindrical surface on the lateral process, for union with a corresponding surface on the second dorsal, already noted above. Above the rear of the articular surfaces for the fourth pair of ribs the bone corresponding to the fourth vertebra is 109 mm. wide. According to Burmeister's figure of *G. asper*² the same bone had a width of about 132 mm. Burmeister's figure indicates that the front end of this vertebral tube, in the region of the articulations of the third, fourth, and fifth pairs of ribs, was bounded on each side by a ridge; but in the specimen here described there are here no such ridges. However, further backward these ridges become very prominent. Again, the median ridge, composed of the coalesced spinous processes, which in Burmeister's figure is still prominent opposite the tenth and eleventh pairs of ribs, is obsolete in *G. petaliferus*. The rear of the twelfth vertebra is rough and was joined to the first lumbar probably

¹ Burmeister, *Anales Mus. Pub.*, Buenos Aires, vol. 2, pl. 30.

² *Idem*, pl. 30, fig. 1.

by fibro-cartilage; hence there was some movement at this point of the vertebral column.

The whole congeries of vertebræ which compose the lumbosacral tube is missing, except a fragment which appears to represent the fourth and fifth sacrals, and another fragment which furnishes the hinder part of the centrum of the seventh sacral and the whole of the eight. To the latter is attached a large part of each lateral process. On the front edge of each of these processes is a stump of the lateral process of the seventh sacral. The hinder end of the centrum of the eighth sacral, smooth for movable union with the first caudal, has a width of 73 mm. and a height of 55 mm.

There are present six caudal vertebræ. The average length of these is 77 mm. These belong at the base of the tail and all bear facets for chevrons. According to Burmeister's figure¹ and that of Lydekker² the tail of *Glyptodon* has 11 vertebræ. Of the whole length of the tail the basal six vertebræ occupy a little more than one-half. It seems probable, therefore, that the tail of *G. petaliferus* had a length of about 840 mm. An estimate indicates that our Texas species had a length of head, body, and tail of about 7 feet.

Both humeri are defective. The heads of both are present and the distal ends of both; but intervening portions are missing. It is, therefore, impossible to determine with certainty the original length of the bone. The humerus figured by Burmeister³ as that of *Glyptodon asper* may be taken for comparison. On the inner border of the bone of the Texas specimen (pl. 3, fig. 9) there are, as in the one just referred to, a pair of tuberosities. Assuming that these are in the same relative positions in the two species the total length of the humerus of the Texas specimen will be 340 mm. The following measurements are taken:

Measurements of humeri of *Glyptodonts* in millimeters.

	<i>G. asper.</i>	<i>G. petaliferus.</i>
Total length.....	360	340±
Distance from distal end to upper border of the upper inner tuberosity.....	220	208
Width across epicondyles.....	130	103
Side-to-side diameter of shaft where least.....	60	40
Distance across distal articulatory surface.....	88	63

It will be seen that the bone of the Texas species is slenderer than in the other, both in relation to the total length and to the distance of the inner tuberosities above the distal end.

¹ Anales Mus. Pub., Buenos Aires, vol. 2, pl. 33.

² Anales Mus. La Plata, vol. 3, 1894, pl. 5.

³ Anales Mus. Pub., Buenos Aires, vol. 2, pl. 32, fig. 2.

Both ulnae are preserved and the left one is wholly uninjured. This may be compared with the corresponding bone of Burmeister's *Glyptodon asper*.¹ The one of the right side is figured (pl. 4, fig. 1) because with it may be shown the corresponding radius.

Measurements of ulnae of Glyptodonts in millimeters.

	<i>G. asper.</i>	<i>G. petaliferus.</i>
Total length of bone.....	250	242
From end of olecranon to front of coronoid process.....	110	70
Depth of bone at sigmoid cavity.....	65	51
Depth of bone at middle of length.....	70	50
Thickness of bone at middle of length.....	.....	20
Depth of bone at lower articular surfaces.....	85	53

The two bones differ little in length, but that of *G. petaliferus* is much slenderer in all parts. A comparison of the figures show considerable differences in the form. In the South American species the middle of the surface for the articulation of the head of the radius is below the middle of the length of the ulna, while in the Texas species it is above the middle. The ulna of the latter is nearly straight, while that of *G. asper* is bent downward toward the distal end.

The right radius (pl. 4, fig. 1) is complete; the left is represented by the distal three-fourths. The total length of the bone is 170 mm.; the greatest width at the upper end is 52 mm.; the greatest at the lower end 55 mm.; the fore-and-aft diameter at the middle of the length, 27 mm.; the side-to-side diameter at this point 20 mm. The total length of the radius of *G. asper* appears to have been 167 mm., while the fore-and-aft diameter was about 26 mm. The bone appears to have had about the same size and proportions in the two species.

Of the innominate bones only fragments have been preserved.

The right femur (pl. 4, fig. 2) is practically complete. It is here compared with that of *Glyptodon asper*, as figured by Burmeister,² who says that his figure is one-half the natural size.

Measurements of femurs of Glyptodonts in millimeters.

	<i>G. asper.</i>	<i>G. petaliferus.</i>
From summit of head to distal part of internal condyle.....	510	425
Side-to-side diameter of head.....	88	70
Width across the trochanters.....	298	238
Side-to-side diameter at middle of length.....	124	90
Fore-and-aft diameter at middle of length.....	.....	55
Width at summit of the third trochanter.....	190	142
Width across condyles.....	195	123

¹ Anales Mus. Pub., Buenos Aires, vol. 2, pl. 33, fig. 2.

² Idem, pl. 34, fig. 2.

The femur measured by Burmeister is, as seen, considerably longer than that of the Texas species here measured. In the upper part the proportions are nearly the same, the length of the bone being made the standard of comparison. However, the width at the middle is somewhat less in *G. petaliferus*. While the width across the third trochanter of *G. asper* is 0.425 of the length of the bone, in *G. petaliferus* this width is only 0.334 of the length. Likewise, the width across the condyles of *G. asper* is 0.382 of the length, in *G. petaliferus* only 0.29.

The patella of the left leg is present. Its general form is quadrate. Its length is 84 mm.; its width near the upper end is 75 mm.; near the lower end 60 mm. The two lines of measurement are not, however, in the same plane, the outer end of the lower one being carried somewhat forward.

A part of each tibia is present, that of the right side (pl. 4, fig. 3) lacking that part of the distal end which was ankylosed to the fibula. The fibulas are represented by a single fragment of each.

Measurements of the tibiae of Glyptodon petaliferus in millimeters.

Total length of the bone.....	242
Distance across the articulatory surfaces for the femur.....	118
Fore-and-aft diameter of surface for inner condyle of femur...	72
Side-to-side diameter of surface for inner condyle of femur...	58
Greatest diameter where bone is smallest.....	62
Width of articulatory surface for astragalus.....	96

On account of the absence of the fibula and the consequent slight injury to the tibia here described, it is not possible to compare the latter accurately with the same bone of *G. asper*. The one measured by Burmeister¹ had a length of 240 mm., a width of 141 mm. across the upper end, and a width of 96 mm. across the articulation for the astragalus. It is evident that this bone in *G. asper* was, relatively to its length, a stouter bone than that of *G. petaliferus*.

A considerable number of foot bones, including nine ungual phalanges, are preserved, but no foot can be reconstructed from them and a description would hardly add anything of value to what has already been published.

Mr. Barnum Brown has described² a new genus and species of glyptodon, *Brachyostrakon mexicanus*. The genus is based for the most part on the form of the carapace. The small part of this preserved in the specimen which I describe above and its disorganized condition make a comparison with Brown's specimen impossible. Practically the only common parts are three teeth. It seems to me

¹ Anales Mus. Pub., Buenos Aires, vol. 2, p. 348.

² Bull. Amer. Mus. Nat. Hist., vol. 31, 1912, pp. 167-177, pls. 13-18.

that these indicate that Brown's species is not identical with the one here described. The vasodentine of the Texan specimen is more branched than in the Mexican, nearly as much as represented in Burmeister's figure of *G. asper*. This is not well shown in figures 3-5 of plate 3. The second upper teeth are different; likewise the upper fourth tooth and the lower sixth; as a close comparison of the figures will show.

NOTHROTHERIUM TEXANUM, new species.

Plates 6, 7.

Diagnosis.—Skull larger than that of the Brazilian species *N. escrivanense* Reinhardt and equal to that of *N. graciliceps* Stock; profile strongly convex; pterygoid bullæ widely open below; anterior tooth with hinder face transversely concave; hindermost upper tooth nearly as large as the others, with a deep furrow on the hinder face.

This species is based on a part of a skull now in the National Museum, No. 8353, which was obtained by exchange from the collection of Baylor University, Waco, Texas. It was presented to that institution about 15 years ago by a clergyman who had secured it from some person now unknown. It is reported to have been found in digging a well, at a depth of 40 feet, in Wheeler County, Texas. Wheeler County adjoins Oklahoma and is in the third tier of counties from the northern boundary of Texas. As to the geological age of this species, we can hardly doubt that it belongs to the Pleistocene.

This skull (pls. 6, 7), furnishes us many important parts, although it is considerably damaged. The whole upper surface is present, and the base as far as the front of the brain cavity. The left maxilla is preserved, together with its teeth. A small part of the right maxilla is likewise present. The bones surrounding the nasal opening are retained, except the premaxillæ. A small part of the anterior end of the right malar is attached to the fragment of the maxilla of that side; and the larger portion of the left malar has been saved. In studying this specimen comparison has been made with the skull of *Nothrotherium escrivanense*, as described by Reinhardt,¹ with the type of *N. graciliceps* Stock from California;² also with skulls of *Choloepus hoffmanni*.

In comparison with the skull of the fossil species found in a cavern in Brazil, the skull here described is considerably larger, the former having a length of 270 mm., from the rear of the occipital condyles to the front of the maxilla; the Texan species, a length of 300 mm. There are also differences in the form of the skull. In the Brazilian species the profile is nearly straight from the rear of the frontals to the anterior end of the nasals, while in the Texas form this outline

¹ Danske Vidensk. Selsk. Skr., ser. 5, vol. 12, pp. 253-349, pls. 1-5.

² Bull. Dept. Geol., Univ. Cal., vol. 7, p. 341.

is convex (pl. 6), but undulating. Also, while the parietal part of the profile in the Brazilian species is pretty strongly convex, in the Texan species it is undulating and little convex.

On the other hand, *N. texanum* is very closely related to *N. graciliceps* Stock. The differences which are believed to exist are considered below.

The following measurements have been made on the skull at hand. In the second column are the corresponding measurements of the skull forming the type of *N. graciliceps*. The premaxillæ not being present in either skull, the basilar length can be determined only approximately.

Measurements of skulls in millimeters.

	<i>N. texanum.</i>	<i>N. graciliceps.</i>
Basilar length.....	313±	323±
Distance from front of occipital foramen to front of maxilla.....	275	286
Distance from rear of occipital condyles to front of maxilla.....	300	310
Lateral extent of occipital condyles.....	76	80
Width of skull at mastoid processes.....	113	112
Width across skull above the orbits.....	105	102
Length of nasals at the midline.....	105	95+
Width of nasals, combined, at hinder end.....	44	57
Height of anterior end of snout.....	48	60
Width of anterior end of snout.....	71	72
Height of occipito-parietal suture above lower face of basioccipital.....	80	83
Height of occipito-parietal suture above lower face of occipital condyles.....	92	90

The upper half of the hinder aspect of the skull presents a very rough surface, for the attachment of muscles. A considerable part of the supraoccipital appears on the upper surface of the skull. The suture between the parietals is 70 mm. long. The parieto-squamosal suture is not as distinct as could be desired, but may be followed with considerable certainty. The squamosals have at the front end a width of 46 mm.

The suture between the frontals has a length of 110 mm. The lower edge of the bone of the right side is broken away; but it is present on the left side, where it is seen to come into contact with the hinder border of the nasal, overlapping its lower hinder angle and the hinder border of the lachrymal. The lower hinder angle of each frontal widely joins the corresponding squamosal. The frontals are coossified with the nasals, but the line of the suture can be easily traced.

The length of the suture between the nasals is 105 mm. These bones are so intimately consolidated with the maxillæ that it has

been somewhat difficult to determine the line of union. On the left side there is, at a distance of 32 mm. from the midline and at the anterior border of the frontal bone, a small foramen from which an indistinct, irregular line may be traced for a few millimeters forward. This line is shown on plate 7, figure 1. At the corresponding position on the left side of the figure is seen a white line. The bone on the right of this line had been separated and later cemented on again. On close examination it is found that there are here well-defined sutural surfaces, the maxilla joining the outer border of the nasal. At this point the distance from the outer edge of one nasal to that of the other is 57 mm. To what extent the naso-maxillary sutures determined the lines of fracture seen on the upper surface of the snout is uncertain.

The lachrymal is articulated principally with the maxilla, but its upper hinder border joins the frontal; while below it is united with the anterior end of the malar. It shows a large lachrymal foramen well in front of the orbit. This foramen is the outer opening of a canal which followed inward soon turns and is directed forward, opening into the nasal chamber just in front of the upper end of the first tooth.

In viewing the skull from below (pl. 7, fig. 2) there are observed behind the ear opening the small condyloid foramen and the large foramen lacerum posterius. The ear opening has a diameter of 10 mm. On the right side the tympanic bone is in its place, forming a ring which is incomplete above. Below it is inflated into a bulla of moderate size whose external surface is rough. On the left side the tympanic is missing, a fact which shows that it had not become ankylosed to the contiguous bones. The absence of the bone permits a view of a part of the petrosal. In front of the petrosal is seen the foramen lacerum medius. This, as it appears, is divided into two parts, the more anterior and outer being well in front of the external auditory meatus.

In front of the great pterygoid bulla is seen the foramen ovale. On the right side there is, in front of the ovale, an opening, the sphenoidal fissure. On the right side there are here two foramina, the hinder of which is probably the foramen rotundum. Farther in front and somewhat higher up and nearer the midline are the canals for the optic nerves. It is evident that these opened out at points in advance of the middle of the length of the skull.

A feature which distinguishes this genus from other *Gravigrada* is the presence of the great pterygoid bullæ (pl. 7, fig. 2). As shown in Reinhardt's figures of *N. eschwanense* these inflations extend well below the midline of the base of the skull. They have their lower surface divided by a longitudinal furrow, broad and deep, into an external portion and an internal. In the specimen from Texas the

lower floor of the bullæ is missing, so that the form of this part, if ever present, can not be observed. According to the description of these bullæ in the Brazilian species there is along the median line a space only about 5 mm. wide between them. They are evidently marked off along their inner boundary much more sharply than in the Texan species. In this animal there is between them a broad, longitudinal groove whose sides slope downward and outward gradually into the walls of the bullæ. The length of each bulla is 50 mm.; the width may be taken as 35 mm. The distance from the outer wall of one to that of the other is 90 mm. The median side of each cavity extends inward and upward into the base of the skull until the two are only 15 mm. apart.

The pterygoid bullae of *N. graciliceps* have been described by Stock. They are called by him tympanic bullae, but they are not such. Mr. Gerrit Miller has directed my attention to similarly placed and apparently homologous cavities at the base of the skull in various bats. As shown by Stock the roof of these bullae is formed by the alisphenoids. The side walls and floor in the Brazilian and the Californian species are certainly formed by the pterygoids. In *N. graciliceps* Stock there is along the inner face of the bulla a slit about 30 mm. long which puts the cavity of the bulla in communication with the pharynx. The bulla of *N. texanum* appears not to have had a floor. The pterygoids seem to form a wall which surrounds the cavity on both sides. On the median side the edge of the wall is partly intact, partly injured. On the outer side the wall comes down to a sharp thin edge which appears to be little if at all injured. In places the edge is certainly wholly natural. Such being the case the bulla is incomplete and is a cavity opening below by a mouth 30 mm. wide. In *N. graciliceps* the outer wall has grown downwards and inwards until it has nearly met the inner wall; in *N. escrivansense* the space between the two walls was apparently abolished. In *Choloepus hoffmanni* there are homologous bullae which open at the anterior end into the mesopterygoid fossa. Similarly placed bullae are found in the great anteater (*Myrmecophaga jubata*), but their structure is somewhat doubtful.¹

In the Texas specimen there is a rough and sharp ridge which begins on the midline between the front ends of the pterygoid bullæ and runs forward as far as the bone is uninjured. A similar struc-

¹ From an examination of skulls of the great anteater in the United States National Museum the writer concludes that the pterygoids and the alisphenoids of each side are so completely coossified that the line of union can not be determined unless it be in younger individuals than are at hand. The bullæ in adult individuals are completely closed. In a not fully grown specimen the impression given is that the bullæ remained open longest on the outer side, near the border of the temporal bone. It is believed that the area called alisphenoid in Weber's figure 332 taken from Pouchet (Säugetiere, p. 434) is not such. Certainly the foramen ovale pierces the alisphenoid; and it is this bone, not the pterygoid, which joins the basisphenoid.

ture is shown in one of Reinhardt's figures. This ridge appears to be on the vomer.

In our specimen the greater part of the palate, the front of the vomer, and the ethmoid bones have been broken away. A part of the hard palate is seen in front, and the underside of this is rough. In the rear of this injured region the cribriform plate has been broken through so as to leave a small opening to the brain-cavity on the left side and a much larger one on the right. In front of this, on the right side (left side of the illustration, pl. 7, fig. 2), are seen openings into sinuses in the frontal bone. The larger of these on each side extend backward to the hinder end of the frontal. Some of the plates of bone nearer the midline evidently belong to the olfactory apparatus. On the right side there remains about 30 mm. of the malar bone. On the left side the front part of the malar is missing, but the hinder part is present. The malar was a triradiate bone. The anterior process joined the lachrymal. The hinder process was directed upward and backward and had a notch in the hinder part of the lower border to receive the anterior end of the zygomatic process of the temporal bone. The lower process is pointed, and it descended about 60 mm. below the level of the palate.

The maxilla on the right side contains the four teeth which are characteristic of this genus (pl. 6; pl. 7, fig. 2). The length of the tooth row is 57 mm. Between each of the teeth and its neighbors is a space of about 5 mm. The grinding surfaces of the teeth stand below the hard palate hardly more than 5 mm. They must have been about on a level with it when the bone was covered with flesh.

The following measurements are obtained from the teeth. The length of the tooth is taken at the middle of its width and far enough above the grinding surface to avoid the effects of wear.

Measurements of teeth in millimeters.

Tooth.	Length.	Width.
1	10	13
2	11	15.5
3	11	15
4	7	14

As usual in the genus, there is for each tooth a front and a rear cutting edge. These are separated by a wide furrow. In the second and the third teeth this furrow turns backward, to end at the inner hinder angle of the tooth. The first, second, and third teeth have a somewhat greater fore-and-aft diameter at the inner side than that given in the table; while the last tooth measures 9.5 mm. on the outer face. The front face of the first tooth is flat transversely, that of

the others convex. The hinder faces of all are concave—that of the fourth tooth most so of all. The inner faces are flat or slightly convex—that of the fourth rather strongly so. The outer faces are somewhat concave, showing a shallow groove along their whole height. All of these teeth have a height of about 50 mm. They are hollow down to within about 10 mm. of the grinding surface.

On the front end of each maxillary there is a surface for the articulation of the corresponding premaxilla. The two surfaces are separated by a space of 20 mm., and each has a length of 30 mm. On the lower side of the maxilla is another surface for a backwardly directed process of the premaxilla. In case the premaxillae corresponded in size to those of the Brazilian species mentioned above, each had a length of about 30 mm.

This is not the first discovery of the genus *Nothrotherium* in North America. In 1905¹ Sinclair reported it, with some doubt, from Potter Creek cave, Shasta County, California. He had for description a part of a lower jaw without teeth and fourteen loose molars. The name *N. shastense* was given to the species.

In order to determine the relationship of the Texan specimen to that found in northern California, it is necessary to compare with the teeth of the former those which Sinclair has represented by figures 3, 5, and 8 of his plate 23. Figures 3 and 5 must be second and third teeth. Of the tooth represented by his figure 3 both the front and the rear faces are convex in section, whereas both the second and the third teeth of *N. texanum* have the front face convex and the rear face concave. Sinclair's figure 5 resembles somewhat the section of the third tooth of the Texan species; but here, as in the tooth of his figure 3, the inner face of the tooth is more or less concave; whereas, in the Texan animal, the inner face is flat. However, it is in the hindermost tooth that the greatest difference is found. In the California species the front of the tooth is convex, the rear flat. In the Texan species the rear of the tooth is deeply concave. It appears to be evident that two distinct species are indicated.

In 1913,² Stock described a skull, lacking the lower jaw and some other parts, which he called *N. graciliceps*. The type is now in the Los Angeles Museum of History, Science, and Art, where the writer has had the privilege of examining it. This skull resembles closely that from Texas in size and proportions, as may be seen from the measurements given on page 117. There are, however, in the Texan skull, certain deviations from that of *N. graciliceps* which appear to make it advisable to give to it a distinctive specific name. One can not rely wholly on the differences which are seen in the two skulls for additional specimens may be intermediate.

¹ Bull. Dept. Geol., Univ. Cal., vol. 4, p. 153, pl. 23.

² Idem, vol. 7, pp. 341-352, figs. 1-8.

It seems to the writer that *N. graciliceps* had the skull more depressed at the anterior half of the frontals. As a result of this, as Stock says, the nasals have their upper surface transversely convex in front, but becoming flattened posteriorly. In *N. texanum* these bones are rather more convex just in front of the hinder end than in front. In *N. texanum* the end of the snout is apparently more depressed than in *N. graciliceps*. The width is nearly the same in the two skulls, but in the latter the height is 60 mm., while in *N. texanum* it is only 48 mm. Unless a serious error is committed as to the structure of the pterygoid bullae in *N. texanum*, these are sufficient to differentiate the two species. In *N. graciliceps* the nasals have a combined width of only 44 mm.; in *N. texanum* the width is 57 mm.

There are apparently differences in the two species as regards the teeth. The type of *N. graciliceps* had not retained the teeth; but the size and forms of these may be determined from the sockets. Stock had one tooth, apparently the second molar, which had been found in the Rancho La Brea deposits. The sockets of the type skull and the tooth mentioned show that the teeth of *N. graciliceps* were larger than those of *N. texanum*. The anteroposterior diameter of the second molar is 13 mm., and thus 2 mm. greater than in the same tooth of *N. texanum*. In *N. graciliceps* the hinder face of the first tooth was evidently convex from side to side; in *N. texanum* it is slightly concave.

EXPLANATION OF PLATES.

PLATE 3.

Glyptodon petaliferus Cope.

- FIG. 1. Upper surface of rear of skull. $\times \frac{1}{2}$.
 2. Palate. $\times \frac{1}{2}$.
 3. Upper left fourth tooth. $\times 1$.
 4. Upper right second tooth. $\times 1$.
 5. Lower right sixth ? tooth. $\times 1$.
 6. Consolidated cervicals, second to fifth, viewed from above. $\times \frac{1}{2}$.
 7. Seventh cervical and first and second dorsals consolidated. Upper view. $\times \frac{1}{3}$.
 8. Third, fourth, and fifth dorsals, seen from above. $\times \frac{1}{3}$.
 9. Right humerus, seen from in front. $\times .46$.

PLATE 4.

Glyptodon petaliferus Cope.

- FIG. 1. Right ulna and radius, seen from the right side. $\times \frac{1}{3}$.
 2. Right femur, seen from in front. $\times \frac{1}{3}$.
 3. Right tibia, seen from in front. $\times .32$.

PLATE 5.

Glyptodon petaliferus Cope. $\times \frac{4}{5}$.

- FIGS. 1-5. Dermal plates belonging to the interior of the carapace.
 6. A dermal plate belonging to the tail.
 7-9. Plates belonging to the front border of the carapace.
 10, 11. Plates belonging to the tail.

PLATE 6.

Nothrotherium texanum, new species.

Skull seen from the left side. $\times \frac{1}{2}$.

PLATE 7.

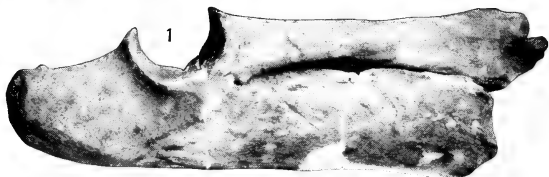
Nothrotherium texanum.

- FIG. 1. View of the skull from above. $\times \frac{1}{2}$.
 2. View of the skull from below. $\times \frac{1}{2}$.



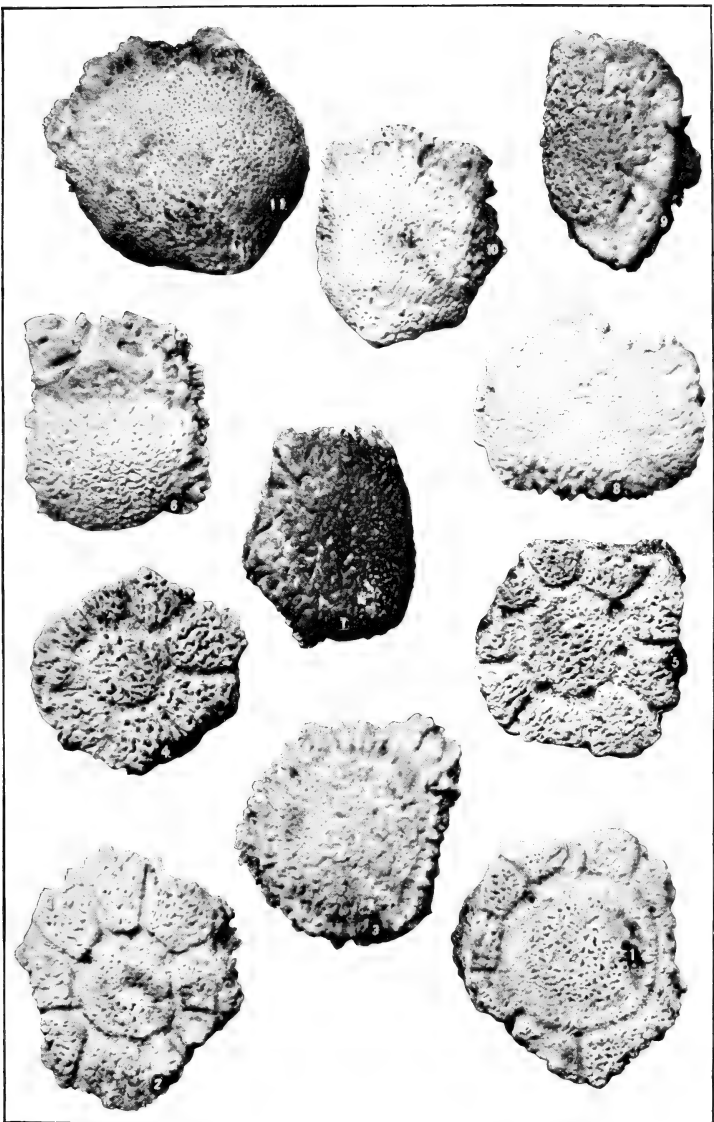
GLYPTODON PETALIFERUS.

FOR EXPLANATION OF PLATE SEE PAGE 123.



GLYPTODON PETALIFERUS.

FOR EXPLANATION OF PLATE SEE PAGE 123.



PLATES OF GLYPTODON PETALIFERUS.

FOR EXPLANATION OF PLATE SEE PAGE 123.



SKULL OF *NOTHROTHERIUM TEXANUM* FROM LEFT SIDE.

FOR EXPLANATION OF PLATE SEE PAGE 123.



SKULL OF NOTHROTHERIUM TEXANUM (1) FROM ABOVE, (2) FROM BELOW.

FOR EXPLANATION OF PLATE SEE PAGE 123.

NEW NORTH AMERICAN HYMENOPTERA
OF THE FAMILY EULOPHIDAE

BY

A. A. GIRAULT

Bureau of Entomology, United States Department of Agriculture

No. 2148.—From the Proceedings of the United States National Museum,
Vol. 51, pages 125-133

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NEW NORTH AMERICAN HYMENOPTERA OF THE FAMILY EULOPHIDAE.

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The following descriptions are based upon type material in the United States National Museum.

Genus ZAGRAMMOSOMA Ashmead.

This genus bears two ring-joints and differs from *Atoposoma* Masi in bearing a long, distinct propodeum.

ZAGRAMMOSOMA NIGROLINEATA Crawford.

This is a *Gyrolasella*. The type and paratype are males. The grooves on the scutellum of *Z. flavolineata* Crawford and *Z. centrolineata* Crawford are very faint.

ZAGRAMMOSOMA INTERLINEATA, new species.

Female.—Length, 2.05 mm.

Differs notably from the description of the genotype as follows: Near the lateral margin of venter of abdomen runs a metallic green line from base to distal two-thirds and which is continuous with the lateral line of the thorax. These markings also differ: No markings on face; the line across cephalic vertex divides laterad and goes to the eyes; the two diverging lines on upper occiput meet at center of the occiput, then diverge, thus forming a large X, each ventral arm curving around to the apex of the eyes and from thence up the lower occipital margin of the eye for a short distance; dorsal edge of scape and a spot above at base of the pedicel; a long curved spot above on hind coxa at base, a round dot on hind femur laterad before apex and two dots dorsad a little more toward base; the dorso-lateral stripe of thorax is broken at cephalic end of the parapsidal furrows; the complete dorso-lateral stripe of pronotum also forms a continuous line with a complete straight stripe through the parapside, but the line changes angle at the parapside; the median line of postscutellum is marked by a triangle which does not extend to the apex; the propodeum is about as in *americana* but the lines in the place of lateral carinae are incomplete at each end; the abdomen is remark-

ably marmorated—a complete (or nearly) median stripe and about 6 complete cross-stripes (excluding the one at base which is also latero-marginal to the first cross-stripe); stripes 1-3 are similar, incomplete, complex, each consisting of a pair of stripes joined broadly across the meson then separated, each concaved or bowed in opposite directions so that their arms diverge laterad but those of the proximal ones are more curved than the others; stripe 4 is similar but the distal arm is much longer, nearly reaching the lateral margin; stripes 2-4 are joined (thus, the distal arm of 2 joins the proximal one of 3 and in succession); stripe 5 has no arms and is more abbreviated; stripe 6 is complete and is followed by a spot on meson before the apex; the following additional spots on abdomen—a pair of marginal spots in a line opposite the forks of stripes 2-4 (the distal of the two opposite 4 more mesad and against the apex of the distal fork of that stripe); a transverse marginal spot opposite 5; and an oblique longer than wide spot in the disk on each side of meson between 5 and 6. Distal stripe of fore wing nearly straight and complete; the middle stripe is only a subtriangular blotch from the apex of the stigmal vein, the proximal one a short dash. Funicle 1 a half longer than wide. Mandibles 6-dentate.

From one female in the United States National Museum, labeled "D. C., October 6, 1880."

Type.—Cat. No. 19641, U.S.N.M., the female on a tag, the hind legs and head on a slide.

The lateral margins of postscutellum are not metallic.

ZAGRAMMOSOMA AMERICANA, new species.

Female.—Length, 1.50 mm. A round dot on caudal femur laterad at distal three-fourths and one ventro-laterad near base.

Golden yellow and agreeing with the figure and description of *multilineata* except as follows: There are no metallic lines on the face; the two lines of the occiput are curved and meet above across cephalic vertex; below they widely diverge, each curving at the lateral margin from ventrad and proceeding up along the occipital margin of the eye; an irregular line along dorsal edge of the scape; the lateral line of the thorax extends only to the metapleurum; there is a complete dorso-lateral line on prothorax, but the median line extends only to distal two-thirds; the median line of scutum fades out just before apex; parapsidal furrows and mesal margin of each axilla very narrowly green, also the lateral grooves of scutellum, an oblique dash from meso-cephalic angle of each axilla nearly to middle and a dorso-lateral line (continuous with that of pronotum) on each parapside but not quite complete caudad; median line of scutellum extending only to center, but there is a dot at meson at apex; propodeum with a line in the position of median and lateral carinae, cephalic margin

to the spiracles (and a parallel line but broken mesad from each side of the postscutellum) and caudal margin less widely; abdomen with one complete basal cross-stripe and the following, thus differing from *multilineata* conspicuously in having most of the stripes abbreviated laterad—six abbreviated cross-stripes out from the basal one, the whole connected along the meson by a mesal stripe; the first stripe has a transverse marginal spot opposite it, the second and third are with a pair of marginal dots in an oblique line (these three cross-stripes about straight); stripe 4 is Y-shaped with a pair of the dots opposite at margin, 5 the same but with longer arms (the arms of the letter distad in both stripes), nearly connected with a marginal spot which is transverse; 6 is about straight and complete, some little distance from the apex and followed by a mesal dot nearer to the apex. Venation yellow except base and apex of marginal and stigmal veins and base of the postmarginal, which are black. Stripes on fore wing about as in the genotype. May be distinguished at once by the presence of a somewhat longer than wide metallic green marking from cephalic margin of scutum not far from cephalo-lateral angle. Parapsidal furrows curving off before the pronotum. Flagellum not seen.

Described from a female reared from *Sarcobatus*, Boulder, Colorado, December, Cockerell.

Type.—Cat. No. 19642, U.S.N.M., the female on a tag.

EPITETRASTICHUS SEMIAURATICEPS, new species.

Female.—Length, 2.50 mm. Abdomen long, conic-ovate, distinctly longer than the rest of the body.

Dark metallic blue green, the wings hyaline, the venation black, the legs golden yellow except the coxae, all the middle of cephalic femur (less broadly ventrad) and the other femora except at apex. Face below the antennae (but not the cheeks) golden yellow excepting a round spot mesad just ventrad of the antennae and an oblique stripe (but incomplete) pointing to each antennal insertion from the green of the cheeks down near (but not at) the apex of the head and extending from its origin a little more than half way to each antenna (that is, dorso-mesad); but in one specimen this stripe was very broad. Mandibles tridentate. Scape compressed; pedicel subelongate, obliquely golden ventrad from base to apex, nearly twice longer than wide at apex, subequal to funicle 1, the latter subequal to the other two funicle joints. Club 3 with a distinct terminal spine, club 1 not so long as any funicle joint but longest of the club. Distal tarsal joint black. Funicle 1 nearly twice longer than wide. A short, distinct postmarginal vein present. Median sulcus of scutum sometimes completely obliterated. Propodeum short at the meson, long laterad, with a broad, glabrous, depressed median carina and no others, the spiracle

rather large. Sculpture usual, no especial punctures or setae. A row of faint punctures across caudal margin of the pronotum. Trochanters, mesal margin of axilla narrowly and sometimes the entire face ventrad of antennae and mesad of the genal sulcus, golden yellow.

From four females reared from a large bud gall on *Pinus scopulorum* at Denver, Colo. (E. Bethel).

Type.—Cat. No. 19643, U.S.N.M., the above specimens on two tags plus a slide bearing two heads.

TETRASTICHUS ASPARAGI Crawford.

Differs from *Tetrastichus banksi* notably in not having a distinct row of punctures along the lateral margin of the scutum and the pronotum is not punctulate but with only a pair of rows of obscure punctures along the caudal margin. In *Hyperteles blastophagi* Ashmead the scape is pale, the body black, the propodeum with a median carina only. *Tetrastichus acutus* Ashmead is more slender, the tibiae and the venation pale, the body black or nearly; so also *Tetrastichodes tibialis* Ashmead. *Tetrastichus microrhopalae* Ashmead is smaller and has pale venation, the tibiae are pallid and there is no lateral carina on the propodeum; from *rapo* Walker (Crawford) in having funicle 1 longer than wide, not nearly subquadrate and there is a lateral carina on the propodeum. *T. rosae* Ashmead has the scape mostly pale. From *bruchophagi* Gahan in the punctate vertex, the dark venation, the reddish tibiae; from *scolyti* Ashmead not very much but the abdomen is shorter, the venation black, the lateral carina of the propodeum different (or rather there are two of them); the one in *scolyti* forks distad and the spiracle is long-elliptical or like a slit and just mesad of the base of the carina; in this species the spiracle is round and of moderate size. The first lateral carina of propodeum is obliqued a little meso-caudad, the second somewhat as in *scolyti*. Types seen.

Two females from Jordan, Ontario, Canada (W. A. Ross), June 8, 1915.

EPITETRASTICHUS PUNCTATIFRONS, new species.

Female.—Length, 2.10 mm.

Like *Tetrastichus asparagi* Crawford but the scape is reddish yellow, the venation yellow, the first two pairs of tibiae are infuscated along proximal two thirds or more, there is a very distinct row of punctures along the lateral margin of scutum, the vertex and upper face are much more densely punctuate, the punctures nearly confluent (scattered on lower face, the facial impression finely scaly) and the pronotum has a slightly rougher sculpture, also the propodeum is punctate, its lateral carina represented by a flat, smooth spiracular "sulcus" whose sides are very finely carinated but the mesal side so only at base and the carina of the lateral side turns in mesad at the

middle then out again; thus, then, a complete carina is just laterad of the spiracle. Club with a terminal nipple, the club joints not long; funicle 1 nearly a half longer than wide, somewhat longer than 3, subequal to the pedicel, the latter longer than in *asparagi* which bears a second, short ring-joint.

From one female in the United States National Museum, labelled "Tempe, Ariz., D. J. Caffrey. Jan.-Feb. Hym slide (antennae) 627."

Type.—Cat. No. 19644, U.S.N.M., the above specimen on a tag, the antennae on a slide.

NEOTETRASTICHODES LONGICORPUS, new species.

Female.—Length, 3.30 mm. Abdomen long, conic-ovate, twice the length of the thorax. Dark metallic blue, the wings subhyaline, the venation yellow brown, the following parts golden yellow: Head (except upper two-thirds of occiput), legs (except the hind coxae and base of the middle coxae), pronotum, except an inverted fleur-de-lis centrally and which bears a slender bow caudad of the others but originating a little laterad of its base (and excepting caudal and cephalic margins narrowly), lateral margin of scutum, somewhat over the distal third of the latter (a little more at meson), scutellum except at immediate base slightly between the first grooves, parapsides except their cephalic apex broadly and broadly less distinctly along the whole meson except immediately caudad of the dark blue of the apex, axillae except an obtriangular projection from cephalic apex to the middle, mesopleurum under the wing insertion, prepectus except dorsal edge, propleurum except ventro-cephalad, apex of the pedicel and ventral edge of the scape more or less. Forewings with a short postmarginal vein, the stigmal of moderate length. A row of punctures along lateral margin of the scutum and along the caudal margin of the pronotum. Tegulae yellow. Club with a terminal nipple. Flagellum dark brownish. Pedicel subelongate, two and a half times longer than wide at apex, distinctly shorter than funicle 1 which is over twice longer than wide; funicle 3 only slightly shorter than 1, longer than club 1 but only slightly so. Propodeum with a short, broad, complete, strong median carina which forks at apex, no lateral carinae. Postscutellum yellowish brown with a metallic greenish meson.

From a female on a tag labeled, "Las Vegas, N. Mexico, 8, 8, Barber and Schwarz."

Type.—Cat. No. 19645, U.S.N.M., the above specimen on a tag, the antennae on a slide.

TETRASTICHUS POLYNEMAE Ashmead.

This is a species of *Aprostocetus*. The body bears the usual sculpture. The original description is about correct. Club with a distinct terminal nipple, its first joint slightly longer than wide. Pedicel slightly longer than wide at apex; funicle 1 longest, over twice longer than wide, 3 somewhat shorter, distinctly longer than the pedicel. Flagellum with scattered, longish hairs. Marginal fringes of the forewing somewhat longer than usual. Propodeum with rather scaly sculpture, a median carina and apparently no others. Mandibles tridentate.

From the type female in the United States National Museum (the head mounted on a slide).

OOTETRASTICHUS MYMARIDIS, new species.

Female.—Length, 1.10 mm.

Of the same size, form, and color as the preceding but differing specifically as follows: The legs are white except proximal three-fourths of the coxae and the tarsi, the latter dusky black; the third tooth of the mandible is broadly, obliquely truncate; the venation is dusky; the sculpture finer, the scutum subglabrous; propodeum scaly, with a pair of diverging median carinae which diverge distad, no lateral carina; club usual for the genus, with but a very obscure terminal nipple; first ringjoint large, the others equal; pedicel subelongate, twice longer than wide at apex, longer than funicle 1, which is two-thirds longer than wide; funicle 3 somewhat shorter, barely longer than club 1; pedicel wholly brown like the rest of the flagellum.

Described from one female labeled "*Tetrastichus polynemae* Ashmead. Type—No. 5323, U.S.N.M., 8694°4. From egg of *Lestes*, Lake Forest, Illinois, August 4, 1899."

Thus part of the type of the other species.

Type.—Cat. No. 19646, U.S.N.M., the above female plus a slide with the head.

EUELMUS ALBOCINCTUS Ashmead (*Tetrastichini*).

The funicle is 4-jointed, the club 3-jointed, one ring-joint. Scape and pedicel pale except the latter above. Coxae and base of femora rather broadly black. Stigmal vein of normal length. Scutum with a median groove. Antennae, legs (except coxae), and over proximal third of abdomen in the male, white; the male funicle 3-jointed. In the female, funicle 4 is longest, about a half longer than wide, 1 somewhat longer than wide, somewhat shorter than the not long pedicel. Scape compressed. Mandibles tridentate. Abdomen rounded. Pro-

podeum not long, scaly, with a very delicate median carina and no others. The types are from Jacksonville, Florida. A head of each sex has been mounted on a slide. Scutellum with the usual four grooves.

SYMPIESOMORPHELLEUS NIGRIPROTHORAX, new species.

Female.—Length, 2 mm.

Honey yellow, the wings subhyaline, the venation yellow, the head, the rather large prothorax, and the abdomen except median line of venter and a line on dorsum just within the margins (around base and down each side for proximal three-fourths). Two black bristles on scutellum just outside of the groove, one at each end. Parapsidal furrows not reaching the pronotum but curved off. Mandibles 10-dentate, the tenth tooth very minute, the next 8 comblike. Scape pale at proximal third. Antennae inserted somewhat below the middle of the face; pedicel a half longer than wide, subequal to funicle 4, which is subequal to club 1; funicle 1 over twice longer than wide, 2 a half longer than wide, subequal to 3 and 4. Axillae not advanced. Body coarsely scaly. Propodeum with a black streak like lateral carinae but only a median carina is present. Stigmal vein about a third of the length of the marginal, shorter than the postmarginal. Club with a small terminal nipple.

Described from one female on a tag in the United States National Museum labeled "April 30. Riley Co., Kansas, Marlatt. 2422."

Type.—Cat. No. 19647, U.S.N.M., the specimen on a tag, the hind legs and head on a slide.

MIROLYNX, new genus (Omphalini).

Female.—Like *Pseudolynx* Girault, but the scutellum with two obtuse grooved lines; and the funicle is 3-jointed, the club 2-jointed and with a minute terminal nipple. Genal suture distinct.

Type of the genus.—*Mirolynx flavitibiae*, new species.

MIROLYNX FLAVITIBIAE, new species.

Female.—Length, 2.25 mm.

Dark metallic green, the antennae and venation dark brown, the scape, tibiae, and tarsi lemon yellow. Fore wings with a fuscous spot along the stigmal vein and another somewhat larger one from the base of the marginal vein; the spot along the proximal side of the stigmal vein projects a little beyond the apex of that vein. Funicle joints 2-3 subequal, each slightly longer than wide, 1 somewhat longer than 2, the latter somewhat longer than the pedicel. Club 1 subquadrate, club 2 at apex acute. Mandibles with three rude teeth, the first acute, the third with several minute dentations along its apical margin. Flagellum (except pedicel) clothed with broad,

flattened hairs. Body densely scaly. Propodeum noncarinate, with spiracular sulci. Scutellum with six bristles, three to a side, two of these cephalad of middle. Middle femur at mesal apex with a stout bristle.

The male is the same (antennae not seen) but the abdomen is depressed and the proximal spot on the fore wing is absent.

Described from four males, two females in the United States National Museum, labeled "Santa Cruz Mountains, California, 59."

Types.—Cat. No. 19648, U.S.N.M., two pairs on four tags plus a slide bearing the female head, a pair of wings and a caudal tibia.

TETRASTICHOPSIS, new genus.

Female.—Like *Aprostocetus* Westwood but the scutellum with only the lateral of the four grooved lines.

Type of the genus.—*Tetrastichopsis prionomeri*, new species.

TETRASTICHOPSIS PRIONOMERI, new species.

Female.—Length, 1.10 mm.

Dark metallic blue, the knees, tibiae, and tarsi (except the last joint of the latter) golden yellow, the wings hyaline, the venation dusky pallid. Differs from *Tetrastichus microrhopalae* Ashmead especially in being darker and the funicle joints are shorter, all slightly wider than long rather than somewhat longer than wide as in the other species. It differs from *Tetrastichus rapo* Walker (Crawford and Gahan) in having funicle 1 subquadrate instead of somewhat longer than wide and the median carina of the propodeum is more distinct. From *Geniocerus chrysopae* Crawford only in the generic character. From *Tetrastichus bruchophagi* Gahan in having the funicle joints distinctly shorter and the body less metallic. Propodeum with a median carina in all of these species but no lateral one; also the club has a terminal nipple. Pedicel in *prionomeri* a little longer than funicle 1.

Described from four females reared from *Prionomerus calceatus*, a leaf-miner in sassafras, Clarksville, Tennessee, June 18, 1915 (W. D. Pierce).

Types.—Cat. No. 19649, U.S.N.M., four females on tags, a head on a slide.

TETRASTICHOMORPHA AJAX, new species.

Female.—Length, 1.50 mm., excluding the ovipositor which is exerted for three-fourths of the abdomen's length.

Agreeing with the original description of *Aprostocetus canadensis* Ashmead but dark green, the legs golden yellow except the coxae and femora, the latter golden yellow along distal third. Mandibles tridentate. Club with a small terminal nipple. Scape compressed; pedicel subequal to funicle 2 which is a little shorter than 1, the

latter nearly twice longer than wide; funicle 3 somewhat longer than wide; club wider than the funicle but not as long. Venation blackish. Head and thorax with the usual scaly, tetrastichine sculpture. Propodeum transverse at the meson, broadening laterad, with an obtuse median carina but no others. Scutum with only a few scattered setae, these along the lateral margin.

Described from three females captured by sweeping in a forest path, Anacostia, District of Columbia, June, 1915.

Types.—Cat. No. 19650, U.S.N.M., the above specimens on a tag, a head on a slide.

ZAGRAMMOSOMA SANGUINEA, new species.

Female.—Length, 1.50 mm.

Blood red, the wings hyaline, the body marked with black as follows: An obscure line across upper occiput, an irregular blotch on upper scape some little distance before apex, upper pedicel at proximal two-thirds, a narrow line along the dorso-lateral aspect of pronotum, parapsidal furrows narrowly except at extreme apex, median line of scutum narrowly, the line broken in three places (thus composed of four longer than wide spots), cephalic margin of propodeum to the spiracle (a wavy line), median line of same (both rather narrowly), an hourglass-shaped median line from base of abdomen, a short, thin line across its apex; and then four wider but incomplete cross-lines of which the last is composed of a transverse spot on each side of the meson and is a little distad of distal three-fourths, while the first of the four is incised at meson caudad. Mandibles 5-dentate. Propodeum noncarinate. Grooves of scutellum absent except on one side distad. Club with a distinct terminal nipple. Two ring-joints; funicle 2 a little longer than wide, shorter than the pedicel. Body finely scaly.

From one female in the United States National Museum, labeled "Colorado, 1094."

Type.—Cat. No. 19651, U.S.N.M., the above specimen on a tag, a middle and hind leg and the head on a slide.

REPORT ON THE JAPANESE MACROUROID FISHES
COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" IN 1906,
WITH A SYNOPSIS OF THE GENERA

BY

CHARLES HENRY GILBERT AND CARL L. HUBBS

Of Stanford University, California

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REPORT ON THE JAPANESE MACROUROID FISHES
COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" IN 1906,
WITH A SYNOPSIS OF THE GENERA

BY

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INTRODUCTION.

During the summer of 1906 the United States Fisheries Steamer *Albatross* made extensive explorations about the islands of Japan. After a few dredge hauls about the Kuril Islands the course was continued through the Tsugaru Strait and southward, in the Sea of Japan, along the west coast of Hondo to Tsuruga; and from there across the Sea of Japan to the east coast of Korea by way of the Oki Group; then southward, through the Eastern Channel of Korea Strait, to the Eastern Sea; thence through Vincennes Strait to Kagoshima Gulf; and northward, through Bungo Channel and the Inland Sea, to Yokohama. The *Albatross* then circumnavigated Hokkaido (Yezo), and, returning southward, dredged extensively in Suruga Gulf and Sagami Bay.

The Macrouroid fishes obtained during this expedition are made the subject of the present report. Large numbers of these deep-sea fishes were dredged off the southern and southeastern coasts of Japan, chiefly in the Eastern Sea, Suruga Gulf, and Sagami Bay. They were found in the Okhotsk Sea and everywhere to the eastward of the islands, but they were not to be discovered in the Sea of Japan nor the Gulf of Tartary, although numerous and successful hauls of the trawl were made at appropriate depths.

SYNOPSIS OF THE GENERA.

It has long been apparent to students of Macrouroid fishes that many of the current genera are incapable of exact definition, forming more or less unnatural groups. This statement is especially true of the genus *Macrourus*, with which widely different groups have been repeatedly identified.

The authors have had the privilege of further examining a large number of species, including nearly all those obtained by the *Albatross* in extensive expeditions in the North Atlantic Ocean, on both coasts of South America, about the Galapagos Archipelago, in Panama Bay, off the west coast of North America, in Bering Sea, about the Hawaiian Islands, and about the Philippine Islands.¹ The senior author critically studied the material in the United States National Museum in 1905. On the basis of the study of these collections a revision of the subfamilies and genera is proposed.

The characters heretofore used to define the genera or subgenera in the large subfamily Coryphaenoidinae (=Macrourinae) have largely proved to be of minor or only specific value, because of the great variation shown by obviously related species as regards these characters. Among these may be mentioned the dentition, which has been used heretofore in the primary division of the subfamily. The dentition of the lower jaw has proved to be of no generic value, as in closely related species of *Coryphaenoides* and *Lionurus* the teeth vary from a single series to a wide band. The enlargement of the outer premaxillary series, forming the heterodont dentition of "*Chalinura*," is not a reliable generic character because of its great variation in different species of *Coryphaenoides*. But in each of three distinct groups there are found two genera or subgenera, one of which contains only one or two series of teeth in both jaws while the other has a distinct premaxillary band. *Nematonurus* is thus separated from *Coryphaenoides*, *Abyssicola* from *Coelorhynchus*, and *Malacocephalus* from *Lionurus*. Other characters are correlated with this difference in dentition. The amount of rostral projection is usually characteristic of the genera, but no value can apparently be placed on this character in the large genera *Coryphaenoides* and *Lionurus* (as here defined). The roughness of the scales is subject to wide variation in the larger genera and apparently distinguishes natural groups in but a single case. In the genus *Lionurus* the subgenus *Lionurus* differs from the subgenus *Nezumia* in the smooth scales of the body. The amount of interdorsal space can only be regarded as of specific value. The serration of the dorsal spine is a valuable character. The serrations are found only in the Coryphaenoidinae (=Macrourinae), and are absent in six genera of that subfamily: *Cynomacrurus*, *Coelorhynchus*, *Abyssicola*, *Hymenocephalus*, *Malacocephalus*, and *Trachonurus*. The serrations are obsolescent in certain species of the large genera *Coryphaenoides* and *Lionurus*. But the strength of the spine and its trenchant anterior edge are retained even in these species. The spine is comparatively

¹ The entire Philippine collection of Macrouroid fishes made by the Fisheries steamer *Albatross* during the years 1907 to 1910 has been kindly sent to us by Dr. Hugh M. Smith, Commissioner of Fisheries.

more slender and the anterior edge rounded in those genera characterized by the total absence of serrations. Two serrations were found on the dorsal spine in a paratype of *Coelorhynchus productus*.

The classifications of genera adopted by Jordan and Evermann,¹ Goode and Bean,² Dollo,³ and by other authors are based chiefly upon that of Günther, proposed in the report on the deep-sea fishes of the *Challenger* expedition (p. 124).

The characters used by us to separate the genera related to *Coryphaenoides* (here referred to the subfamily Coryphaenoidinae) are small, but their value lies in their constancy, which has been tested in a large majority of the species.

Many nomenclatural changes follow as a result of this rearrangement of the genera. *Dolloa* (= *Moseleya*), *Albatrossia*, and *Bogoslavius* are regarded as synonyms of *Nematonurus*. *Chalinura* can not be separated from *Coryphaenoides*, and the most of the numerous species heretofore referred to *Macrourus* are now regarded as species of *Coryphaenoides* on the one hand and of *Lionurus* on the other. These changes are further indicated in the list of species and in the generic descriptions.

The number of branchiostegal rays is a character of great value in this group, and is used in the present classification in the primary subdivision of the subfamily Coryphaenoidinae. One group of genera, undoubtedly related to *Coryphaenoides*, has six branchiostegal rays. The species of these genera have the anus immediately anterior to the anal fin, with the exception of *Coryphaenoides hystomus*, *Abyssicola macrochir*, and several aberrant species of *Coelorhynchus*. Another large group, similarly interrelated, has seven branchiostegal rays, and the anus remote from the anal fin. Alcock⁴ is the only author who has used this interesting correlation in the classification of the group, but he used it merely in his key to the species which he referred to *Macrurus*, and based no genera upon this correlation. The genus *Hymenocephalus* alone has seven branchiostegals and the anus immediately before the anal. This correlation confirms the isolated position of *Hymenocephalus* among the Coryphaenoidinae, as further indicated by the presence of ventral striae, the large lateral and subterminal mouth, the long forward extension of the gill openings, the smooth dorsal spine, the thin and weakly armed scales, the presence of two ventral lens-shaped bodies,

¹ The Fishes of North and Middle America, Bull. U. S. Nat. Mus., No. 47, pl. 3, 1898, p. 2561.

² Oceanic Ichthyology, Smiths. Inst., Sp. Bull., 1895, p. 389.

³ Expédition Antarctique Belge. Rés. du Voy. du S. Y. *Belgica*. Zoologie: Poissons, 1904, p. 32.

⁴ Alcock, Journal of the Asiatic Society of Bengal, vol. 63, pt. 2, 1894, pp. 126 and 127; Goode and Bean, Oceanic Ichthyology, 1895, p. 532 (reprinted from Alcock); and Alcock, A Descriptive Catalogue of the Deep-Sea Fishes in the Indian Museum, 1899, pp. 108 and 109.

and other characters. Further generic division of these two major groups is based largely on dentition, amount of rostral projection, the presence or absence of serrations on the dorsal spine, and other characters, which were formerly used in the primary division of the subfamily.

Most of the genera as here accepted seem to be well-defined groups of doubtlessly related species, to which genera new species may be referred with convenience and with little or no doubt. The value and correctness of the classification as here adopted has been verified in the study of several collections of Macrouroid fishes, which have not been reported on. Future study may further subdivide some of the larger genera into more compact groups, as the species vary within wide limits.

Macrourus berglax Lacépède (1800), the type-species of the genus *Macrourus*, is found to be congeneric with *Coryphaenoides rupestris* Gunner (1765). *Macrourus* (= *Macrurus*, a changed spelling), therefore becomes a synonym of *Coryphaenoides*, and the family name Macrouridae must also be discarded. The oldest and best known genus is taken as the type of the family, which should apparently stand as Coryphaenoididae.

The most remarkable of the Coryphaenoididae collected on the expedition of the *Albatross* to Japan in 1906, is *Squalogadus modificatus*, a new genus and species related to *Macrouroides inflaticeps*,¹ from the Philippine Islands, but differing chiefly in the presence of small ventral fins. On the evidence of this discovery, we do not accept *Macrouroides* as the type of a distinct family. The single dorsal fin of these two fishes is also shared by *Lyconus*,² which has the anterior dorsal rays more or less elevated. *Lyconus*³ appears to be an ally of *Bathygadus*.

The only constant character known, by which the Coryphaenoididae can be separated from the Gadidae, is the absence of a caudal fin, the dorsal and anal fins being continuous around the long, whip-like tail. A pseudocaudal is frequently formed, probably after an injury to the slender tip of the tail, but even in this case the vertical fins are confluent around the tail. The posterior position of the ventrals is not a constant character in the Coryphaenoididae. They are well in advance of the pectorals in *Squalogadus*, *Cetonurus*, and in several species of *Lionurus* (most advanced in position in *Lionurus gibber*,⁴ from the Hawaiian Islands). Regan³ has noticed the close resemblance between *Macruronus* and the Gadidae. The Muraenolepididae have the vertical fins confluent around the tail, but differ widely from the Coryphaenoididae in the rounded caudal; the restricted gill open-

¹ Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1913, p. 139, pl. 31, fig. 3.

² Günther, *Challenger Reports*, vol. 23, Deep-Sea Fishes, 1887, p. 158.

³ Regan, Ann. Mag. Nat. Hist., ser. 7, vol. 11, 1903, pp. 464 to 466.

⁴ Gilbert and Cramer, Proc. U. S. Nat. Mus., vol. 19, 1897, p. 426, pl. 44, fig. 2; Gilbert, Bull. U. S. Fish Com., 1903 (1905), pt. 2, p. 668.

ings; the small elongate scales at right angle, as in *Anguilla* and *Otophidium*; and in the increased number of pectoral actinosts. We do not accept Regan's reference¹ of *Melanonus*² to this family, since *Melanonus* has a separate caudal fin.

KEY TO THE SUBFAMILIES AND GENERA.

A¹. No fold of membrane attached to first gill-arch and restricting the gill-slit; gill-rakers not tubercular; pseudobranchiae present or absent; second dorsal ray not modified and spinelike; anterior portion of dorsal better developed than posterior portion of anal.

B¹. Two separate dorsal fins.

C¹. Vomerine teeth present; anterior portion of anal more or less elevated; teeth in one or two series in jaws; "neural arch of first vertebra suturally united to exoccipitals and its neural spine directly and firmly attached to the supraoccipital crest."-----MACRURONINAE.

a¹. Anterior portion of anal forming a pronounced lobe; anus anterior, nearly between ventrals; ventral area with striae, consisting of alternating and parallel streaks of dark and silvery pigment.

Steindachneria.

a². Anterior portion of anal not forming a pronounced lobe; anus posterior, immediately before anal fin; no ventral striae; pectoral actinosts 4⁴-----*Macruronus*.

C². No vomerine teeth; anal low throughout its length; teeth in bands in jaws; "the first vertebra articulating normally with the skull, its neural spine not directly attached to the occipital crest."³

BATHYGADINAE.

b¹. Mouth terminal; no scaleless fossa at side of nape; scales all cycloid, those along bases of dorsal and anal not modified; gill-rakers long and slender; second dorsal much higher than anal; pectoral actinosts 3.⁴

c¹. Barbel vary short or absent; teeth of moderate size---*Bathygadus*.

c². Barbel very long; teeth exceedingly minute-----*Gadomus*.

b². Mouth entirely inferior, the snout being greatly produced; a scaleless fossa on each side of nape; scales rough, especially in a strongly modified series along anterior portions of dorsal and anal bases; gill-rakers styliform; second dorsal not much higher than anal; pectoral actinosts 6⁴-----*Trachyrhynchus*.

B². Dorsal fin single, the anterior rays more or less elevated; head not massive; a few enlarged canines in jaws; teeth present on vomer; mouth terminal; scales cycloid; ventral fins not reduced; no barbel.

LYCONINAE.

Lyconus.

¹ Regan, Ann. Mag. Nat. Hist., ser. 7, vol. 11, 1903, pp. 464 to 466.

² *Melanonus gracilis* Günther, Ann. Mag. Nat. Hist., 1878, vol. 2, p. 19; *Challenger Reports*, vol. 22, Deep-Sea Fishes, 1887, p. 83, pl. 14, fig. B; Brauer, Die Tiefsee Fische, 1906, p. 277, pl. 12, fig. 5; Zugmayer, Rés. Camp. Sci. Monaco, fasc. 35, p. 120, pl. 6, fig. 1.

Melanonosoma acuticaudatum Gilchrist, Mar. Inv. S. Africa, vol. 2, 1902, p. 106 (an ally of *Melanonus gracilis*).

³ Regan, Ann. Mag. Nat. Hist., ser. 7, vol. 11, 1903, p. 465.

⁴ Regan (Ann. Mag. Nat. Hist., vol. 11, 1903, p. 462) gives the number of actinosts in this family as follows: *Bathygadus* and *Gadomus*, 3; *Macruronus*, 4; *Hymenocephalus*, 5; *Macrurus*, *Coryphaenoides*, and *Trachyrhynchus*, 6. We have counted 3 in *Bathygadus antrodes*; 4 in *Hymenocephalus torvus*, *H. striatissimus*, *Lionurus latirostratus*, and *L. proximus*, and 5 in *Coryphaenoides acrolepis* and *C. marginatus*.

- B*². Dorsal fin single, low throughout its extent; head exceedingly massive and soft; teeth in bands, on jaws only; scales spinigerous; mouth entirely inferior, below or behind eye; ventral fins greatly reduced or absent ----- *MACROUROIDINAE*.
- d*¹. Ventrals small, with 5 rays; pectoral with 25 rays; gill-rakers long; gill-membranes free from the isthmus; mouth behind eye; pseudobranchial filaments present ----- *Squalogadus*.
- d*². Ventrals absent; pectoral with 16 rays; gill-rakers short; gill-membranes joined to the isthmus; mouth below eye; pseudobranchial filaments absent ----- *Macrouroides*.
- A*³. A fold of membrane attached to first gill-arch, and restricting the first gill-slit; gill-rakers tubercular; no pseudobranchiae; second dorsal ray a modified spine, often with serrations on its anterior edge; anal better developed than second dorsal; teeth in jaws only.
- D*¹. Pectoral fin not pedunculated; pectoral actinosts 4 to 6.
- CORYPHAENOIDINAE*.
- e*¹. Six branchiostegal rays; anus immediately before anal fin (except in *Coryphaenoides hyostomus*, *Abysicola macrochir*, and some aberrant species of *Coelorhynchus*); anus not preceded by a naked area or fossa, except in *Abysicola* and certain species of *Coelorhynchus*; no striated regions on under side of trunk; scales usually of moderate size (enlarged in some species of *Coelorhynchus*); gill-rakers fewer than 15 on lower limb of second arch; gill-membranes broadly united, scarcely extended forward ventrally; species large and widely distributed, usually reaching a length of over two feet.
- f*¹. No barbel; anal not much higher than second dorsal; dorsal spine slender and smooth; premaxillary teeth unequal, in a narrow band separated by an interspace from the marginal series of small teeth, one of which is enlarged to form a large anterolateral canine; physiognomy as in *Bathygadus*, the mouth terminal ----- *Cynomacurus*.
- f*². Barbel always present; anal much higher than dorsal; no specialized pair of anterolateral canines; mouth never completely terminal.
- g*¹. Snout little produced; no strongly marked ridges on head, the suborbital ridge not extending to preopercle; dorsal spine trenchant on anterior edge and serrate (serrations rarely obsolescent).
- h*¹. Outer series of premaxillary teeth enlarged, one or two inner series; inner mandibular series enlarged, one outer series in some species; physiognomy usually approaching that of *Bathygadus* ----- *Nematonurus*.
- h*². Teeth in a villiform or cardiform band in upper jaw, varying from a single series to a band in the lower jaw ----- *Coryphaenoides*.
- g*². Snout usually greatly produced; head with prominent ridges, armed with modified scales, the suborbital ridge extending to preopercle; dorsal spine smooth and rounded anteriorly.
- i*¹. Teeth in bands in jaws; ridges of head strong; the side of head strongly angulated at the suborbital ridge ----- *Coelorhynchus*.

- i³. Teeth biserial in jaws; ridges of head less prominent; the side of head little angulated at the suborbital ridge ----- *Abyssicola*.
- e³. Seven branchiostegal rays; anus immediately before anal; midventral line with two lens-shaped bodies connected by a black ridge on wall of abdominal cavity, one immediately before anus, the other in advance of ventrals; ventral regions marked with striae, consisting of fine parallel lines of alternating dark and silvery pigment; scales large and thin, smooth or weakly spined; more than 15 gill-rakers on lower limb of second arch; gill-membranes narrowly united, the gill-opening extended forward ventrally; species fragile, less than a foot in length, and confined to tropical waters.
- Hymenocephalus*.
- e³. Seven branchiostegal rays; anus remote from anal fin; anus preceded by a naked area; no ventral striae; scales small; gill-rakers fewer than 15 on lower limb of second arch; gill-membranes broadly united, little extended forward ventrally; species confined to tropical or subtropical waters.
- f⁴. Premaxillary teeth biserial, mandibular teeth uniserial; pyloric caeca very numerous and profusely branched; dorsal spine smooth and rounded ----- *Malacocephalus*.
- f². Premaxillary teeth in a band, mandibular teeth varying from an irregular series to a band; pyloric caeca in moderate numbers, fewer than 100, not branched.
- k¹. Bones of head firm, the sensory canals moderately developed, the skull without high crests; form of body usually slender, the head not very massive, the snout not exceedingly broad and high, the tail not rapidly constricted from trunk; gill-cavity not restricted in size; margin of preopercle not adnate; barbel moderate or long; lateral line pores, as in all genera except *Squalogadus* and *Cetonurus*, along a well marked, continuous, superficial groove (sometimes slightly interrupted); scales along dorsal base not enlarged (except in *Trachonurus*).
- l¹. Scales everywhere well imbricate, their spinules directed backward (except in *Lionurus parvipes* and *L. cetonuropsis*); dorsal spine trenchant on anterior edge, and serrate (serrations obsolescent in some forms); small species, less than 15 inches long.
- m¹. Snout moderately produced ----- *Lionurus*.
- m². Snout greatly produced, much as in *Coelorrhynchus* ----- *Mataeocephalus*.
- l². Scales not imbricate, their spinules erect; dorsal spine slender, smooth and rounded; snout moderately produced ----- *Trachonurus*.

*k*². Bones of head soft, the sensory canals greatly developed, the skull with high crests; form very robust, the head massive, the snout broad and high, the tail rapidly constricted from trunk; gill-cavity restricted in size; margin of preopercle adnate to interopercle; barbel very short; lateral line consisting of widely spaced pores, without a well-marked superficial groove; an accessory dorsal branch of lateral line pores; scales enlarged and modified in a series along base of dorsal; spinules of scales erect; dorsal spine serrate.....*Cetomurus*.

D. Pectoral fin strikingly pedunculated; first dorsal and ventral fins produced.....ATELEBRACHINAE.

Atelebrachium.

LIST OF THE KNOWN SPECIES OF MACROUROID FISHES.

The Japanese species here reported on are marked in the following list by an asterisk (*). Other species examined by the writers are marked with a dagger (†). Nominal species are excluded.

Family CORYPHAENOIDIDAE Collett.

Subfamily MACRURONINAE Regan.

Genus *Steindachneria* Goode and Bean (*argentea*).

S. argentea Goode and Bean.†

Genus *Macruronus* Günther (*novae-zealandiae*).

M. novae-zealandiae (Hector).†

M. magellanicus Lönnberg.

Subfamily BATHYGADINAE Jordan and Evermann.

Genus *Bathygadus* Günther (*cottoides*).

B. cottoides Günther.

B. melanobranchus Vaillant.†

B. favosus Goode and Bean.†

B. antrodes (Jordan and Gilbert).*

B. bowersi (Gilbert).†

B. micronema (Gilbert).†

B. furvescens Alcock.†

B. macrops Goode and Bean.†

B. nipponicus (Jordan and Gilbert).†

B. filamentosus (Smith and Radcliffe).†

B. sulcatus (Smith and Radcliffe).†

B. garretti, new species.*

Genus *Gadomus* Regan (*longifilis*).

G. longifilis (Goode and Bean).†

G. multifilis (Günther).†

G. melanopterus Gilbert.†

G. arcuatus (Goode and Bean).†

G. dispar Vaillant.

G. colletti Jordan and Gilbert.*

Genus *Trachyrhynchus* Giorna (no type mentioned).

T. trachyrhynchus (Giorna).

T. longirostris (Günther).

T. murrayi Günther.

T. helolepis Gilbert.†

Subfamily LYCONINAE, new name.

(=*Lyconidae* Günther, *Challenger Reports*, vol. 23, Deep-Sea Fishes, 1887, p. 158.)

Genus *Lyconus* Günther (*pinnatus*).

L. pinnatus Günther.

L. brachycolus Holt and Byrne.

Subfamily MACROUROIDINAE, new name.

(=*Macrouroididae* Smith and Radcliffe).

Genus *Squalogadus*, new (*modificatus*).

S. modificatus, new species.*

Genus *Macrouroides* Smith and Radcliffe (*inflaticeps*).

M. inflaticeps Smith and Radcliffe.

Subfamily CORYPHAENOIDINAE, new name.

Genus *Cynomacrurus* Dollo (*piriei*).

C. piriei Dollo.

Genus *Nematonurus* Günther (*armatus*).¹

N. longifilis (Günther).*

N. clarki (Jordan and Gilbert).†

N. firmisquamis (Gill and Townsend).†

N. cyclolepis Gilbert.†

N. pectoralis (Gilbert).*

N. lecointei (Dollo).

N. suborbitalis (Gill and Townsend).†

N. bulbiceps (Garman).†

N. bona-nox (Jordan and Thompson).*¹

N. abyssorum Gilbert.†

N. gigas (Vaillant). (?=*N. armatus*).

N. goodei (Günther).†

N. affinis (Günther).

N. armatus (Hector).

Genus *Coryphaenoides* Gunner (*rupestris*).

C. rupestris Gunner.†

C. murrayi Günther.

C. fernandezianus (Günther).

C. filifer (Gilbert).†

C. liocephalus Günther).

C. leptolepis (Günther).

C. simulus (Goode and Bean).†

C. paradoxus (Smith and Radcliffe).

C. brevibarbus (Goode and Bean).†

C. mediterraneus (Giglioli).

C. carapinus Goode and Bean.†

C. awae Jordan and Gilbert.*

C. spinulosus (Gilbert and Burke).†

C. acrolepis (Bean).†

C. marginatus Steindachner and Döderlein.*

C. ferrieri (Regan).

C. whitsoni (Regan).

C. bucephalus (Garman).†

C. capito (Garman).†

C. boöps (Garman).†

¹ See footnote under *N. bona-nox* on p. 162.

- C. leucophaeus* (Garman).†
C. carminatus (Garman).†
C. anguliceps (Garman).†
C. latinus (Garman).†
C. longicirrhus (Gilbert).†
C. microps (Smith and Radcliffe).†
C. dubius (Smith and Radcliffe).†
C. aequatoris (Smith and Radcliffe).†
C. cinereus (Gilbert).*
C. liraticeps (Garman).†
C. lepturus (Gill and Townsend).†
C. altipinnis Günther.
C. nasutus Günther.*
C. serrulatus Günther.
C. ariommus Gilbert and Thompson.†
C. ingolfi (Lütken).
C. guentheri (Vaillant).
C. sublaevis (Vaillant).
C. heattii (Alcock).
C. wood-masoni (Alcock).
C. macrolophus (Alcock) (= *M. tophtotes* Alcock).
C. hoskynii (Alcock).
C. serrulus (Bean).†
C. camurus (Smith and Radcliffe).†
C. orthogrammus (Smith and Radcliffe).†
C. rudis Günther. (The largest specimen, the one figured, may be designated as the type; the other specimen, under 12 inches long, represents some species of *Lionurus*.)
C. asper Günther.
C. denticulatus (Richardson).
C. berglax (Lacépède).†
C. holotrachys (Günther).
C. carinatus Günther.
C. hyostomus (Smith and Radcliffe).†
 Genus *Coelorhynchus* Giorna (*coelorhynchus*).
 Subgenus *Coelorhynchus*.
 C. scaphopsis (Gilbert).†
 C. patagoniae Gilbert and Thompson.†
 C. canus (Garman).†
 C. carminatus (Goode).†
 C. coelorhynchus (Risso).†
 C. caribbaeus (Goode and Bean).†
 Subgenus *Paramacrurus* Bleeker (*australis*).
 C. aspercephalus Waite.
 C. innotabilis McCulloch.
 C. australis (Richardson).
 C. notatus Smith and Radcliffe.†
 C. kishinouyei Jordan and Snyder.*
 C. fasciatus (Günther).†
 C. jordani Smith and Pope.*
 C. gladius Gilbert and Cramer.†
 Subgenus *Oxymacrurus* Bleeker (*japonicus*).

¹ See footnote under *N. bononox* on p. 162.

- C. argentatus* Smith and Radcliffe.†
- C. chilensis* Gilbert and Thompson.†
- C. anatirostris* Jordan and Gilbert.†
- C. productus*, new species.*
- C. flabellispinis* (Alcock).
- C. platorhynchus* Smith and Radcliffe.†
- C. commutabilis* Smith and Radcliffe.†
- C. japonicus* (Temminck and Schlegel).*
- C. tokiensis* (Steindachner and Döderlein).*
- C. macrorhynchus* Smith and Radcliffe.†
- C. quadricristatus* (Alcock).
- C. acutirostris* Smith and Radcliffe.†
- C. parallelus* (Günther).*
- C. kermadecus* Jordan and Gilbert.
- C. sp.* (*parallelus* Brauer, not of Günther).
- C. aratrum* Gilbert.†
- C. doryssus* Gilbert.†
- C. occa* (Goode and Bean).†
- C. talismani* (Collett). (= *C. japonicus* Vaillant, not of Temminck and Schlegel.)

Genus *Abyssicola* Goode and Bean (*macrochir*).

- A. macrochir* (Günther).*

Genus *Hymenocephalus* Giglioli (*italicus*).

- H. longibarbis* (Günther).
- H. longiceps* Smith and Radcliffe.†
- H. longipes* Smith and Radcliffe.†
- H. torvus* Smith and Radcliffe.†
- H. striatissimus* Jordan and Gilbert.*
- H. heterolepis* Alcock.†
- H. italicus* Giglioli.†
- H. cavernosus* (Goode and Bean).†
- H. antraeus* Gilbert and Cramer.†
- H. lethonemus* Jordan and Gilbert.*
- H. striatulus* Gilbert.†
- H. papyraceus* Jordan and Gilbert.†
- H. aterrimus* Gilbert.†

Genus *Malacocephalus* Günther (*laevis*).

- M. nipponensis*, new species.*
- M. laevis* (Lowe).
- M. hawaiiensis* Gilbert.†

Genus *Lionurus* Günther (*filicauda*).

- Subgenus *Nezumia* Jordan (*condylura*).
- L. lucifer* (Smith and Radcliffe).†
- L. nigromaculatus* (Smith and Radcliffe).†
- L. atherodon* (Gilbert and Cramer).†
- L. petersoni* (Alcock) (= *Macrurus hispidus* Alcock).
- L. occidentalis* (Goode and Bean).†
- L. garmani* (Jordan and Gilbert).*
- L. ctenomelas* (Gilbert and Cramer).†
- L. misakius* (Jordan and Gilbert).*
- L. macronemus* (Smith and Radcliffe).†
- L. stelgidolepis* (Gilbert) (= *Macrurus gracillicauda* Garman).†
- L. condylura* (Jordan and Gilbert).*

- L. darus*, new species.*
- L. orbitalis* (Garman).†
- L. loricatus* (Garman).†
- L. cuspidatus* (Garman).†
- L. convergens* (Garman).†
- L. latirostratus* (Garman).†
- L. trichiurus* (Garman).†
- L. cctenes* (Gilbert and Cramer).†
- L. propinquus* (Gilbert and Cramer).†
- L. holocentrus* (Gilbert and Cramer).†
- L. gibber* (Gilbert and Cramer).†
- L. pudens* (Gilbert and Thompson).†
- L. burragei* (Gilbert).†
- L. obliquatus* (Gilbert).†
- L. hebetatus* (Gilbert).†
- L. bairdii* (Goode and Bean).†
- L. nigromaculatus* (McCulloch).
- L. aequalis* (Günther).
- L. smiliophorus* (Vaillant).
- L. sclerorhynchus* (Valenciennes).
- L. hirundo* (Collett).
- L. polylepis* (Alcock).
- L. pumiliceps* (Alcock).†
- L. investigatoris* (Alcock).
- L. brevirostris* (Alcock).
- L. semiquincunciatus* (Alcock).
- L. spinosus*, new species.*
- L. proximus* (Smith and Radcliffe).*
- L. parvipis* (Smith and Radcliffe).†
- L. cetonuropsis*, new species.*

Subgenus *Lionurus*.

- L. flicauda* (Günther).
- L. liolepis* (Gilbert).†
- L. fragilis* (Garman).†
- L. barbiger* (Garman).†
- L. microlepis* (Günther).

Genus *Mataeocephalus* Berg (*acipenserinus*).

- M. adustus* Smith and Radcliffe.†
- M. tenuicauda* (Garman).†
- M. acipenserinus* (Gilbert and Cramer).†
- M. nigrescens* Smith and Radcliffe.†
- M. microstomus* (Regan).

Genus *Trachonurus* Günther (*villosus*).

- T. villosus* (Günther).*
- T. sulcatus* (Goode and Bean).†
- T. sentipellis* Gilbert and Cramer.†
- T. asperrimus* (Vaillant).

Genus *Cetonurus* Günther (*crassiceps*).

- C. crassiceps* (Günther).
- C. globiceps* (Vaillant).†
- C. microps* Vaillant.
- C. robustus*, new species.*

ATELEBRACHINAE, new subfamily.

Genus *Ateleobranchium* Gilbert and Burke (*pterotum*).¹*A. pterotum* Gilbert and Burke.†

LIST OF DOUBTFUL FORMS.

1. Genus uncertain.

Macrurus serratus Lowe.*Macrurus macrolepidotus* Kaup." *Optonurus* " *denticulatus* (Richardson).*Macrurus labiatus* Koehler.*Macrurus caudani* Koehler.*Macrurus zaniophorus* Vaillant.*Macrurus violaceus* Vaillant.*Macrurus microps* Vaillant.Most of these species are probably referable to *Lionurus*.

2. Larval forms.

The larval forms of certain Mediterranean Macroroid fishes have been described by Italian ichthyologists under the name *Krohnins*.² These larval forms have been referred to other genera, but the identification must be regarded at present as very doubtful. Thus the type-species of *Krohnius*, *K. filamentosus*, has been placed in the synonymy of *Coelorhynchus coelorhynchus*.

3. Fossil forms.

Fossil otoliths³ have been named as species of *Macrurus* and *Hymenocephalus*, but the references must be regarded as extremely doubtful.

METHODS OF MEASUREMENTS AND COUNTS.

In the following descriptions the proportions in each species are given as obtained by measurement on the specimen; for example, the orbit is measured over the lateral curve of the head. In the tables the measurements are expressed in hundredths of the length from the tip of the snout to the center of the anus. The tail is so frequently injured, with or without the regenerated pseudocaudal, that the total length can not be used satisfactorily. These measurements were made with dividers and a proportional scale, and are valuable in discriminating between closely allied species.

The measurements were made and recorded as follows: The total length in millimeters (the fact mentioned in a footnote when a pseudocaudal is developed, and followed by a + mark when the tail is broken); length of head from tip of snout to end of membrane behind upper angle of opercle; greatest length of orbit, whether the longest diameter is horizontal or oblique; the least width of the interorbital; the least width of the entire bony suborbital region; the distance between the posterior margin of the orbit and the angle of the

¹ Possibly a larval form (see Murray and Hjort, *Depths of the Ocean*, 1912, p. 745, fig. 537).

² Cocco, Lettera al Sig. Augusto Krohn, *Pesci del Mare de Messina*, vol. 1, 1884. Emery, *Note ittologiche*: *Atti della Soc. ital. di Sci. nat. Milano*, 1878; *Contribuzioni all' Ittiologia*, II, *Mittheil. a. d. Zool. Stat. zu Neapel*, 1879, vol. 4, p. 588; *Contrib.*, vol. 9, *Mittheil.* 3, 1883, p. 417 to 418.

³ Schubert, *Jahrb. geol. Reichs.*, vol. 55, p. 615.

Koken, *Z. geol. Ges.*, vol. 43, p. 77 (and other papers).

preopercular margin; the preocular length of the snout; the greatest width of the snout opposite the anterior orbital margins; the length of maxillary from tip of premaxillary; the length of the free portion of the barbel; the greatest depth of the body, usually from the origin of the first dorsal to the midline of the abdomen; the width of the body over the bases of the pectoral fins; the distance between the center of the anus and the origin of the anal; the distance between the center of the anus and the base of the outer ventral ray; the distance from the base of the outer ventral ray to the isthmus, at the anterior end of the scaly area; and the length of the pectoral from the base of the second ray.

The number of scales is counted in a series from the origin of the second dorsal to the lateral line, including the small series along the base of the fin, and also in a series from the lateral line to the origin of the anal, the lateral line scale being excluded in each case. Both the rudimentary and the developed spine of the first dorsal are described, but in the tables only the soft rays are enumerated, including the last ones, which are always short and unbranched; the uppermost pectoral ray, which is counted, is short, unbranched, and inarticulate—stiff and sharp in the Coryphaenoidinae, but flexible in the Bathygadinae; all the serrations of the dorsal spine are counted, including the rudimentary ones. The gill-rakers are counted on the lower limb of the outer arch, unless otherwise indicated; when one is at the angle of the arch, it is counted among those on the lower limb.

When two counts are given of the rays of the paired fins, the first one was made on the left side.

SYSTEMATIC DESCRIPTIONS.

Genus **BATHYGADUS** Günther.

Bathygadus GÜNTHER, *Challenger Reports*, vol. 22, Deep-Sea Fishes, 1887, p. 154 (*cottoides*).

Melanobranchus REGAN, *Ann. Mag. Nat. Hist.*, ser. 7, vol. 11, 1903, p. 459 (*melanobranchus*).

Regania JORDAN, *Bull. U. S. Fish Comm.*, 1902 (1904), p. 604 (*nipponica*).

Excluding the anomalous *Trachyrhynchus*, we are unable to separate more than two genera of the *Bathygadinae*: *Bathygadus*, which has the teeth comparatively coarse, and the barbel absent or rudimentary,¹ and *Gadomus*, which has the teeth very minute, and the barbel very long. We do not accept the genus *Melanobranchus*, which was described as differing from *Bathygadus* in the presence of four gills, and a slit behind the last arch. Mr. C. Tate Regan, of the British Museum, having kindly examined the type of *B. cottoides*, writes us that it agrees with *B. melanobranchus* in the character of the gills, contrary to Günther's description, in which it is stated that *B. cot-*

¹ In *B. melanopterus*, *macrops*, *sulcatus*, and *garretti*.

toides has but $3\frac{1}{2}$ gills, with no slit behind the last arch. We also fail to recognize *Regania*, as the firmness of the head varies widely among the species of both *Bathygadus* and *Gadomus*.

A reexamination of the coracoid foramen in a number of species of *Bathygadus* and *Gadomus* indicates that its position is not of generic value in this group, since it is apparently variable in groups of evidently related species. The foramen is within the hypercoracoid in *Gadomus melanopterus*, but between the hypercoracoid and the hypocoracoid in our specimens of *G. multifilis* and *G. colletti*. Moreover, the foramen lies between the two bones in *B. macrops* and *B. garretti*, but perforates the hypercoracoid in *B. sulcatus* and *B. filamentosus*. These four species closely resemble one another, and are probably closely related. Finally, an intermediate condition is evident in *B. antrodes*, in which species the walls of the foramen lie almost entirely within the hypercoracoid, but remain in contact with the suture. The position of the coracoid foramen has been used as a generic character by Regan,¹ Jordan,² Gilbert,³ and Radcliffe.⁴

Branchiostegals 7; first pectoral ray flexible, unbranched, and articulate; no scaleless pits, grooves, nor ventral striae present in any species. A very peculiar type of squamation is found in the species of *Bathygadus*. The large sensory canal just anterior to the origin of the lateral line is covered by a group of large imbricating scales, several times the ordinary size, marked with radii and concentric striae, and overlapping normal scales posteriorly. These large scales are completely covered by normal scales. The same type of squamation is developed in *Hymenocephalus*, in which the sensory canals are also enlarged. In both the Bathygadinae and the Coryphaenoidinae, then, these scales are best developed in genera in which the sensory canals are excessively developed.

1. BATHYGADUS ANTRODES (Jordan and Gilbert).

Melanobranchus antrodes JORDAN and GILBERT, Bull. U. S. Fish. Comm., 1902 (1904), p. 606, pl. 4, fig. 1.

Sixteen specimens, from 104 to 483 mm. in total length, 37 to 163 mm. to anus, were dredged off the east coast of central Hondo.

<i>Albatross station.</i>	General locality.	Depth of fathoms.	Number of specimens.
4969.....	Off Shio Misaki.....	587	5
4971.....	do.....	649	2
4972.....	do.....	440	1
4973.....	do.....	600	3
4975.....	do.....	545-712	1
5080.....	Off Omi Saki.....	505	1
5082.....	do.....	662	1
5083.....	do.....	624	1
5085.....	Sagami Bay.....	622	1

¹ Ann. Mag. Nat. Hist., ser. 7, vol. 11, 1903, p. 459.

² Bull. U. S. Fish. Comm., 1902 (1904), p. 602.

³ Idem., 1903 (1905), pt. 2, pp. 359 to 661.

⁴ Proc. U. S. Nat. Mus., vol. 43, 1913, p. 105.

This excellent material makes it possible to give a number of additions and corrections to the original description.

The premaxillary band of teeth is of nearly uniform width, narrowing on its posterior third. A modified inner portion of much smaller teeth is constantly present. It is sharply defined from the outer portion, being separated from it by a longitudinal groove, and is widest somewhat behind the middle of the maxillary, narrowing in both directions, and extending forward to the anterior third of the outer band. In the young, about 130 mm. long, this modified inner portion of the band is nearly as wide as the outer portion, and is separated from it by a groove more distinct than that of the adult. The mandibular band is very narrow, comparatively little curved in cross section, and consisting of about 3 or 4 irregular rows of teeth similar to those of the outer premaxillary band. No trace of a barbel can be found on any of the specimens. The pseudobranchial filaments are always present, and are located at the edge of a deep conic pit.

Inner edge of shoulder girdle naked.

Pyloric caeca in five specimens: 10, 15, 16, 16, 18.

Anus located immediately before the anal fin.

The slender fin filaments were evidently broken in the type of the species, none of the fins being described as longer than the head. In our specimens the dorsal, pectoral, and ventral filamentary rays, when entire, are all longer than the head. In a paratype of *B. bowersi*,¹ from the Hawaiian Islands, the pectoral filamentary ray appears entire, and is much shorter than the head. Further comparison with *B. bowersi* is made in the table of measurements.

Table of measurements in hundredths of length to anus.

Albatross station.....	4969	4971	5082	4975	4969	5080	4969	5083	24151
Total length, mm.....	426	483	368+	353+	335	325+	335+	297+	265
Length to anus, mm.....	163	154	127	126	106	107	109	96	86
Length, head.....	55	56.5	55.5	56.5	60	58	59	60	62.5
Length, orbit.....	11	11	13	12.5	14	13	12.5	13	14
Width, interorbital.....	17.5	18	20	20	21	21	21	23	24.5
Width, suborbital.....	10	10.5	9.5	12	12	11	11	12	9
Orbit to preopercle.....	26.5	25.5	27	29	29	28.5	27.5	27.5	32
Length, snout.....	17	16.5	17	17	18	17.5	18	17.5	18
Length, maxillary.....	30	31.5	32	32.5	35	34	33	32	36
Depth, body.....	45	40	47	43	49	48	44	49	45
Width, body.....	23	20.5	23	21	24	23	24	23	21
Anus to ventral.....			42						40
Ventral to isthmus.....			29						306
Height, second dorsal spine.....			60		70	66			
Length, dorsal base.....	17	15.5	16	18	17	17	16	15	20
Height, second dorsal.....		14+		16			13		
Height, anal.....							7.5		
Length, first P. ray.....	11	11	10.5	12	8	110.5	10.5	10	12.5
Length, second P. ray.....		58.5	63	58	65				32
Length, outer ventral ray.....			72	65+	65+	57+		81	32
Length, second ventral ray.....				22	20	17			
Soft rays, first dorsal.....	9	7	8	8	8	8	8	8	
Ventral rays.....	9	9	9	9	9	9	9	9	
Pectoral rays.....	15	14	16	16	14	14	14	14	
Gill-rakers, lower limb.....	4+21	5+21	5+21	6+23	5+24	6+22	6+21	6+20	
Length, gill-rakers.....	7.5	6	7	8	8.5	8.5	8	8	

¹ Gilbert. Bull. U. S. Fish Comm., 1903 (1905), pt. 2, p. 659, fig. 257.

² Paratype of *B. bowersi*.

³ A pseudocaudal developed.

2. *BATHYGADUS GARRETTI*, new species.

Plate 8, fig. 1.

Bathygadus garretti differs from the type description of the related species, *B. nipponicus*,¹ in the presence of a small barbel; in the more numerous gill-rakers, 18 or 19 instead of 16, on the lower limb of the outer arch; in the narrower interorbital, 4 instead of 3.43 in head; in the smaller orbit, 4.7 instead of 4.2; in the whitish color of the second dorsal fin anteriorly; in the fewer dorsal rays, II, 9 instead of II, 10; and in the more numerous ventral rays, 10 or 11 instead of 9. It differs widely from the remaining species of *Bathygadus* with comparatively firm heads, from *B. macrops*,² in the much smaller eye, coarser teeth, and darker color; from *B. filamentosus*,³ in the much larger eye, narrower interorbital, firmer head, absence of long fin filaments, lighter color, and the presence of a barbel; and from *B. sulcatus*⁴ (which it closely resembles) in the wider interorbital, lighter color, and lower curve in the lateral line.

Type-specimen.—Cat. No. 76863, U.S.N.M.; length 513 mm., 176 mm. to anus; from *Albatross* station 5059, at a depth of 197–297 fathom, in Suruga Gulf.

Dorsal, II, 9; ventral, 10; pectoral, 17.

Dorsal and ventral contours about equally curved; snout, near axis of body, angulated at the upper end of the premaxillary spine; head and trunk with subvertical sides; the width of the body over the pectoral bases about equal to the postorbital length of the head, and about three-fourths the vertical depth of the body; width of the tail twice the length of the head behind tip of snout, $2\frac{1}{4}$ in the depth at that vertical.

Head comparatively firm, about as in *Gadomus multifilis*, its length 4.9 in the total length (the tail entire). Orbit 4.7 in head, 1.2 in the bony interorbital width, which is contained 4 times in the head; length of snout 3.5; least width of suborbital 1.9 in orbit; the thin suborbital ridge little oblique, and not prominent. Opercle with two weak, divergent ridges, the upper one ending in a weak flat spine; margin of interopercle produced backward at its upper angle in the form of a rounded lobe, visible behind the margin of the preopercle, which forms a semicircular curve. Mouth terminal, little oblique; maxillary 1.9 in head, extending past vertical from

¹ Jordan and Gilbert, Bull. U. S. Fish Comm., 1902 (1904), p. 605, figure.

² Goode and Bean, Proc. U. S. Nat. Mus., vol. 8, 1885, p. 598; Günther, *Challenger* Reports, vol. 22, Deep-Sea Fishes, 1887, p. 156; Goode and Bean, *Oceanic Ichthyology*, 1895, p. 423; Jordan and Evermann, *Fishes of North and Middle America*, vol. 3, 1898, p. 2566.

³ Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 107.

⁴ *Idem.*, p. 108.

posterior margin of orbit; premaxillary teeth in a band consisting of an outer portion with moderate teeth, not closely set, including the entire band anteriorly, but narrowing posteriorly; and an inner portion of specialized teeth, much finer and more closely set than those of the outer portion, and including the entire band posteriorly, but disappearing at the end of the anterior third of the band; the two portions separated by a groove, which is less distinct than that found in *B. antrodes*; the change in size of the teeth of the two portions also less abrupt than in *B. antrodes*, an intermediate portion being indicated, but poorly defined; mandibular band much narrower, with a small symphyseal knob; barbel minute and slender; branchiostegals 7; gill-openings extending forward to below pupil; 19 smooth gill-rakers on the lower limb of the outer arch, the longest half the interorbital width; pseudobranchiae rudimentary, covered with skin, located at the edge of a deep conic pit. Coracoid foramen on the suture between the hypercoracoid and the hypocoracoid.¹ Fifty pyloric caeca (in the paratype), the longest 2.3 in head.

Lateral line extending nearly parallel to the dorsal outline of the body for a distance greater than the postorbital length of the head, thence obliquely downward to a point behind the origin of the anal, and then straight along the tail, below the middle of its depth.

First dorsal spine rudimentary, its distance from the end of the occipital spine 2.4 in the distance from the end of the occipital spine to the tip of the snout (2.6 times in the paratype; 2.25 times in the type of *B. nipponicus*); the second spine slender, round, and smooth, with a short slender filament, its length 2.4 in head; interdorsal space very short; second dorsal much better developed than the anal, high throughout its extent; origin of anal under twelfth ray of second dorsal, its distance from anus 2 in orbit (2.5 in paratype); ventral rays broken, the outer one weak, probably not reaching past anus when entire; pectoral without a filament, its length 1.7 in head (1.6 in paratype), the first ray short, flexible, unbranched and inarticulate, the second ray also unbranched. Ventral inserted slightly more anteriorly than the base of the pectoral or the origin of the dorsal.

Color in alcohol light grayish-brown, the breast and belly not darker; branchiostegal membranes light, becoming dusky opposite the opercle; buccal, branchial, and peritoneal cavities blackish, except for a narrow whitish margin on the inner side of the branchiostegal membrane. First dorsal, pectorals and ventrals dusky; pectorals and ventrals slightly overlaid with a bluish-gray color; second dorsal and anal whitish anteriorly, shading into bluish-black posteriorly.

¹ Hypercoracoid said to be perforate in *B. nipponicus*.

The firmer texture and lighter color of this species is correlated with the fact that it occurs in warmer, shallower water than *B. antrodes*.

One paratype from the type station. Only the two specimens known; they agree in all essential respects, but differ in a few proportions, as indicated in the following table:

Table of measurements in hundredths of length to anus.

	Type.	Paratype.
<i>Albatross</i> station.....	5059	5059
Total length, mm.....	513	1 487
Length to anus, mm.....	176	1163
Length, head.....	59.7	57
Length, orbit.....	13.5	13
Width, interorbital.....	15.5	14.5
Width, suborbital.....	7	7.5
Orbit to preopercle.....	26.5	26.5
Length, snout.....	17	15.5
Length, maxillary.....	32	29
Length, barbel.....	1	1
Depth, body.....	40.5	38.5
Anus to anal.....	7	5
Anus to ventral.....	41.5	43
Ventral to isthmus.....	33	33.5
Height, second dorsal spine.....	26	25
Length, first dorsal base.....	17	16.5
Height, second dorsal.....	16	16
Height, anal.....		11
Length, first pectoral ray.....	9.5	10.5
Length, second pectoral ray.....	34	36
Length, third pectoral ray.....	37	
Length, outer ventral ray.....	$\frac{3}{2}$	31.5+
Length, second ventral ray.....		22.3
Scales, above lateral line.....	7	7
Soft rays, first dorsal.....	9	9
Ventral rays.....	10	10-11
Pectoral rays.....	17	18
Gill-rakers, lower limb, first arch.....	4+19	5+18
Length, gill-rakers.....	7	7.5

¹ A small pseudocaudal developed.

This species is named for the late Lieut. Commander L. M. Garrett, U. S. N., who was in command of the *Albatross* during the expedition in the Northwest Pacific and contributed largely to the success of that expedition. He was lost overboard during a storm on the return voyage from Japan.

3. GADOMUS, species.

One specimen, 106 mm. long (tip of tail broken), from *Albatross* station 4973, in 600 fathoms, off the east coast of Hondo.

This species is readily separable from *G. colletti*. The head is wider, and the sensory canals larger, the structure of the head approaching the type found in *Bathygadus cottoïdes*, *B. antrodes*, *B. bowersi*, and related species; interorbital wider, as wide as the eye (about two-thirds the eye in *G. colletti*); color darker, the branchial cavity without the diagnostic light margin on the branchiostegal

membranes; the anus less remote from the origin of the anal. Correlated with these differences is the difference in bathymetric distribution of the two species, as this form inhabits much deeper water than *G. colletti*.

The single young specimen obtained differs from our larger Philippine specimens of *B. multifilis*¹ chiefly in the longer gill-rakers, which are nearly as long as the interorbital width; and in having fewer pyloric caeca, 16 instead of 35 to 52.

First dorsal, II, 9; ventral, 8; pectoral, 16; gill-rakers 6+27, including the most anterior gill-raker (which is tubercular).

Measurements in hundredths of length to anus (35 mm.): Length of head, 62; length of orbit, 16; least width of interorbital, 14; least width of suborbital, 8; distance between orbit and preopercle, 28; length of snout, 19; distance from center of anus to base of outer ventral ray, 38; distance from base of outer ventral ray to isthmus, 27; length of first dorsal base, 19; length of second pectoral ray, 107 (the second dorsal spine and outer ventral ray also thickened, and evidently produced, but broken in the specimen at hand); length of longest gill-rakers, 13.

4. GADOMUS COLLETTI Jordan and Gilbert.

Gadomus colletti JORDAN and GILBERT, Bull. U. S. Fish Comm., 1902 (1904), p. 603, text fig.

<i>Albatross station.</i>	General locality.	Depth in fathoms.	Number of specimens.	Length, mm.
5062.....	Suruga Gulf.....	250	1	302
5065.....	.....do.....	211-235	1	190
5067.....	.....do.....	293	2	68-76

In our specimens the coracoid foramen is in the suture between the hypercoracoid and the hypocoracoid, contrary to the original description, in which the hypercoracoid is said to be perforate. The lateral line is angulated anteriorly as in the other species of the genus, not "rising anteriorly by a gently concave curve." On the tail, the lateral line is below the median line of the body, abruptly rising anteriorly above the anus, in the direction of the end of the first dorsal, for a distance equal to the length of the snout, thence forward to the nape, along a line which is slightly curved downward.

¹ *Bathygadus multifilis* Günther, *Challenger Reports*, vol. 22, Deep-Sea Fishes, 1887, p. 155, pl. 42, fig. B.

Further differences between our specimens and the type, and between specimens of different size, are tabulated below.

	Type.	Station 5062.	Station 5065.
Total length, mm.....	332	302	190
Depth of body in total length.....	7.33	6.5	6.5
Length of head in total length.....	5.4	5.3	5.4
Snout in head.....	3.57	3.8	3.9
Vertical width of the suborbital below middle of orbit.....	5.6	6.7	7.4
Interorbital width.....	6	5.9	5.6
Maxillary.....	2	1.9	1.9
Barbel (fraction of head).....	0.66	0.8	0.9
Dorsal spine in total length.....	3.66	-----	4.75
Filamentous pectoral ray.....	3	3	4
Outer ventral ray.....	5.5	5.8	5.3
Gill-rakers.....	4 or 5+19	5+22	6+21
Pectoral rays.....	21	20	18
Dorsal soft rays.....	10	10	10
Ventral rays.....	9	8	8

Ninety-five pyloric caeca were counted in the specimen 190 mm. long.

First dorsal, pectoral, and ventral fins dark, overlaid with bluish-gray pigment; the pectoral and ventral with elongate dark spots.

In the young specimens, 68 and 76 mm. long, the snout is blunter than in the adult; the first dorsal spine better developed, sharp instead of concealed; the pectoral and dorsal filamentous rays shorter, and the outer ventral ray longer. These differences are indicated in the table of proportional measurements. The pseudobranchial filaments are conspicuous in the young, small in the specimen 190 mm. long, and absent in the specimen 302 mm. long, and in the type, 332 mm. long.

Table of measurements in hundredths of length to anus.

Albatross station.....	5062	5065	5067
Total length, mm.....	302	190	68
Length to anus, mm.....	99.5	60	22.5
Length, head.....	56	60	61
Length, orbit.....	14.3	17	22
Width, interorbital.....	9	10.5	13
Width, suborbital.....	7	6	-----
Orbit to preopercle.....	25	26	-----
Length, snout.....	15	16	14
Length, maxillary.....	29.6	32	37
Length, barbel.....	47	56	57
Depth, body.....	45	48.5	-----
Width, body.....	26.5	27	-----
Anus to anal.....	11.7	11.5	10
Anus to ventral.....	38	37	36
Ventral to isthmus.....	37	39	-----
Height, second dorsal spine.....	91	71	41
Height, third dorsal ray.....	31	36	-----
Length, first dorsal base.....	18	19	20
Height, second dorsal.....	20	23	21
Height, anal.....	8	11	-----
Length, first pectoral ray.....	10	11	-----
Length, second pectoral ray.....	100	84	43
Length, third pectoral ray.....	33	36	-----
Length, outer ventral ray.....	41	55	72
Length, second ventral ray.....	31.6	36	33
Scales, above lateral line.....	9	9	-----
Soft rays, first dorsal.....	10	10	10
Ventral rays.....	8	8	8
Pectoral rays.....	20	18	-----
Gill-rakers.....	5+22	6+21	-----
Length, gill-rakers.....	5.5	8	-----

SQUALOGADUS, new genus.

This remarkable genus is an ally of *Macrouroides* Smith and Radcliffe,¹ and together with it forms the subfamily Macrouroidinae (=Macrouroididae Smith and Radcliffe), a group which resembles the Bathygadinae closely in the following characters: The free gill arches, the first not being united to the wall of the pharyngeal cavity by a membrane; the slender, numerous gill-rakers; the pseudobranchial filaments, located beside a conic pit; the forward and ventral extension of the gill openings; the dorsal better developed than the anal; the second dorsal ray not a modified spine; and the seven branchiostegal rays correlated with the position of the anus immediately before the anal fin. The Macrouroidinae resemble the Coryphaenoidinae and differ from the Bathygadinae in the rough scales and the spinous uppermost pectoral ray. The many peculiar characters of the Macrouroidinae are listed in the Key to the Subfamilies and Genera.

Squalogadus differs from *Macrouroides* in the presence of ventral fins; in the wide pectorals, with 25 rays; in the long gill-rakers; in the presence of pseudobranchial filaments; and in the more posterior mouth, which is wholly behind the eye.

Generic description.—Head extremely massive, ellipsoidal, and covered with a lax skin, and everywhere rounded in outline, without any prominent ridges; trunk short, strongly compressed; a single long dorsal of low rays, confluent around the leptocercal tail with the still lower anal; ventrals small, with only five rays, inserted in advance of pectorals; eye very small; mouth inferior, wholly behind orbit; teeth small, in bands, on jaws only; four gills on short arches, the first free, without a fold of membrane, a slit behind the last gill; gill-rakers long and slender; short pseudobranchiae; gill membranes free from the isthmus, united anteriorly; seven branchiostegals; anus immediately before anal fin; lateral line with scattered pores; scales small, covered with spinules, and very irregular on head.

(*Squalus*, a shark; *Gadus*, the cod.)

Type of the genus.—*Squalogadus modificatus*, new species.

5. SQUALOGADUS MODIFICATUS, new species.

Plate 8, fig. 2.

Type-specimen.—327 mm. in total length, 124 mm. from tip of snout to anus; from *Albatross* station 4956, in Bungo Channel, off Kyushu, at a depth of 720 fathoms; Cat. No. 76864, U.S.N.M.

Dorsal contour of trunk and tail gently descending posteriorly, ventral contour straight and nearly horizontal; body strongly com-

¹ Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 138.

pressed, the greatest width across the pectoral bases less than half the depth of the trunk, the greatest width directly above the anus little more than one-fourth the depth at the vertical through that point; tail one-fifth as wide as deep at a distance behind the anus equal to half length of head.

Head soft and greatly enlarged; the sensory canals excessively developed; contours of the head evenly curved from the snout to the dorsal fin, and from the snout to the mouth; snout exceedingly massive, rounded, and produced, its preocular length 3.4, its preoral length 2.3; tip of snout slightly below horizontal through middle of eye; nostrils nearly round, small, the anterior about two-thirds the size of the posterior, the diameter of nasal fossa 1.5 in eye, the interspace between nasal fossa and eye half the diameter of the fossa; eye nearly round, on the vertical passing through the anterior third of head, the distance from its lower margin to front of mouth equal to preocular length of snout; eye 9.5 in head, 6.25 in the highly convex interorbital space, but only 4 times in the straight distance from eye to eye; opercle placed high, very short, its length 4.5 in postorbital length of head, an even rounded portion of the interopercle visible behind the margin of the preopercle, the width of the exposed portion one-fourth length of eye; mouth U-shaped, wholly inferior, the front of premaxillaries slightly behind posterior margin of eye; maxillary as long as the snout, its tip acuminate; teeth equal, all minute, the premaxillary band widest at the end of its anterior third; mandibular band much narrower; no barbel; seven branchiostegal rays, the lower flexible; gill openings not extending forward to tip of maxillaries, the membranes narrowly joined to the isthmus, with a moderate free fold; gill-rakers 6+22 on the first arch, 0.4 as long as eye, their inner edges rough, those on succeeding arches short and compressed; gill arches short, the first one not bound down by a fold of membrane, the gill slit before it as long as the arch, and contained 4.5 times in length of head; fourth arch much shorter, with a double series of filaments, followed by a slit only two-thirds the diameter of the small eye; eight short pseudobranchial filaments, near a conic pit, which is smaller than the similar pit found in *Bathygadus*; sensory papillae of head well developed, located in small, oblong, scaleless areas, which align themselves as shown in the figure.

Scales small, in about 12 series from origin of dorsal fin to lateral line; scales of body poorly imbricate, arranged in definite series, and hispid with small suberect spinules in irregular quincunx order, of variable number, 7 to 17 on several scales counted; scales of head non-imbricate, large, without definite form or arrangement, hispid with nearly erect spinules, which are in more or less definite quincunx order, much shorter, more numerous, and more crowded than those on the body. Rami of mandibles and the gular and branchiostegal

membranes scaled; a small naked area behind pectoral, none on belly; inner edge of shoulder girdle naked. Lateral line high, consisting of widely spaced pores, parallel to the dorsal base (position on tail uncertain, owing to loss of scales).

Origin of the single low dorsal over the ventrals, anterior to the pectoral base and the end of opercle; origin of anal immediately behind anus, its distance from base of ventrals about one-fourth head; anal rays more slender and probably shorter than the dorsal rays; ventrals greatly reduced in size, with 5 rays; pectorals with 25 rays, the uppermost unbranched, inarticulate and stiff, as in the *Coryphaenoidinae*.

Color in alcohol brown, the head somewhat lighter than the body. Dorsal, anal, and pectorals blackish; ventrals light brown; nasal fossa dark; lips and lining of buccal cavity dusky bluish; branchial cavity lined with bluish black; peritoneal cavity lined with black.

A single small paratype, 124 mm. long, 40 mm. to anus, was dredged with the type. Scales with fewer spinules than in the larger type, those of the body with but one, as in the small type of *Macrouroides inflaticeps*. Pseudobranchial filaments relatively larger than in the type. Ventral rays, 5; pectoral rays, 25.

Table of measurements in hundredths of length to anus.

	Type.	Paratype.
Total length, mm	327	124
Length to anus, mm	124	40
Length, head	89	90
Length, eye	10	12
Width, interorbital	40	.....
Orbit to preopercle	53	.....
Preocular length, snout	27	26
Preoral length, snout	38.5	.....
Length, maxillary	27	25
Depth, body	53	.....
Width, body	33	30
Anus to ventral	21	.....
Ventral to isthmus	11.5	.....
Length, second ventral ray .....	.....	12

Genus NEMATONURUS Günther.¹

Nematonurus GÜNTHER, *Challenger Reports*, vol. 22, Deep-Sea Fishes, 1887, p. 124 (*armatus*); (as a subgenus of *Macrurus*).

Moseleya GOODE and BEAN, *Oceanic Ichthyology*, 1895, p. 417.—JORDAN and EVERMANN, *Fishes of North and Middle America*, vol. 3, 1898, p. 2570 (*longifilis*).

Albatrossia JORDAN and EVERMANN, *Fishes of North and Middle America*, vol. 3, 1898, p. 2573 (*pectoralis*).

Bogoslavius JORDAN and EVERMANN, *Fishes of North and Middle America*, vol. 3, 1898, p. 2574.—GILBERT and CRAMER, *Bull. U. S. Fish Comm.*, 1910 (1912), p. 93 (*clarki*).

Dolloa JORDAN, *American Naturalist*, vol. 34, 1900, p. 897 (substitute for *Moseleya*, preoccupied).

¹ *Nematonurus* must be regarded as a subgenus of *Coryphaenoides*; see note under *N. bona-nox*.

The characters which have been used to separate the nominal genera included in the synonymy vary to such an extent among the different species that we are forced to regard them as of only specific value. The strength of the serrations of the dorsal spine range, with intermediate forms, from an obsolescent condition on the one hand, as in *N. abyssorum*,¹ to a well developed condition on the other hand, as in *N. clarki*.

This genus probably forms a natural group, but the dentition is the only character by which it is constantly separated from *Coryphaenoides*. The premaxillary teeth are in a double series, instead of a band, and the mandibular teeth are never in bands, as usual in *Coryphaenoides*. The mouth is usually more nearly terminal, and the physiognomy frequently approaches that of *Bathygadus*.

6. NEMATONURUS LONGIFILIS (Günther).

Coryphaenoides longifilis GÜNTHER, Ann. Mag. Nat. Hist., vol. 20, 1877, p. 439.

Macrurus longifilis GÜNTHER, Challenger Reports, vol. 22, 1887, p. 151, pl. 35.

Moseleya longifilis GOODE AND BEAN, Oceanic Ichthyology, 1895, p. 417.

Dolloa longifilis JORDAN, American Naturalist, vol. 34, 1900, p. 897.

This species, hitherto known only from the type, collected by the *Challenger* south of Hondo, at a depth of 565 fathoms, was rediscovered by the *Albatross*, which dredged three specimens, one at station 4956 in 720 fathoms, and two at station 4980 in 507 fathoms, both off the southeast coast of Hondo.

The two specimens from station 4980 (the head 130 mm. long) are in very poor condition. They differ in several respects, chiefly in the weakly armed scales, and in the stronger pectoral, from the smaller specimen, which was dredged at station 4956 (head 96 mm. long). The larger specimens agree more closely than the smaller one with the type description, as regards the character of the scales and the pectoral. This may be due to the fact that the type was a large specimen.

Dorsal, II, 12 to 14; ventral, 8-9, 9, and 10 (in the three specimens); pectoral, 17 or 18.

The form of the body is well shown in Günther's figure, except that the artist probably rounded out the snout too much; depth of body about 1.6 in length of head; width over pectoral bases less than half depth. Head compressed, with subvertical sides, its width 2.4 to 2.7 in its depth; orbit suborbicular, the vertical diameter 0.9 the horizontal diameter, which is contained 4.6 to 5.2 times in the head; interorbital width 4 to 4.6 in head; length of snout about equal to interorbital width; width of suborbital 9 to 11 in head; the free portion of the barbel shorter than the anterior canines in the jaws; length of

¹ Gilbert, Proc. U. S. Nat. Mus., vol. 48, 1915, p. 374, pl. 21, fig. 23, from off Santa Catalina Island, California.

maxillary 2.2 to 3.33; teeth biserial in both jaws,¹ those of the outer premaxillary series sharp, conic, and strongly curved inward, enlarged anteriorly, being twice as long as and much stronger than those of the inner series; teeth of the inner mandibular series (9 to 16 on each side) much enlarged, and of nearly uniform size, about as long as those of the outer premaxillary series, but less curved; those of the outer mandibular series small, and close to the inner series; six branchiostegals; gill membranes with a wide, free fold, 2+14 short, broad, movable gill-rakers on the first arch, better developed than usual in the Coryphaenoidinae, each provided with a group of terminal spines; width of gill slit before first arch 1.2 in orbit, the slit behind the last arch 1.4 to 1.6; no pseudobranchiae.

About 12 scales in a series between the origin of the second dorsal and the lateral line; scales thin, and almost unarmed on anterior sides, with about three feeble ridges, cycloid in an area just behind pectoral; other scales of body with 5 to 7 ridges, some strongly divergent, others nearly parallel, the ridges with a few weak spines in the two larger specimens, but well armed with imbricating spines in the smallest one; scales on opercle and top of head similar to those on tail, becoming smaller on the snout, suborbital region, and the cheeks; gular and branchiostegal membranes scaleless. Lateral line with a very wide surface groove, and with widely spaced pores, about one-fourth as numerous as the scale rows on the trunk.

First dorsal spine minute and concealed; the second spine nearly as long as the head, compressed, and ending in an extremely fine filament, its anterior edge trenchant, and armed with about 32 weak, recumbent serrations, except on the proximal and distal ends; first soft ray 1.8 in head; last 2 or 3 rays simple. Pectoral long and wide in the two larger specimens, as shown in Günther's figure, the first ray a short spine; the second compressed, stiff, unbranched, and inarticulate, 1.6 in head; the third and longest ray unbranched, 1.2; pectoral in the smallest specimen longer and narrower, the second ray weaker and less strongly compressed, 1.2 in the head, the third ray 1.07 times the length of the head. Outer ventral ray strengthened and greatly produced, nearly twice the length of the head in the smallest specimen (broken near tip).

Color uniform brown, blackish on mandibles and branchiostegal membranes; fins dusky; buccal, branchial, and peritoneal cavities with a black lining, excepting the narrow interrupted whitish margin of the branchial cavity along the inner edge of the opercle.

Table of measurements in hundredths of length to anus (148 mm.), of a specimen 552 mm. long, from *Albatross* station 4956.

Length of head, 65; length of orbit, 15; least interorbital width, 15; least suborbital width, 5.8; distance between orbit and margin

¹ Described as uniserial in the lower jaw by Günther.

of preopercle, 26.7; length of snout, 16; length of maxillary, 30; length of barbel, 1.5; greatest depth of body, 42; width of body over pectoral bases, 21; distance from anus to base of outer ventral ray, 31; distance from base of outer ventral ray to isthmus, 31; height of second dorsal spine, 63; length of first dorsal base, 22; interdorsal space, 11.5; height of second dorsal, 5; height of anal, 13; length of pectoral rays—first, 8.7; second, 56; third, 77; outer ventral ray, 120+, second ventral ray, 32.

7. NEMATONURUS PECTORALIS (Gilbert).

Macrurus (Malacocephalus) pectoralis GILBERT, Proc. U. S. Nat. Mus., vol. 14, 1891, p. 563.

Macrurus (Nematonurus) magnus GILL and TOWNSEND, Proc. Biol. Soc. Washington, vol. 2, 1897, p. 234.

Albatrossia pectoralis JORDAN and EVERMANN, Fishes of North and Middle America, vol. 3, 1898, p. 2573.

<i>Albatross</i> station.	General locality.	Depth in fathoms.	Number of specimens.
5015.....	Off southeast coast, Sagkalin Island.	510	1
5029.....	Off east coast, Sagkalin Island.	440	1
5044.....	Off south coast, Hokkaido (Yezo).	309-359	1

Other specimens were dredged, but not preserved, at stations 5044 and 5045 (in 359 fathoms).

The Japanese specimens are identical with a series from Alaska.

Contrary to the type description, the ventral filament usually reaches not more than two-thirds, instead of five-sixths, the distance from the ventral base to the anus. Interdorsal space 0.4 to 0.9 the base of the first dorsal.

Pyloric caeca very long, about as long as the head, 16 in number in two specimens counted.

The scales show great variation in the same individuals as regards their spination. Those on the head and belly usually bear a nearly smooth median ridge, and frequently a divergent lateral pair; those on the back and sides usually bear three moderately divergent ridges, armed with 3 to 7 nonimbricated spinules; other scales, however, bearing about 7 (4 to 10) nearly parallel ridges, are grouped in certain very definite areas, which are located as follows in six large Alaskan specimens:

1. Left side, none. Right side, about eight rows of scales extending obliquely backward and downward from the first dorsal, across the back and sides.

2. Left side, several scales scattered at intervals between lateral line and dorsal base. Right side, a few scales above middle of anal base.

3. Left side, the scales in an area between pectoral, ventral, and gill-opening; eight rows of scales extending obliquely forward at a distance behind the pectoral equal to the length of the head; this group followed, after an interspace two-thirds length of head, by an area about eight scale rows wide, and parallel to the first; a few scales irregularly placed near these areas. Right side, no scales with more than five ridges.

4. Scales largely lost; a few with many ridges on the right side below origin of the second dorsal.

5. Left side, none. Right side, a few scales in oblique series below anterior end of second dorsal; four horizontal scale rows below middle of dorsal base.

6. Left side, the scales in an area above the lateral line, below the first dorsal base and the interdorsal space; about 30 continuous oblique scale rows on middle of sides below lateral line. Right side, scales largely lost, but a large area indicated behind pectoral.

From these descriptions it is apparent that the many-ridged scales occur in definite areas, usually on continuous scale rows, which may extend obliquely forward, obliquely backward, or horizontally; and it is further apparent that these areas are not similar on the two sides of the fish.

Ventral rays in Alaskan specimens:

Rays -----	6	7	7-8	8
Specimens -----	1	6	1	1

8. NEMATONURUS BONA-NOX (Jordan and Thompson).¹

Coryphaenoides bona-nox JORDAN and THOMPSON, Mem. Carnegie Mus., vol. 6, pt. 4, 1914, p. 305, pl. 38, fig. 1 and 1a.

Two large specimens, overlooked by Jordan and Thompson, are here reported on. One of them bears the label: "Enoshima- 22 II 05."

This species differs from the description of *Coryphaenoides altipinnis*,² a Japanese species not obtained by the *Albatross*, in the lower dorsal spine, and especially in the more strongly armed scales, which are excessively rough, usually with 7 to 9 strongly spinous ridges; but a few of the scales in certain regions, as in *N. pectoralis*, have an increased number of spines (as many as 18).

Premaxillary teeth biserial, rather blunt, and slightly arrow-shaped, the inner series the smaller, rather irregular, becoming bi-

¹ Subsequent study has shown *C. bona-nox* to be identical with *C. acrolepis* (Bean) of California and Bering Sea. The dentition of *C. acrolepis* is intermediate between that of *Coryphaenoides* and that of *Nematonurus*. *Nematonurus* should be merged with *Coryphaenoides*, but may be retained as a subgenus; it should include *C. acrolepis* (Bean) and *C. lepturus* (Gill and Townsend).

² *Coryphaenoides altipinnis* Günther, Ann. Mag. Nat. Hist., ser. 4, vol. 20, 1877, p. 439. *Macurus altipinnis* Günther, Challenger Reports, vol. 22, Deep-Sea Fishes, 1887, p. 138, pl. 39, fig. A (in explanation of plate erroneously stated to be from the Japanese Sea).

serial posteriorly. Inner series of mandibular teeth similar to the outer premaxillary series, the outer mandibular series smaller, becoming very irregular at the symphysis. Thirteen pyloric caeca, two-thirds as long as the head.

Table of measurements in hundredths of length to anus.

Locality.	?Enoshima.	Enoshima.
Total length, mm.....	1780	
Length to anus, mm.....	268	256
Length, head.....	62	62
Length, orbit.....	15	17
Width, interorbital.....	13.3	15
Width, suborbital.....	7.7	7.5
Orbit to preopercle.....	26	27
Length, snout.....	17.5	18.3
Length, maxillary.....	23.5	25.3
Length, barbel.....	9	
Depth, body.....	45	52
Width, body.....	26.7	
Anus to anal.....	4	4
Anus to ventral.....	33.7	36.5
Ventral to isthmus.....	27.5	26
Height, second dorsal spine.....	38.6	
Height, third dorsal ray.....	33.3	
Length, first dorsal base.....	16.2	16
Interdorsal space.....	8.2	9
Height, second dorsal.....	7.6	
Height, anal.....	15.5	
Length, first pectoral ray.....	4	6
Length, second pectoral ray.....	20	
Length, fourth pectoral ray.....	31	
Length, outer ventral ray.....	33.5	
Length, second ventral ray.....	18.5	
Scales, above lateral line.....	9	9
Soft rays, first dorsal.....	10	8
Ventral rays.....	8	8
Pectoral rays.....	22	
Serrations of the dorsal spine.....	17	17

Genus CORYPHAENOIDES Gunner.

Coryphaenoides GUNNER, Trondhjem Selskabs. Skrifter, vol. 3, 1765, p. 50, pl. 3, fig. 1 (*rupestris*).

Macrourus BLOCH, Naturgeschichte der ausländ. Fische, vol. 2, 1786, p. 152, pl. 177; Ichthyologie, vol. 5, 1787, p. 122, pl. 177 (*rupestris*=*bergglax*).

Macrurus BLOCH (Ed. Schneider), Systema Ichthyologie, 1801, p. 103, pl. 26.—GÜNTHER, Cat. Fishes Brit. Mus., vol. 4, 1862, p. 390 (changed spelling).

Branchiostegus RAFINESQUE, Analyse de la Nature, 1810, p. 86 (substitute for *Coryphaenoides*).

Chalinura GOODE AND BEAN, Bull. Mus. Comp. Zool., vol. 10, 1883, p. 5 (*simula*).

Chalinurus GÜNTHER, Challenger Reports, vol. 22, Deep-Sea Fishes, 1887, pp. 124, 144 (changed spelling).

?*Optonurus* GÜNTHER, Challenger Reports, vol. 22, Deep-Sea Fishes, 1887, pp. 124, 147 (*denticulatus*).

This large genus possibly contains several natural groups, but our analysis of the species has failed to define them. The physiognomy, the dentition, and the size and position of the mouth vary, with many intermediate species,² between two extremes. On the one hand are

¹ A pseudocaudal developed.

² As intermediate species may be mentioned: *C. carapinus* Goode and Bean, *C. spinulosus* (Gilbert and Burke), and *C. paradoxus* (Smith and Radcliffe).

those species formerly referred to *Chalinura*, such as *C. simula*, with a large, nearly terminal mouth, and other characters closely approaching the typical species of *Nematonurus*, including further the enlarged outer series of teeth in the upper jaw and the single series of the lower jaw. The other extreme is typified by such species as *C. nasutus* Günther, with small, inferior mouth, and villiform bands of teeth in the jaws. The form of the snout, the serration of the dorsal spine, the spination of the scales, and other characters are also widely variable, but apparently do not mark natural divisions of the genus. *C. holotrachys* Günther¹ seems to approach *Coelorrhynchus* in the form of the snout and the ridges of the head. *C. hyostomus* (Smith and Radcliffe)² differs from all other species of the genus in having the anus remote from the anal fin.

The shoulder girdle is naked in all the species of *Coryphaenoides* and *Nematonurus* examined.

9. CORYPHAENOIDES MARGINATUS Steindachner and Döderlein.

Coryphaenoides marginatus STEINDACHNER and DÖDERLEIN, Fische Japans, vol. 4, 1887, p. 284.

<i>Albatross station.</i>	General locality.	Depth in fathoms.	Number of specimens.	Length to anus, mm.
4906.....	Eastern Sea.....	369-406	1	68
4907.....	do.....	406	1	100
4908.....	do.....	434	5	51 to 83
4909.....	do.....	434	6	60 to 84
4911.....	do.....	391	1	86.5
4912.....	do.....	391	1	81
4915.....	do.....	427	2	82.5 to 98
4919.....	do.....	440	1	66.5
5054.....	Suruga Gulf.....	282	1	115
5056.....	do.....	258	1	81.5
5059.....	do.....	197-297	6	54 to 97.5
5060.....	do.....	197	7	26 to 56
5065.....	do.....	211-235	6	25.5 to 30
5067.....	do.....	293	3	39 to 106
5072.....	do.....	148-284	1	86.5

The large type of this species, 53 cm. long, was well described by Steindachner and Döderlein. Smaller specimens differ markedly in the long filament of the dorsal spine, which is more than twice the length of the head in some specimens. The spine is also short in the young of about 30 mm. The serrations of the dorsal spine are more numerous in the young, which is an unusual condition, as the reverse is usually true; the serrations are also much stronger in the young.

¹ Ann. Mag. Nat. Hist., vol. 2, 1878, p. 24; *Challenger Reports*, vol. 22, Deep-Sea Fishes, p. 136, pl. 28, fig. 13.

² Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 121, pl. 27, fig. 1.

The ridges on the scales are more numerous in the larger specimens. These variations with size are indicated in the following table:

Length to anus.	Head in dorsal spine.	Serrations of dorsal spine.	Ridges on the scales.
115.....	1.25	4	15
106.....	1.5	6	13
98.....	1.6	5	11
96.....	2	8	8
90.....	1.6	6	11
83.....	2.1	-----	-----
74.....	2.25	9	8
65.....	2.1	9	-----
52.....	2	10	-----
30.....	1.15	13	3

Nine scales from origin of second dorsal to lateral line, excluding the lateral line scale.

The terminal rostral tubercle is similar to that of *C. nasutus*; it is rounded, transversely oval, but with only about 7 ridges, each of which is strongly armed with about 5 nearly erect spines, somewhat stronger on the upper than on the lower half of the tubercle; lateral tubercles less prominent and less convex than the median tubercle, with similar ridges and spines.

Pyloric caeca about as long as the orbit, numbering in the five specimens counted 12, 13, 13, 14, 14.

Branchiostegals 6; gill membranes without a free fold; gill-rakers of first arch represented by rudimentary tubercles; gill slit before first arch one-fourth as wide as orbit. The distances between the anus and base of ventral, and between the isthmus and the base of ventral are each about equal to the postorbital length of the head.

Color in alcohol, light brownish on back and sides; under side of head whitish; lower part of opercles, breast, and belly silvery, with brown chromatophores; upper part of opercles dusky. First dorsal whitish centrally, the base and the tips of the soft rays and the filament of the spine dusky; second dorsal light anteriorly, dark posteriorly; anal whitish anteriorly, with a dusky margin, entirely dusky posteriorly; base and tip of ventral dusky, the middle of rays whitish; base of pectoral, the uppermost rays, and the tips of all the rays dusky, leaving a well defined whitish area. Buccal, branchial, and peritoneal cavities lined with black.

This species is common in southern Japan, especially in the Eastern Sea and Suruga Gulf. *C. nasutus* is also common in southern Japan, but the two species were never taken at the same station, *C. marginatus* inhabiting warmer, shallower water than *C. nasutus*. The much lighter color, the more compressed body, the firmer flesh, and the general appearance of *C. marginatus* is correlated with this distribution.

The relationships of this species are with species of the Indian and Philippine faunas, from all of which it differs in the larger eye, which is about as long as the snout. *C. marginatus* further differs from *C. hyostomus* (Smith and Radcliffe)¹ in the posterior position of the anus, which is immediately before the anal fin, and in the spination of the scales, the spinules being arranged in definite parallel series, as also in *C. microps* (Smith and Radcliffe), instead of being in quincunx order, as in *C. hyostomus*.

The smallest specimen of *Coryphaenoides* obtained by the *Albatross* in Japan is 59 mm. long. It was dredged at a depth of 406 fathoms, in the Eastern Sea, at station 4907, at which *C. marginatus* was also obtained. The specimen can not be specifically identified, owing to its small size and the poor state of preservation; it shows none of the characters of the larval forms described as *Krohnii*.

Table of measurements in hundredths of length to anus.

<i>Albatross</i> station.....	4915	4907	4911	5072	4900	4908	4908	5067
Total length, mm.....	^a 296	^a 312	^a 298	328	^a 272	240+	192	160
Length to anus, mm.....	94	100	86	86.5	84	74	51	38.5
Length, head.....	65	62.5	68	62	63	65	66	68
Length, orbit.....	17	17	19.5	20	18	20	21	22
Width, interorbital.....	12	11	16	12.5	14	13	15	12.5
Orbit to preopercle.....	26	24	26	23	24	25	25	24
Length, snout.....	19	18	20.5	18	18.5	19	20	19
Length, maxillary.....	20	20	20.5	17.5	18.5	19	20	20.5
Length, barbel.....	5	4	7	5	6	5	5	6.5
Depth, body.....	51	51	51	49	52.5	52.5	54	52
Width, body.....	25	22	22	26	27	26	28	23
Height, second dorsal spine.....	126	114	125	106	112	142	129	120
Height, third dorsal ray.....	51	40.5						
Length, first dorsal base.....	18	18	17.5	19.5	18	19	18	19
Interdorsal space.....	14	14	19.5	17	17	11	11.5	10
Height, second dorsal.....	7.5							9
Height, anal.....	17		17.5					
Length, first P. ray.....	4.5	5	6	4	7	5	7	6.5
Length, second P. ray.....	24.5	21.5	29	22.5	22	21.5	24	23.5
Length, third P. ray.....	30.5	27	31	30.5	27	29.5	29	30
Length, outer ventral ray.....	31.5	33	44	38	37	38	37	38
Length, second ventral ray.....	18	17.5	21	21	20	20.5		23
Soft rays, first dorsal.....	9	11	10	11	10	10	10	9
Ventral rays.....	8	8-9	8	8-7	8	8	8	7
Pectoral rays.....	22	21	20		20	20	21	21
Serrations, dorsal spine.....	8	6	12	7	9	11	10	7

[CORYPHAENOIDES AWAE Jordan and Gilbert.³

This species is known only from the type, a mature female 620 mm. long, from off Nanaura, in Awa, in the entrance to the Bay of Tokyo. As stated in the type description, it is related to *C. marginatus*. A series of proportional measurements has been prepared for further comparison with that species.

Length to anus, 185 mm.; length of head, 63 hundredths of the length to the anus; length of orbit, 14.3; least width of interorbital, 12.3; least width of suborbital, 9; distance between orbit and margin of preopercle, 27; length of snout, 18; length of maxillary, 20; length

¹ Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, pp. 116 to 122.

² A pseudocaudal developed.

³ Bull. U. S. Fish Comm., 1902 (1904), p. 608, text figure.

of barbel, 6; depth of body, 58; width of body over pectoral bases, 34; distance from middle of anus to base of outer ventral ray, 33; distance from ventral to isthmus, 30; height of second dorsal spine, 62.2; length of first dorsal base, 19; length of outer ventral ray, 32.5; length of second ventral ray, 18.2.]

10. CORYPHAENOIDES CINEREUS (Gilbert).

Macrourus cinereus GILBERT, Rept. U. S. Fish Comm., 1893 (1896), p. 457.—
 JORDAN and GILBERT, Rept. Fur Seal Invest., vol. 3, 1898, p. 487.—GILBERT and BURKE, Bull. U. S. Fish Comm., vol. 30, 1910 (1912), p. 92.

Two specimens, dredged in 510 fathoms off the southeastern coast of Sagkalin Island at *Albatross* station 5015, extend the southern range of this species from Kamchatka. *C. cinereus* is an abundant species in Bering Sea, and comparison of the Japanese specimens with material from Bering Sea has disclosed no constant differences.

The number of radiating ridges on the strong median rostral tubercle varies from 6 to 10, each ridge being composed of stiff spinules; the tubercle is flat, the lower half vertical, the upper half oblique.

Pyloric caeca much shorter than the orbit, 5 to 7 in number, as counted on the two Japanese and three Alaskan specimens.

The distance between the ventral base and the anus is about nine-tenths the distance from the ventral base to the isthmus, which is about equal to the postorbital length of the head.

The following measurements illustrate the large variation in the length of the filamentous outer ventral ray.

Table of measurements in hundredths of length to anus.

<i>Albatross</i> station.....	5015	5015	¹ 3340	² 3338
Total length, mm.....	364	390	368	350
Length to anus, mm.....	93	94.5	83	104
Length, head.....	66	68	62	71
Length, orbit.....	21.5	21.5	22	23
Width, interorbital.....	20	18.5	19	21
Width, suborbital.....	10	8	10	9
Orbit to preopercle.....	28	28	31	31
Length, snout.....	17.5	18.	17.5	19
Length, maxillary.....	23	24	24	27
Length, barbel.....	6	4.5	4	6
Depth, body.....	51	50	52	53.5
Width, body.....	32	30	32.5	33
Anus to ventral.....	28	27	25	26.5
Ventral to isthmus.....	30.5	31.5	26	28
Height, second dorsal spine.....	70	65	60.5	61
Height, third dorsal ray.....	59	42	.....	50
Length, first dorsal base.....	26	22.5	21.5	23
Interdorsal space.....	11.5	12	11	15
Length, first pectoral ray.....	7.5	7	.....	8
Length, second pectoral ray.....	41	38	39	44.5
Length, third pectoral ray.....	51	48	45	52
Length, outer ventral ray.....	74	42.5	48	75
Length, second ventral ray.....	.....	28	31	36
Scales, above lateral line.....	7	6	7	8
Scales, below lateral line.....	23	18	.....	.....
Soft rays, first dorsal.....	14	11	11	11
Ventral rays.....	9	8	9	9
Pectoral rays.....	20	21	21	20
Gill rakers, lower limb.....	10	11	.....	.....
Serrations, dorsal spine.....	33	39	44	37

¹ Station 3340, off Chirikof Island, Alaska, one of the types.

² Station 3338, off Shumagin Island, Alaska.

³ A pseudocaudal developed.

11. CORYPHAENOIDES NASUTUS Günther.

Coryphaenoides nasutus GÜNTHER, Ann. Mag. Nat. Hist., ser. 4, vol. 20, 1877, p. 440.

Macrurus nasutus GÜNTHER, Challenger Reports, vol. 22, Deep-sea Fishes, p. 132, pl. 30, fig. B.

Macrourus nasutus JORDAN AND GILBERT, Bull. U. S. Fish Comm., 1902 (1904), p. 616 (exclusive of the specimen from Izu, which is here referred to *Lionurus proximus*).—FRANZ, Abh. math.-phys. kl. k. Bayer. Akad. der Wissensch., vol. 4, Suppl. Bd. 1, 1910, p. 26.—JORDAN and THOMPSON, Mem. Carnegie Mus., vol. 6, pt. 4, 1914, p. 306.

Macrurus nasutus DOLLO, Expéd. Antarctique Belge, Res. du Voy. du S. Y. Belgique, Poissons, 1904; pl. 8, figs. 1 and 3 (from Günther's types; to illustrate pseudocaudal).

Albatross station.	General locality.	Depth in fathoms.	Number of specimens.
4957.....	Bungo Channel.....	437	7
4958.....	do.....	405	1
4969.....	Kii Channel.....	587	6
4971.....	do.....	649	1
4972.....	do.....	440	11
4973.....	do.....	600	5
4977.....	do.....	544	2
4980.....	SW. of Suruga Gulf.....	507	4
5045.....	Off south coast of Hokkaido (Yezo).....	359	2
5053.....	Suruga Gulf.....	503	1
5061.....	do.....	250-332	2
5080.....	Off Omai Saki, east coast of Hondo.....	505	2
5087.....	Sagami Bay.....	614	1

The smallest specimen (data lost) is 148 mm. long.

Seven or eight scales from origin of second dorsal to lateral line, excluding the lateral line scale. The terminal rostral tubercle is hemispheric in shape, with about 12 radiating, strongly spinous ridges; lateral tubercles oval, less convex, with about 10 strongly spinous ridges, stronger above than below. The preopercular ridge is strongly produced backward at its angle, more strongly than the preopercular margin.

The distance from the base of the outer ventral ray to the isthmus is about 0.9 the distance from the ventral to the center of the anus, a distance which is equal to the postorbital length of the head.

Pyloric caeca shorter and fewer than in *C. marginatus*, but longer and more numerous than in *C. cinereus*. They are shorter than the orbit, and number, in five specimens counted, 8, 9, 10, 10, 10.

Fins proximally overlaid with a bluish gray pigment. Under side of head and trunk underlaid with silvery pigment which is scarcely apparent where the scales remain.

The specimens dredged in comparatively shallow water, off the south coast of Hokkaido, greatly extend the northern limit of the known distribution of *C. nasutus*. It is of further interest to note that these specimens were dredged with *Nematonurus pectoralis*, which has Bering Sea for its center of distribution.

Table of measurements in hundredths of length to anus.

Albatross station.....	5080	4973	4980	4973	4972	4989	4969
Total length, mm.....	¹ 365	375	¹ 350	380	265	263	197
Length to anus, mm.....	111	115	113	121	104	57	54
Length, head.....	66	67	63.5	63.5	64.5	68	68
Length, orbit.....	18	18	16.7	17.3	19.5	21	21
Width, interorbital.....	17	13	15	12.5	14	14	16
Orbit to preopercle.....	28	28.5	27.5	27	28	27	26.5
Length, snout.....	20	20	19	18.5	19.5	21	21
Length, maxillary.....	20	22	20	19	19	20	20
Length, barbel.....	5	4.5	5	3.5	4	4	3.7
Depth, body.....	49	46	50	50	46	46	48
Width, body, over pectorals.....	31	30	33	32	28	27	26
Height, second dorsal spine.....	62	63.5	52	52	71	72	64
Height, third dorsal ray.....	46	43					
Length, first dorsal base.....	17	17	16.5	17	16	18	17
Interdorsal space.....	51	53	59	49	52	54	54
Height, second dorsal.....	11						8
Height, anal.....	17+						14+
Length, first pectoral ray.....	5	4	4.5	4	4	7	5
Length, second pectoral ray.....		22	24.7	23	25	23.5	17
Length, third pectoral ray.....	31		29	30	27.5		22
Length, outer ventral ray.....	40	34	42	31	31	39	40
Scales below lateral line.....	28						
Soft rays, first dorsal.....	10	10	10	10	10	10	10
Ventral rays.....	9	9	9	9	9-10	9	9
Pectoral rays.....	22	22	21	20	21	21	23
Serrations, second dorsal spine.....	30	20	24	27	28	20	19

Genus COELORHYNCHUS Giorna.

Coelorhynchus GIORNA, Memoire della R. Accademia della Scienze di Torino (Turin), vol. 16, 1803, p. 178 (*coelorhynchus*).

Paramacurus BLEEKER, Verslagen en Mededeelingen der k. Akademie van Wetenschappen, Amsterdam (2), vol. 8, 1874, p. 370 (*australis*).

Orymacurus BLEEKER, Verslagen en Mededeelingen der k. Akademie van Wetenschappen, Amsterdam (2), vol. 8, 1874, p. 370 (*japonicus*).

Coelorhynchus is a natural group of species, being constantly characterized by the presence of six branchiostegal rays; by the projecting snout; the wholly inferior, U-shaped mouth; the smooth, rounded second dorsal spine;² and the presence of definite ridges on the head, covered with modified scales. The suborbital ridge is the most prominent; it is continuous from the tip of the snout to the preopercle, and forms a prominent angle on the side of the head. *Mataeocephalus*, formerly regarded as differing from *Coelorhynchus* only in the presence of serrations on the dorsal spine, has seven branchiostegals, and is closely related to *Lionurus*. The sturgeon-like snout evidently has been independently derived in the two genera, as it has surely been in *Trachyrhynchus*, a genus of the Bathygadinae.

In some species of *Coelorhynchus* the anus is remote from the anal fin; in some one or two scaleless fossae are developed on the mid-ventral line anterior to the anus.

This genus contains a large series of species, one extreme of which is typified by *C. coelorhynchus*, with a comparatively short snout,

¹ A pseudocaudal developed.

² A few rudimentary serrations are present on the dorsal spine of a paratype of *C. proeductus*. The same condition was noted on the type of *C. gladius* Gilbert and Cramer (Proc. U. S. Nat. Mus., vol. 19, 1896, p. 422).

the other extreme by species with a very long sturgeon-like snout. Several apparently natural groups can be defined, and are here regarded as subgenera.

KEY TO THE SUBGENERA AND THE JAPANESE SPECIES OF COELORHYNCHUS.

- A¹. Subopercular margin rounded; snout moderate, not greatly produced, with a prominent double terminal tubercle.....*Coelorhynchus*.
- A². Subopercular margin produced backward at the angle in a pointed flap; snout without a prominent double terminal tubercle.
- B¹. Snout usually only moderately produced; scales with equal parallel spinous ridges; body usually with distinctive bars or spots.
Paramacrurus.
- a¹. An elongate scaleless thoracic fossa present on mid-ventral line; body with a large round spot behind pectoral and below first dorsal, and another below second dorsal; orbit longer than postorbital length of head; pectoral with 17 rays; pyloric caeca 19 to 23; inner edge of shoulder girdle scaled.....*kishinouyei*.
- a². No naked thoracic fossa; spot near pectoral smaller, posterior spot absent; orbit shorter than postorbital length of head; pectoral with 14 to 15 rays, weaker and shorter; pyloric caeca 25 to 31; inner edge of shoulder girdle scaled.....*jordani*.
- B². Snout greatly produced, sturgeon-like; spinules of scales variously arranged, but never on equal parallel ridges; inner edge of shoulder girdle naked.....*Oxymacrurus*.
- b¹. Spinules on scales in strongly divergent series.
- c¹. Snout, with a terminal spine, less than twice as long as head in adults.
- d¹. Four or five rows of scales in a series from origin of second dorsal to lateral line; under side of head naked.
- e¹. Three to five spinous ridges on scales; snout longer, not shaped like a duck's bill; eye 1.8 in snout; barbel 6 in orbit.....*productus*.
- e². Six to nine spinous ridges on scales; snout shaped like a duck's bill; eye 1.5 in snout; barbel about half orbit.....*anatirostris*.
- d². Six or seven rows of scales in a series from origin of second dorsal to lateral line; under side of head scaled; barbel 3 to 4.5 in orbit.....*japonicus*.
- e². Snout without a terminal spine, more than twice as long as eye in adult.....*tokiensis*.
- b². Spinules on scales strongest on a median keel, the other spinules arranged in one or two parallel rows, but not on ridges; under side of head scaled.....*parallelus*.

12. COELORHYNCHUS KISHINOUEI Jordan and Snyder.

Coelorhynchus kishinouyei JORDAN and SNYDER, Proc. U. S. Nat. Mus., 23, 1901, p. 376, pl. 20.

Albatross station.	General locality.	Depth in fathoms.	Number of specimens.
5060.....	Suruga Gulf.....	197	1
5062.....	do.....	250	1
5065 (from fishermen).	do.....	211-235	5

Pyloric caeca shorter than the orbit, numbering, in four specimens, 19, 20, 22, 23.

The scales are strong on the ridges of the head, on which the suberect spinules radiate from the center of the scale. The median rostral ridge composed of about 10 wide scales and extending half the distance from the tip of the snout to the occiput, widening posteriorly. The median occipital scute well marked and preceded on each side by a similar scale; these scales similar to those along the ridges of the head. The scales on top of the head are larger than the scales of the body, and bear 3 to 5 strongly divergent ridges; these scales are in definite rows, one median, extending from the occiput to the rostral ridge, a row extending just within the occipital ridges and just without the rostral ridge, and a row of small scales extending forward from the anterior end of the occipital ridge to the anterior end of the nasal fossa. The upper margins of the nasal fossa and the orbit are armed with linear scales forming a continuous ridge. The occipital ridges are similar to the median rostral ridge, but stronger; they extend backward from above the middle of the pupil and curve outward; another ridge extends from the upper orbital margin to the end of the gill opening; between this ridge and the occipital ridge the scales are arranged in three longitudinal rows, with other smaller scales. The scales on the opercle and preopercle are similar to those on the body, but their crests are somewhat more divergent; those on the cheeks are smaller. The suborbital ridge is strong, strongest posteriorly, covered by two rows of scales below the posterior half of the orbit. Under side of head completely naked. The scales of the body bear a variable number of parallel spinous ridges, the largest number, about 20, occurring on scales above the lateral line, near the second dark spot. The spinules on the sides of the trunk, and on the posterior half of the tail are parallel with the axis of the body, but those between these regions are directed obliquely downward. The scales before the dorsal are small and bear a few divergent ridges.

Color in alcohol light brownish, underlaid with silvery on the lower sides of trunk, and with blackish on the belly. A large, dark brown, round spot, nearly two-thirds the diameter of the large eye, located above and behind the pectoral, below the lateral line, covering about six scale-rows; another dark brown spot, about five scale-rows wide, extending from dorsal base to a little below the lateral line, its anterior edge constantly twice the length of the head from the tip of snout; indistinct traces of other dark areas are present, but the two spots are constant in size and position, and are highly diagnostic of the species. Iris with dark brown chromatophores along its margin, its upper half blue, its lower half silvery; opercle and preopercle dark

brown, underlaid with silvery; region behind and below eye silvery, with large dark brown punctulations; nasal fossa dark brown, except on margins of nostrils; top of head lighter than the color of the body; underside of head colorless anteriorly, silvery posteriorly, with large dark brown punctulations scattered near tip of snout, on midline of snout, about mouth, and laterally on the posterior half of this region; rami of the mandibles almost uniform blackish brown; gular and branchiostegal membranes black, except for a narrow posterior whitish margin. First dorsal gray, the base with a narrow blackish band, the second spine and the tips of the soft rays black; second dorsal whitish; anal dusky on posterior third, lighter on middle third, and with a blackish margin of variable width on the anterior third; ventral blackish near base, the outer ray dusky, except on the white filament, the other rays light proximally, dark distally; ventral in some specimens nearly uniform blackish; pectoral base black on inner surface, silvery on outer surface, the fin gray, with dark punctulations, thickest near base of lower rays. Buccal cavity whitish; branchial cavity lined with whitish or gray, except for a well-defined black bar near margin of opercular membrane, leaving a narrow whitish border; peritoneum silvery, with blackish brown punctulations.

The firm texture and light, variegated color of this species, and of *C. jordani*, are correlated with the fact that they live in comparatively warm and shallow water.

The small specimen from *Albatross* station 5060 differs from those described in having 12 or fewer series of spines on the scales, and in proportions, as shown in the following table:

Table of measurements in hundredths of length to anus.

<i>Albatross</i> station.....	5065	5065	5065	5065	5065	5062	5060
Total length, mm.....	290	293	295	283	265	253	192
Length to anus, mm.....	84	78	77.5	76	75	71	48
Length, head.....	71	73	77	74	72	73	76
Length, orbit.....	26	29	28	27	25	27	27
Width, interorbital.....	16	16	18	16.5	15	16.5	15
Width, suborbital.....	10	10	12	11	9	11	10
Orbit to preopercle.....	30	28	30	29	29	29	27
Length, snout.....	23	25	27	26	26	26	30
Length, maxillary.....	20	20	19	19	19	19	18
Length, barbel.....	5	6	6	6	4	4	5
Depth, body.....	53	52	54	52	51	51	46
Width, body.....	32	31	35	33	31	32	28
Anus to anal.....	10	10	9	9.5	11	12	8
Anus to ventral.....	21	21	21	21	20	21	17
Ventral to isthmus.....	25.5	25	23	25	26	25	23
Height, second dorsal spine.....	51	51	54	54	45	51	45
Length, first dorsal base.....	18	19	19	19	20	18	17.5
Interdorsal space.....	39	28	28	20	25	33	28
Length, pectoral.....	47	50	56	55	44	45	42
Length, outer ventral ray.....	36	38	37	38	27	33	34
Length, second ventral ray.....	24	25	26	26	23	22	22
Scales, above lateral line.....	5	5	5	5	5	5	5
Scales, below lateral line.....	16	16	15	15	17	16	16
Soft rays, first dorsal.....	9	9	9	9	9	9	9
Ventral rays.....	7	7	7	7	7	7	7
Pectoral rays.....	17	17	17	17	17	17	17

¹ A pseudocaudal developed.

13. COELORHYNCHUS JORDANI Smith and Pope.

Coelorhynchus jordani SMITH and POPE, Proc. U. S. Nat. Mus., vol. 31, 1906, p. 494, fig. 11.

Albatross station.	General locality.	Depth in fathoms.	Number of specimens.
4897.....	Kagoshima Market.....		5
4898.....	Eastern Sea.....	207	1
4940.....	do.....	207	1
4941.....	Kagoshima Gulf.....	115	1
4942.....	do.....	117	2
4943.....	do.....	118	4
	do.....	119	10

This species is very closely related to *C. kishinouyei*, and appears to represent that form in Kagoshima Gulf and Eastern Sea. *C. kishinouyei* is known only from Suruga Gulf and Sagami Bay.

C. jordani is the smaller form, and differs constantly from *C. kishinouyei* in a number of details, as follows:

1. The absence of the naked thoracic fossa between the ventrals. (A gland-like body is located in the muscles between the ventral fins, similar to that found beneath the fossa in *Abyssicola macrochir*.)
2. The orbit much smaller in the adult, apparently decreasing more rapidly with age, being shorter instead of longer than the postorbital length of the head.
3. The longer barbel.
4. The pectoral fin shorter and narrower; its rays weaker and fewer, 14 or 15, instead of 17, as constantly found in *C. kishinouyei*.
5. The ventral fin usually shorter.
6. The scales on the head, especially on the ridges, much smoother and more regularly imbricate; the scales between the occipital ridges not in the three definite rows characteristic of *C. kishinouyei*; scales otherwise similar in the two species.
7. The posterior margin of the preopercular ridge, and of the subopercle, more strongly curved.
8. The backward projection of the subopercle, its lower angle longer and slenderer.
9. Pyloric caeca more numerous, slenderer, and shorter, about half as long as the orbit, numbering in the six specimens counted: 25, 26, 28, 29, 31, 31.
10. Coloration agreeing in almost every detail, but generally lighter; the posterior of the two spots on the body absent in all but one young specimen, the anterior spot in the same position, but much more indistinct, and much narrower, covering only 2 or 3, instead of about 6 scale-rows. The outer ventral ray white, the blackish base overlaid with gray, the rays not lighter in the middle than at their distal ends.

The original description, based on four small specimens from Kagoshima, the only specimens hitherto known, may be corrected and supplemented by the following measurements of mature specimens. Snout 2.9 to 3.1 in head, orbit equal to or shorter than snout; interorbital about 5; $4\frac{1}{2}$ or 5 scales in a series from origin of second dorsal to lateral line, not including the scale on the lateral line, 5 or 6 below the second spine of the first dorsal; pectorals with 14 or 15, instead of 17, rays; vertical diameter of orbit 1.1 in horizontal diameter; median rostral ridge extending somewhat beyond vertical through anterior margins of eye; length of second spine of first dorsal about 0.8 the distance between its base and the anterior margin of orbit; pectoral a little more than half as long as head; ventral filament usually reaching well beyond origin of anal. Neither the length of the snout, nor the number of spinous ridges on the scales distinguish *C. jordani* from *C. kishinouyei*, these being the two differences held by Smith and Pope to separate the two.

The two young specimens from the Eastern Sea differ from those taken in Kagoshima Gulf in the longer snout, more acutely angulated preopercular ridge, shorter distance from ventral to isthmus, but the material is too limited to form definite conclusions.

Length of specimens 80 to 225 mm., 26 to 70 mm. to anus.

Table to show the number of spinous ridges on the scales.

<i>Albatross</i> station.	Length to anus, mm.	Number of ridges.
4897.....	29	3 to 5
4898.....	35.5	4 to 7
Kagoshima market.....	40	6 to 11
4941.....	41	7 to 11
4942.....	44	10 to 13
Kagoshima market.....	45	7 to 11
Do.....	50	8 to 20
4942.....	51	11 to 20
4941.....	57.5	8 to 18
4940.....	62.5	9 to 18
4943.....	63	9 to 18
Kagoshima market.....	70	10 to 23
Do.....	70	12 to 23

Table of fin ray counts.

Dorsal.		Ventral.		Pectoral.	
Rays.	Specimens.	Rays.	Specimens.	Rays.	Specimens.
11, 8	3	7	16	14	5
11, 9	10	.....	.....	15	12
11, 10	2	.....	.....	.....	.....

Table of measurements in hundredths of length to anus.

Albatross station.....	Kagoshima.		4940	4941	4942	4988
Total length, mm.....	1 219	225+	1 201	192	1 170	1 123
Length to anus, mm.....	70	70	62.5	57.5	51	35.5
Length, head.....	71	72	77	82	76	76
Length, orbit.....	22.5	24	26	29	28	27
Width, interorbital.....	15	14	16	16	17	18
Width, suborbital.....	10	10	11	10	10	11
Orbit to preopercle.....	29	29	30	30	26	31
Length, snout.....	25	24	26	29	27	30
Length, maxillary.....	20	20	21	21	21	21
Length, barbel.....	8.5	7	9	8	8	8
Depth, body.....	52	51				44
Width, body.....	32	34	34			29
Anus to anal.....				5		6
Anus to ventral.....	24			20		20
Ventral to isthmus.....	25	24	25			21
Height, second dorsal spine.....	50	51	52			51
Length, first dorsal base.....	19	21	19	20	21	19
Interdorsal space.....	26	25	27	28	26	20
Length, pectoral fin.....	38	36	41	40	41	35
Length, outer ventral ray.....	30	27	31	30	36	37
Length, second ventral ray.....	22	18	22	19	22	20
Scales, above lateral line.....	5	5	5	5	5	
Scales, below lateral line.....	17	16				

14. COELORHYNCHUS PRODUCTUS, new species.

Plate 9, fig. 1.

This species is a close ally of *C. anatirostris* Jordan and Gilbert,² described from a specimen from Misaki, Japan. *C. anatirostris* has been recorded twice since the original description: by Franz, as *C. antirostris*,³ from Aburatsubo, Sagami Bay, and by Jordan and Thompson, as *C. anagiostrostris*,⁴ from Misaki, also in Sagami Bay. *C. productus* is described from ten specimens dredged in Suruga Gulf. It differs from *C. anatirostris* in the longer snout, not shaped like a duck's bill; the eye, in the largest specimen, 1.8 in the snout, instead of 1.5; the barbel shorter, about 6 in orbit, instead of about half eye; maxillary 4.6 in head instead of 4; gill membranes without a free fold; scales with 3 to 5, instead of 6 to 9, divergent spinous ridges, those on the top of the head not similar to those on body, bearing but one to three ridges; length of orbit little less than distance from ventral to anus, instead of 1.4 in this distance, as measured on the figure of *C. anatirostris*.

Type-specimen.—306 mm. long, 109 mm. to anus, from Albatross station 5059, Suruga Gulf, Japan, depth, 197 to 297 fathoms; Cat. No. 76865, U.S.N.M.

Dorsal, II, 8 (8 to 10); ventral, 7; pectoral, 18 (17 to 19).

Dorsal contour of snout slightly concave, but evenly convex from middle of snout to the dorsal fin; the base of first dorsal nearly hori-

¹ A pseudocaudal developed.

² Bull. U. S. Fish Comm., 1902 (1904), p. 619, text fig.

³ Abh. math.-phys. Kl. K. Bayer. Akad. der Wissensch., vol. 4, Suppl. Bd. 1, 1910, p. 27.

⁴ Mem. Carnegie Mus., vol. 6, pt. 4, 1914, p. 306; a specimen smaller than the type. 21 cm. long, with a shorter snout and a larger eye.

zontal; ventral contour little convex. Depth of body about half length of head; width of body over pectoral bases about 1.3 in its depth; width of tail 2.25 in its depth at a point twice length of head from tip of snout.

Head 3.95 in total length; snout 2.15 in head, its sides little convex, straight from tip backward a distance equal to length of orbit; tip of snout acuminate and spinigerous, its width, opposite anterior orbital margins, 1.3 in its length; its depth vertically above front of premaxillaries 1.9; suborbital ridge strong, continuous to preopercular angle; occipital ridges slightly converging toward their middle, and slightly diverging to the posterior ends; ridge above nasal fossa and orbit continuous with the postorbital ridge; denticulate membranous margin of preopercle produced backward as a rounded lobe; margin of subopercle, at lower angle, sharply produced downward and backward, as in all related species. Orbit oblong, the vertical diameter two-thirds the horizontal diameter, which is contained 1.8 times in the snout, nearly 4 in head; least interorbital width 0.8 orbit. Mouth small, extending to below middle of pupil; maxillary 4.6 in head; teeth in bands, the outer premaxillary series scarcely enlarged. Barbel short and slender, about 6 in orbit. Six branchiostegals; gill membranes attached to isthmus, without a free fold.

Pyloric caeca scarcely shorter than the orbit; 27 were counted in a paratype.

Distance from center of anus to origin of anal fin 3 in orbit, its distance from base of outer ventral ray a little greater than length of orbit; distance from ventral to isthmus equal to length of orbit. No thoracic scaleless pit.

Scales large, $4\frac{1}{2}$ or 5 in a series from origin of second dorsal to the lateral line (excluding lateral line scale); those on the body bear usually five very strongly spinous, divergent ridges, the median ridge strongest, armed with about five imbricate spines, these becoming larger posteriorly on all the ridges, the last spine extending beyond the margin of the scale; some scales have 3 or 4 ridges, but none have more than 5; the scales before the first dorsal and those on the belly smaller than those on sides of body; the scales on the median rostral ridge are not strongly specialized and are elliptical in outline, bearing one to four divergent crests; the medirostral ridge is bounded on each side by a definite series of scales, each of which bears several ridges; toward the tip of the snout the scales become smaller and usually bear but a single keel composed of suberect spinules; the median occipital scute and the scales on the occipital ridges and on the ridge above the orbit bear each a single strongly spinous keel; scales on ridge on upper margin of nasal fossa with about three keels; a series of large scales, similar to those of the body, extend backward from

the orbit, midway between the occipital and postorbital ridges, the remaining scales between these ridges being small; scales on opercles similar to those on body, but those on suborbital region are small; tip of snout with a spinigerous plate above and below; underside of head wholly scaleless, even below the angle of preopercle.

First dorsal spine small but sharp, entirely smooth (with two small spinules in a paratype), longer than the snout, and slightly longer than the soft rays; base of first dorsal 1.5 in orbit, 1.75 in interdorsal space. Pectoral 2.9 in head. Outer ventral ray reaching past anus, but not to origin of anal, the other rays not reaching anus.

Color in alcohol brownish, underlaid with silvery on breast and anterior part of sides and with blackish on belly; underside of head grayish anteriorly, silvery posteriorly, with small grayish brown punctulations; buccal and branchial cavities lined with blackish, excepting a narrow border on inner edge of opercular membrane; peritoneum blackish, underlaid with silvery.

Six paratypes, five from *Albatross* station 5059, at which the type was dredged, and one from station 5066, also in Suruga Gulf; depth, 211 to 293 fathoms. Some of these have a shorter, broader snout than the type. In addition, three small specimens, 86 to 90 mm. long, 27 to 30 mm. to anus, were dredged at stations 5059, 5066, and 5072, 148 to 297 fathoms; Suruga Gulf. These differ from the larger specimens in several characters probably due to the difference in size: Orbit, 3.4 to 3.6 in head, 1.4 to 1.5 in snout; snout, 2.3 to 2.4 in head; maxillary, 4.4 to 4.6; distance from ventrals to anus, about equal to orbit; distance from anus to anal, 3.3 in orbit; scaly ridges of head strong; scales of body bearing one to three ridges.

Table of measurements in hundredths of length to anus.

<i>Albatross</i> station.....	5059	5059	5059	5059	5059	5059	5066
Total length, mm.....	306	286	261+	217	1 220	1 190	223
Length to anus, mm.....	109	93	93	83	89	73.5	75
Length, head.....	72	72.5	72	70	71	71.5	73
Length, orbit.....	18.5	19.5	19	20	20	20	20
Width, interorbital.....	14.7	14.5	15	13	13	14.7	14
Width, suborbital.....	10	9.5	8.5	9	8.5	9.5	9.5
Orbit to preopercle.....	22	22	22.5	22	21	22	21
Length, snout.....	33.5	33.5	33	31	31.5	31.7	33
Width, snout.....	26	23.5	23	24	25	26	24
Length, maxillary.....	16	16	16	15	.....	16	16
Length, barbel.....	3.5	2.5	2.7	4	3.5	3.5	3.5
Depth, body.....	33.5	32	32	31	31.5	30.2	31
Width, body.....	28	26	27	26	26	22.5	26
Anus to anal.....	6.5	5	5	5	6	5.5	6
Anus to ventral.....	23.5	22	23	23	20	19.5	20
Ventral to isthmus.....	19	20.5	19.5	.....	18.5	18	19
Height, second dorsal spine.....	27	38	38.5	36	36	37	.....
Length, first dorsal base.....	11.8	14	15	15	14.5	13	13
Interdorsal space.....	19	19.3	18	16	18	20	16
Length, pectoral fin.....	27	.....	27	27	25	29	.....
Length, outer ventral ray.....	24.2	26	25	26	25	25.5	25
Length, second ventral ray.....	18	16.2	17	18	.....	19	16
Scales, above lateral line.....	5	5	5	5	5	5	5
Scales, below lateral line.....	16	18	17	17	18	18	.....
Soft rays, first dorsal.....	8	8	10	5	9	9	9
Ventral rays.....	7	7	7	9	7	7	7
Pectoral rays.....	17	18	18	18	18	19	18

¹ A pseudocaudal developed.

15. COELORHYNCHUS JAPONICUS (Temminck and Schlegel).

Macurus japonicus TEMMINCK and SCHLEGEL, Fauna Japonica, 1846, p. 256, pl. 112, fig. 2.—GÜNTHER, *Challenger Reports*, vol. 22, Deep-Sea Fishes, 1887, p. 127, pl. 29, fig. C.—STEINDACHNER and DÖDERLEIN, *Fische Japans*, vol. 4, 1887, p. 283.

Coelorhynchus japonicus JORDAN and GILBERT, Bull. U. S. Fish Comm., 1902 (1904), p. 617.—FRANZ, Abh. math.-phys. kl. k. Bayer. Akad. der Wissensch., vol. 4, Suppl. Bd. 1, 1910, p. 26.—JORDAN and THOMPSON, Mem. Carnegie Mus., vol. 6, pt. 4, 1914, p. 306.

Albatross station.	General locality.	Depth in fathoms.	Number of specimens.
4967.....	Off east coast of central Hondo.....	244-253	1
4968.....	do.....	253	1
5059.....	Suruga Gulf.....	197-297	2
5062.....	do.....	250	1

Scales with 3 to 5 strongly divergent spinous ridges; 6 or 7 scales from origin of second dorsal to the lateral line; those on ridges of head moderately strengthened; the median rostral ridge extends to opposite the anterior margins of orbits, and bears a series of about 12 subquadrate scales with 4 to 8 spinous ridges, which radiate from a point near the anterior margin of the scale; the occipital and postorbital ridges bear a series of narrow scales with one or two ridges armed with a few conic spines; a similar scale forms the occipital scute; the ridge on the upper orbital margin bears a series of scales with conic spines along several divergent ridges; the ridge on the posterior half of the upper margin of the nasal fossa bears four scales which become smaller and narrower anteriorly; the scales in a series midway between the occipital and postorbital ridges are similar to the scales of the body, but larger; those on the next series below, and those on the opercles, are similar to those on the body; a patch of small scales, with a single crest, on the upper end of the preopercle; the tip of the snout is covered with a modified triangular scale, with suberect spinules; scales elsewhere on the head are mostly with a single ridge armed with sharp spinules. Posterior half of nasal fossa, and the gular and branchiostegal membranes are naked.

Lateral margins of snout but slightly convex, the dorsal contour concave.

Fifty pyloric caeca, shorter than the orbit, were counted in one specimen.

The young, as usual in the genus, have a shorter, broader snout, larger eye, and other differences brought out in the following table:

Table of measurements in hundredths of length to anus.

Albatross station.....	4968	4967	5059	5059	5062
Total length, mm.....	25	307	182	158	166
Length to anus, mm.....	142	120	55	49	58
Length, head.....	73	75	77	77	76
Length, orbit.....	23	20	23	23	22
Width, interorbital.....	18.3	14	16	16	15
Width, suborbital.....	9.5	9	10	9	8
Orbit to preopercle.....	25	25	25	26	24
Length, snout.....	31	33.5	33	33	34
Length, maxillary.....	20	19.5	20	18	18
Length, barbel.....	6.5	6.5	7	5	6
Depth, body.....	.....	34	36	36	34
Width, body.....	.....	24	27	23	24
Anus to anal.....	6	5	5	4	4
Anus to ventral.....	22	23	22	19	20
Ventral to isthmus.....	20	20	21	20	20.5
Height, second dorsal spine.....	26	24	31	31	31
Length, first dorsal base.....	9.5	11	13	13	12
Interdorsal space.....	17	16	19	17	17
Length, pectoral.....	.....	.....	28	.....	26
Length, outer ventral ray.....	22	23	34	34	30
Scales, above lateral line.....	7	7	7	.....	.....
Soft rays, first dorsal.....	8	10	9	9	8
Ventral rays.....	7	7	7	7	7
Pectoral rays.....	19	19	.....	.....	.....

16. COELORHYNCHUS TOKIENSIS (Steindachner and Döderlein).

Macrurus tokiensis STEINDACHNER AND DÖDERLEIN, Fische Japans, vol. 4, 1887, p. 283.

Albatross station.	General locality.	Depth in fathoms.	Number of specimens.
4911	Eastern Sea.....	391	1
4916	.....do.....	361	1

Description of a specimen 212 mm. long, from station 4916:

Dorsal contour of head evenly convex, the sides nearly straight forward and backward from the prominent rounded lateral angle; depth of body equal to length of snout, 2.3 in head; width of snout at base 1.3 in its length; vertical depth over front of premaxillaries 1.66 in its length; preoral length of snout 1.2 in preocular length; suborbital ridge armed anteriorly by a single row, and posteriorly by a double series of strongly spinous scales; scales on the rounded tip of snout and on the lateral angles somewhat strengthened and more strongly armed than the neighboring ones, but not forming prominent tubercles; median rostral ridge with a series of quadrate scales; occipital ridges strong and nearly parallel, but slightly converging towards the middle of their length from both ends, the least width between the ridges half the interorbital; a weaker postorbital ridge from the upper orbital margin to the upper margin of the opercle; lower angle of subopercle sharply produced backwards. Orbit oval, its vertical diameter 1.3 in its horizontal diameter, which is contained 1.8 times in the snout, 4.2 times in head. Maxillary longer than orbit, 1.66 in snout, extending past vertical from pupil. Barbel short and slender, 3.8 in orbit. Six branchiostegals; gill-membranes with a

wide free fold; gill slit before first arch 1.5 in orbit, slit behind fourth arch 2.9.

Six scales between origin of second dorsal and lateral line, excluding the lateral line scale; most of the scales of the body with 5, some with 3, strong divergent ridges, armed with about 5 strong procumbent imbricate spines, the posterior one strongest, and extending beyond the scale margin. Lower surface of head completely naked, with the exception of a very well defined, elliptical patch of scales below the angle of the preopercle. A few prickly scales on the lower acute end of the large pyriform nasal fossa, which is as long as the eye; a pair of naked grooves near tip of snout, converging anteriorly; scales of the median rostral ridge anteriorly with two divergent ridges, posteriorly with a single keel, and with a few lateral spinules; two well-defined series of scales on each side of the rostral ridge between it and a lateral groove parallel to it; the scales in these series are armed each with a single spinous ridge; the two series on each side diverge opposite the end of the rostral ridge, the inner series of each side meeting above the middle of the orbit, and forming a median occipital series, the outer series becoming continuous with the occipital ridge; two lateral occipital series, between the occipital ridge and the median series, not extending on the snout; scales small and prickly outward from the lateral rostral grooves; scales in the modified series midway between occipital and postorbital ridges, and on the opercles, with 3 spinous divergent ridges, those on the suborbital ridge with several spinous ridges; other scales of the head with a single trenchant spinous crest, strongest on the occipital and postorbital ridges.

Color light brown (dark on belly), with about six distinct dark brown bars extending across the body, and about as wide as the interspaces between them; one is located behind the occiput, the second below the first dorsal, one below the interdorsal space, three broad ones on the anterior half of tail, and several indistinct ones behind these. Head grayish, except on the dusky opercle. Vertical fins dusky, the anal with a blackish margin; ventral dark, but with a light filament; two uppermost pectoral rays, and the distal ends of the other rays dark. Buccal, branchial, and peritoneal cavities lined with blackish, the branchial cavity with a whitish margin on the opercular membranes, the peritoneal lining spotted, underlaid with silvery.

A larger specimen, in poor condition, about 535 mm. long, from station 4911, differs from the smaller specimen in the following characters: Scales on anterolateral angle of snout scarcely enlarged; length of snout 2.27, width 1.55 in its length; depth over tip of premaxillaries 1.65; orbit smaller, 2.1 in snout; maxillary 3.65; scaly ridges less prominent; scales with 5 to 7 ridges; nasal fossa more completely scaled anteriorly; a few lateral spinules besides the median keel on the scales on top of head; scales on median rostral ridge with 5

spinous ridges; those on the opercles, and on the series between the occipital and postorbital ridges with 3 to 7 spinous ridges. First dorsal spine concealed (sharp in the smaller specimen). Fifty pyloric caeca, shorter than the orbit.

C. tokiensis is probably most closely related to *C. macrorhynchus* Smith and Radcliffe,¹ a Philippine species, and to *C. quadricristatus* (Alcock),² an Indian species. From *C. macrorhynchus*, it differs in the absence of scales on the under side of the head, excepting the definite small posterior patch; the dark bars of the body; the blunt snout; and the shorter interdorsal space, which is shorter, instead of longer, than the base of the first dorsal. From *C. quadricristatus*, it differs in the shorter blunter snout; the larger eye; the naked under-side of head; in the more numerous pectoral rays, 18 or 19, instead of 16; and in the ventral extension of the dark bars to the anal base.

Table of measurements in hundredths of length to anus.

Albatross station.....	4911	4916
Total length, mm.....	529	212
Length to anus, mm.....	231	73.5
Length, head.....	71	77.5
Length, orbit.....	16	19
Width, interorbital.....	14.6	17.5
Width, suborbital.....	7	9
Orbit to preopercle.....	26.3	28
Length, snout.....	32.5	33.5
Width, snout.....	20.5	26
Length, maxillary.....	20.5	20
Length, barbel.....	5	5
Depth, body.....	32	33.5
Width, body.....	23.5	24
Anus to anal.....	.....	7
Anus to ventral.....	21	21
Ventral to isthmus.....	20	21
Height, second dorsal spine.....	26.5	.....
Length first dorsal base.....	12	12.5
Interdorsal space.....	11.5	9
Length, outer ventral ray.....	26	37
Length, second ventral ray.....	14.5	18
Scales, above lateral line.....	6	6
Soft rays, first dorsal.....	9	9
Ventral rays.....	7	7
Pectoral rays.....	18	19

17. COELORHYNCHUS PARALLELUS (Günther).

Macrurus parallelus GÜNTHER, Ann. Mag. Nat. Hist., ser. 4, vol. 20, 1877, p. 439; *Challenger Reports*, vol. 22, Deep-Sea Fishes, 1887, p. 125 (in part).

Coelorhynchus parallelus JORDAN and GILBERT, Bull. U. S. Fish Comm., 1902 (1904), p. 618.—FRANZ, Abh. math.-phys. kl. k. Bayer. Akad. der Wissensch., vol. 4, Suppl. Bd. 1, 1910, p. 26.

Albatross station.	General locality.	Depth in fathoms.	Number of specimens.
4906	Eastern Sea.....	369-406	1
4908	.....do.....	434	1
4909	.....do.....	434	2

¹ Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 127, pl. 29, fig. 1.

² Alcock in Wood-Mason and Alcock, Ann. Mag. Nat. Hist. (6), vol. 8, 1891, p. 119; Alcock, Journ. Asiatic Soc. Bengal, vol. 63, pt. 2, 1894, p. 126; Illustrations of the Zoology of the *Investigator*, 1894, pl. 3, fig. 1; A Descriptive Catalogue of the Indian Deep-sea Fishes, 1889, p. 106.

Under side of head completely scaled; scales between the strong ridges of the head small, mostly with a single median keel, excepting a series of scales midway between the occipital and postorbital ridges.

Subopercle sharply produced downward and backward at its lower angle. Branchiostegals 6. Only 9 pyloric caeca, two-thirds as long as the eye.

Table of measurements in hundredths of length to anus.

Albatross station.....	4909	4909	4906	4908
Total length, mm.....	249	.....	104	83
Length to anus, mm.....	99	72	32	27
Length, head.....	69.5	73	76	79
Length, orbit.....	19	21	22	22
Width, interorbital.....	15.5	17	17	16
Width, suborbital.....	9	10	10	.....
Orbit to preopercle.....	23	23	26	.....
Length, maxillary.....	16.5	16.5	.....	19
Length, snout.....	30	32	30	33
Length, barbel.....	4	5	.....	.....
Depth, body.....	33	30	29	32
Width, body.....	28	.....	25	.....
Anus to anal.....	3	2.5	.....	.....
Anus to ventral.....	27	25	23	24
Ventral to isthmus.....	17	16	16	16
Height, second dorsal spine.....	26	.....	.....	.....
Length, first dorsal base.....	11	11	.....	.....
Interdorsal space.....	13.5	12.5	.....	.....
Length, pectoral.....	25	25	.....	.....
Length, outer ventral ray.....	25	27	.....	.....
Length, second ventral ray.....	12.5	15	.....	.....
Scales, above lateral line.....	5	5	.....	.....
Soft rays, first dorsal.....	8	8	.....	.....
Ventral rays.....	7	7	.....	.....
Pectoral rays.....	18	18	.....	.....

Genus ABYSSICOLA Goode and Bean.

Abyssicola GOODE AND BEAN, Oceanic Ichthyology, 1895, p. 417.

This genus is doubtless a close ally of *Coelorhynchus*, having the snout produced, the suborbital ridge continuous to the preopercle, the median rostral, occipital, and postorbital ridges present, and the dorsal spine smooth. *Abyssicola* differs from *Coelorhynchus* chiefly in dentition, having the teeth biserial in both jaws (crowded on sides of upper jaw) instead of in bands. The ridges of the head are weaker and the sides of the head much straighter, being much less angulated at the preorbital ridge. The sharp, backward projection of the subopercle at its lower angle and the strongly divergent ridges on the scales seem to place *Abyssicola* near those species of *Coelorhynchus* here referred to the subgenus *Oxymacrus*, but the snout is less produced and the anus more remote from the anal than in any species in that section of *Coelorhynchus*. The anus is preceded by a large naked fossa, containing a gland-like body covered by thickly pigmented tissue.

Only the type-species is known, and this is rather common off the east coast of Hondo.

18. ABYSSICOLA MACROCHIR (Günther).

Macrurus macrochir GÜNTHER, Ann. Mag. Nat. Hist. (4), vol. 20, 1877, p. 438; *Challenger* Reports, vol. 22, Deep-Sea Fishes, 1887, p. 148, fig. 29, fig. B. (off Enoshima, 345 fathoms).

Abyssicola macrochir GOODE AND BEAN, Oceanic Ichthyology, 1895, p. 417, pl. C, fig. 348.—JORDAN and SNYDER, Proc. U. S. Nat. Mus., vol. 23, 1900, p. 376 (off Tokyo; *Albatross*, 1896).—JORDAN and GILBERT, Bull. U. S. Fish Comm., 1902 (1904), p. 607 (Sagami Bay, *Albatross*, 1900).—FRANZ, Abh. math. phys. kl. k. Bayer. Akad. der Wissensch., vol. 4, Suppl. Bd. 1, 1910, p. 26.

<i>Albatross</i> station.	General locality.	Depth in fathoms.	Number of speci- mens.
4916.....	Eastern Sea	361	1
4957.....	Bungo Channel, off Kyushu.....	437	2
4958.....	do.....	405	1
5048.....	Off Matsushima Bay.....	129	29
5049.....	do.....	182	3

Owing to the incompleteness of the original description, five large specimens are here described, all more than 500 mm. long.

Width of body over pectoral bases 2.4 to 3 in length of head to upper angle of opercle. Head with subvertical sides, its width 2.1 to 2.3 in its length. Vertical diameter of orbit 0.8 the horizontal diameter, which is contained 3.3 to 3.7 times in head, an anterior crescent-shaped portion scaled, the iris yellow, about one-third as wide as pupil, membrane connecting iris with margin of orbit light brown, the two colors sharply contrasted. Interorbital region convex, not abruptly widened posteriorly, its width about equal to length of orbit; snout 3.25 to 3.6, conic and produced, the tip on a horizontal through middle of pupil; terminal and lateral tubercles little strengthened; median superior rostral ridge extending from tip of snout to past front of orbit; lateral ridges well marked, but feebly developed when compared to the ridge in *Coelorhynchus*, curved downward below the orbit, and extending to the preopercular angle, which is acutely produced backward, as in *Coelorhynchus*; occipital ridges converging rather strongly from both ends toward the middle of their length, the least width between them 2.5 to 3 in the interorbital width; margin of subopercle sharply produced downward and backward at its lower angle, opposite the end of the lower limb of the opercle, as in the subgenera *Oxymacrurus* and *Paramacrurus* of the genus *Coelorhynchus*; interopercle and subopercle concealed behind the preopercle. Barbel 5.5 to 7 in orbit. Mouth a little oblique, large, extending from below nostrils to beyond orbit; maxillary 2.3 to 2.4 in head; teeth biserial in both jaws,¹ crowded posteriorly in

¹ Teeth incorrectly described by Günther as being "coarsely villiform in a narrow band on the upper jaw, and in a single series in the lower."

upper jaw to form three series, the outer premaxillary series either larger or smaller than the inner series; teeth of inner mandibular series always enlarged, the outer series close to the inner series, as in *Nematonurus*. Six branchiostegals; gill membranes with a wide free fold; width of slit before first arch 1.6 to 1.7 in orbit, the slit behind last arch 2 to 2.5; gill-rakers tubercular.

Seven scales in a series from the origin of the second dorsal to the lateral line, 18 or 19 in a series from origin of anal to lateral line, counted obliquely forward and upward, exclusive of the lateral line scale. Scales on back and sides with 7 to 10 strongly divergent ridges, armed with retrorse spinules, the last of which does not project beyond the margin of the scale; those on belly smaller, with 3 to 5 ridges. Under side of head completely scaled excepting the gular and branchiostegal membranes. Nasal fossa less than half as long as orbit, and naked, with the exception of a few scales near its anterior end. Inner edge of shoulder girdle with cycloid scales near outer margin. The scales of the head are considerably differentiated in certain areas, and along the ridges, but are apparently not so highly differentiated as in *Coelorhynchus*. Those on the occipital ridges are little modified anteriorly, bearing about 5 divergent ridges, but become stronger posteriorly, the median ridge forming a strong keel, the lateral ones smaller, entirely obsolete on some scales; those on top of head with 3 to 7 divergent spinous ridges, becoming smaller anteriorly, being scarcely more than prickles between the indistinct rostral groove and the anterolateral margin of snout; median superior rostral ridge with a series of subquadrate scales, widening posteriorly, each armed with about ten rows of spinules radiating from near the center of the scale, the last spine pointed posteriorly; those on the lower half of cheeks, and on the under side of the head, similar to those on the belly, not being so greatly reduced as in *Coelorhynchus*; suborbital ridge sharp, accompanied above by one row of small scales before pupil, becoming smaller anteriorly, and by two series of large irregular scales from below pupil to preopercle; those on opercle and preopercle enlarged, bearing 7 to 12 ridges.

Twenty-nine and 31 pyloric caeca were counted in two southern specimens, and 29 in one northern specimen, the longest in each case shorter than the orbit.

Anus preceded by an oval black scaleless fossa. A large glandular body is located in the body wall, above this fossa. A similar fossa is found in some species of *Coelorhynchus*, in *Malacocephalus*, and in some species of the large genus *Lionurus*.

Color light brown, underlaid with silvery on the lower half of trunk and head, belly somewhat darker; ventrals blackish; other fins dusky, the first dorsal blackish near tips of rays. Young lighter in

color, with much more silver; fins light, ventral blackish near base only.

First dorsal spine small but sharp, compressed anteroposteriorly; the second spine rounded and smooth.

The specimens dredged in comparatively shallow water, off Matsushima Bay, greatly extend the northern limit of distribution of this species. They are evidently the young of *A. macrochir*; they differ from the southern specimens in the much lighter color, as described, and in the proportions of the head, having the eye larger, the snout longer, and the postorbital length of head shorter. These differences are assumed to be due to the difference in size between the northern and southern specimens, and are well illustrated in the tables of proportional measurements. The specimens from station 5048 are from 91 to 268 mm. long, 24 to 72 mm. to anus. A similar specimen, 19 mm. long to anus, was dredged in the Eastern Sea.

Tables of measurements in hundredths of length to anus.

SOUTHERN SPECIMENS.

<i>Albatross</i> station.....	(1)	(2)	4957	4957	4958
Total length, mm.....		+550	³ 570	554	634
Length to anus, mm.....	191	162	161	157	156
Length, head.....	75	71	72.5	73.5	71.5
Length, orbit.....	23.5	20.5	22.5	23	21.5
Width, interorbital.....	21.5	21.5	22.5	22.5	22
Width, suborbital.....	9	8			8.5
Orbit to preopercle.....	35	32.5	33	34.5	33
Length, snout.....	22.5	22	21.5	22	21
Length, maxillary.....	33	28	30.5	31.5	29.5
Length, barbel.....	4.5	3.5	4	4	3
Depth, body.....		47	50	49	49
Width, body.....	28.5	29	29	31	29.5
Anus to anal.....	10	11.5	12.5	12	13
Anus to ventral.....	20	18.5			20
Ventral to isthmus.....	27	25.5			29
Height, second dorsal spine.....			36	34	38
Height, third dorsal ray.....					
Length, first dorsal base.....	18	15.5	18	19	18
Interdorsal space.....	40.5	26.5	38	43.5	38
Height, second dorsal.....	9				
Height, anal.....	22				20
Length, pectoral fin.....		42.5			48
Length, first pectoral ray.....	3	3.5	3	3.5	4
Length, second pectoral ray.....			30	39	39
Length, third pectoral ray.....			38		40
Length, outer ventral ray.....	22	25	27.5	28	27.5
Length, second ventral ray.....	20	20	19.5		22.5
Soft rays, first dorsal.....	9	10	10	10	11
Ventral rays.....	7	7	7-8	7	7
Pectoral rays.....	18	18-17	18	18	17

¹ Tokyo market; K. Otaki; No. 8442, Stanford Univ. Museum.

² Sagami Bay, Japan; *Albatross*, 1900; No. 8307, Stanford Univ. Museum.

³ A pseudocaudal developed

NORTHERN SPECIMENS.

<i>Albatross station</i>	5049	5049	5049	5048	5048	5048	5048
Total length, mm.....	385	355	356	268	+150	134	91
Length to anus, mm.....	100	95	95	72	43.5	34	24
Length, head.....	76	74	76	74	76	78	76
Length, orbit.....	23	23	23	24	28	27	30
Width, interorbital.....	24	25	24	25	27	25	27
Width, suborbital.....	9	9	9	8.5	9	10	9
Orbit to preopercle.....	34	33	32	31	31	31	30
Length, snout.....	26	26	26	26	27	27	26
Length, maxillary.....	23.5	27	29	27	27	29	26
Length, barbel.....	4	3.5	4	4	5	4	.....
Depth, body.....	52	50	50	47	49	46	41
Width, body.....	29	33	32	30	31	29	28
Anus to anal.....	12	11	10	12	11	11	11
Anus to ventral.....	20	18	20	20	19	20	22
Ventral to isthmus.....	26	27.5	26	27	28	30	29
Height, second dorsal spine.....	.....	39	.....	40.5	43	.....	40
Height, third dorsal ray.....	.....	.....	.....	40	42	.....	.....
Length, first dorsal base.....	19	17	17	16.5	20	18	19
Interdorsal space.....	32	35	34	31	34	33	34
Length, pectoral fin.....	43	44.5	42.5	43	42	41	40
Length, first pectoral ray.....	.....	.....	.....	5	7	.....	.....
Length, second pectoral ray.....	.....	.....	.....	35	40	.....	.....
Length, third pectoral ray.....	.....	.....	.....	40	40	.....	.....
Length, outer ventral ray.....	29	27	30	31.5	36	37	41
Length, second ventral ray.....	23	.....	.....	26.5	26	.....	.....
Soft rays, first dorsal.....	11	9	10	9	10	10	10
Ventral rays.....	7	7	7	7	7	7	7
Pectoral rays.....	17	17	17	17	18	.....	.....

Genus HYMENOCEPHALUS Giglioli.

This genus is the most distinct of any in the subfamily. It is distinguished from all other Macrouroid fishes, with the exception of *Steindachneria argentea*, by the presence of ventral striae, consisting of fine parallel lines of dark, alternating with silvery, pigment, on the ventral areas of the body. There are invariably two "lens-shaped bodies," possibly photophores, on the mid-ventral line, one immediately before the anus and one before the ventrals, connected by a black ridge along the wall of the abdominal cavity. The large thin scales with weak spinules, the papery structure of the bones of the head, and the narrow pectoral are characteristic of *Hymenocephalus*. In several characters, *Hymenocephalus* resembles *Bathygadus* and its allies. Among these may be mentioned the large modified scales over the sensory canal on the side of the head, anterior to the origin of the lateral line; the large sensory canals; the anteroventral extension of the gill opening; the comparatively wide slit before the first arch; the numerous gill-rakers (more than 15 on the lower limb of the outer arch); the large lateral and subterminal mouth; the thin scales; the variation in the barbel, which is absent, rudimentary, or well developed in different species within each group. It resembles the *Bathygadus* group also in having seven branchiostegals, correlated with a posterior position of the anus, which is immediately before the anal fin.

The 13 known species are all fragile and small, less than 1 foot in length, and are confined entirely to tropical or subtropical waters.

19. HYMENOCEPHALUS STRIATISSIMUS (Jordan and Gilbert).

Hymenocephalus striatissimus JORDAN and GILBERT, Bull. U. S. Fish Comm., 1902 (1904), p. 612, text figure.

Albatross station.	General locality.	Depth in fathoms.	Number of specimens.
4897.....	Eastern Sea.....	207	1
4966.....	Off east coast of Hondo.....	244-290	1
4967.....	do.....	244-253	8
4968.....	do.....	253	4
5059.....	Suruga Gulf.....	197-297	1

The posterior of the two lens-shaped bodies is characteristically bilobed in this species.

The fins were all injured in the type-specimens. The height of the second dorsal spine is contained nearly 1.3 times in the head; third dorsal ray, 1.3; height of anal, 3.75; length of first articulated pectoral ray, 1.5; the second and longest, 1.4; length of outer ventral ray, 1.6, reaching to second anal ray; second ventral ray, 2.1, not nearly reaching to anus.

Shoulder girdle naked on inner edge.

Table of fin rays.

Albatross station.	First dorsal.	Ventral.	Pectoral.
4897.....	II, 8	8	15
4966.....	II, 9	8	15
4967.....	II, 9	8	16
4967.....	II, 8	8	14
4967.....	II, 8	8	14
4967.....	II, 8	8	14
4967.....	II, 8	8	14
4967.....	II, 9	8	14
4967.....	II, 9	8	14
5059.....	II, 8	8	13

Tables of measurements in hundredths of length to anus.

Albatross station.....	5059	4966	4897	4968	4968	4968
Total length, mm.....	160	170	159	170	183	178
Length to anus, mm.....	41	43	40.5	43	46	45
Length, head.....	63	66	63	63	63	61
Length, orbit.....	26	29	26	26	29	26
Width, interorbital.....	19	19	19	19	20	20
Width, suborbital.....	7.5	8	7	7	8	8
Orbit to preopercle.....	27	28.5	29	30	30	28
Length, snout.....	14	16	14	15	15	15
Length, maxillary.....	32	37	36	35	37.5	34
Length, barbel.....	10	11	10.5	10	9	10
Depth, body.....	48	49	50	44	47	43
Width, body.....	29	32	31	25	26	29
Anus to ventral.....	38					
Ventral to isthmus.....	41					
Height, second dorsal spine.....	50				51	
Height, third dorsal ray.....	50				49	
Length, first dorsal base.....	22	22.5	21	23	22	21
Interdorsal space.....	49	52	55	55	51	54
Height, second dorsal.....	10	10				
Height, anal (first ray).....	19	19.5	19	18	20	18
Length, first pectoral ray.....	3.5			3.5	3	
Length, second pectoral ray.....	41		40	38	40.5	39
Length, outer ventral ray.....	43	43	37	43	41	
Length, second ventral ray.....	32	31	30	32	32	31
Scales, above lateral line.....	3	3	3		3	
Gill-rakers, lower limb, second arch.....	20	19	18	18	20	

Table of measurements in hundredths of length to anus—Continued.

Albatross station.....	4967	4967	4967	4967	4967	4967	4967	4967
Total length, mm.....	129	137	127	134	141	131	160	144
Length to anus, mm.....	44	34	38	35.5	36	42	36	35
Length, head.....	62.5	63	63	67	66	68	69	63
Length, orbit.....	25	28	26	28	.....	25	29	29
Width, interorbital.....	.....	21	19	20	.....	20	20	20
Orbit to preopercle.....	30	30	29	31	.....	31	32	29
Length, snout.....	13	16	16	14	17	16	17	14
Length, maxillary.....	37	34	35	37	36	36	39	36
Length, barbel.....	11	11.5	9	12	12	11	11	14

20. HYMENOCEPHALUS LETHONEMUS (Jordan and Gilbert).

Hymenocephalus lethonemus JORDAN and GILBERT, Bull. U. S. Fish Comm., 1902 (1904), p. 615, text figure.

Albatross station.	General locality.	Depth in fathoms.	Number of specimens.
4918.....	Eastern Sea.....	361	2
4919.....	do.....	440	7
4968.....	Off east coast of Hondo.....	253	2
5059.....	Suruga Gulf.....	197-297	1
5060.....	do.....	197	2
5066.....	do.....	211-293	1
5067.....	do.....	293	2
5086.....	Sagami Bay.....	292	3
5093.....	Uruga Strait.....	302	2

The lens-shaped body just before the anus is round, as usual in the genus, or slightly oval transversely, but never bilobed, as in *H. striatissimus*.

Height of second dorsal spine, 1.4 in head; height of anal fin, 3.1; length of first articulated pectoral ray, 1.8, second and longest, 1.7; outer ventral ray nearly as long as head, and reaching to about twelfth anal ray, when unbroken; second ventral ray reaching the posterior lens-shaped body, 2.35.

Scales from the back, near base of dorsal, with about 24 sharp weak spines; those from the sides and belly appear entirely cycloid. Shoulder girdle naked on inner edge.

Table of Fin Rays.

Albatross station.	First dorsal.	Ventral.	Pectoral.
4919.....	II, 10	12	15
4919.....	II, 10	11	17
5060.....	II, 11	11	16
4918.....	II, 10	11	16
4918.....	II, 10	11	14
4968.....	II, 10	11	16
5066.....	II, 11	11	17
5086.....	II, 11	11	17
5086.....	II, 11	11	16
5093.....	II, 11	11	15

Table of measurements in hundredths of length to anus.

Albatross station.....	4919	5060	4919	4919
Total length, mm.....	180+	¹ 122	¹ 182	¹ 177
Length to anus, mm.....	49.5	45	50	49
Length, head.....	67	63	67	65
Length, orbit.....	23	20	20	19
Width, interorbital.....	19	20	20	20
Width, suborbital.....	9	9	9	8.5
Orbit to preopercle.....	29	30	30	29
Length, snout.....	20	19	22	19
Length, maxillary.....	35	33	36	34
Depth, body.....	45	40	40	43
Anus to ventral.....		33.5		
Ventral to gill membrane.....		37		
Height, second dorsal spine.....			58	51
Height, third dorsal ray.....		46		47
Length, first dorsal base.....	23	22	26	24
Interdorsal space.....	42	37	38	47
Length, first pectoral ray.....	2	4		
Length, second pectoral ray.....	40	37	35	33
Length, third pectoral ray.....	40	40	38	35
Length, outer ventral ray.....	70		59	
Length, second ventral ray.....		30	30	28
Gill-rakers, lower limb, second arch.....	18	19		

¹ A small pseudocaudal developed.

Genus MALACOCEPHALUS Günther.

Malacocephalus differs from *Lionurus*, and the other genera of the Coryphaenoidinae with seven branchiostegal rays, in the dentition and in the profuse branching of the numerous pyloric caeca. Teeth biserial in upper jaw; uniserial in lower jaw.

21. MALACOCEPHALUS NIPPONENSIS, new species.

Plate 9, fig. 2.

Type-specimen.—460 mm. long (a small pseudocaudal developed), from Albatross station 4967, off the east coast of central Hondo, at a depth of 244 to 253 fathoms; Cat. No. 76866, U.S.N.M.

Comparison of specimens from the Hawaiian Islands, Japan, and the Philippine Islands indicates the presence of three species in the Pacific Ocean, one in each locality mentioned. Although we have no specimens of *M. laevis*, the Atlantic species, it seems unsafe to identify any one of the Pacific species with it, as certain differences appear in the descriptions. The relationships of the species are indicated in the following key:

- a*¹. Snout short blunt and low, its bony tip on a horizontal through lower edge of pupil; preoral length of snout 3.7 in postorbital length of head; dorsal rays II, 10; pectoral rays, 16 or 17; fins uniformly dusky; teeth much stronger than in other species.....*M. species* (Philippine Is.).
- a*². Snout more pointed and higher, the bony tip on a horizontal through upper part of pupil; preoral length of snout, 2.2 to 2.5 in postorbital length of head.
- b*¹. Eye less than two-thirds postorbital length of head; ventral fins uniform blackish.
- c*¹. Dorsal rays II, 11 or 12; pectoral rays 17 or 18; ventral fossa (before anus) triangular, larger; pectoral more than half as long as head.

laevis.

- c*². Dorsal rays II, 10; pectoral rays 20; ventral fossa (before anus) smaller, round; interorbital wider than eye; pectoral less than half as long as head-----*nipponensis*.
- b*². Eye more than two-thirds postorbital length of head; ventrals with a light base and a blackish tip; dorsal rays II, 11 to 13; pectoral rays 19 or 20; ventral fossa round; interorbital narrower than eye; pectoral half as long as head-----*hawaiiensis*.

When compared directly with paratypes of *M. hawaiiensis*,¹ the type of *M. nipponensis* is found to differ in the following characters: The eye smaller, the head longer, especially the postorbital length; the interorbital wider; the maxillary longer; the snout longer; the spinules of the scales more numerous, more densely crowded and shorter; the soft dorsal rays fewer, 10, instead of 11 to 13; and in the uniform coloration of the ventral fin. These differences are brought out in the table of measurements, and have been verified in four comparable paratypes of *M. hawaiiensis*.

Nothing can be said of the relationships of *M. nipponensis* with the species found in the Indian Ocean, and identified with *M. laevis* by Alcock² and Brauer.³

Dorsal II, 10; ventral, 9; pectoral, 20; 15 scales above lateral line.

Contours of body little arched. Head rather pointed; snout high, its bony tip above middle of eye; preoral length of snout 2.2 in postorbital length of head; preocular length of snout 0.4 in head; orbit, 3.25; interorbital space wider than orbit; preopercular angle produced backward, the angle sharply rounded; mouth large, the maxillary half as long as head; teeth uniserial in lower jaw, becoming irregular at the symphysis, and similar to but less strongly curved than those of the outer premaxillary series, which is the stronger of the two premaxillary series; the teeth about as in *M. hawaiiensis*, but much smaller than in the Philippine species, the longest one-tenth as long as orbit; barbel slender, one-third the orbit; branchiostegals seven; about nine short, movable, spinigerous gill-rakers on the lower limb of the outer arch.

Scales small, with numerous (about 20 to 30) small, suberect spinules arranged in quincunx order in a diamond-shaped patch on each scale; these spinules more numerous, more crowded, and shorter than in either larger or smaller specimens of *M. hawaiiensis*. Anterior curve of lateral line low, about 1.5 times as long as the head. Gular membrane naked; a series of scales on the branchiostegal membrane over each ray; inner edge of shoulder girdle mostly scaled, as in the other Pacific species.

¹ Gilbert, Bull. U. S. Fish Comm., 1903 (1905), pt. 2, p. 677, fig. 265.

² Alcock, Ann. Mag. Nat. Hist. (6), vol. 4, 1889, p. 398, and (6), vol. 8, 1891, p. 123; A Descriptive Catalogue of the Indian Deep-Sea Fishes, 1899, p. 119.

³ Brauer, die Tiefsee-Fische, p. 270.

The numerous pyloric caeca are profusely branched. Anus midway between anal and ventrals. A small, round, naked fossa between ventrals, its diameter one-fourth that of orbit, separated by a scaly region from the oval naked area surrounding the anus.

The stomach contained the remains of the eyes of a cephalopod.

First dorsal spine sharp, the second spine 1.45 times as long as orbit, not greatly strengthened, its anterior edge rounded, separated by a well marked longitudinal groove from the rest of the spine; base of first dorsal nearly as long as the snout, about half the interdorsal space. Pectorals nearly half as long as head. Outer ventral ray as long as orbit, with a short filament.

Color light brown above, silvery on the sides, shading into blackish on belly. Lining of buccal cavity white; that of branchial cavity white, with a blackish band just within the narrow whitish border of the opercular membrane; gular membrane blackish; branchiostegal membrane gray, punctate; peritoneum silvery. Dorsal fins, ventral, and pectoral black; anal whitish, punctate, and margined with blackish.

Only the type known.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes, <i>M. hawaiiensis</i> .		
		4134	4134	4134
<i>Albatross station</i>	4967	4134	4134	4134
<i>Total length, mm</i>	1406	340+	330+	285+
<i>Length to anus, mm</i>	77	69	66	53
<i>Length, head</i>	92	85	84.5	86.5
<i>Length, orbit</i>	30.5	31	29	31
<i>Width, interorbital</i>	32	26	28	29
<i>Width, suborbital</i>	11	10	9	9
<i>Orbit to preopercle</i>	42	37	36	39
<i>Length, snout</i>	27	23	24.5	24
<i>Postorbital length, head</i>	43	35	36	36.5
<i>Length, maxillary</i>	47	40.5	40	42
<i>Length, barbel</i>	15	13.5	16	17
<i>Depth, body</i>.....	.....	74	71	84
<i>Width, body</i>	45	44	42.5	39
<i>Anus to anal</i> ¹	17	7.5	10	9
<i>Anus to ventral</i>	17	17	17	16.5
<i>Ventral to isthmus</i>	34	29	30	27
<i>Height, second dorsal spine</i>.....	.....	.....	52	.....
<i>Height, third dorsal ray</i>	44	.....	.....	.....
<i>Length, first dorsal base</i>	26	26	24.5	28
<i>Interdorsal space</i>	50	53	52.5	57
<i>Length, pectoral fin</i>	45	.....	.....	46
<i>Length, first pectoral ray</i>	4	4	4	6
<i>Length, second pectoral ray</i>	42	.....	.....	.....
<i>Length, third pectoral ray</i>	41	.....	.....	.....
<i>Length, outer ventral ray</i>	30	31	.....	.....
<i>Length, second ventral ray</i>	24	.....	.....	.....
<i>Soft rays, first dorsal</i>	10	13	12	11
<i>Ventral rays</i>	9	9	9	9
<i>Gill-rakers, lower limb</i>	9	7-8	7	9

¹ A pseudocaudal developed.

² In the figure of the type of *H. hawaiiensis* the anus is represented as remote from the anal as in the type of *M. nipponensis*.

Genus LIONURUS Günther.

Lionurus GÜNTHER, *Challenger Reports*, vol. 22, Deep-Sea Fishes, 1887, pp. 124, 141.—JORDAN and EVERMANN, *Fishes of North and Middle America*, vol. 3, 1898, p. 2592 (*flicauda*).

Nezumia JORDAN, in Jordan and Starks, *Bull. U. S. Fish Com.*, 1902 (1904), p. 620.—McCULLOCH, *Records Australian Mus.*, vol. 6, pt. 5, 1907, p. 34 (*condylura*).

?*Macruroplus* BLEEKER, *Typi non nulli generici piscium neglecti*, *Verslagen en Mededeelingen der k. Akademie van Wetenschappen*, Amsterdam, (2), vol. 8, 1874, p. 369; based on *Macrourus serratus* Lowe, a species not identified by other authors. Lowe's short description indicates that his species is probably referable to this genus. If *M. serratus* is ever recognized, and proves to belong to the present genus, the name *Macruroplus* must replace *Lionurus*.

This genus as here characterized is very extensive, including most of the species of Coryphaenoidinae which have seven branchiostegal rays. The other genera with seven branchiostegal rays are closely related to *Lionurus*. They are: *Malacocephalus*, *Mataeocephalus*, *Trachonurus*, and *Cetonurus*. The species of *Lionurus* vary within wide limits. On the one hand are species closely resembling *Malacocephalus*, with a large, subterminal mouth, the maxillaries more than one-third the length of the head, and other characters indicating a natural group. These species are as follows: *L. lucifer*, *L. nigromaculatus*, *L. atherodon*, *L. petersoni*, *L. occidentalis*, *L. garmani*, *L. ctenomelas*, *L. misakia*, and *L. macronema*. On the other hand is a series with a small mouth, the maxillaries being decidedly less than one-third the length of the head (except in *L. stelgidolepis*). At one end of this series of small-mouthed forms are the more typical species, such as *L. bairdii*, *L. aequalis*, and *L. sclerorhynchus*, with conical projecting snout and slender form, with the ventrals containing but few rays and located below the pectorals, and with the origin of the anal behind the first dorsal. At the other end of the series are species in which some or all of the following modifications are shown: Anterior profile of snout subvertical; form robust; base of first dorsal oblique; ventrals far anterior to pectorals; origin of anal under first dorsal base; and the ventrals with an increased number of rays. Two species, *L. parvipes* and *L. cetonuropsis*, are evidently related to *Cetonurops*, as discussed in detail in the description of *L. cetonuropsis*. Five species with smooth scales are grouped in the subgenus *Lionurus*, as originally proposed by Günther. Generic rank is not assigned them because the group is characterized only by the smooth scales (a character which may have been independently derived in the different species). Moreover, the scales of the head are spinigerous in *L. liolepis*.

The dorsal spine is smooth or weakly armed in the subgenus *Lionurus*. All the species of *Lionurus* with rough scales are provisionally

referred to the subgenus *Nezumia*, which was originally proposed to include species with an increased number of ventral rays. But the ventral rays vary in different species, with all intermediate numbers, from 5 to 17.

22. LIONURUS GARMANI (Jordan and Gilbert).

Coryphaenoides garmani JORDAN and GILBERT, Bull. U. S. Fish Comm., 1902 (1904), p. 610, text fig.—FRANZ, Abh. math.-phys. kl. k. Bayer. Akad. der Wissensch., vol. 4, Suppl. Bd. 1, 1910, p. 26.—JORDAN and THOMPSON, Mem. Carnegie Museum, vol. 6, pt. 4, 1914, p. 306.

Albatross station.	General locality.	Depth in fathoms.	Number of specimens.
4917.....	Eastern Sea.....	361	1
4966.....	Kii Channel.....	244-290	1
4967.....	do.....	244-253	4
4968.....	do.....	253	6
5048.....	Off Matsushima Bay.....	129	1
5054.....	Suruga Gulf.....	282	1
5059.....	do.....	197-297	3
5060.....	do.....	197	4
5062.....	do.....	250	2
5065.....	do.....	211-235	1
5066.....	do.....	211-293	1
5069.....	do.....	108-131	1
5072.....	do.....	148-284	1
5086.....	Sagami Bay.....	292	2
5088.....	do.....	369-405	1

Franz correctly counted 8 scales between the lateral line and the second dorsal spine, but stated that Jordan and Gilbert gave 5. The original description, however, expressly enumerates those "between the lateral line and the origin of the second dorsal," and these are $5\frac{1}{2}$ in number. A band of cycloid scales near margin of inner edge of shoulder girdle. Contrary to the original description, there is a naked fossa directly between the ventrals, but it is very much smaller than in *L. misakia* or in *Malacocephalus*. As usual, this fossa is separated from the naked area surrounding the anus by a scaly area.

The snout in our larger specimens is contained 3.7 to 4 times in the head; orbit, 2.8 to 3.25; interorbital, 3.3 to 3.6; barbel, 3.8 to 4.2; second dorsal spine, 1.25 to 1.33; outer ventral ray, 2.5 to 2.7; pectoral fin, 0.9 to 1.1 times length of snout plus orbit.

A specimen 87+ mm. long has about 4 spinules on the scales; one 138 mm. long has 6; another, 280 mm. long, has 18 to 22; the type, 292 mm. long, has 30 to 40. The spinules are strongest near the dorsal base.

The serrations on the dorsal spine are much coarser in small specimens; one 87+ mm. long has 3; one 138 mm. long has 12; 190 mm., 21; 232 mm., 41; a paratype, 255+ mm. long, has 49.

The sides, especially below the lateral line, and an area extending backward from below origin of second dorsal, are coarsely punctate

with dark brown chromatophores, similar to those covering the posterior sides of *L. misakia*, but finer.

Table of measurements in hundredths of length to anus.

								Paratypes, Sagami Bay.	
	5054	5059	5059	5059	5060	5066	5048	-----	-----
<i>Albatross station</i>	5054	5059	5059	5059	5060	5066	5048	-----	-----
Total length, mm.....	1255	1272	282	253	247	232	87+	263	190
Length to anus, mm.....	53.5	53.5	59.5	50	49	45	15	54	40
Length, head.....	85.5	85.5	83	88	87	86	88	86	83
Length, orbit.....	30.5	31	28	31	30	31	35	30	32
Width, interorbital.....	25.5	25.5	26	26	27	27	-----	24	26
Width, suborbital.....	11	10.5	10.5	12	10.5	10	-----	11	11
Orbit to preopercle.....	36	38	37.5	38	35	37	-----	38	37
Length, snout.....	23	-----	27	23	23	23	22	25	22
Length, maxillary.....	40	40	43	42	40	39	42	39	39
Length, barbel.....	23	24	23	23	23	25	22	24	26
Depth, body.....	76	78	72	76	74	77	-----	-----	72
Width, body.....	40	43	40	39	38	37	-----	41	38
Anus to anal.....	17.5	17	16	14	17	16	-----	16	14
Anus to ventral.....	11	13	13	13	13	13	-----	-----	-----
Ventral to isthmus.....	41	42	43	43	42	43	-----	-----	-----
Height, second dorsal spine.....	-----	-----	67	69	-----	70	-----	-----	-----
Height, third dorsal ray.....	-----	-----	-----	68	-----	68	-----	-----	-----
Length, first dorsal base.....	59	66	-----	-----	-----	-----	-----	-----	-----
Interdorsal space.....	26.5	31	25	29	26	26	-----	26	25
Height, second dorsal ray.....	59	59	61	55	56	51	-----	61	49
Length, pectoral.....	-----	8	-----	8	-----	8	-----	7.5	-----
Length, first pectoral ray.....	50	51	47	49	48	48	-----	48	48
Length, second pectoral ray.....	5	5	5	5	4	7	-----	3	4
Length, outer ventral ray.....	-----	-----	38	40	37	43	-----	37.5	-----
Length, second ventral ray.....	-----	37	32	34	33	36	-----	34	-----
Scales, above lateral line.....	28	30	30	30	27	26	-----	29	-----
Soft rays, first dorsal.....	-----	6	6	6	-----	6	-----	-----	-----
Ventral rays.....	11	12	11	10	10	11	12	11	10
Pectoral rays.....	8	9-8	8	9-8	8	8	8	9	9
Serrations, dorsal spine.....	20	20	21	21	23	21	-----	21	-----
Gill-rakers, lower limb, second arch.....	-----	-----	41	43	-----	43	3	-----	-----
	14	13	14	13	15	14	-----	-----	-----

¹ A pseudocaudal developed.

23. LIONURUS MISAKUS (Jordan and Gilbert).

Coryphaenoides misakius JORDAN and GILBERT, Bull. U. S. Fish Comm., 1902 (1904), p. 611, text fig.—JORDAN and THOMPSON, Mem. Carnegie Mus., vol. 6, pt. 4, 1914, p. 306.

Macrourus asper JORDAN and THOMPSON, Mem. Carnegie Mus., vol. 6, pt. 4, 1914, p. 306, pl. 38, fig. 2 (not *Coryphaenoides asper* Günther).

A single small specimen of this well-marked species is included in the present collection. The data for this specimen have been unfortunately lost. It is smaller than the type-specimens and differs from the type in several proportions, as shown in the table. These differences are doubtless due to the difference in size.

Shoulder girdle with cycloid scales near margin of inner edge.

Table of measurements in hundredths of length to anus.

	Type.	
Total length, mm.	340+	113+
Length to anus, mm.	80	30
Length, head.	85	90
Length, orbit.	30	41
Width, interorbital.	28	29
Width, suborbital.	10	12
Orbit to preopercle.	38.5	37
Length, snout.	21.5	.....
Length, maxillary.	35	38
Length, barbel.	4	4
Depth, body.	63	62
Width, body.	36	28
Anus to anal.	11.5	13
Anus to ventral.	11.5	13
Ventral to isthmus.	28	26
Height, second dorsal spine.	59	.....
Height, third dorsal ray.	59	.....
Length, first dorsal base.	22.5	22
Interdorsal space.	37	.....
Length, pectoral.	50	.....
Length, outer ventral ray.	31.5	.....
Length, second ventral ray.	28	.....
Soft rays, first dorsal.	11	11
Ventral rays.	8	8

24. LIONURUS CONDYLURA (Jordan and Gilbert).

Nezumia condylura JORDAN AND GILBERT, Bull. U. S. Fish Comm., 1902 (1904), p. 620, pl. 4, fig. 2.

<i>Albatross</i> station.	General locality.	Depth in fathoms.	Number of speci- mens.
4957.	Bungo Channel.	437	3
4972.	Kii Channel.	440	1
5059.	Suruga Gulf.	197-297	1
5060.	do.	197	9
5061.	do.	250-332	1
5062.	do.	250	2
5065.	do.	211-235	4
5066.	do.	211-293	4
5067.	do.	293	1
5086.	Sagami Bay.	292	2
5088.	do.	369-405	1

Table of fin ray counts.

<i>Albatross</i> station.	Soft rays, first dorsal.	Ventral rays.	Pectoral rays.
4957.	12	14-15	21-21
5059.	12	15-15	22
5059.	11	15-15	20-20
5060.	11	14-12	20-20
5060.	11	15-14	20-19
5062.	13	16-16	22-22
5062.	12	16-17	21-21
5065.	11	14-14	21-22
5065.	11	15-15	19-19
5067.	10	15-15	22-19
5086.	11	14-14	21-20
5086.	11	14-14	20-19

Table to show the variation, with size, of the number of spinules on the second dorsal spine, and of the average number of spinous ridges on the scales:

Total length, mm.	Spinules on dorsal spine.	Ridges on scales.
103	5	3
116	9	3
117	8	3
136	9	4
160	12	7
164	11	6
172	10	7
187	17	8
200	16	10
204	15	9

When the specimens listed in the foregoing table had an incomplete tail, the total length was estimated from specimens of similar length to anus.

A small naked fossa is present between the ventrals, separated by a band of scales from the naked area surrounding the anus.

The pyloric caeca in five specimens vary in number from 24 to 36. They are shorter than the orbit.

We find no series of cycloid scales along each side of the dorsal fin anteriorly, as mentioned in the type description. The scales in that area bear spinous ridges similar to those on neighboring scales. The lateral line rises anteriorly in the form of a rather strong arch, as long as the orbit plus the postorbital length of the head. Inner edge of shoulder girdle naked.

The specimens from deeper water than 350 fathoms (from stations 4957, 4972, and 5088) are more darkly colored than those from depths less than 300 fathoms.

This species differs from all other known Macrouroids, with the exception of three other species of *Lionurus*, in the increased number of ventral rays. A Hawaiian species, *L. gibber*,¹ has 12 or 13 rays, but differs greatly, among other characters, in having the ventrals far in advance of the pectorals. Another Hawaiian species, *L. propinquus*,² has 16 ventral rays, but differs in the deeper body, and the more oblique first dorsal base. An Australian species, *L. nigromaculatus*,³ is closely related to *L. condylura*, having 13 to 15 ventral rays, but has a much larger eye, which is contained $2\frac{1}{4}$ times in the head, instead of 3.

¹ *Macrourus gibber* Gilbert and Cramer, Proc. U. S., Nat. Mus., vol. 19, 1897, p. 426, pl. 44, fig. 2; Gilbert, Bull. U. S. Fish Comm., 1903 (1905), pt. 2, p. 668.

² *Macrourus propinquus* Gilbert and Cramer, Proc. U. S. Nat. Mus., vol. 19, 1897, p. 424, pl. 42, fig. 2; Gilbert, Bull. U. S. Fish Comm., 1903 (1905), pt. 2, p. 667.

³ *Macrourus nigromaculatus* McCulloch, Records Australian Mus., vol. 6, pt. 5, 1907, p. 347.

Table of measurements in hundredths of length to anus.

<i>Albatross station</i>	5067	5086	5059	5060	5065	5062	5060
<i>Total length, mm.</i>	205	¹ 180	¹ 187	¹ 204	186	184	187
<i>Length to anus, mm.</i>	42	41	39	45	36	37.5	36
<i>Length, head</i>	74	72	73	72	73	74	74
<i>Length, orbit</i>	24	24	23	24	26	27	25
<i>Width, interorbital</i>	19	18	19	18	18	17.5	20
<i>Width, suborbital</i>	11	11	11	10	11	12	12
<i>Orbit to preopercle</i>	27	29	28	28	29	28	29
<i>Length, snout</i>	21	21	21	20	21	21	20.5
<i>Length, maxillary</i>	23	24	23	24	26	25	25
<i>Length, barbel</i>	12.5	12	12	14	14	13	11
<i>Depth, body</i>	76	66	72	70	70	71	68
<i>Anus to anal</i>	16	17	-----	14	-----	14	13
<i>Anus to ventral</i>	18	19	-----	18	-----	18	19
<i>Ventral to isthmus</i>	32	33	30	33	39	35	30
<i>Height, second dorsal spine</i>	72	70	68	64	79	76	70
<i>Height, third dorsal ray</i>	67	66	62	60	76	70	-----
<i>Length, first dorsal base</i>	23	23	23	25	26	27	26
<i>Interdorsal space</i>	31	31	41	22	28	23	33
<i>Length, pectoral</i>	42	40	42	42	36	43	45
<i>Length, outer ventral ray</i>	50	55	50	51	55	55	57
<i>Length, second ventral ray</i>	27	23	28	29	26	26	30
<i>Scales, above lateral line</i>	11	11	11	11	11	11	11
<i>Serrations, dorsal spine</i>	16	16	15	16	13	18	13
<i>Gill-rakers, lower limb</i>	8	8	-----	-----	-----	-----	-----

¹ A pseudocaudal developed.

25. LIONURUS DARUS, new species.

Plate 10, fig. 1.

This species is represented only by the type-specimen, 132 mm. long; dredged at a depth of 197 fathoms, at *Albatross station* 5060, in Suruga Gulf, Hondo; Cat. No. 76867, U.S.N.M.

Dorsal II, 10; ventral, 9; pectoral, about 19.

Body robust; the greatest depth, below the origin of the first dorsal, 1.15 in head; width of body over pectorals less than half the depth. Origin of first dorsal high, on the crest of a sharp elevation of the dorsal contour; the base of the first dorsal very oblique. Ventral contour evenly and rather strongly curved. Tail very slender.

Head firm; the sensory canals comparatively little developed. Snout 3.7 in head, its anterior edge nearly vertical; tip of snout apparently with a scaleless groove just within each lateral margin, and armed with a strongly spined terminal tubercle. Lateral margins and lateral tubercles not prominent. Preopercular margin bluntly rounded, not projecting backward at angle, the ridge evenly rounded; a triangular portion of the interopercle visible behind preopercle; suborbital ridge rather sharp, rising forward at an angle of about 50 degrees; the median rostral ridge, and the two lateral ridges, which curve inward above the nostrils, are prominent (possibly due to shrinkage in alcohol); occipital crests convergent backward, meeting the supraoccipital crest, which extends backward to within a distance equal to length of snout from the origin of the dorsal. Orbit round, 3.1 in head. Interorbital, at its narrowest point above the anterior edge of pupil, 1.4 in orbit, widening rather abruptly posteriorly. Suborbital about half as wide as orbit. Mouth

located farther forward than usual, the maxillary scarcely extending to the vertical from front of pupil. Teeth rather coarse, in moderate bands on jaws, the outer premaxillary series enlarged. Barbel slender, two-thirds as long as the orbit. Branchiostegals 7. About 7 tubercular gill-rakers.

Eleven scales from origin of second dorsal to lateral line, excluding the lateral line scale. Scales round, with prominent concentric striae, armed with one to five long, slender, recumbent spinules (the number of spinules would probably be greater in larger specimens). The scales on the head and belly are smaller than on the sides. Lateral line rising anteriorly, forming a high curve, as long as the snout plus the orbit. Gular and branchiostegal membranes and inner edge of shoulder girdle naked.

First dorsal spine short, triangular, compressed; the second spine rather robust, broken in the type, the remaining portion, a little longer than the postorbital length of the head, with ten sharp serrations, which are small near the base of the spine; base of first dorsal about as long as the snout, equal to the interdorsal space; second dorsal low, little more than half as high as the orbital diameter; anal nearly three times as high as the second dorsal, its origin below the middle of the first dorsal base; pectoral 1.4 in head, inserted midway between the verticals from the origin of the dorsal and the insertion of the ventral; outer ventral ray with a filament reaching the eighth anal ray, the second ray extending about to origin of anal; ventral inserted anterior to the vertical from the origin of the first dorsal a distance nearly equal to the interorbital width.

Anus far forward, its distance from the base of outer ventral ray about two-thirds its distance from origin of anal; distance from ventral base to isthmus equal to orbit, about 0.9 the distance between the origin of the anal and the base of the ventral. A large naked area about anus, extending forward to between ventrals.

Body light brown, shading into blackish on belly; branchiostegal membranes brownish black; gular membrane and opercle with dark punctulations. First dorsal, pectoral, and the bases of a few of the anterior anal rays, dusky; ventral blackish, except for the light tips of the rays, including the filament; second dorsal and anal light. Buccal cavity light, a little dusky on roof of mouth, and just within the mandibular series of teeth; branchial cavity dusky under the opercles, with a narrow whitish border on the edge of the branchiostegal membranes, whitish on the membrane covering the hyoid arch; isthmus silvery, with large punctulations; peritoneum silvery, mottled with brownish.

This species is apparently not closely related to any East Indian or Japanese species, but closely approaches two Hawaiian forms: *L.*

ectenes (Gilbert and Cramer),¹ from which it differs in the lighter color and much smaller eye (2.4 in head in *L. ectenes*); and *L. hebetatus* (Gilbert),² from which it differs in the color, lacking the cross-bars, and in the fin formula (D. II, 12; V. 8; P. 24, in *L. hebetatus*).

(*Darus*, from "Dara," the Japanese name of certain Macrouroid fishes.)

26. *LIONURUS SPINOSUS*, new species.

Plate 10, fig. 2.

Type-specimen.—280 mm. long, from *Albatross* station 4915, in the Eastern Sea; depth, 427 fathoms; Cat. No. 76868, U.S.N.M.

Dorsal II, 10; ventral, 8; pectoral, 21.

Dorsal contour slightly and gently curved from tip of snout to origin of dorsal; base of first dorsal only moderately oblique; width of body over pectoral bases 1.8 in head; width of tail, near middle of its length, one-third its depth.

Head firm, the sensory canals little developed. Snout conic, its preocular length 3.4 in head, preoral length equal to diameter of orbit; a scaleless groove behind anterolateral margin of snout between the lateral and the terminal tubercles; a groove above the scale-row of the suborbital ridge; terminal tubercle strong, double, each half with about six rows of strong spines, arranged on a hemispheric base; lateral tubercles, and the margin of the snout between the tubercles with similar but smaller spines. Margin of preopercle a little curved, nearly vertical, its angle rounded; a triangular portion of the interopercle visible behind the preopercle; no ridges except the suborbital, which is little oblique and extends to below posterior margin of pupil. Orbit round, 3.7 in head. Least interorbital width, above middle of pupil, one-fourth length of orbit; least suborbital width 2.2 in orbit. Mouth wide, the maxillary as long as the snout, extending to below posterior margin of pupil. Teeth in wide villiform bands in jaws, the outer premaxillary series consisting of enlarged teeth, larger than usual in *Lionurus*, the longest 0.15 the length of orbit. Barbel slightly more than half as long as orbit. Seven branchiostegals. Seven tubercular gill-rakers on the lower limb of the outer arch.

Eight scales in a series from origin of second dorsal to the lateral line, not including the lateral line scale. Scales with long retrorse spinules, arranged in quincunx order, the longest frequently extending beyond the scale a distance equal to one-third the width of the scale. Those anterior to the dorsal and on the head (excepting the

¹*Macrourus ectenes* Gilbert and Cramer, Proc. U. S. Nat. Mus., vol. 19, 1897, p. 423, pl. 44, fig. 1; Gilbert, Bull. U. S. Fish Comm., 1903 (1905), pt. 2, p. 667.

²*Macrourus hebetatus* Gilbert, Bull. U. S. Fish Comm., 1903 (1905), pt. 2, p. 671, fig. 262.

opercular regions) with shorter, stronger, and more numerous spines; under side of head completely naked; inner edge of shoulder girdle naked; nasal fossa naked, its longer axis horizontal, 0.4 that of orbit; nostrils without raised edges. Lateral line rising anteriorly from below origin of second dorsal in a low convex curve.

First dorsal spine short, but comparatively well developed, its anterior portion conic, separated by a groove from the posterior portion, which is lower and much more compressed than the anterior portion; the second spine very long and slender distally, its length exceeding that of head by a distance equal to length of snout, armed with 16 widely and irregularly spaced serrations; base of first dorsal about as long as snout, 1.2 in interdorsal space; pectoral pointed, half as long as head; outer ventral ray with a filament extending to the seventh anal ray, the second ray extending to between anus and origin of anal.

Anus nearly midway between origin of anal and a line joining the ventral bases, preceded by a black naked area, which extends forward in a triangular shape to between ventrals. The anterior end of this scaleless area is occupied by a small round area covered with papillae. This structure is evidently homologous with the ventral fossa mentioned in the descriptions of other species.

Light brown on back and sides of trunk, and on tail; shading into black on belly. Branchiostegal membrane grayish-brown; gular membrane and under side of snout dusky; lining of buccal, branchial, and abdominal cavities black; no lighter margin on the branchiostegal membrane. Dorsal spine, and proximal half of soft rays of first dorsal blackish, the distal half of the soft rays white; second dorsal light; ventral black; pectoral and anal dusky.

Measurements of the type in hundredths of length to anus (64.5 mm.): Length of head, 73; length of orbit, 20; least interorbital width, 15.5; least suborbital width, 9; distance between orbit and preopercular margin, 24; length of snout, 22; length of maxillary, 22; length of barbel, 10; depth of body, 56; width of body over pectorals, 39; distance from center of anus to origin of anal, 13.5; anus to base of outer ventral ray, 16.5; base of outer ventral ray to isthmus, 26; height of second dorsal spine, 96.5; height of third dorsal ray, 68; base of first dorsal, 22; interdorsal space, 27; height of second dorsal, 9; height of anal, 20; length of pectoral, 37; length of outer ventral ray, 40; length of second ventral ray, 22.

L. spinosus differs from the following species, *L. proximus*, in the naked under side of the head; longer dorsal spine; longer spinules on scales; longer teeth in the outer premaxillary series; and in numerous other details.

Only the type known.

27. LIONURUS PROXIMUS (Smith and Radcliffe).

Macrourus proximus SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 119, pl. 26, fig. 2.

Macrourus nasutus JORDAN and GILBERT, in Jordan and Starks, Bull. U. S. Fish Comm., 1902 (1904), p. 618 (the specimen from off Izu; not *Coryphaenoides nasutus* Günther).

Albatross station.	General locality.	Depth in fathoms.	Number of specimens.
4915.....	Eastern Sea.....	427	1
4918.....	do.....	361	1
4957.....	Bungo Channel.....	437	1
4958.....	Off Shio Misaki.....	253	1
4977.....	do.....	544	1
4980.....	34° 09' N., 137° 55' E.....	507	6

Careful comparison of our material from southern Japan with the type and two paratypes from the Philippine Islands, has disclosed no constant differences.

This species bears a strong superficial resemblance to *Coryphaenoides nasutus*, with which it was dredged at several stations. This close resemblance has led to the identification by Jordan and Gilbert of a specimen of *L. proximus* from off Izu with *C. nasutus*. Smith and Radcliffe were likewise misled by the similar appearance of the two forms, stating in the description of this species that it is closely related to *C. nasutus*, and the name *proximus* was evidently applied because of this supposed relationship. Alcock¹ similarly confused his *Macrurus brevirostris*, a species of *Lionurus*, with *C. nasutus*. But *C. nasutus* differs generically from both the above in having 6 instead of 7 branchiostegal rays, and in the posterior position of the anus.

L. proximus differs from the descriptions of *L. brevirostris*, from the Indian Ocean, in having 9 (rarely 8 or 10) ventral rays, instead of 10, and in the shorter dorsal spine, which is much shorter instead of longer than the head.

The eye is much longer in the young than in the adult, as shown in the tables of measurements; its decrease in relative size with age being more pronounced than usual.

The position of the anus is highly variable in this species. The distance from the ventral to the anal is especially great in the specimen from Izu. The naked area does not extend forward to the ventrals, and no fossa is apparent.

¹ Alcock, Ann. Mag. Nat. Hist. (6), vol. 4, 1889, p. 393; Journal of the Asiatic Society of Bengal, vol. 63, pt. 2, 1894, p. 127; Illustrations of the Zoology of the Investigator, Fishes, 1894, pl. 13, fig. 3; A Descriptive Cat. of the Indian Deep-Sea Fishes in the Ind. Mus., 1899, p. 108 and 111. Brauer, die Tiefsee-Fische, p. 263; Sewell, Rec. Ind. Mus., vol. 7, 1912, p. 9.

The spinules of the scales are in quincunx order, increasing in number with age, becoming densely crowded in the adult. The individual spines vary in shape in different specimens, being either conic or hastate.

Inner edge of shoulder girdle almost completely naked.

Pyloric caeca long and slender, nearly as long as postorbital length of head, 24 and 29 in number in two Japanese specimens counted.

Color dark brown; the entire abdominal region blackish; peritoneum silvery, with brown spots.

Table of measurements in hundredths of length to anus.

	Japan.					Philippine Islands.		
						Type.	Paratypes.	
<i>Albatross station</i>	¹ Izu	4977	4915	4968	4918	5202	5201	5527
<i>Total length, mm.</i>	312+	² 216	226	124+	133	² 283	249	210
<i>Length to anus, mm.</i>	69	66.2	49.7	32.5	25	77	55	55
<i>Length, head</i>	79	71	73	76	80	74	76	81
<i>Length, orbit</i>	26	21	26	28.5	28	21	22	23
<i>Width, interorbital</i>	16	17	15	18.5	18	14	17.5	19
<i>Width, suborbital</i>	11	11	10	10	10	10	11	11
<i>Orbit to preopercle</i>	29	26.5	26	24	28	29	27.5	31
<i>Length, snout</i>	23	21	22	23.5	26	22	22.5	25
<i>Length, maxillary</i>	25	23	21	.....	26	25	24	26
<i>Length, barbel</i>	17.5	16	11	12	.....	15	13	14
<i>Depth, body</i>	52	56	51	44	.....	59	60	56
<i>Width, body</i>	38	35	29	23.5	30	29	.....	.....
<i>Anus to anal</i>	26	23	17	20	13	17	17	17
<i>Anus to ventral</i>	24	15	16	18	13	15	13	14
<i>Ventral to isthmus</i>	30	27	30	.....	27	30.5	26	28
<i>Height, second dorsal spine</i>	62	66.5	66	71	71	69	62	74
<i>Height, third dorsal ray</i>	56	61	.....	.....	.....	62	.....	67.5
<i>Length, first dorsal base</i>	19.5	20.5	21	19.5	22	23	21	22.5
<i>Interdorsal space</i>	31	26	31	.....	.....	27.5	32	34
<i>Length, pectoral</i>	41	37	38	.....	40	41.5	38	40
<i>Length, first pectoral ray</i>	5.5	4	6	.....	.....	.....	.....	.....
<i>Length, second pectoral ray</i>	34	29	30	.....	.....	.....	.....	.....
<i>Length, third pectoral ray</i>	40.5	34	37	.....	.....	.....	.....	.....
<i>Length, outer ventral ray</i>.....	.....	.....	34	.....	50	39	45	42
<i>Length, second ventral ray</i>	28	.....	25	.....	31	27	28	29
<i>Scales, above lateral line</i>	7	8	8	.....	8	8	8	8
<i>Soft rays, first dorsal</i>	9	10	9	9	10	9	11	10
<i>Ventral rays</i>	10-8	9	9	9-10	8	9	9	9
<i>Pectoral rays</i>	20	20	20	.....	19	18	19	19
<i>Serrations, dorsal spine</i>	13	18	12	9	6	.....	18	17

28. LIONURUS CETONUOPSIS, new species.

Plate 11, fig. 1.

This interesting species is very close to a Philippine species, *L. parvipes* (Smith and Radcliffe).³ These two species are apparently related to *Cetonurus*, as their common characters indicate. Among these may be mentioned the following: Body rather robust; snout very high and broad, intermediate in form between typical *Lionurus* and *Cetonurus*; suborbital ridge comparatively well marked; scales small, hispid with suberect spinules, much as in *Cetonurus*; external groove

¹ Izu, Japan; a specimen sent to Stanford University from the Imperial University; No. 8302, Fish Collections, Stanford University (see synonymy).

² A pseudocaudal developed.

³ Proc. U. S. Nat. Mus., vol. 43, 1912, p. 124, pl. 28, fig. 1.

along lateral line somewhat interrupted; bones of head rather soft, intermediate in condition between *Lionurus* and *Cetonurus*. These species have 5 or 6 ventral rays, while all other species of *Lionurus* and of *Cetonurus* have 7 to 17.

Type-specimen.—A mature female, 58 mm. long to anus; *Albatross* station 5084; 918 fathoms; off east coast of Hondo; Cat. No. 76869, U.S.N.M.

Dorsal, II, 9; ventral, 6; pectoral, 18; 11 scales between lateral line and origin of second dorsal.

Body more robust than in *L. parvipes*, the depth below origin of dorsal 1.25 in head; trunk more compressed than usual, the width across pectoral bases 2.4 in head; tail slender, and less strongly compressed than usual, rather sharply constricted behind anus; depth 2.7 in head at a point twice length of head from tip of snout; width of tail about half its depth anteriorly, two-fifths its depth posteriorly; first dorsal base oblique; sides of head vertical and nearly parallel behind anterior margin of orbit; anterolateral angles of snout prominent, on a vertical passing slightly in front of tip of premaxillary, and on a vertical passing through upper part of pupil; distance between lateral angles slightly greater than the interorbital width, and nearly equal to length of snout; snout 2.59 in head, broadly triangular before the lateral prominences, the terminal angle, viewed from above, being 110 degrees; tip of snout high, on a horizontal passing between the pupil and the upper orbital margin; preoral length of snout 3.9 in head, equal to vertical depth of snout above tip of premaxillaries; suborbital ridge distinct, curved, and oblique, its length 2.25 in head, both its ends free, not extending to preopercle nor lateral prominence of snout; free margin of preopercle not adnate, extending downward and backward to the evenly curved angle; in no place entirely overlapping the subopercle or interopercle, leaving a narrow margin of interopercle visible; preopercular ridge strongly produced backward in a semicircular form, its upper vertical portion, above the curve, short, 1.6 in orbit; orbit nearly round, its longitudinal diameter 4 in head; interorbital convex, 3.1 in head; suborbital angulated at ridge, its least width 1.8 in orbit; mouth oblique, the maxillary extending to below anterior third of pupil; teeth in bands on jaws, the outer premaxillary series slightly enlarged; barbel slender and short, 4.5 in orbit; nostrils in an oval naked fossa, one-third as long as orbit; the posterior margin of the small circular anterior nostril elevated; scaleless groove parallel to anterolateral margin of snout, scarcely developed; head soft, the sensory canals comparatively greatly developed. Branchiostegals 7; 9 tubercular gill-rakers on lower limb of second arch; slit before first arch constricted, 2 in orbit, slit behind fourth arch, 3.

Scales small; those along base of vertical fins not enlarged; spinules curved, suberect, in quincunx order, 10 to 15 on each scale on sides of trunk; scales of head irregular, their boundaries rather difficult to determine, their spinules erect, becoming stronger on snout, but there are no spinous tubercles; under side of head completely scaled; gular and branchiostegal membranes, and anterior part of mandibles, naked; inner edge of shoulder girdle completely naked. Lateral line with a very short anterior arch, one-fourth as high as long, its length 2.25 in head.

Distance from occiput to origin of dorsal 2.15 in head. First dorsal spine broadly triangular, compressed, sharp, with an indistinct longitudinal groove; the second spine 1.6 in head, its anterior edge trenchant, armed with strong, widely spaced serrations, 6 on proximal two-thirds of spine, about 10 in all; last four dorsal rays unbranched; length of first dorsal base half the interdorsal space, and equal to distance between lateral and terminal angles of snout; second dorsal low. Origin of anal slightly behind vertical from end of first dorsal. Pectoral pointed, 1.95 in head, the rays slender; base of pectoral in front of origin of dorsal. Ventral small, with six weak rays, the outer one with a short slender filament which reaches to anus; ventral inserted anterior to pectoral and anterior to end of opercle.

Distance from center of anus to origin of anal less than usual in *Lionurus*, being only half the distance from the anus to base of outer ventral ray. Anus surrounded by a black naked area, two-thirds as long as orbit; no other naked areas on breast.

Color in alcohol light brown on back and sides, shading into bluish black on belly; head gray, with a large blackish opercular patch; branchiostegal membranes black, without a light inner margin; gular membrane and lips blackish; lining of buccal, branchial, and abdominal cavities black.

L. cetonuropsis differs from *L. parvipes* in the shorter dorsal spine (length 0.51 of length to anus, instead of 0.58 to 0.64), with fewer stronger serrations; the much lighter color, especially of the head and fins, which are pale instead of dusky; the weaker spinules on the scales; the somewhat stronger dentition; the shorter, blunter head; the narrower suborbital (0.115, instead of 0.13 to 0.16 of length to anus). These differences have been verified in each of the six Philippine specimens of *L. parvipes*.

One young specimen, in poor condition, 20 mm. long to anus, was dredged with the type.

Table of measurements in hundredths of length to anus.

	Type.	<i>L. parvipis.</i>					
		Type.	Paratypes.				
<i>Albatross station</i>	5084	5636	5609	3608	5609	5636	5670
<i>Total length, mm</i>	268	1 218	1 284	1 274	283	308	210
<i>Length to anus, mm</i>	58	65	72	48			
<i>Length, head</i>	77.5	81	79	86			
<i>Length, orbit</i>	21	20	20	22			
<i>Width, interorbital</i>	27	25	24	29			
<i>Width, suborbital</i>	11.5	14	13	16			
<i>Orbit to preopercle</i>	30	30	29	31			
<i>Length, snout</i>	27.5	28	25	31			
<i>Length, maxillary</i>	22.5	22	20	26			
<i>Length, barbel</i>	5	3	5.5	8			
<i>Depth, body</i>	61	57		64			
<i>Width, body</i>	31	30					
<i>Anus to anal</i>	11	8	12	7			
<i>Anus to ventral</i>	21.5	20	23	18			
<i>Ventral to isthmus</i>	20	18	20.5	18			
<i>Height, second dorsal spine</i>	51	60		64			
<i>Length, first dorsal base</i>	16.5	16	13	18			
<i>Interdorsal space</i>	31	36	31	41			
<i>Length, pectoral</i>	42						
<i>Length, outer ventral ray</i>	22	24					
<i>Length, second ventral ray</i>	22						
<i>Scales, above lateral line</i>	11	11	11	12		10	
<i>Soft rays, first dorsal</i>	9	8	7	8	8	8	11
<i>Ventral rays</i>	6	6	6-5	6			6
<i>Pectoral rays</i>	18	17	17	18		19	
<i>Serrations, dorsal spine</i>	10	27		13	19	18+	

¹ A pseudocaudal developed.

29. TRACHONURUS VILLOSUS (Günther).

Coryphaenoides villosus GÜNTHER, Ann. Mag. Nat. Hist., ser. 4, vol. 20, 1877, p. 441.

Macrurus villosus GÜNTHER, Challenger Reports, vol. 22, Deep-Sea Fishes, 1887, p. 142, pl. 36, fig. B.—BRAUER, die Tiefsee-Fische, 1906, p. 268.

This species was frequently dredged in Japan, but only four specimens are preserved, the loss of specimens being largely due to the soft character of the flesh.

Description of a fine specimen 455 mm. long (a small pseudocaudal developed), dredged in 505 fathoms, off the east coast of Hondo, at *Albatross station* 5080.

Body sharply compressed, tapering to a longer and slenderer tail than usual, which is narrowly oblong in cross-section, its width near middle 3.6 in its depth; width of body over the pectoral bases 1.8 in the greatest depth, which is contained 1.2 times in the head. Ventral contour gently curved; base of first dorsal not greatly elevated anteriorly; interorbital flat, wide, and widening rather rapidly posteriorly, its least width 3 in head; snout subconic, bluntly pointed, as long as orbit, its blunt lateral angles near vertical from front of premaxillaries; mouth large, the maxillaries extending to below posterior border of pupil, equal to width of interorbital, larger in the

young (see tables); teeth in moderate villiform bands in jaws, the outer premaxillary series not enlarged; orbit one-fourth length of head, with an irregular outline; least suborbital width 2.2 in orbit; distance from orbit to margin of preopercle equal to interorbital width; no prominent ridges nor tubercles; interopercle widely exposed, in no part covered by preopercle; posterior margin of anterior nostril elevated and forming a well-marked flap; barbel shorter than pupil; branchiostegals, 7; gill-rakers tubercular; gill slit before first arch half length of orbit, about as wide as the slit behind the fourth arch.

Fourteen pyloric caeca about as long as the snout.

Five scales between middle of first dorsal and lateral line, 6 below origin of second dorsal (not including the lateral line scale); 25 from lateral line to origin of anal. Those along anterior portion of dorsal and anal bases enlarged. Scales diamond-shaped and nonimbricate, each with 10 to 16 large, suberect spinules, strongest on a series of scales along the bases of the vertical fins. Lateral line forming a low, convex curve anteriorly. A naked area behind pectoral, extending upwards and forwards. Rami of mandibles, the gular membrane, and the anterior part of branchiostegal membranes scaled; a single scale located on the branchiostegal membrane on each side, opposite the upper angle of interopercle (also present in the smaller specimen, 225 mm. long); a few extending on base of second dorsal spine, surrounding the first spine; inner edge of shoulder girdle completely naked.

First dorsal spine almost concealed; the second entirely smooth, slender, rounded on its anterior edge, its length 1.6 in head; last three dorsal rays unbranched; base of first dorsal 1.3 in orbit, 1.6 in interdorsal space; height of second dorsal rays about half the orbit. Longest anal rays 3.5 in head. Length of pectoral 2.25. Filament of outer ventral ray reaching to fifth anal ray, the second ray nearly reaching anal; ventral inserted below first dorsal base, further back than usual.

Distance from anus to base of outer ventral ray equal to orbit, twice that from anus to anal; distance from ventral to isthmus 1.7 in head. Area between ventrals and anal naked.

Body dark brown; fins, belly, and lining of buccal cavity dusky; lining of branchial cavity black, without a light margin on opercular membrane; peritoneum black.

A smaller specimen, 225 mm. long, 51 mm. to anus, from *Albatross* station 4971, in 649 fathoms, off the east coast of central Hondo, differs from the larger specimen, just described, as follows: snout 1.2 in orbit; maxillary reaching to below middle of pupil; teeth coarser;

orbit 3.3 in head; nostril flap shorter; 4 to 6 spinules on scales of body; an additional naked area, as in *T. sentipellis*,¹ the Hawaiian species, located at the upper angle of the preopercle; second dorsal spine half as long as head; base of first dorsal 1.3 in interdorsal space. A still smaller specimen, 131 mm. long, 26 mm. to anus, also from station 4971, has only 1 to 4 spinules on the scales; the teeth coarser; and the opercle with a sharp but weak spine at the end of each limb.

Günther's short description evidently errs in stating that the second dorsal begins immediately behind the first, and the mouth is probably described and figured too small.

T. villosus differs from *T. sentipellis*, the Hawaiian species, in having the gular membrane scaled, and in certain proportions, as indicated in the following table:

Table of measurements in hundredths of length to anus.

	<i>T. villosus.</i>			<i>T. sentipellis.</i>			
	5080	4971	4971	(²)	(²)	(²)	³ 3474
Albatross station.....	5080	4971	4971	(²)	(²)	(²)	³ 3474
Total length, mm.....	4455	225+	131	250	255		
Length to anus, mm.....	103	51	26	66	56	33	
Length, head.....	69	73		74	76	74	
Length, orbit.....	17.5	22	25	22	23	26	
Width, interorbital.....	23	25	21	25.5	23	21	
Width, suborbital.....	8	9		9	8	9	
Orbit to preopercle.....	23	23		25	25	23	
Length, snout.....	17.5	19		18	18	17	
Width, snout, at base.....	24	24		26	24		
Length, maxillary.....	24.5		26	21	24	27	
Length, barbel.....	6			9	8		
Depth, body.....		56	44	60	60	49	
Width, body.....	36	28		43	36		
Anus to anal.....	7.5	10		6	7	6	
Anus to ventral.....	15.5	16		11.5	13	20	
Ventral to isthmus.....	41	43		39	36	37	
Height, second dorsal spine.....	43	39	36	46	43	37	
Height, third dorsal ray.....	37						
Length, first dorsal base.....	13	16		12	17	16	
Interdorsal space.....	24	22		17	12		Longer.
Length, pectoral.....	31			32	33		
Length, outer ventral ray.....	27.5						
Length, second ventral ray.....	21			22	21		
Scales, above lateral line.....	6	6		6	6	6	6
Soft rays, first dorsal.....	8	9	8	7	7	8	7
Ventral rays.....	7	7		7	7	7	7
Pectoral rays.....	15	16		16	15		

30. CETONURUS ROBUSTUS, new species.

Plate 11, fig. 2.

The genus *Cetonurus* is fully defined in the key to the subfamilies and genera.

C. robustus is apparently closely related to *C. crassiceps* (Günther),⁵ known from a single specimen taken by the *Challenger* north

¹ Gilbert and Cramer, Proc. U. S. Nat. Mus., vol. 19, 1897, p. 429, pl. 45, fig. 1; Gilbert, Bull. U. S. Fish Comm., 1903 (1905), pt. 2, p. 679.

² Hawaiian Islands; *Albatross*, 1902.

³ Paratype.

⁴ A pseudocaudal developed.

⁵ *Corphacnoides crassiceps* Günther, Ann. Mag. Nat. Hist., ser. 5, vol. 2, 1878, p. 25.

Macrurus crassiceps Günther, *Challenger* Reports, vol. 22, Deep-Sea Fishes, 1887, p. 143, pl. 37.

of the Kermadec Islands, at a depth of 520 fathoms. It differs from Günther's description in the larger eye, 4 to 4.5, instead of less than 5, in head, more than half the postorbital length of head; in the less sudden constriction of the tail from the trunk; in the smaller mouth, the maxillaries not extending beyond eye; and in the distinct serrations of the dorsal spine. Günther's figure shows the ventrals nearly twice as long as the orbit, while they are less than half the orbit in *C. robustus*. The Japanese species is also very close to the Atlantic species, *C. globiceps* Vaillant,¹ but differs from a specimen referred to that species from the east coast of South America in the absence of enlarged scales along the anterior base of anal; in the squamation of the gular membrane, which is naked in the Atlantic specimen; in the more numerous and much stronger spinules on the scales, especially on the enlarged scales along the dorsal base; in the absence of an area with enlarged scales near origin of anal; and in the more widely spaced scales on the head. Its relationships with the Atlantic species, *C. microps* Vaillant,² are unknown.

Type-specimen—more than 285 mm. long (tip of tail broken), 765 mm. to anus; dredged at a depth of 649 fathoms off the east coast of central Hondo, at *Albatross* station 4971. Cat. No. 76870. U.S.N.M.

Dorsal, II, 9; ventral, 10; pectoral, 17.

Body robust, very deep, and strongly compressed, especially compressed toward the belly. Depth of body over base of ventrals, 1.22 in head; under origin of dorsal, 1.3; over fifteenth anal ray, 2.5; at a vertical twice length of head behind tip of snout, 3.9. Width of body over base of pectorals, 3 in head; just behind pectorals, 4.65; width one-third the depth of the slender tail, measured behind the robust anterior portion. Dorsal contour rising in an even curve to origin of first dorsal, the base of which is oblique, the anterior end being higher than the posterior end by a vertical distance half as long as the base of fin.

Sides of head vertical, without projecting ridges; anterolateral angles of snout prominent, slightly anterior to a vertical from front of premaxillaries, and on a horizontal passing through eye between pupil and upper orbital margin; distance between lateral angles and eye 1.8 in orbit; distance between lateral angles greater than the interorbital width or the length of the snout, equal to postorbital length of head; snout broadly triangular in front of lateral angles, its preoral length equal to its preocular length, 3 in head; the tip of snout on a horizontal passing through upper margin of orbit; orbit nearly round, 4 in head, 1.6 in postorbital length; inter-

¹ *Macrurus globiceps* Vaillant, in Filhol, *La Nature*, No. 560, Feb. 23, 1884, p. 199.

Hymenocephalus crassiceps Vaillant, *Expéd. Sci. du Travailleur et du Talisman*, Poissons, 1888, p. 214, pl. 20.

Hymenocephalus globiceps Vaillant, *idem.*, p. 386.

² *Bull. Mus. Monaco*, No. 41, 1905, p. 3; name only.

orbital wide, 2.5 in head, its sides parallel; least suborbital width 1.25 in orbit, its ridge bluntly angulated transversely, horizontal below posterior half of orbit, rising abruptly anteriorly toward anterolateral rostral angle; margin of preopercle evenly curved, almost completely adnate to subopercle and interopercle, which it fails to cover at any point; preopercular ridge produced backward as a semicircular arch, the chord of which is contained 1.25 in orbit. Mouth oblique, the maxillary extending to below middle of eye, 3.75 in head. Teeth small, confined to anterior half of jaws; the premaxillary band narrow, the outer series scarcely enlarged; the mandibular band very narrow, not more than two or three scales deep at any point; barbel short and slender, 0.15 of the orbit; nostrils in a round naked fossa, about one-third as long as orbit; scaleless groove parallel to anterolateral margin of snout very narrow, but distinct. Branchiostegals 7; gill-rakers tubercular; gill slit before first arch, and that behind fourth arch, each about one-third as long as orbit.

Pyloric caeca very short, only half as long as orbit, 9 in number in a paratype.

Scales small, 14 in a series from origin of second dorsal to lateral line, 38 from anal origin to lateral line; scales in rather irregular series on body, nonimbricate on the head. Those on the body bear long, curved, and suberect spinules arranged in quincunx order, 5 to 12 on each scale on trunk, about 5 on each scale on head, similar to those on body. Terminal tubercle of snout comparatively weak, rounded, armed with conic spinules; lateral tubercles indistinct. A series of enlarged scales along base of second dorsal, armed with very strong spinules. Lateral line with the external groove obsolescent or concealed, opening through a series of widely spaced black papillae extending along middle of tail, slightly rising anteriorly, but not forming an arch, a line of similar papillae extending from origin of lateral line backward near dorsal base; scattered papillae near anal base; one constantly present, located vertically below origin of dorsal a distance contained 2.5 times in orbit; a series of papillae extending forward from first dorsal on each side, near dorsal contour. Median line of gular membrane scaled; branchiostegal membrane naked; inner edge of shoulder girdle completely naked.

First dorsal spine small but sharp, without a longitudinal groove, the anterior edge rounded; second spine rather strong at base, filamentous at tip, about half length of head, its anterior edge trenchant, and armed with 21 small, procumbent serrations (stronger in some of the paratypes); base of first dorsal 1.9 in interdorsal space, 1.3 in orbit; second dorsal low, the longest rays 3 in orbit. Origin of

anal scarcely behind end of first dorsal. Pectoral 2.6 in head (in a paratype), inserted below first dorsal. Outer ventral ray scarcely filamentous, just reaching anus, 1.33 in orbit; ventral inserted anterior to end of opercle.

Anus less removed from anal than usual in the group of genera to which *Cetonurus* belongs; distance from center of anus to origin of anal one-third its distance from base of outer ventral ray; distance from ventral to isthmus equal to length of orbit. A naked area, two-fifths as long as orbit, surrounding anus, and extending to anal fin; no other naked areas on breast.

Color of body light brown, shading into blackish on belly; head grayish; opercles, lips, and mandibles dusky; gular and branchiostegal membranes black; lining of buccal and branchial cavities black, without light margins; peritoneum black.

Four paratypes from *Albatross* station 4971, at which the type was dredged, and one small paratype from station 4973, near the type locality at a depth of 600 fathoms.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.				
		4971	4971	4971	4971	4973
<i>Albatross</i> station.....	4971	4971	4971	4971	4971	4973
Total length, mm.....	285+	279+	288+	265+	252+	116+
Length to anus, mm.....	76.5	77.7	76	62	57.2	ca38
Length, head.....	78	80.2	81	79	85.5	.....
Length, orbit.....	22.5	20.7	23	22	23.5	.....
Width, interorbital.....	30	31	32	31	33.5	.....
Width, suborbital.....	20	21.6	22.5	22.5	24.5	.....
Orbit to preopercle.....	33	34.2	34.3	33	36	.....
Length, snout.....	27	29	27	30	31	.....
Length, maxillary.....	21.7	23	24.5	25	25.5	.....
Length, barbel.....	3	3.5	2.3	3.5	.....	.....
Depth, body.....	64	60	62	60.5	61	.....
Width, body.....	25	26	29	27.5	28	.....
Anus to anal.....	5	6.5	.....	6.5	6	.....
Anus to ventral.....	17	16	18	17	19	.....
Ventral to isthmus.....	20	23	23	22	21.5	.....
Height, second dorsal spine.....	38	40	.....	42	46	.....
Height, third dorsal ray.....	40	.....	.....	.....	.....	.....
Length, first dorsal base.....	14	13	15.5	15.5	17	.....
Interdorsal space.....	26.5	30	27.2	24	21.5	.....
Length, pectoral.....	.....	31	.....	.....	.....	.....
Length, outer ventral ray.....	17	.....	19	.....	.....	.....
Length, second ventral ray.....	17	.....	18	19	.....	.....
Scales, above lateral line.....	14	14	15	14	13	.....
Soft rays, first dorsal.....	9	10	9	10	10	10
Ventral rays.....	10	10	10	10-9	9	9
Pectoral rays.....	17	17	18	.....	18	.....
Serrations, dorsal spine.....	21	22	16+	18	22	.....

DETAILED LIST OF STATIONS.

ABBREVIATIONS AND SYMBOLS.

* Signifies depth as shown by chart, when no sounding was made.

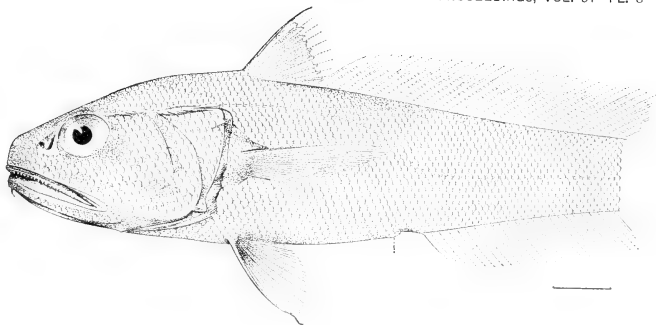
** Signifies character and depth of bottom, as obtained by sounding at previous station.

The character of the bottom is expressed by the following abbreviations:

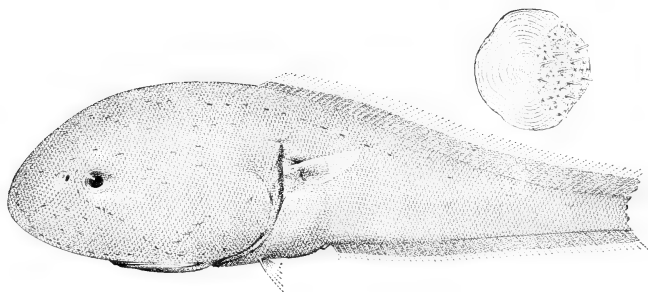
bk-----	black.	gn.-gy-----	greenish-gray.
bl-----	blue.	gy-----	gray.
br-----	brown.	hrd-----	hard.
br.-gn-----	brownish-green.	lav-----	lava.
brk-----	broken.	M-----	mud.
C-----	clay.	Oz-----	ooze.
Co-----	coral.	P-----	pebbles.
crs-----	coarse.	R-----	rock.
dk-----	dark.	rky-----	rocky.
fne-----	fine.	S-----	sand.
For-----	foraminifera.	Sh-----	shells.
G-----	gravel.	sml-----	small.
Glob-----	globigerina.	Sp-----	specks.
gn-----	green.	St-----	stones.
gn.-br-----	greenish-brown.	vol-----	volcanic.

Station (Dredge No.)	Latitude N.	Longitude E.	Date.	Depth in fathoms.	Character of bottom.	Bottom tem- perature.	Number of speci- mens.	Species of Coryphaenoididae.
	° ' "	° ' "				° F.		
4897	32 33 00	128 19 00	1906. Aug. 10	207	fine. gy. S., brk. Sh., For	49.7	1	<i>Coclorhynchus jordani</i> .
4898	32 33 30	128 20 00	...do...	**207	...do.**		1	<i>Hymenoccephalus striatissimus</i> .
4906	31 39 00	129 20 30	Aug. 11	**369-406			1	<i>Coclorhynchus jordani</i> .
4907	31 39 30	129 24 00	...do...	406	gy. Glob. Oz.	42.6	1	<i>Coryphaenoides marginatus</i> .
4908	31 40 00	129 29 40	...do...	434	...do...	42.9	5	<i>Coryphaenoides marginatus</i> .
4909	31 38 30	129 27 30	...do...	**434	...do.**		6	<i>Coclorhynchus parvifidus</i> .
4911	31 38 30	129 19 00	Aug. 12	391	gy. Glob. Oz.	41.9	2	<i>Coclorhynchus parvifidus</i> .
4912	31 39 40	129 20 00	...do...	**391	...do.**		1	<i>Coclorhynchus tokensis</i> .
4915	31 31 00	129 25 30	...do...	**427	gy. Glob. Oz., brk. Sh.**		2	<i>Coryphaenoides marginatus</i> .
4916	30 25 00	129 06 40	Aug. 13	361	gy. S., Glob., brk. Sh.	42.7	1	<i>Lionurus spinosus</i> Type.
4917	30 24 00	129 06 00	...do...	**361	...do.**		1	<i>Coclorhynchus foliopsis</i> .
4918	30 22 00	129 08 30	...do...	361	...do. (?)		1	<i>Lionurus proximus</i> .
4919	30 34 00	129 19 30	...do...	440	Glob. Oz.		1	<i>Coclorhynchus macrochir</i> .
4940	31 22 00	130 40 10	Aug. 17	115	br. M., bk. Sp.	41.8	1	<i>Lionurus garmani</i> .
4941	31 22 00	130 39 20	...do...	*117	...do...	59.8	2	<i>Hymenoccephalus ichthomemus</i> .
4942	31 23 10	130 39 10	...do...	*118	...do...		1	<i>Coryphaenoides marginatus</i> .
4943	31 24 35	130 38 40	...do...	*119	...do...		7	<i>Coclorhynchus jordani</i> .
4956	32 32 00	132 25 00	Aug. 23	720	gn-br. M., fine. gy. S., For	37.5	8	<i>Coclorhynchus jordani</i> .
4957	32 36 00	132 23 00	...do...	437	...do...		1	<i>Squalogadus modificatus</i> Type.
4958	32 36 20	132 24 30	...do...	405	...do...		1	<i>Nematonurus longifidus</i> .
4966	33 25 20	135 36 20	Aug. 29	290-244	br. M., S., For	44.1	7	<i>Coryphaenoides nasutus</i> .
4967	33 25 10	135 37 20	...do...	244-253	...do...	45.9	3	<i>Abyssicola macrochir</i> .
							1	<i>Lionurus condylura</i> .
							1	<i>Lionurus protrimus</i> .
							2	<i>Coryphaenoides nasutus</i> .
							2	<i>Coclorhynchus sp. indeter.?</i> (Young specimens; in poor condition).
							1	<i>Hymenoccephalus striatissimus</i> .
							1	<i>Lionurus garmani</i> .
							1	<i>Coclorhynchus japonicus</i> .
							8	<i>Hymenoccephalus striatissimus</i> .
							1	<i>Matacocephalus nipponicus</i> Type.
							4	<i>Lionurus garmani</i> .

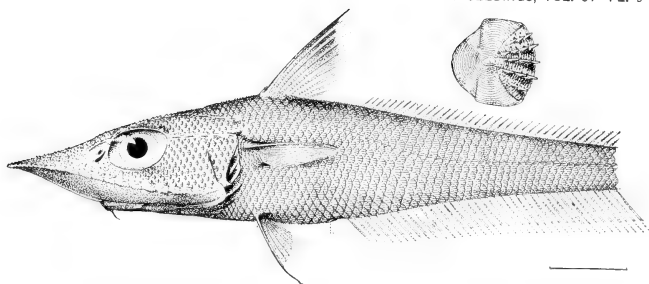
Station (Dredge No.)	Latitude N.	Longitude E.	Date.	Depth in fathoms.	Character of bottom.	Bottom tem- perature.	Number of spec- imens.	Species of Coryphaenoididae.
	° ' "	° ' "				° F.		
			1906.				7	<i>Coryphaenoides marginatus.</i>
5060	35 06 00	138 40 10	...do....	197	crs. bk. S.	50.6	1	<i>Coelorhynchus kishinouyei.</i>
							2	<i>Hymenoccephalus lethoneus</i>
							4	<i>Lionurus garmani.</i>
							9	<i>Lionurus condylura.</i>
5061	35 04 50	138 38 00	...do....	332-250	br. M., fine. gy. S.	43.7	1	<i>Lionurus darrus</i> Type.
							2	<i>Coryphaenoides nasutus.</i>
							1	<i>Lionurus condylura.</i>
							1	<i>Gadomus colleti.</i>
							1	<i>Coelorhynchus kishinouyei.</i>
							2	<i>Coelorhynchus japonicus.</i>
							2	<i>Lionurus garmani.</i>
							2	<i>Lionurus condylura.</i>
							1	<i>Gadomus colleti.</i>
							1	<i>Coryphaenoides marginatus.</i>
5065	35 05 40	138 39 30	Oct. 15	235-211	bk. S., brk. Sh.	48.5	6	<i>Coelorhynchus kishinouyei.</i>
							5	<i>Lionurus garmani.</i>
							1	<i>Lionurus condylura.</i>
							4	<i>Coelorhynchus productus</i> Paratype.
							1	<i>Coelorhynchus productus.</i>
							1	<i>Hymenoccephalus lethoneus.</i>
5066	35 06 05	138 40 20	...do....	211-293	fine. bk. S.	50.8	1	<i>Lionurus garmani.</i>
							1	<i>Lionurus condylura.</i>
							4	<i>Gadomus colleti.</i>
							2	<i>Coryphaenoides marginatus.</i>
5067	35 05 50	138 41 15	...do....	293	bk. S., brk. Sh.	45	3	<i>Hymenoccephalus lethoneus.</i>
							2	<i>Lionurus condylura.</i>
							1	<i>Lionurus garmani.</i>
5069	35 03 10	138 47 00	...do....	131-108	M., S., brk. Sh.	55.8	1	<i>Coryphaenoides marginatus.</i>
							1	<i>Hymenoccephalus lethoneus.</i>
5072	34 44 55	138 22 20	Oct. 16	284-148	fy. M.	44.1	1	<i>Lionurus condylura.</i>
							1	<i>Lionurus garmani.</i>
							1	<i>Coryphaenoides marginatus.</i>
5080	34 10 30	138 40 00	Oct. 19	505	fine. gy. S., Glob.	38.7	1	<i>Lionurus garmani.</i>
							1	<i>Coelorhynchus productus.</i>
							1	<i>Bathygadus antrodes.</i>
5082	34 05 00	137 59 00	Oct. 20	662	gn. M., fine. S., Glob.	37.7	2	<i>Coryphaenoides nasutus.</i>
							1	<i>Bathygadus antrodes.</i>
5083	34 04 20	137 57 30	...do....	624	fine. gy. S., Glob.	38.1	1	<i>Trachonurus villosus.</i>
							1	<i>Bathygadus antrodes.</i>
5084	34 00 00	137 49 40	...do....	918	gn. M., fine. S., Glob.	36.8	1	<i>Lionurus ctenuropterus</i> Type.
							1	<i>Lionurus ctenuropterus</i> , Young.
5085	35 06 45	139 19 45	Oct. 23	622	gn. M., fine. bk. S.	37.8	1	<i>Bathygadus antrodes.</i>
							3	<i>Hymenoccephalus lethoneus.</i>
5086	35 08 15	139 20 00	...do....	292	gn. M., crs. bk. S.	43.7	2	<i>Lionurus garmani.</i>
							2	<i>Lionurus condylura.</i>
5087	35 09 40	139 19 05	...do....	614	gn. M.	37.5	1	<i>Coryphaenoides nasutus.</i>
5088	35 11 25	139 28 20	Oct. 25	369-405	gn. M.	41.8	1	<i>Lionurus garmani.</i>
							1	<i>Lionurus condylura.</i>
5093	35 03 15	139 37 42	Oct. 26	302	crs. bk. S.	43.9	2	<i>Hymenoccephalus lethoneus.</i>



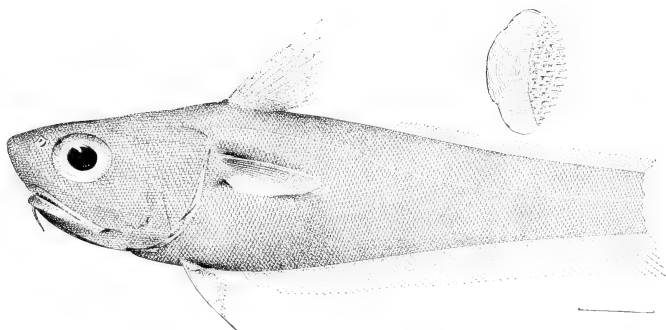
1. BATHYGADUS GARRETTI. (PAGE 151.) FROM THE TYPE.



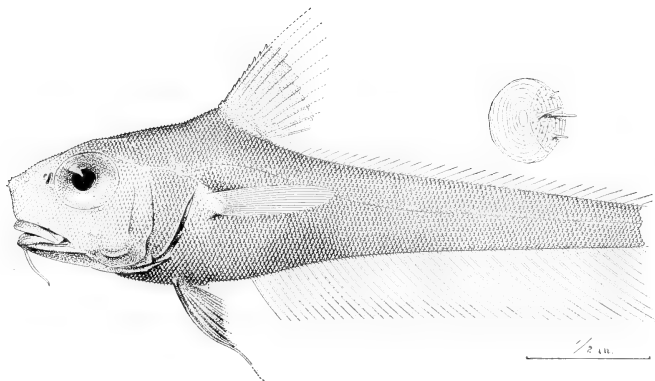
2. SQUALOGADUS MODIFICATUS. (PAGE 156.) FROM THE TYPE.



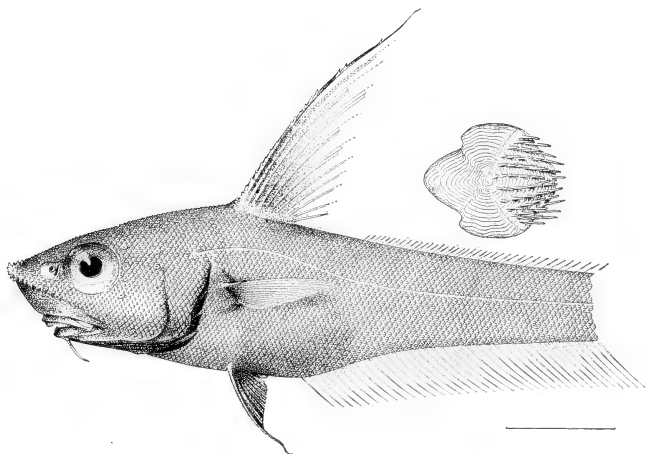
1. COELORHYNCHUS PRODUCTUS. (PAGE 175.) FROM THE TYPE.



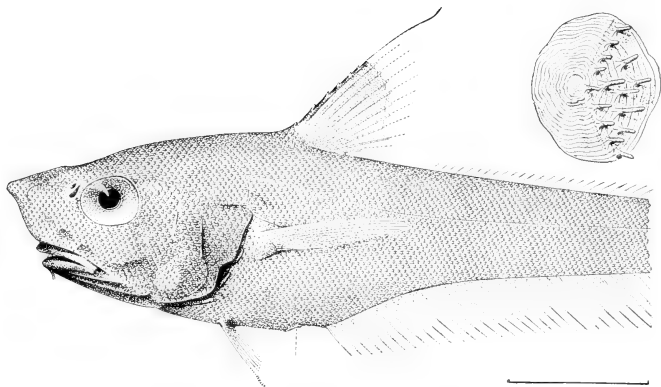
2. MALACOCEPHALUS NIPPONENSIS. (PAGE 189.) FROM THE TYPE.



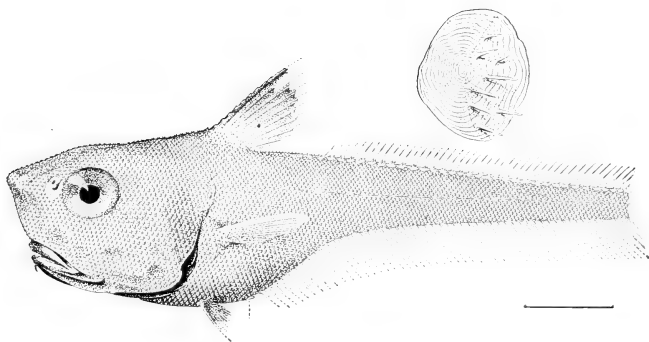
1. *LIONURUS DURUS*. (PAGE 197.) FROM THE TYPE.



2. *LIONURUS SPINOSUS*. (PAGE 199.) FROM THE TYPE.



1. *LIONURUS CETONUOPSIS*. (PAGE 202.) FROM THE TYPE.



2. *CETONURUS ROBUSTUS*. (PAGE 207.) FROM THE TYPE.

NEW AND LITTLE-KNOWN HETEROPTEROUS
HEMIPTERA IN THE UNITED STATES
NATIONAL MUSEUM

BY

E. BERGROTH

Of Jamsa, Finland

No. 2150.—From the Proceedings of the United States National Museum,
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NEW AND LITTLE-KNOWN HETEROPTEROUS HEMIPTERA IN THE UNITED STATES NATIONAL MUSEUM.

BY E. BERGROTH.

Of Jamsa, Finland.

The following notes and descriptions of new genera and species present the results of my studies of a miscellaneous collection of exotic Hemiptera Heteroptera kindly forwarded to me for examination by the authorities of the United States National Museum.

Family PENTATOMIDAE.

Subfamily HALYINAE.

SPUDAEUS GLAUCUS, new species.

Glabrous, glaucous-green, dorsum of abdomen bluish black, venter straw-yellow with a sharply defined sublateral longitudinal black band including the stigmata and reaching from the base of the venter to near the apical margin of the last segment. Body above, underside of head, and pleurae remotely and irregularly punctured with black, still more remotely so toward base of head and in the triangular basal area of the scutellum; pronotum with four subtriangular pale brownish more thickly punctured basal spots, and scutellum with a similar oval thickly punctured brown spot at the lateral margins not far from the base; corium more finely and more irregularly punctate than the rest of the upper side; connexival segments more strongly and subconfluently punctate near their base; venter smooth, very slightly strigulose toward the lateral margins. Head as long as pronotum in the middle, with a strongly punctured, partly cupreous, partly brassy-green spot between ocelli and eyes; ocelli three times more distant from each other than from eyes; rostrum reaching base of fifth ventral segment, apical half of its last joint blackish; first two antennal joints streaked with brown on the outer side, the first slightly passing apex of head, third half as long again as second, black except at base (last two joints wanting). Pronotum

with the lateral margins sinuate a little behind the middle and slightly rounded between the sinuosity and the apical angles, lateral angles produced into a moderately long acute spine directed straight outward and black above except the anterior margin. Scutellum with an obovate black impresison at the basal angles. Propleurae and mesopleurae with a punctured aeneous-green spot at the base of the acetabula. Hemelytra slightly passing apex of abdomen, corium reaching apical margin of penultimate connexival segment, membrane pale grayish testaceous with the interior basal area black and a curved brownish fascia behind the middle, veins piceous. Abdomen with the black sublateral ventral bands brassy at the base, fifth male ventral segment in the middle scarcely half the length of the fourth, sixth segment a little shorter than the three preceding ones taken together. Legs pale glaucous, femora dotted with black toward apex, tibiae with the keels of the upper side and the apex black (fore legs and all tarsi wanting in type).

Length.—Male, 16 mm.

Type.—Cat. No. 20141, U.S.N.M.

British New Guinea (Moroka, 3,500 feet, A. S. Anthony). Allied to *S. variabilis* Tryon, but smaller, not pubescent (except very slightly on the venter), differently colored, much more sparingly punctured, and with longer rostrum.

COENOMORPHA AMPLA, new species.

Dull ochraceous, rather densely but irregularly punctured with fuscous black. Head as long as the pronotum in the middle, longer than broad, subparallel between the eyes and the anteapical angle of the juga; basal part above, as far as a little beyond the eyes, with six subimpressed longitudinal lines, the outermost on each side being broader, inclosing the ocellus, and emitting a branch to the eyes; clypeus and its basal continuation bordered with a black punctulate line; each jugum with two rather broad subimpressed lines; all impressed lines of the head black and thickly punctulate, their interspaces and the clypeus impunctate and a little elevated; apical angles of juga approximated over the tip of the clypeus; under side of head thickly punctulate with black, except the bucculae and a vitta between the inferior margin of the eyes and the base of the antennae; rostrum somewhat passing base of fifth ventral segment, fuscous beneath except at apex of third joint, last joint piceous; antennae pale castaneous, base of the first three joints narrowly ochraceous, second and third joints of equal length (last two joints missing). Pronotum two and one-half times broader than its median length, anteriorly depressed between the somewhat elevated cicatrical areas; immediately within the medially very slightly sinuate lateral margins

with a densely punctate black vitta, the posterior half of which is interiorly bordered with a callose almost impunctate ridge having on its interior side a thickly punctate apically broadened impression within which there is an oblong rather broad almost impunctate area; the teeth of the lateral margins ochraceous, posterior lateral margins a little notched behind the slightly prominent lateral angles. Scutellum with an elongate impunctate callus near the basal angles and a small transverse median basal callus. Propleurae close to the lateral margin with a thickly punctate black vitta. Hemelytra (female) nearly reaching apex of abdomen; corium reaching base of ultimate connexival segment, the punctuation partially condensed and confluent, forming a blackish C on the right corium and an inverted C (∩) on the left one; membrane subopaque, whitish, blackish at the interior basal angle and very slightly suffused with brownish in the middle, veins pale brownish. Abdomen rather strongly rounded on the sides, apical angles of the segments obtusely prominent, the densely punctate connexival segments with a much less thickly punctate rounded spot in the middle and with the impunctate narrow lateral margin fuscous at the base and apex of the segments; venter suffused with brownish, all segments with the stigmata and an oblong inwardly rounded lateral spot pale ochraceous; median furrow deep, reaching apex of fifth segment; basal lobes of female genital segment black, rugulose, and somewhat tumid. Legs ochraceous, femora streaked and mottled with brown; tibiae, except a broad ring nearer to the base than to the apex, and last tarsal joint pitchy black.

Length.—Female, 22.5 mm.; breadth, 13.5 mm..

Type.—Cat. No. 20142, U.S.N.M. Angola (Kuhiriri River, Mr. Penrice).

The largest species in the genus and very distinct by the sculpture of the pronotum and head, apparently coming nearest to *C. implexa* Distant.

Subfamily PENTATOMINAE.

EURYMENIDA,¹ new genus.

Body broadly oval. Head much broader than long, antecular part very short, narrowing toward the broad apex, scarcely sinuate before the eyes. Scutellum reaching far beyond the middle of the abdomen, the postfrenal part much broader than long, apex very broadly rounded. Frena scarcely reaching the middle of the scutellum. Other characters as in *Menida* Motschulsky.

Type of the genus.—*Eurymenida vallicola*, new species.

¹*eupus*=broad; *Menida*.

EURYMENIDA VALLICOLA, new species.

Polished, black, finely and rather sparingly punctate; an oblong antepical area to the brownish-black corium and the middle of the venter impunctate; an interrupted line on the clypeus, a vitta on the juga, a round dot at the interior margin of the eyes, three or four spots on vertex; the bucculae, a dot between them and the antenniferous tubercles; numerous small irregular spots on the pronotum (particularly its anterior half), apical and lateral margins of pronotum (very narrowly), an oval, smooth callose spot near the basal angles of the scutellum, a few transverse irregular spots behind these; the apex of scutellum (rather broadly), lateral margin of corium, an oblong lateral spot to connexival segments, a spot at anterior and posterior margin of propleurae, a curved vitta inside the apical half of their lateral margin, posterior angle of mesopleurae, lateral border of metapleurae, orificial prolongation, all acetabula, basal spine of venter, a double row of discal spots to venter (one on each segment) not far from the medium line, an oblong spot to ventral segments, two smaller rounded spots inside each lateral spot, and the sides of the male genital segment (inclosing a fuscous subapical spot) yellow or reddish yellow; antennae yellowish testaceous, apex of third joint, the fourth (except base) and the fifth fuscous; membrane hyaline with a large rounded fuscous subbasal spot; legs yellowish testaceous, femora very finely dotted with brown and with a piceous ring (interrupted above) somewhat before apex. Head rather strongly declivous, the anteocular part a little longer than the longitudinal diameter of the rather large transverse eyes; ocelli placed very near the eyes; rostrum reaching hind coxae; first antennal joint not reaching apex of head, second joint at least twice the length of first, the following joints gradually increasing in length, each being a little longer than the preceding one. Pronotum not quite two and a half times broader than head and almost three times broader than its median length, the smooth elevated apical margin not interrupted behind the eyes but with a few small impressed points at this place; lateral margins distinctly rounded; humeral angles rounded, not prominent. Scutellum a little shorter than corium. Hemelytra (male) passing apex of abdomen by half the length of the membrane, apical margin of corium a little rounded, exocorium with two rows of punctures which are subconfluent at base and confused at apex. Basal spine of venter a little passing hind coxae, last male ventral segment in the middle slightly shorter than the three preceding segments taken together; male genital segment rather large, trisinate at apex, the median notch much deeper than the lateral ones.

Length (without membrane).—Male 5 mm., breadth 4.5 mm.

Type—Cat. No. 20143, U.S.N.M. Kashmir (Goorais Valley).

Judging from the description, the African *Menida parvula* Signoret, which was placed by Stål in a distinct division of that genus, belongs to *Eurymenida*.

Subfamily ACANTHOSOMATINAE.

LANOPIS ALGESCENS, new species.

Orchraceous, above and on the pleuræ punctured with fuscous; posterior part of pronotum and the corium dark brownish olivaceous; scutellum brownish ochraceous; membrane fuscous, the veins not darker; mesosternum in the middle, a small metapleural spot at the apex of the orificial ridge, a lateral line at the basal angles of the abdominal segments (visible from above and from beneath), and a dot at the apical angles of the ochraceous connexival segments black; dorsum of abdomen also black, but the three last segments (except apical half of the last one) sanguineous, a more or less distinct basal fascia to the connexial segments brownish; venter usually and sometimes pleuræ densely sprinkled with purplish or dark ferruginous; antennæ brownish ochraceous, a stripe to the interior side of the basal joint and the two (rarely three) last joints fuscous; rostrum ochraceous, last joint (except base) pitch black; legs ochraceous, femora fulvous sprinkled with purplish, apex of tibiae, first tarsal joint, and apex of second joint fuscous. Head as long as broad, sparsely punctate; juga scarcely longer than clypeus but a little convergent at apex, making the clypeus narrower at apex than a little behind it, from which point the clypeus gradually narrows to the acute base; first antennal joint very distinctly passing apex of head, second joint about twice the length of first, third as long as first, fourth one-half longer than third, fifth a little longer than fourth; rostrum reaching hind coxæ, second joint a little longer than third, and this a little longer than fourth. Pronotum somewhat rugose, more coarsely and densely punctured than the head, and with an oblique impression somewhat inside the posterior half of the anterolateral margins, the anterior ends of these impressions united by a more or less distinct transverse impression which sometimes is interrupted by two irregular flattened tubercles; anterolateral margins sinuate behind the apical angles, then rounded, the rounded part being longer than the sinuate one; lateral angles broadly prominent outward, subangularly rounded at apex, posterior lateral margins roundedly angular at the costal margin of the corium, more or less distinctly sinuate behind the lateral angles. Scutellum strongly and sparsely punctate, the apical half with a median keel, the apex spatulate. Pleuræ strongly and rather thinly punctate; the opaque

evaporative area extremely small, hardly visible, forming a very narrow stripe bordering the anterior and posterior margins of the orificial prolongation which is a little curved behind and distinctly shorter than the distance between its tip and the lateral margin of the metapeura. Hemelytra (male) slightly passing apex of abdomen; corium rather finely and thickly punctate, its costal margin roundedly angular a little before the middle, its apical margin slightly rounded or almost straight. Abdomen (male) beneath roof-shaped but not carinate in the middle, very superficially and remotely concolorously punctate, the apical angles of the segments slightly and obtusely prominent, not distinctly tuberculate, apical angles of the last segment rounded; first male genital segment with the broad apical margin slightly sinuate in the middle, second genital segment broader than the first but only half its length, the apical margin rounded and trisinate.

Length.—Male, 8—8.5 mm.

Type.—Cat. No. 20144, U.S.N.M. Patagonia (Chubut). I have seen numerous males but no female of this species which is smaller than *L. rugosus* Signoret, and differs from it by the longer basal joint to the antennae. The more strongly rounded posterior part of the anterolateral pronotal margins, the shorter orificial prolongation, the less prominent and less tumid apical angles to the ventral segments, the darker, more uniformly colored corium, the differently colored legs, and the smoother, red-speckled venter, the segments of which are black at the basal angles, not at the apical angles as in *rugosus*. From *L. chubuti* Distant it differs by the much longer second joint of the quite differently colored antennae by darker membrane, and smaller size.

As Distant says that *L. chubuti* is larger than *rugosus*, I suppose he has not seen the true *rugosus* from Chile, which is of the same size as *chubuti*. Distant and some other British authors treat Chubut as the name of a collector, but it is the name of the central province of the Patagonian part of Argentina, between the Rio Negro territory in the north and the Santa Cruz territory (Patagonia proper) in the south.

EA AUSTRALIS Distant.

Distant's descriptions of this genus and species, and of his other South American Acanthosomatinae, are generally good, yet a few additions and corrections to his description of this insect are necessary. The veins of the membrane are very few in number and more or less anastomosing near base. The rostrum scarcely passes the middle coxae. The orificia are only as long as the trochanters, not "as long as coxae and trochanters together." The venter is concolorously punctate, the fifth and sixth segments in the female on

each side somewhat within the lateral margin with a rather large transverse dull impunctate impression, that of the fifth segment situated at the apical margin, that of the sixth segment less distinct and placed at the basal margin. The sixth ventral segment of the male is in the middle distinctly longer than the two preceding segments together, that of the female slightly shorter than these. The male genital segment is as long as the sixth ventral segment, transversely impressed before the apical margin, which is rounded, in the middle slightly sinuate and thickly fringed with pale ferruginous hairs. The basal lobes of the female genital segment are about as long as broad, rounded exteriorly and a little narrower there than interiorly; the median lobes are narrow, transverse; the apical lobes transverse, separated interiorly by a triangular incision. After death the olivaceous green color of the upper side of the body sometimes fades into pale brownish. The black spots of the connexivum occupy more than the apical half of the segments.

Patagonia (Chubut).

Numerous specimens of both sexes have been examined.

This genus is not "to be placed near *Hellica* Stål," with which it has no resemblance, but is allied to *Sinopla* Signoret.

ACROPHYMA,¹ new genus.

Body oval. Head shorter than pronotum, rather strongly narrowing from the eyes to the apex, anteocular part broader than long, lateral margins slightly sinuate, clypeus gradually widening from base to apex, juga as long as clypeus, ocelli over two times more distant from each other than from eyes; bucculae low, not reaching base of head; rostrum reaching hind coxae, first joint as long as bucculae, second longer than third; first joint of antennae much shorter than head, but passing its apex; second joint longer than first and third. Pronotum moderately declivous, apical margin sinuate, obliquely truncate behind eyes, apical angles narrowly rounded, lateral margins slightly rounded, not elevated, lateral angles rounded, not prominent, basal angles very obtuse, basal margin straight. Scutellum equilaterally triangular, not reaching middle of abdomen, with a small callose spot at basal angles, apex subacute and very shortly spatulate. Mesosternum with a median carina. Orificia extended in a straight parallel sulcated fold, which is half as long as the distance between its tip and the lateral margin of the metapleura. Corium with rounded costal margin and straight apical margin; membrane with five simple veins, the three median ones united not far from the base by an oblique cross-vein, forming two median basal cells. Abdomen scarcely broader than

¹ ακρος=acute; φυμα=tubercle.

the hemelytra and almost entirely covered by them, beneath at the base with a pointed tubercle, the point of which is directed obliquely upward toward the depressed metasternum, apical angles of the segments not at all prominent, apical margin of sixth dorsal segment sinuated; the male with two genital segments visible on the underside, the second segment consisting of the underside of the protruding dorsal genital segment. Tibiae cylindrical.

This genus is intermediate in structure between Stål's divisions 1 (12) and 12 (1). It differs from *Ditomotarsus* Spinola and *Hyperbius* Stål by the keeled mesosternum, the structure of the base of the venter, and somewhat shorter scutellum; from the former, moreover, by having the ocelli placed nearer to the eyes, from the latter by less convex head and pronotum, and not at all callose pronotal lateral margins. From *Sinopla* Signoret it is distinguished by the position of the ocelli; more rounded, not elevated pronotal lateral margins, more rounded, not prominent humeral angles, shorter scutellum, straight apical margin to corium, and by having the straight spine of the second ventral segment replaced by an acute tubercle curved upward, with its apex touching the surface of the metasternum.

Type of the genus.—*Acrophyma frigidula*, new species.

ACROPHYMA FRIGIDULA, new species.

Opaque, whitish or pale ochraceous; above thickly, beneath less thickly and more finely punctured with black; dorsum of abdomen blackish, shining, impunctate, dark ferruginous in the middle, connexivum impunctate, black, segments 2-5 with an obliquely triangular ochraceous basal spot, sixth (and sometimes fifth) segment with the whole basal half ochraceous, abdomen beneath with an oblong rectangular black spot at the apical angles of the segments and in the male with a median fuscous vitta or a series of fuscous spots not continued through the genital segments, metapleurae with a black spot at the end of the orificial fold; antennae, rostrum, and legs pale yellowish testaceous, first antennal joint with a fuscous streak on the inside, last three joints fuscous black, excepting base of these joints and apex of third joint; last joint of rostrum piceous; femora dotted with fuscous and with an incomplete subapical fuscous ring, a superior basal dot to tibiae and their extreme tip, and apex of tarsal joints fuscous. Head a little broader than long, a streak on the underside of juga and another shorter streak before the eyes piceous; second joint of antennae half as long again as first, third subequal to first or a little shorter, fourth and fifth each a little longer than second and more incrassated. Pronotum two and a third times broader than long in the middle. Scutellum with an impunctate slightly raised median line in the apical half. Mem-

brane infuscated with a broad sinuous hyaline fascia immediately before the middle, and two dark brown triangular basal spot, one at the inner basal angle, the other at the middle of the basal margin and occupying the outer one of the two median basal cells, the outer half of the basal margin also narrowly fuscous, the posterior border of the hyaline fascia of a darker fuscous color than the rest of the apical part. Posterior tibiae slightly curved.

Length.—Male 6.5 mm., female 7 mm.

Male.—Abdomen beneath bluntly roof-shaped, the segments contracted in the middle, sixth segment as long in the middle as the three preceding ones together, its apical angles rounded; first genital segment subtriangular, in the middle as long as the segments 4–6 together, the broad apical margin sinuated in the middle; second genital segment (=underside of dorsal genital segment) much shorter and a little broader than first, strongly transverse, its apical margin subtruncate; dorsal genital segment large and broad, protruding, wide open above, covered only by the membrane, not by the last dorsal segment, fuscous, the apical half (except the sides) pale ochraceous, the basal angles with a brush of hairs protruding from under the last dorsal segment, the apical margin subtruncate and reflexed with a small recurved hook at the angles; interior appendages acutely pointed at tip.

Female.—Abdomen beneath moderately and evenly convex, the segments not contracted, sixth segment in the middle as long as the two preceding ones together, its apical angles obtuse, its apical margin on each side broadly triangularly produced; basal lobes of genital segment subtriangular, about as long as broad; median lobes very strongly converging, placed almost transversally, narrow from the base to the middle, then triangularly dilated; the transversal apical lobes confluent interiorly, consisting of the apical underside of the dorsal genital segment, which is about half the length of the sixth dorsal segment, with the apical margin broadly rounded.

Type.—Cat. No. 20145, U.S.N.M. Patagonia (Chubut).

Three males and three females have been examined. The sexes are constant in size and color. This insect differs from all other Chilean and Patagonian Acanthosomatinae by the color markings of the membrane, but these are clearly visible only when the hemelytra are outspread.

Judging from the débris adhering to the bodies of many specimens of Patagonian Acanthosomatinae, they live under the bark of rotten stubs.

Note.—Considerable confusion prevails in the nomenclature of some Chilean Acanthosomatinae, and this is chiefly due to the fact that most authors in determining them have used Signoret's re-descriptions instead of Spinola's and Blanchard's original descriptions

in Gay's "Historia fisica de Chili." Signoret united *Ditomotarsus punctiventris* Spinola with *gayi* Spinola, apparently because he had seen a specimen of *punctiventris* wrongly labeled *gayi* and without comparing Spinola's descriptions. These two species are even generically distinct. The figure 8a on plate 1, which represents *gayi* in profile, clearly shows that it is a *Planois*, and this is the only Chilean genus tallying with the statement in the specific diagnosis and description of *gayi*: "Antennarum articulo primo secundum longitudine aequante—primero y segundo articulos de las antenas de igual longitud." It seems uncertain, however, whether *gayi* is the same species as *Planois bimaculatus* Signoret. *D. punctiventris* is the species standing in almost all collections under the name *gayi*, but the figure 9 on plate 1, said in Gay's work to be that of *punctiventris*, has been wrongly numbered, and has nothing to do with *punctiventris*; this is quite evident if it is compared with the description. There is fortunately no reason to change the generic nomenclature as now standing in our catalogues; *D. punctiventris* must be considered the type of *Ditomotarsus*, and the following synonymy will result:

<i>Ditomotarsus</i> Spinola.	|	<i>impluviatus</i> Blanchard.
(<i>Ruscoba</i> Stål).		<i>Planois</i> Signoret.
<i>punctiventris</i> Spinola.		(<i>Diaomotarsus</i> Spinola, ex p.)
<i>sanguineiventris</i> Stål.		<i>bimaculatus</i> Signoret.
<i>gayi</i> Signoret (not Spinola).		<i>gayi</i> Spinola.

Subfamily UROLABIDINAE.

UROSTYLIS BLATTIFORMIS, new species.

Above depressed and hairless, grass-green; dorsum of abdomen, connexivum and underside of body yellow or greenish testaceous; corium with several tortuous vermicular partly confluent ochraceous bands mostly placed longitudinally; two small spots before middle of pronotum, a lateral spot near apical angles of the connexival and ventral segments, a sharply defined sublateral vitta to propleurae, a lateral spot to metapleurae, and a series of spots, one in each segment, on either side of the venter between its middle and the lateral margins, black. Head impunctate, very finely and superficially transversely wrinkled, smooth within the eyes, and with a very fine and narrow curved impressed line before each ocellus; antennae fuscous black, first joint and basal fourth of second ferruginous, first with or without a fuscous vitta on the outer side, base of third joint narrowly, base of fourth and fifth joints broadly pale testaceous, first joint as long as pronotum, second as long as first, third half the length of second, fourth distinctly shorter than second, fifth shorter than fourth; rostrum reaching a little beyond anterior coxae, third

joint constricted near base, somewhat dilated toward apex. Pronotum sparsely punctured with fuscous, apical margin neither smooth nor elevated, lateral margins narrowly reflexed, very slightly sinuate or almost straight, lateral angles very narrowly rounded. Scutellum very distinctly longer than broad, punctured the same as the pronotum. Breast impunctate, except a few colorless punctures on the posterior part of the propleurae. Hemelytra considerably passing apex of abdomen, corium more than twice the length of scutellum, costal margin reflexed from base to beyond middle, apical angle very acute, apical margin slightly bisinuate, exocorium rather sparingly punctured with fuscous, mesocorium sparsely and extremely finely concolorously punctulate, but with a series of much larger close-set pale fuscous punctures along the interior margin, endocorium with a similar row of punctures along the exterior and interior margins; membrane narrowly rounded at apex, transparent, tinged with fuscous, more so at apex. Wings iridescent, hyaline, rather broadly infuscated at apex. Abdomen impunctate, apical angles of the segments not at all prominent. Legs greenish testaceous

Length (without membrane).—Male 10.8 mm., female 12.5 mm.

Males.—First genital segment subtriangular, transversely strongly convex, apical margin a little sinuate in the middle; second genital segment beneath in the middle with a rather long straight process directed backward and a little upward, constricted near base and somewhat dilated toward the truncate end, at the upper basal angles of the segment with a tubercle and immediately behind this with a spine-like process directed obliquely backward, upward, and a little outward, the interior margin of this process, the apical margin of the segment, and the margins of the median process fringed with pale hairs; the interior appendages bifid at tip.

Female.—Dorsal genital segment a little shorter and narrower than sixth dorsal segment, apical margin slightly sinuate, the lateral parts visible from beneath in the form of a curved triangular lobe; ventral genital lobes triangular, much broader than long, the posterior ones apically produced in a triangular lobe visible also from above, between these lobes two smaller triangular lobules protruding from the interior.

Type.—Cat. No. 20146, U.S.N.M., China (Foo-chow, H. R. Caldwell).

Very distinct from all previously described species. It has a peculiar facies, different from that of the other species I have seen, and reminding one of a green blattid. After death the green color of the head, and partly also of the pronotum and scutellum, more or less fades into testaceous. The male genital segment is not unlike

that of *U. virescens* Reuter¹ but the lateral processes are much more acute and divergent.

Family COREIDAE.

TYPHLOCOLPURA VULCANALIS, new species.

Grayish fuscous (including antennae and rostrum), punctate, the whole body strewn with short narrowly scale-like decumbent yellowish bristles; a broad, ochraceous, posteriorly paler vitta running through the whole connexivum and immediately within the lateral margin of the venter. Head a little longer than broad and scarcely longer than pronotum, transversely somewhat convex, with two short oblique denuded streaks between the eyes, the callose tubercle behind the eyes rather large; antennae inserted somewhat farther from eyes than from apex of head, first joint a little shorter than head, second somewhat longer than first (last two joints wanting); rostrum reaching base of fourth abdominal segment. Pronotum distinctly transverse, almost two-thirds broader than long in the middle, basal half slightly declivous, apical half horizontal but with the cicatrical areas a little convex, lateral margins rather deeply sinuate in the middle, before and behind the sinuosity straight, those of the basal half scarcely raised, those of the apical half distinctly elevated, very slightly convergent toward apex, ending behind and outside the collar in a subacutely prominent triangular lobelet directed straight ahead, the distance between the tips of these subapical lobelets considerably broader than the width of the depressed apical collar, humeral angles rounded, basal margin straight before the base of the scutellum, which is very slightly longer than broad. Hemelytra twice the length of the scutellum, not quite reaching middle of third (=Breddin's fourth) abdominal tergite; corium with scarcely raised indistinct veins, claval part more distinctly punctured than the rest, exterior apical angle of corium and outer half of apical margin broadly rounded, claval commissure half the length of the scutellum; membrane grayish luteous, very short, forming only a narrow, broadly rounded border to apical margin of corium. Abdomen (male) about three-fifths broader than pronotum; last tergite (male) twice the length of the preceding segment, its apical part transversely convex, apical margin rounded; apical angles of third segment slightly, those of fourth and especially fifth segment more distinctly prominent; venter with a deep median furrow reaching from its base to apical margin of fourth segment, the intralateral glandular spots of the three last segments very distinct, subequal in size, round, opaque, velvet-black, their distance from the lateral margin much greater than their diameter; male genital segment

¹ Figured in *Revue d'Entom.*, 1888, p. 202.

apically produced in a broad process which is deeply angularly incised in the middle. Legs fuscous, tinged with testaceous, femora unarmed, toward the base, especially the third pair, pale testaceous, tibiae not sulcated above.

Length.—Male, 10 mm.

Type.—Cat. No. 20147, U.S.N.M. Philippine Islands (Mount Apo, Mindanao, E. A. Mearns).

Very distinct in several structural characters from the three known species of this interesting genus, two of which are from Java and one from Celebes.

Family REDUVIIDAE.

Subfamily REDUVIINAE.

HETEROPINUS CORTICALIS, new species.

Above sparingly shortly erectly setose, the hairs on the head longer; head, pronotum, and scutellum pitchy ferruginous, shining; scutellar keels, clavus, and corium buffy ochraceous, apex of clavus infuscated, exocorium with a rusty tinge; membrane black, its interior basal part (as far as to the exterior margin of the outer basal cell) buffy ochraceous but including an oblong fuscous spot at the base of the inner basal cell; connexivum and body beneath luteous; antennae dark testaceous; rostrum and legs luteous (hind legs wanting). Head (excluding the neck) broader than long, with a long hair before each ocellus and at the inner margin of the eyes, the few other hairs being somewhat shorter, the space between the eyes about four times broader than an eye; ocelli very wide apart; the throat with a few rigid hairs arising from very small granules; rostrum pubescent; antennae pilose, first joint somewhat passing apex of head, second as long as the head's breadth, the adventitious jointlet interposed between the two first joints very short, not longer than broad, third and fourth joints capillary, subequal in length, each a little shorter than second, fourth still finer and more hairlike than third. Pronotum a trifle over two times broader than head; apical angles very broadly rounded, effaced, with no trace of a tubercle, the transverse impression (except its middle part) crenulated; anterior lobe with the median impression impunctate; disk a little convex, smooth but with a small fovea on each side; the lateral margins studded with a row of small acute tubercles, each of which bears a short hair easily coming off; posterior lobe scarcely longer than anterior lobe with the median impression punctate, the lateral angles rounded, somewhat gibbous, not prominent. Scutellum with a sharply defined three-branched Y-shaped carination. Prosternum with stiff fuscous hairs at the middle of the apical margin; acetabula moderately tumid, not visible from above. Mesosternum with a broad

median impression longitudinally divided by a keel. Metasternum with the pleurae divided by two longitudinal keels, inner keel somewhat curved, inner area of pleurae transversely rugose. Hemelytra reaching apex of abdomen, opaque, corium besides the hairs with narrow ochraceous scales arranged in two or three longitudinal rows, the epipleura with similar scales, apical angle of corium truncate, inner basal cell of membrane scarcely reaching middle of outer basal cell. Abdomen somewhat broader than pronotum, connexivum near outer margin with decumbent hairs and with a long semierect hair at the somewhat prominent apical angle of the segments, venter with the flat discal area much narrower than the rather strongly ascending lateral areas, basal margin of the segments strongly crenulate within the flattened area, sixth segment of female in the middle a little longer than the two preceding segments united. Fore legs with the trochanters setose, femora rather strongly incrassated. Middle legs more separated from each other than the hind legs.

Length.—Female 7 mm.

Type.—Cat. No. 20148, U.S.N.M. Guinea (Mount Coffee, Liberia, R. P. Currie).

Allied to *H. mollis* Breddin (which I know only from the rather short description), but lacking the long, soft, decumbent pilosity, differently colored, and with the adventitious jointlet between the first and second antennal joints much shorter. The other known species, *H. discretus*, var? (of which I have examined a cotype), differs from *corticalis* by numerous characters, and principally by the much larger size, the more depressed body, the more tumid anterior acetabula which are visible from above, the acute apical angle of the corium, the longer inner basal cell of the membrane which passes the middle of the outer basal cell, and the much less strongly ascending lateral areas of the venter. As the genus has been somewhat imperfectly described, I have included some generic characters in the above description, but the peculiar carinated sculpture of the venter is not mentioned, as it was described by me.¹ Breddin's supposition² that this sculpture is a male sexual character does not prove to be correct, the ventral sculpture of the now discovered female being quite identical with that of the male.

The species of this genus doubtless live under bark like the other Reduviinae with flattened abdomen.

The genus *Heteropinus* Breddin was placed by its founder near *Opinus* Laporte, and the allied genus *Platymicrus* Bergroth was also placed by me near *Opinus*, but we were both wrong in so placing them. Although the small setiferous tubercles on the underside of

¹ Bol. Soc. Esp. Hist. Nat., 1904, p. 362.

² Wien. Ent. Zeit., 1905, p. 264.

the head and prosternum are not distinctly developed in all species of *Heteropinus* and *Platymicrus*, these genera must certainly be placed in Stål's division 50 (1) near *Croscius* Stål. The Indian genus *Marbodius* Distant is very closely related to *Heteropinus*, and was quite correctly placed by Distant after *Epirodera* Westwood. On the other hand, Distant¹ wrongly transferred the genus *Croscius* to the vicinity of *Opinus*.

Subfamily PLOIARIINAE.

STENOLAEMUS SCHWARZII, new species.

Rather longly pilose; ground-color of body, including hemelytra, antennae, and legs, whitish. Head with the whole underside, the antecular part, and the sides of the postocular part fuscous; rostrum pale brown; first joint of antennae a little longer than pronotum, with four fuscous annuli, second joint one-sixth shorter than first, with the base, apex, and two annuli fuscous, third and fourth joints fuscous, third as long as fore tarsi, fourth one-half longer than third; pilosity of first antennal joint long and moderately thick, the three remaining joints thickly but very shortly pilose, the second with a few longer hairs above near the base; postocular part of head bituberculate, longitudinally impressed in the middle. Prothorax with two fuscous vittae above on the anterior tumid part of the fore lobe, and with a fuscous vitta on the acetabula, the tumid part transversely impressed at the sides, which are rounded behind the impression; posterior petiolated part of this lobe a little shorter than the anterior part, with a lateral vitta and a median prosternal vitta fuscous, these vittae confluent anteriorly; posterior pronotal lobe with these blunt longitudinal ridges, the lateral ridges ending posteriorly on the disk in a small tubercle, lateral angles tuberculate, lateral margins slightly rounded anteriorly, basal margin subangularly sinuate. Scutellar spine suberect, fuscous. Hemelytra glabrous except costal margin of corium, which is densely fringed with short curved hairs; mesocorium behind the middle with four or five transverse fuscous bars which are widened at their interior end; the large triangular anterior basal cell of the membrane fuscous, with two feeble whitish transverse veins; posterior basal cell of membrane fuscous, excepting exterior border, and longitudinally divided by a white vein emitting one or two short branches laterally; rest of membrane with some small fuscous spots and at the interior border behind the posterior basal cell with three larger transverse fasciate fuscous spots; terminal cell and apex of the preceding cells fuscous, mottled with whitish; all hemelytral veins whitish. Wings whitish. Abdomen somewhat infuscated on the back, toward the apex of the venter, and at the

¹Ann. Mag. Nat. Hist., ser. 7, vol. 13, p. 276.

apical angles of the segments. Legs moderately thickly clothed with very long white hairs; fore coxae with a brownish ring in the apical half, middle and hind coxae variegated with fuscous; fore femora with three, middle and hind femora with five brown annulations, middle ring of hind femora darker, almost black; all tibiae with three dark rings in their basal half, the annulations of the fore tibiae and the first narrow annulation of the other tibiae being brown, the two other annulations of the middle and hind tibiae black; apex of all trochanters and of tibiae, and extreme base of femora brownish, apex of fore tarsi and the whole middle and hind tarsi fuscous; all dark annuli of the four posterior femora and tibiae bearing, besides the ordinary long white pilosity, a thick tuft of shorter hairs which are brown on the brown annuli, black on the black ones; fore coxae as long as the apical tumid part of the prothorax; fore femora and tibiae armed beneath down their whole length with short, black spinelets, the femora moreover near the base with two strong slightly curved spines which are white with the extreme apex black; fore femora a little shorter than the pronotum.

Length.—Female, 8.5 mm., with membrane 10 mm.

Female.—Distance between inner margins of eyes not quite twice broader than an eye; abdomen dilated, elongately suboval, lateral margins at the junction of the four last segments produced in a triangular lobule constructed as in the other species and as described by me.¹

Mexico (Tampico, E. A. Schwarz).

Type.—Cat. No. 20149, U.S.N.M.

Very distinct from *S. spiniventris* Signoret (the only American species hitherto known) and more related to *S. muiri* Kirkaldy from the Fiji Islands, from which it differs principally by the nontufted antennae and the structure of the pronotum.

SCHIDIUM.² new genus.

Head without an apical spine. Rostrum with the first joint but little shorter than the antecular part of the head, always passing the middle of the antecular part, longer than or as long as the second joint which passes the eyes, third joint shorter than first and second together. Other characters as in *Ghilianella* Spinola.

Type of the genus.—*Schidium lemur*, new species.

To this genus also belong the African *Ghilianella matercula* Bergroth and *nutricula* Bergroth, and the Indian *Gh. phasma* Distant. These Old World species can not be included in the American genus *Ghilianella*, in which the head is armed with a spine at the apex, and which has the first rostral joint much shorter than the

¹ Bull. Amer. Mus. Nat. Hist., vol. 31, p. 347.

² σχιδιον=stick.

anteocular part of the head, scarcely passing the antenniferous tubercles, and shorter than the second joint which does not reach the posterior margin of the eyes, and the third joint longer than the first and second together.

SCHIDIUM LEMUR, new species.

Narrow, linear, very finely alutaceous, not granulated, black; head above with a luteous streak on each side immediately behind the transverse impression; abdomen beneath brownish black sprinkled with small pale yellow spots, especially along the median line; rostrum piceous, with the articulations of the joints whitish yellow; antennae castaneous; fore legs piceous black, the spines of the femora (except their extreme tip) and a median annulation to the tibiae whitish; middle legs castaneous, their femora with four and their tibiae in the basal half with three narrow whitish rings more or less interrupted beneath; hind legs mutilated, but judging from the still existing basal half of the femora colored as the middle legs. Head with the postocular part scarcely constricted in the middle; first joint of antennae somewhat longer than head and thorax together; first joint of rostrum a trifle shorter than anteocular part of head and nearly twice the length of second joint. Prothorax two and a half times longer than head; mesothorax distinctly shorter than prothorax and a little longer than metathorax. Abdomen half as long again as head and thorax together, parallel from its base to apex of fifth segment, sixth segment somewhat widening from base to apex; female dorsal genital plate a little shorter than sixth segment, a little narrowing from the base to the truncate apex, longitudinally ridged in the middle, ventral sutures curved forward. Fore legs: Coxae a little shorter than head and prothorax together; femora somewhat longer than coxae, their unarmed basal part a little longer than the spined apical part; tibiae very finely denticulated beneath; tarsi not reaching the first long spine of the femora.

Length.—Female, 27 mm.

Type.—Cat. No. 20150, U.S.N.M. Guinea (Mount Coffee, Liberia, R. P. Currie).

Allied to *Sch. matercula* Bergroth, from which it differs principally by smaller size, shorter metathorax, and differently shaped female dorsal genital plate.

Note.—In my description of *matercula* the mesothorax is by some lapsus said to be “prothorace nonnihil longior”; it is a little shorter than the prothorax.

Family NABIDAE.

ARCHNOCORIS TRINITATIS, new species.

Smooth, shining, glabrous, piceous black; posterior lobe of pronotum finely and thickly punctulate with an extremely short erect whitish pubescence; scutellum with a few rather long hairs; abdomen aenescent; posterior margin of pronotum and of propleura, apical spine of scutellum, a subbasal vitta, median fascia, and triangular spot at apical angle of corium, and margin of acetabula white; under side of head, orificia, and the evaporative area testaceous yellow; metapleura at the anterior angle, ventral segments (except fourth and sixth) at the lateral margins, and second ventral segment at middle of apical margin with an ivory white callus; antennae, rostrum, and legs pitchy black; apex of second antennal joint, fourth joint (except base and apex), extreme apex of all femora, and a rather broad annulation to hind femora (nearer to apex than to base) yellow or reddish; tibiae and tarsi fuscotestaceous, base of tibiae narrowly whitish. First joint of antennae as long as head, second twice the length of first, third distinctly longer than second, fourth somewhat shorter than second. Pronotum scarcely as long as broad, posterior lobe two-thirds longer than anterior lobe with collar. Scutellum with a short semierect spine at apex. Hemelytra somewhat passing apex of abdomen. Middle femora not incrassated in either sex.

Length (without membrane).—Male and female, 4-4.2 mm.

Type.—Cat. No. 20151, U. S. N. M. Trinidad (Montserrat, A. Busck).

Allied to *A. panamensis* Distant, but with differently colored antennae and legs, and shorter pronotum. Described from 4 males and 1 female.

Family HENICOCEPHALIDAE.

HENICOCEPHALUS COOKI, new species.

Dull black, hemelytra and pectus brownish black, abdomen dark testaceous; fourth and apex of third antennal joint, base of hemelytra, trochanters, knees, and apex of tibiae whitish. Head shortly pilose, vertex (female) between the small eyes more than three times broader than an eye; postocular part subglobose, slightly broader than long and as broad as the width across the eyes, with a very fine impressed median line; first antennal joint scarcely passing apex of head, second joint as long as antecular part of head together with the eyes, third joint one-fourth shorter than second and a little longer than fourth. Pronotum with extremely short pubescence; fore lobe (collar) conspicuously longer in the middle than at the sides, with a very slight median impression; middle lobe twice the

length of the fore lobe and (female) one-fourth narrower than the hind lobe, subparallel from the base to beyond the middle, then strongly narrowing to apex, the disk with a **└**-shaped median impression and on each side with a three-branched impression, on the outside of which is a small round foveola visible only from the side; hind lobe shorter than middle lobe, its basal margin slightly rounded. Hemelytra reaching a little beyond apex of abdomen, discal cell closed. Fore femora a little more than three times longer than broad, fore tibiae at apex somewhat narrower than fore femora in the middle. Hind femora reaching base of last ventral segment, longitudinally somewhat convex above, straight beneath.

Length.—Female, 6.5 mm.

Type.—Cat. No. 20152, U.S.N.M., Guinea (Mount Coffee, Liberia, O. F. Cook).

Not nearly allied to any described African species.

Family ANTHOCORIDAE.

MONTANDONIOLA THRIPODES, new species.

Oblong, shining, glabrous, impunctate, black; corium and clavus white, subtransparent; inner margin and commissure of clavus, the narrow posteriorly somewhat widening embolium, and cuneus black; membrane hyaline, iridescent, with a rather broad parallel brownish-black vitta running from near the interior basal angle to the apex and lying in the longitudinal axis of the body when the hemelytra are closed; third (and probably fourth) joint of antennae, apex of second joint of rostrum, its third joint (except apex), fore tibiae (except extreme base), and all tarsi yellow. Head longer than pronotum in the middle; postocular part shorter than antecular part, but forming together with the apex of the pronotum a cylindrical neck which is equal in length to the antecular part; eyes (male) moderately prominent, seen from above not quite twice longer than broad, a trifle longer than antecular part; vertex between the eyes one-half broader than an eye and twice broader than the gular interspace between them, ocelli placed close to the posterior inner margin of the eyes; antennae very finely and shortly pilose, first joint glabrous, slightly passing apex of head, second joint as long as the distance between ocelli and apex of head, subcylindrical, incrassated, twice thicker than first joint, third joint somewhat longer than first and slightly narrower (fourth joint wanting); rostrum scarcely reaching anterior coxae, first joint very short, second reaching posterior margin of eyes (female), linear, third as long as second. Pronotum with a short apical neck but with no distinct apical annulation (collar), lateral margins narrowly carinate and slightly sinuate between the neck and the humeral angles, posterior

margin cut off obliquely before base of corium, deeply sinuated in front of scutellum, the disk with a transverse median impression. Scutellum impressed in the middle. Orificia curved toward anterior angle of metapleura but not nearly reaching this angle. Hemelytra passing apex of abdomen by a little less than half the membrane; membrane with two veins, one somewhat within the outer margin, the other near the inner margin. Abdomen not broader than the closed hemelytra, male genital segment with some long hairs directed backward. Legs rather slender, glabrous.

Length (without membrane).—Male 2 mm.

Type.—Cat. No. 20153, U.S.N.M.

China (Hongkong, A. Koebele).

In shape and color this insect, like the species of *Macrotrachelia* Reuter, reminds one of a *Thrips*.

Only two species of this interesting genus were previously known, one from the Balearic Islands, the other from Kilimanjaro.

Family MIRIDAE.

IX,¹ new genus.

Body oblong, subparallel between base of hemelytra and base of cuneus; punctulate above, except head and pronotal calli; impunctate beneath, except the punctulate propleurae. Head narrow, subhorizontally projecting, about one-half longer than broad and more than twice longer than its basal height; eyes somewhat removed from base of head, large but moderately prominent, seen from above elliptical, considerably longer than broad, seen in profile obliquely subovate, occupying the whole height of the head; antecular part shorter than eyes, seen from above triangular, acute at tip, seen from the side rounded at apex; clypeus not separated from the forehead by an impression, lorae confluent with genae, the part of the vertex lying between the eyes narrower behind the middle; postocular part of head separated from the rest of the head by a distinct constriction visible round the head both above (where it is a little curved backward), on the sides, and beneath, shorter than the antecular part, slightly widening from the constriction to the base and forming together with the apex of the pronotum a subcylindrical neck which is a little broader than long and slightly narrower anteriorly; throat long, almost straight and horizontal, interrupted only by the postocular constriction; antennae inserted at the anterior angle of the eyes, slender, but the first joint somewhat incrassated, narrower at base and apex than in the middle, half the length of the head and passing apex of head by two-thirds its length, second joint much longer than first; rostrum reaching a little beyond anterior

¹♄=an insect injurious to vegetation.

margin of mesosternum, first joint reaching middle of eyes, second and third subequal in length, each a little longer than first and a little shorter than fourth. Pronotum gently sloping, strongly narrowed from the subacute very slightly prominent humeral angles to the apical collar which is as long as the postocular part of the head, well defined posteriorly by an impressed line continued through the sides and prosternum, not callose though transversally convex, punctulate the same as the disk of the pronotum, with its lateral margins parallel; calli confluent, forming a transverse impunctate area immediately behind the collar and reaching the sides, in the middle a little longer than the collar but narrowing toward the sides, together with the collar in length occupying scarcely more than the apical third of the pronotum; lateral margins from the base of the collar to the humeral angles straight, obtuse, vertically rounded but with a slightly raised impunctate line separating the pronotum from the propleura and visible only from the side, basal margin rounded, covering the base of the scutellum. The uncovered part of the scutellum half the length of the pronotum without collar, a little broader than long, the extreme tip a little callose. Xyphus of prosternum with a small median impression, very finely margined, blunt at apex. Orificia distinct, rounded. Hemelytra passing apex of abdomen, veins of corium and clavus not distinct, cuneus moderately inclined, longer than broad, the incisure shallow, the outer and inner margins slightly rounded, membrane with a single cell not reaching beyond apex of cuneus, inner apex of cell subobtusely angular. Vagina of female passing middle of abdomen. Legs slender; fore coxae not reaching middle of mesosternum; all femora linear, the hind pair a little thicker than the others; tibiae sparingly, shortly, and softly pilose, not spinulose; third joint of tarsi incrassated toward apex, claws small, strongly curved, arolia shortly laminate.

This genus must be referred to the subfamily Bryocorinae, from all other genera of which it differs by the horizontally produced head. The membrane *appears* to be bicellulate, there being a vein separating a narrow elongate outer cell from the other, but unless I am mistaken it is the anal vein of the underlying membrane which is visible through the translucent upper membrane.

Type of the genus.—*Ix porrecta*, new species.

IX PORRECTA, new species.

Subglabrous, shining, beneath more so; above castaneous, cuneus, and a costal spot immediately before it red, beneath piceous (except the pale castaneous throat); membrane pellucid, a little shaded with brownish gray, iridescent, its veins piceous; antennae, rostrum, and legs pale yellowish testaceous, first joint of antennae pitchy casta-

neous, punctuation of prothorax, scutellum, and hemelytra fuscous, thick and fine but deep. Head a little over half the length of the pronotum; vertex between the eyes at its narrowest place one-third narrower than an eye, with a very short longitudinal impressed line not reaching the postocular transverse impression; antennae thinly and shortly pilose, first joint glabrous, second joint at least three times longer than first and as long as the width across the humeri, sublinear, apical half very slightly thicker than basal half. Pronotum slightly broader than long, about four times broader than its apex, and thrice broader than the head. Hemelytra passing apex of abdomen by half the membrane, cuneus reaching apex of abdomen. Femora beneath sparingly and erectly pilose.

Length (without membrane)—Female, 4.5 mm.

Type.—Cat. No. 20140, U.S.N.M. China (Hongkong, A. Koebele).

In examining the type it was injured, and after repairing the pronotum was found to be a little more inclined than in its natural position.

Family GERRIDAE.

LIMNOGONUS CURRIEI, new species.

Opaque, excepting the somewhat shining clypeus; above dark brown, except the black head and the following yellow markings: a spot at anterior angles of eyes, a median and basal fascia to vertex, the former of which does not reach the eyes and emits a longitudinal line from each end forward, and the margins and a narrow median vitta to pronotum; a whitish lateral vitta running from anterior margin of mesonotum to near apex of hind acetabula but narrowly interrupted at their base; interior part of hemelytra dark brownish testaceous; beneath pale yellowish, metasternum and venter with a faint grayish bloom; a spot on fore acetabula, a vitta on middle acetabula, a mesosternal lateral vitta running from the fore to the middle coxae, and a broad posteriorly tapering sublateral vitta to venter dark fuscous; antennae and legs brown, fore coxae, trochanters, and femora pale yellowish, except a vitta to the trochanters and a superior and inferior vitta to the femora; rostrum pale yellowish, a lateral spot to the first joint, apex of third, and the whole fourth joint piceous. Head as broad as pronotum (of the macropterous form) across the humeral angles; first joint of antennae reaching middle of pronotum, second joint one-fourth shorter than first; rostrum not reaching middle of mesosternum, first joint longer than broad, second broader than long. Pronotum with the anterolateral margins a little sinuate behind the middle, posterior process triangular, narrowly rounded at apex. Mesosternum with the rather broad and shallow rostral furrow reaching its middle. Metasternum

one-third the length of the mesosternum and as long as the two first segments and half the third segment of the venter taken together, with the orificium placed in a foveate impression near the hind margin. Hemelytra a little longer than abdomen. Venter as long as mesosternum; sixth segment deeply arcuately sinuate at apex, in the middle a little longer than the preceding segment; apical angles acute, almost reaching second male genital segment which is about twice the length of first genital segment. Fore femora almost as long as mesosternum, somewhat thickened toward base; second joint of fore tarsi more than twice the length of first joint. Middle coxae not quite reaching base of hind acetabula. Middle and hind femora subequal in length and but slightly shorter than the body; middle tibiae a little shorter than the femora and more than three times longer than the tarsi; hind tibiae and tarsi together about half the length of the femora.

Length.—Male, 7 mm.

Type.—Cat. No. 20154, U.S.N.M.

Remarkable by its dull color, all other known species being shining, and by the very short basal joint of the fore tarsi.

Note.—The confusion prevailing in the genus *Gerris* is great, and is chiefly due to the fact that some authors have confounded quite distinct genera with *Gerris*, often even without indicating to what subgenera or groups of "*Gerris*" in this wide sense their species belong, and without mentioning such characters from which the species could be systematically located. Of that sort are all the Indian species described by Distant. *Aquarius* Schellenberg (*Hygrotrechus* Stål) can be considered a subgenus of *Gerris* Fabricius (*Limnotrechus* Stål), but *Limnoporos* Stål, *Tenagogonus* Stål (*Limnometra* Mayr), and *Limnogonus* Stål are good genera. *Tenagogonus* was founded in 1853 without a type, but in 1855 Stål described a single species of this genus, *albovittatus*, from Natal, which thus is the type. This species was omitted by Stål himself in his Hemiptera Africana and by Lethierry and Severin in their Catalogue, but Kirkaldy had seen specimens (probably also types) of it, and says that it is a *Limnometra*.

CYLINDROSTETHUS QUADRIVITTATUS, new species.

Apterous form.—Above fulvous with a distinct buffy tint, beneath pale testaceous; clypeus and adjacent parts of juga, apex of antenniferous tubercles, an oblong spot at posterior half of inner margin of eyes, two vittae slightly curved outward to pronotum, four vittae to mesonotum (the two median ones shortly interrupted [male] or narrowed [female] behind the middle), two vittae to metanotum, dorsum of abdomen (except the first [female] or three first [male]

segments in the middle), apical spines of last abdominal segment, a vitta to upper side of genital segments, an apical spot to all acetabula, a basal streak to middle acetabula, and a sublateral vitta to venter (but faintly indicated in the male) black; a line exteriorly bordering the lateral vittae of the mesonotum, a spot at basal angles of mesonotum, a spot on upper side of acetabula, and a slightly waved line interiorly bordering the ventral vittae, clothed with very short but thick golden yellow sericeous pubescence; antennae, last two joints of rostrum, an upper (abbreviated) and lower vitta to fore femora, the fore tibiae and tarsi, and the four posterior legs (except coxae and trochanters) fuscous black. Head a trifle longer than broad, antecular part a little shorter than the eyes, distinctly broadening from anterior angles of eyes to apex of antenniferous tubercles; eyes obliquely produced backward a little beyond base of head, twice broader than the interocular space at its narrowest place; rostrum slightly passing anterior margin of prosternum, antennae about reaching the middle of the body, first joint a little longer than head and distinctly longer than the two following joints united, second joint scarcely more than half the length of first and twice the length of third, fourth subequal to second. Pronotum a little longer than the vertex from its base to the apex of the eyes, a little rounded at the sides, rather broadly longitudinally impressed in the middle, apical margin straight, basal margin convexly rounded. Mesonotum in the middle three times longer than pronotum, slightly widening from apex to base, lateral margins straight, apical margin sinuate, basal margin bisinuate, shortly and roundedly produced between the sinuosities. Metanotum in the middle very slightly shorter than pronotum. Mesosternum somewhat longer than mesonotum, shortly and roundedly produced at apex between the fore coxae. Metasternum one-third the length of mesosternum, a trifle longer (female) or very distinctly longer (male) than the two first ventral segments together, the orificium placed in the transversely impressed line running a little in front of the posterior margin. Abdomen above as long as (female) or somewhat shorter than (male) thorax, beneath as long as mesosternum and metasternum together; connexivum in the male strongly reflexed, but not quite erect, in the female very strongly inflexed over the dorsum, covering the greater part of it, apical angle of last segment shortly and acutely triangularly produced (female) or armed with a strong somewhat divergent spine passing the middle of the first dorsal genital segment (male), last ventral segment at apex deeply arcuately sinuate (male) or much less deeply bisinuate (female); genital segments in both sexes, particularly in the female, slightly irregular, turned a little to the right. Fore femora straight, incrassated, sub-

parallel from base to beyond middle, then somewhat narrowed, a little longer than head and pronotum together, tibiae a little curved, first joint of tarsi less than half the length of second joint. Middle coxae not reaching base of hind acetabula. Middle and hind femora equal in length, a little shorter than the body. Middle tibiae about one-fourth shorter than femora. Hind tibiae more than half the length of femora. Middle tarsi about half the length of tibiae and about three times longer than hind tarsi.

Length.—Male, 10–10.4 mm.; female, 11.5–12 mm.

Male.—First dorsal genital segment a little shorter than last abdominal segment, its apical margin rounded; second dorsal genital segment a little shorter than first and only one-third its breadth, rounded at apex; first ventral genital segment a little longer than last abdominal segment, its apical angles somewhat produced; second ventral genital segment longer than first, subconical, not quite reaching apex of second dorsal genital segment.

Female.—First dorsal genital segment shorter than last abdominal segment, narrowing from the base to the subtruncate apex; ventral genital segment as long as the corresponding dorsal segment, but narrower, subparallel; second genital segment very short.

Type.—Cat. No. 20155, U.S.M.N. Guinea (Mount Coffee, Liberia, R. P. Currie).

This is the first *Cylindrostethus* recorded from Africa. In coloration it is quite distinct from the American species, and still more so from the Asiatic ones. No winged specimens of this fine species were found.



A REVIEW OF THE FOSSIL PLANTS IN THE UNITED STATES NATIONAL MUSEUM FROM THE FLORISSANT LAKE BEDS AT FLORISSANT, COLORADO, WITH DESCRIPTIONS OF NEW SPECIES AND LIST OF TYPE-SPECIMENS

BY

F. H. KNOWLTON

Custodian of Mesozoic Plants, United States National Museum

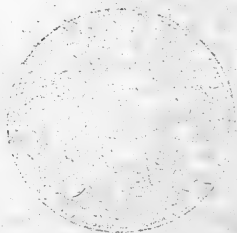
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BEDS AT FLORISSANT, COLORADO, WITH DESCRIPTIONS
OF NEW SPECIES AND LIST OF TYPE-SPECIMENS.

By F. H. KNOWLTON,

Custodian of Mesozoic Plants, United States National Museum.

The Florissant lake beds of Colorado have been a perennial and never-failing source of supply for finely preserved fossil plants and insects since their discovery nearly fifty years ago; in fact, it is perhaps safe to say that this locality has supplied a greater number of specimens in these groups than any other single locality in the world. It has been reported that more than 30,000 specimens of insects, representing over 1,000 species, have been obtained here, but no accurate estimate has been, or indeed can be made, of the number of plants collected, though they undoubtedly amount to very many thousands, now scattered through the museums and collections of the world. Notwithstanding the wealth of plant material, every considerable collection that is made there is almost certain to include new forms or material throwing additional light on previously described species.

The present paper was primarily undertaken for the purpose of placing on record studies of a number of collections not previously investigated, or only partially studied, but has been expanded to include practically all of the plant material from Florissant now deposited in the United States National Museum. These collections and their sources are as follows:

1. *The Hambach collection.*—This is a collection of about 100 specimens, forming a part of an extensive paleontological collection purchased in 1907 from Dr. Gustavus Hambach, of St. Louis, Missouri. It includes the types of species of Florissant plants described and figured by Walter C. G. Kirchner,¹ and also is especially rich in specimens of exceptionally well-preserved flowers and fruits, many of which were unnamed.

¹ Kirchner, Walter C. G., Contributions to the fossil flora of Florissant, Colorado, Trans. Acad. Sci. St. Louis, vol. 8, 1898, pp. 161-188, pls. 11-15.

2. *The Scudder collection.*—This collection was made by the late Samuel H. Scudder, of Cambridge, Massachusetts, under the auspices of the United States Geological and Geographical Survey of the Territories, of which Dr. F. V. Hayden was the director. This collection of plants was made as an incident in collecting fossil insects, in which group Scudder was the well-known authority. Although comprising only about 150 specimens, it is made up of carefully selected material and contains a number of undescribed forms as well as some very fine examples of previously known species. It had remained packed in the original boxes in the National Museum until the occupancy of the new museum building in 1911.

3. *The Lacoë collection.*—This is a collection of about 200 specimens that was acquired by the late R. D. Lacoë, of Pittston, Pennsylvania, and by him donated to the United States National Museum in 1893, together with his immense collection of Paleozoic material. These specimens are in the main exceptionally well preserved and were studied and named by Leo Lesquereux¹ in his well known account of the Florissant flora. As many of these type-specimens were apparently received by Lesquereux too late to be figured in his work, they are figured in the present paper, either under the names given them by Lesquereux, or under species that subsequent study has shown them to belong with.

4. *Old National Museum collections.*—This material, which is comprised in several unit trays, represents collections that have been acquired in various ways and at different times by the United States National Museum, but which has remained unstudied. It is made up mainly of well-known species, though one or two apparently new forms were detected.

In addition to the unnamed material, the entire United States National Museum collections of Florissant material has been re-studied and named in accordance with the later understanding of this flora. This embraces the original material obtained by the Hayden survey, and which served in large part as the basis for Lesquereux's work as published in his Tertiary Flora and Cretaceous and Tertiary Floras. A large portion, if not indeed all, of the material used in the preparation of the latter work that is not now in the United States National Museum, is, or should be, in the museum of Princeton University.

5. *Collection of 1913.*—This is a small and relatively unimportant collection made in 1913, when Edward W. Berry and the writer spent several days at Florissant. The most valuable part of this collection is a series of specimens of fossil wood from the well-known "fossil forest," located about 2 miles west of the town of Florissant. No fossil wood from this locality was previously contained in the

¹ Lesquereux, Leo, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cretaceous and Tertiary Floras), 1883.

United States National Museum collections. It is not described in the present paper.

A word may be said regarding the geological occurrence and stratigraphic position of the fossiliferous lake beds at Florissant. So far as now known the first geological account of the Florissant Lake basin was made by Dr. A. C. Peale¹ who visited the area and made a small collection of plants on October 11, 1873. In his account he presented a map showing the approximate outline of the ancient lake, and in addition to the brief description of the beds and their abundant fossil contents, gave a section of the succession of the strata as observed in a low bluff just below the town of Florissant.

In point of time apparently the next geological account of this lake basin was given by Samuel H. Scudder,² who visited the locality in the summer of 1877. After quoting in full Doctor Peale's account he presents his own observations which were made jointly with Prof. Arthur Lakes. He gives descriptions of the beds, several geological sections, and a revised map. It is probable that the Scudder collection of plants here reported on was made at this time.

As the locality became more and more widely known for its fossil resources, additional accounts were published, but it is not necessary to review these in the present place. One of the latest and perhaps best accounts is that given by Prof. Junius Henderson,³ based on the results of a visit in 1905.

From the several descriptions it appears that Lake Florissant was a small lake approximately 5 miles in length and not much if any exceeding a mile in width, but with a very irregular shore line. Henderson says:

The whole topography of the region indicates that the basin was formerly a mountain valley and its laterals formed in granite by stream erosion. * * * The ramification of the lake into lateral valleys and consequent tortuous outline gives a great length of shore line in proportion to the area. It consisted of two somewhat distinct bodies of water connected by a narrow strait and placed at such an angle with each other as to form a wide L; or, to state it another way, the lake was nearly divided at the angle by two promontories which jutted into it from opposite shores.

That the lake was shallow is attested by the sun-cracking of some of the shales, the character of the fish remains, and the erect stumps of *Sequoia*. According to Henderson—

The beds are comprised chiefly of volcanic ashes, mud, and sand, the component particles of which are generally somewhat though not very much worn by the action of water. The conclusion reached in both field and laboratory is that the deposits were formed largely by volcanic ashes from repeated eruptions falling upon the surface of the water and settling to the bottom, assorted by the sluggish lake currents; also by mud and ashes falling or flowing into position where they were rapidly washed into the lake by rains, streams, and waves without much grinding.

¹ Peale, A. C., U. S. Geol. and Geogr. Surv. Terr., Ann. Rept. 1873 [1874], p. 210.

² Scudder, S. H., U. S. Geol. and Geogr. Surv. Terr., Bull., vol. 6, 1882, pp. 279-300

³ Henderson, Junius, Univ. of Colorado Studies, vol. 3, 1906, pp. 145-151

The strata of the upper deposits differ greatly from each other in composition, fineness of material, and thickness. At least the whole fossiliferous portion examined has been deposited in water, is thin-bedded, and very distinctly stratified. It often weathers out in large scales little thicker than ordinary writing paper. During the periods of deposition large numbers of insects and plants were sometimes entombed and preserved in great perfection. While there is a general sameness to the formation in various parts of the basin, yet, upon more particular examination of the strata, great dissimilarity in minor details forces itself upon the attention. Especially is this true when one compares a vertical section in the northwestern basin with one in the southeastern basin.

The lower part of the formation seems wholly nonfossiliferous, is of a drab color, quite homogeneous, thick-bedded, and has a decidedly conchoidal fracture. Our limited examination of that portion of the formation left the impression that it was formed by mud flows without much assortment by moving water. This is offered merely as a suggestion for future work, not as a final conclusion, and its investigation may throw important light on the history of the lake. Near the northwestern end of the basin a shaft has been sunk for some distance into the nonfossiliferous beds, and in other places wells have been sunk, affording excellent sections and showing that the floor deposits extend to considerable depth—just what depth we have not learned. The fossiliferous beds above the floor deposits are approximately 20 feet in thickness.

As regards the geological age of these lake beds there has been some difference of opinion. As they lie on, and are completely surrounded by, granite, and further are isolated from all other sedimentary rocks by several miles of crystallines, no aid can be expected from stratigraphy and dependence must be placed entirely in the paleontological contents. As a result of his hasty examination Doctor Peale inclined to regard them as of Pliocene age, but Lesquereux, who studied the plants, at first considered them as probably belonging to the upper Miocene. Later, when larger collections became available, Lesquereux came into substantial agreement with Cope, who had studied the scant fish remains, and these beds came to be referred to the lower Miocene or Oligocene, which is the age usually assigned them in textbooks and elsewhere. Within the past few years, however, there has been a revival of interest in the study of the Florissant flora and fauna, due largely to the activities of Prof. T. D. A. Cockerell,¹ and as a result of these studies and comparisons with various floras of this country and Europe, the conviction has been growing that the position originally assigned by Lesquereux is more nearly correct, namely, that the beds are upper Miocene in age. While it is improbable that the final word has been said regarding the exact stratigraphic position of these beds, until conclusive evidence to the contrary has been presented the Florissant plant-bearing beds may be regarded as upper Miocene.

It may be of interest to note in this connection that lake beds of similar lithologic composition, and containing many of the Florissant species of plants, have recently been discovered in other parts of Colorado. These will be described and discussed in full in a later publication.

¹ See Univ. Colorado Studies, vol. 3, No. 3, 1906, pp. 157-176; Amer. Nat., vol. 44, 1910, pp. 31-47.

MOSSES.¹

HYPNUM? BROWNI *Kirchner.*

Hypnum brownii KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 178, pl. 12, figs. 4, 4a.—BRITTON and HOLLICK, Bull. Torrey Bot. Club, vol. 34, 1907, p. 139, pl. 9, figs 3, 3a.

Type.—Cat. No. 33,678, U.S.N.M.

I have examined this specimen with care, and am unable to make more out of it than did the author of the species. It consists of a cluster of delicate, arched and often forked branches, while the leaves are ovate-lanceolate and acute. It seems beyond any reasonable question to be a moss, but, as Britton and Hollick have said, its reference to *Hypnum* is a matter requiring confirmation. The Scudder collection contains a single fragmentary branch that appears to belong here.

POLYTRICHUM? FLORISSANTI, *new species.*

Plate 12, fig. 4, three times enlarged.

Type.—Cat. No. 34,760, U.S.N.M.

The Hambach collection contains a single example—the one here figured—that appears to be a fruiting moss. It has a long, exceedingly slender pedicel fully 2 cm. in length, and a large ovoid capsule that is nearly 3 mm. long and a little over 1.5 mm. in diameter. The capsule appears to be ribbed and somewhat fimbriate at apex, but this appearance may be due to the state of preservation. The pedicel is practically straight, evidently erect, and the capsule is erect and symmetrical. There is no evidence concerning either calypah, operculum, or peristome. The ribbed appearance of the

¹ In 1883, Lesquereux described from Florissant what was supposed to be a moss under the name: *Fontinalis pristina* Lesquereux (Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 135, pl. 21, fig. 9).

The specimens figured seemed to represent an axis or "stem" with numerous, obscurely two-ranked linear "leaves," and were tacitly assumed to have been correctly referred to the mosses. When the short list of American fossil mosses was reviewed by Britton and Hollick [Bull. Torr. Bot. Club, vol. 34, 1907, pp. 139-142, pl. 9], they passed over the present form with the statement that "it may be merely remarked that the correctness of its reference to the genus *Fontinalis* is questionable."

In the Scudder and Hambach collections there was found several specimens that agree perfectly with the figures given by Lesquereux, and without special study they were referred to *Fontinalis pristina*. Later however, a specimen was noted that showed conclusively that it is a feather. It is about 21 mm. in length and 4 mm. in width, and is preserved entire, consisting of the calamus or basal portion about 3 mm. long, and the delicate rachis that passes to within about 3 mm. of the tip. Arranged on either side are the delicate barbs with faint indications of the barbules and interlocking processes; in other words it is perfect and unmistakable feather. It has been submitted to a number of ornithologists, among them Dr. Charles W. Richmond and Mr. H. C. Oberholser, who indorse this reference without qualification, the latter suggesting that it was doubtless from a small bird, and not improbably a passerine bird. As two species of birds have been described from the Florissant lake beds, there is every reasonable probability of separate feathers being occasionally preserved.

If there had been present only the upper half of the above described feather it would have been identified at once as Lesquereux's *Fontinalis pristina*, for it would then be indistinguishable from the original figure as well as from specimens usually so identified, but being preserved entire, as it is, its avian character is at once apparent.

capsule suggests a fully mature and more or less shriveled condition after the discharge of the spores. There is no evidence of the presence of leaves. This moss, if it has been correctly interpreted, suggests an old fruiting plant of the genus *Polytrichum*, such for instance as the well-known hair-cap moss, *Polytrichum juniperinum*, but on account of its poor preservation, it is not possible to be certain of its affinity. The generic reference has consequently been questioned.

PLAGIOPODOPSIS SCUDDERI Britton and Hollick.

Plate 12, fig. 2.

Plagiopodopsis scudderi BRITTON and HOLLICK. Bull. Torrey Bot. Club, vol. 42, 1915, p. 10, text figs. 1, 2.

This splendid moss was detected in the Scudder collection by the writer and by him submitted to Mrs. Elizabeth G. Britton and Dr. Arthur Hollick for examination and publication. As it has the fruit preserved in a fair degree of perfection it was possible to determine its affinity with the living species *Plagiopus oederi* (Gunner) Limpricht, of the Bartramiaceae, with reasonable certainty. They established for it the genus *Plagiopodopsis*, with the following description:

Plants caespitose, matted together by basal radicles; stem about 1 cm. high, erect, simple, or branching; leaves crowded, spreading, about 2 mm. long by 0.5 mm. wide, lanceolate-acuminate, costate to apex; perichaetial leaves longer, extending to or beyond the capsule; seta terminal, 2-3 mm. long, erect and partly exerted; capsule ovoid, 1.5 mm. long by 0.75 mm. broad, erect or inclined, rugose or plicate; mouth 0.5 mm. broad, too indistinct to show any traces of peristome; calyptra and lid unknown.

The figure here given (pl. 12, fig. 2) is a new figure of the type-specimen, showing it three times natural size. It is a somewhat clearer figure than that given by Britton and Hollick.

Family POLYPODIACEAE.

PHEGOPTERIS GUYOTTII (Lesquereux) Cockerell.

Plate 12, fig. 1.

Phegopteris guyottii (LESQUEREUX) COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 76.

Sphenopteris guyottii LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 137, pl. 21, figs. 1-7.

A fine specimen in the Hambach collection, but again without trace of fruit.

DRYOPTERIS SCANSA Cockerell.

Dryopteris scansa COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 76, pl. 6, fig. 9; pl. 10, fig. 38.

A single specimen in the Scudder collection that is apparently the same as the first of the figures given by Cockerell, though not quite so

well preserved. The reference of this to *Dryopteris* must be considered doubtful.

Family PSILOACEAE.

TMESIPTERIS ALLENI (Lesquereux) Hollick.

Tmesipteris allenii (LESQUEREUX) HOLLICK, Bull. Torr. Bot. Club, vol. 21, 1894, p. 256, pl. 205, fig. 12.

Ophioglossum allenii LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1872 [1873], p. 371.

Salvinia allenii (LESQUEREUX) LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 65, pl. 5, fig. 11.

This is one of the most characteristic plants found at Florissant, and while not actually abundant, is present in almost every collection from there and is always perfectly preserved. It is regularly elliptical in shape with a pronounced emarginate apex and excurrent midvein. The nervation is peculiar in that there is the strong midvein, between which and the margin there is a very coarse reticulate areolation. Not one of these leaves, so far as known to the writer, has ever been found attached, nor has a trace of fruit been observed, though if correctly referred to this modern genus, the fruit might fall off and not be recognizable thereafter.

The single living species of *Tmesipteris* (*T. tannensis*), which is widely distributed throughout Australia, New Zealand, Tasmania, and the Polynesian islands, has drooping branches thickly beset with small linear decurrent leaves which are either sharply apiculate or emarginate with the midvein excurrent. The nervation consists of a very strong midvein and a very fine reticulate areolation between it and the margin.

Broadly speaking the fossil form resembles the living in the emarginate, excurrent apex and in the manner of areolation, but it differs widely in shape, manner of attachment of the leaves, and in the very coarse reticulation. It seems doubtful if they are congeneric, though they may belong to the same family.

Family PINACEAE.

PINUS FLORISSANTI Lesquereux.

Pinus florissanti LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 138, pl. 21, fig. 13.

The Hambach collection contains a single cone that is referred to this species, but it is much less perfect than the type. *Pinus florissanti* was established by Lesquereux for a finely preserved, nearly perfect cone, and so far as known to the writer, no specimen has been obtained which in any way connects this type of cone with the leaf-bearing specimens, though doubtless one of them was the species which bore the cone.

PINUS WHEELERI Cockerell.

Plate 12, fig. 3.

Pinus wheeleri COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 78, pl. 6, fig. 11.

Cat. No. 34,755, U.S.N.M.

The Scudder collection contains a fine specimen belonging to this species, which is much better than the type upon which it was based. It includes two short "spurs" a centimeter in length, each bearing a cluster of five leaves. None of the leaves is entirely preserved, however, the longest being only retained for 4.5 cm. of its length, which, according to the original description, was 12 cm. or more.

A fragment of a cone has been attributed to this species by Professor Cockerell, but it is purely conjectural as to whether it belongs here or to the better known *P. florissantii*. The only cone found in the collections under consideration is referred to the latter species.

SEQUOIA AFFINIS Lesquereux.

Sequoia affinis LESQUEREUX, U. S. Geol. and Geogr. Surv. Terr. Bull., vol. 1, 1875 [1876], p. 384; Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1874 [1876], p. 310; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 75, pl. 7, figs. 3-5; pl. 65, figs. 1-4; vol. 8 (Cret. and Tert. Fl.), 1883, p. 138.

Glyptostrobus ungeri? HEER. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 139, pl. 22, figs. 1-6a.

Sequoia haydenii (LESQUEREUX) COCKERELL, Science, vol. 26, 1907, p. 447; Pop. Sci. Mon., vol. 73, 1908, p. 122, fig. in text; Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 78.

With the exception of the dictotyledonous leaves referred to the several species of *Myrica* or *Fagopsis*, this coniferous plant is possibly the most abundant form found at Florissant. It occurs in pieces of all sizes, from single slender twigs up to forking branches and branchlets covering a square foot or more in area, and often preserved in a high degree of perfection. The branches and branchlets with the two quite distinct kinds of leaves, the male aments and the mature cones are all known in completeness of detail but little inferior to living material.

That this conifer is the form described by Lesquereux under the name of *Sequoia affinis*, there can, of course, be no doubt, nor can there be any question as to the identity with it of the material described and figured by him as *Glyptostrobus ungeri* Heer. That it is properly referred to the genus *Sequoia* is also reasonably certain, for as Cockerell and others have pointed out, it is of the type of the living *S. sempervirens*, and is not a *Glyptostrobus*. I quite agree with Cockerell that there is probably only a single species of this type of conifer present at Florissant, and for this it seems to me the available name is *Sequoia affinis*.

Cockerell, as set forth in the synonymy outlined above, includes this species under the name of *Sequoia haydenii* (Lesquereux) Cockerell, on the ground of its identity with *Hypnum haydenii* Lesquereux,¹ which would give the specific name *haydenii* the priority. It seems impossible that this should belong to *Sequoia*, and the suggestion of Britton and Hollick² that it is nearest to certain forms of *Juniperus* is followed, and consequently *Hypnum haydenii* Lesquereux, is treated as a doubtful species of *Juniperus*.

The reference of certain fossil trunks to this species, while possibly true, is unwarranted on the basis of our present knowledge, since they have never been—nor are they likely ever to be—found connected. The inferential combination of species not found in actual organic connection is often harmful and misleading.

SABINA LINGUAEFOLIA (Lesquereux) Cockerell.

Plate 14.

Sabina linguaefolia (LESQUEREUX) COCKERELL, Univ. Colorado Studies, vol. 3, 1906, p. 175.

Widdringtonia linguaefolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.) 1883, p. 139, pl. 21, figs. 14, 14a.

Glyptostrobus europaeus HEER. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 74, pl. 7, figs. 1, 2.

This beautiful species is exceedingly abundant in all collections from Florissant. The Scudder collection contains a specimen covering an area 25 cm. in length by 12 cm. in width.

JUNIPERUS? HAYDENII (Lesquereux), new combination.

Hypnum haydenii LESQUEREUX, U. S. Geol. and Geogr. Surv. Terr. Bull., vol. 1, 1875, p. 383; U. S. Geol. and Geogr. Surv. Terr. Ann. Rept., 1874 [1876], p. 309; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.) 1878, p. 44, pl. 5, figs. 14, 14b; vol. 8 (Cret. and Tert. Fl.) 1883, p. 136.—BRITTON and HOLLICK, Bull. Torr. Bot. Club, vol. 34, 1907, p. 139, pl. 9, fig. 2, 2a.

Type.—Cat. No. 37, U.S.N.M.

The type, and so far as known the only specimen, of this form is preserved in the United States National Museum, and has proved to be more or less of a puzzle to all who have studied it. As it was described as a moss by Lesquereux, who was a recognized authority on this group of plants, it was for many years accepted as one of the extremely few fossil American representatives of this group. It has always appeared anomalous and not closely comparable to any known living species.

In 1907, when Mrs. E. G. Britton, and Dr. Arthur Hollick were collecting all available information regarding American fossil mosses,

¹ U. S. Geol. and Geogr. Surv. Terr. Bull., vol. 1, 1875 [1876], p. 383; Ann. Rept., 1874 [1876], p. 309; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 44, pl. 5, figs. 14-14b.

² Bull. Torr. Bot. Club, vol. 34, 1907, p. 140.

they took special occasion to reinvestigate this "*Hypnum haydenii*," the type being sent them for this purpose. Their conclusion regarding it is as follows:¹

We are satisfied that it is not a moss, and Dr. L. M. Underwood, of Columbia University, has expressed his opinion that it can not be a *Lycopodium*. The closest comparisons which we have been able to make are with certain conifers, especially with forms of *Juniperus communis* L., in which the young growing branchlets often present a striking similarity in general appearance to this specimen.

It is on the basis of the above statement that it is referred tentatively to *Juniperus*, with the frank admission that it does not agree very clearly with the well-known forms of this genus, since it can not be referred either to the *Musci* or to the *Lycopodiaceae*. It is quite well marked and will be easily recognized should it be found again.

MUHLENBERGIA FLORISSANTI, new species.

Plate 13, figs. 1-3.

In the Hambach collection several beautifully preserved spikelets of a grass were found. They were shown to Mrs. Agnes Chase, the well-known graminologist, who recognized at once their reference to the genus *Muhlenbergia*. Mrs. Chase kindly consented to prepare brief notes and measurements from which the following characterization is compiled:

Stems and leaves unknown; axis of inflorescence not well defined; spikelets borne on pedicels about 1.5 mm. long, the body of the spikelet being spindle-shaped, about 2.8 mm. long, and 0.6 to 0.7 mm. wide; awn slender, 2 to 3 times as long as the body, being fully 7 mm. long. In one of the specimens [34,751] in which there are fewer, more scattered spikelets, some of the florets have apparently fallen from their glumes, the body of the floret being about 2 mm. long.

Type.—Cat. Nos. 34,750 [=fig. 1]; 34,751 [=fig. 3], U.S.N.M.

These specimens happen to be preserved on very fine-grained shale with the result that they are retained with a great degree of fidelity. They consist simply of little groups of spikelets broken from the panicle or inflorescence, and they exhibit no trace of the axis to which they were attached. The figures, of which figure 1 is nearly natural size and figures 2 and 3 are multiplied 3 times, give an excellent idea of the characters.

This species appears to be very near to the living *Muhlenbergia porteri* Scribner, a species ranging from Colorado and western Texas to California and Mexico. This species, known as the mesquite grass, is especially common in many parts of New Mexico, where it almost always grows in the shade of mesquite bushes. It has slender, lax stems and open spreading panicles.

¹ Bull. Torr. Bot. Club, vol. 34, 1907, p. 140.

The only other grass described from Florissant is *Stipa laminarum* Cockerell,¹ based on isolated long-awned grains similar to those of the living *Stipa connata* Trinius and Ruprecht. The grain is said to be 10–11 mm. long and about 2 mm. broad, while the awn is “quite 60 mm.” long. It is obviously very distinct from the species here described.

Family TYPHACEAE.

TYPHA LESQUEREUXI Cockerell.

Typha lesquereuxi COCKERELL, Bull. Torr. Bot. Club, vol. 33, 1906, p. 307.

Typha latissima AL. BRAUN. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 141, pl. 23, figs. 4, 4a. [Not *T. latissima* Al. Braun.]

A single characteristic example showing the complete apical portion of a leaf; from the Scudder collection.

Family POTAMOGETONACEAE?

PALAEOPOTAMOGETON, new genus.

PALAEOPOTAMOGETON FLORISSANTI, new species.

Plate 16, fig. 1; plate 17, fig. 3.

Stems slender, erect, weak, possibly aquatic; leaves opposite, short, grass-like, acuminate at apex, probably sheathing at the base, nervation obscure, a midrib only discernible; fruit borne on long, slender almost filiform, axillary peduncles, the fruits spheroid, short-pedicel, apparently indehiscent.

Types.—Cat. Nos. 34,748, 34,749, U.S.N.M.

This form is represented by the two specimens figured and by a number of isolated fruits. With the exception of the fruits, they are very faintly impressed on the matrix, as though the stems were soft and weak, suggesting an aquatic habitat. The best preserved specimen (fig. 1), representing the upper portion of a stem now about 11 cm. in length, which bears at the apex a number of leaves that are apparently broader than the other leaves and suggest the possibility that they were floating.

The fruits, as already pointed out, are the most definite parts preserved. They are spheroid or ovoid, about 2 mm. in diameter, and evidently had a very hard “shell” or test. There is evidence of the presence of rather strong ridges, but nothing to indicate that they were dehiscent, in fact they suggest akenes rather than capsules. Each fruit is short-pedicel and borne on a long, slender, axillary peduncle. The peduncles are clearly alternate, but this is probably an incident rather than a point of significance.

¹Cockerell, T. D. A., Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 79, pl. 6, figs. 1, 3.

The affinity of this plant has not been recognized with certainty. In some ways it certainly suggests *Potamogeton*, to which it was referred by Lesquereux, but its opposite leaves and pediceled fruits are not wholly in accord with this genus. It has been shown to many botanists and no one has been able to suggest anything like an obviously close relationship for it. It is not at all certain that the implication in the generic name given it is the correct one, for it may not really be allied to *Potamogeton*, and it is published at this time simply to make it a matter of record and in the hope that some one may be able to place it more definitely.

Family NAIADACEAE.

NAJADOPSIS RUGULOSA Lesquereux.

Najadopsis rugulosa LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.) 1883, p. 142, pl. 23, fig. 7.

A single example in the Scudder material.

Family LEMNACEAE.

SPIRODELLA PENICILLATA (Lesquereux) Cockerell.

Spirodella penicillata (LESQUEREUX) COCKERELL, Univ. Colorado Studies, vol. 3, 1906, p. 174; Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 79.

Lemna penicillata LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.) 1883, p. 143, pl. 23, fig. 8.

Type.—Cat. No. 1,628, U.S.N.M.

This specimen, so far as known, still remains unique. It is very obscure and may or may not have been correctly interpreted and figured, and at best it can not be considered of great value.

Family PALMACEAE?

PALMOCARPON? GLOBOSUM Lesquereux.

Palmocarpon? globosum LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 144, pl. 24, fig. 3.

The Scudder collection contains two well-preserved specimens that are referable to this species. It is extremely doubtful if this fruit has anything to do with the palms, which so far as authentically known did not occur at Florissant.

Family JUGLANDACEAE.

JUGLANS MAGNIFICA, new species.

Plate 15. (About half natural size.)

Juglans crossii KNOWLTON. KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 183, pl. 14, fig. 1.

Leaf of large size, at least 30 cm. long and about 25 cm. broad, odd-pinnate, with at least 11 leaflets; rachis thick (3 mm.), especially below; terminal leaflets long-petiolulate (3.5 long), symmetrical,

narrowly obovate, wedge-shaped from above the middle, obtuse at apex; lateral leaflets opposite, nearly or quite sessile; upper pair much the larger, elliptical-lanceolate in shape, very unequal-sided, rather abruptly narrowed at base, pointed at apex (14 cm. long, 5 cm. broad); next pair similar but smaller (9 cm. long, about 4 cm. broad); lower pair smallest, about 6 cm. long and only 2.5 cm. broad, very unequal-sided; all leaflets coarsely, somewhat doubly serrate, the teeth large, rather obtuse; nervation consisting of a very strong midrib and numerous thin, close, slightly arched craspedodrome secondaries; finer nervation obscure.

Type.—Cat. No. 33,765, U.S.N.M.

This splendid specimen was contained in the Hambach collection, and as may be seen in the figure, is nearly perfect, the three terminal leaflets being absolutely so, and several of the lower ones nearly complete. In the Florissant material belonging to the United States National Museum there is a specimen [No. 50,288] that was donated by Mr. R. D. Lacoë, which belongs to this species. It shows portions of the terminal parts of two leaves, each with several leaflets, but they are obscure and fail to give the clear exposition of characters to be noted in the type-specimen. This Lacoë specimen had passed through Lesquereux's hands and was noted as a new species of *Juglans*, but it was never published.

The specimen that was identified by Kirchner¹ as *Juglans crossii* Knowlton, is now in the United States National Museum [No. 33,682], and is before me. The shape of the best preserved leaflet in this specimen is very much like some of the leaflets in Lesquereux's figure,² but it appears that the latter must have been palmately compound, that is the leaflets originated from the top of a common petiole, whereas the present specimen is distinctly pinnately compound. There is no doubt that this Kirchner specimen belongs to *Juglans magnifica*.

The Scudder collection contains three or four leaflets that obviously belong to this species, but it would have been difficult to place them without the specimens showing the leaflets attached.

Juglans magnifica appears to be a rather rare species, since only four specimens are contained in the Museum collections, which number many hundreds. It must have been a tree of imposing appearance when living, and doubtless supplied the fruits described under separate name, but they can not yet be placed together. It is clearly not the same as Kirchner's *J. affinis*, which is described from a single, narrowly lanceolate, sparingly toothed leaflet.

¹ Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 183, pl. 14, fig. 7.

² Called *J. denticulata* Heer, Tert. Fl., pl. 58, fig. 1.

JUGLANS FLORISSANTI Lesquereux.

Plate 17, fig. 2.

Juglans florissanti LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.) 1883, p. 190

Type.—Cat. No. 50,355, U.S.N.M. [Original No. 80 of Lacoë's cabinet.]

This species, here figured for the first time, was named and described by Lesquereux in 1883, and became the property of the United States National Museum by the accession of the Lacoë collection. It is possible that it is the same as the species here described as *Juglans magnifica*, but it appears slightly different and is held distinct. It has, as Lesquereux said, a rough surface and is altogether of a coarser aspect than *J. magnifica*; it is also much less unequal-sided at base.

JUGLANS AFFINIS Kirchner.

Juglans affinis KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 184, pl. 13; fig. 2.

Type.—Cat. No. 33,680, U.S.N.M.

JUGLANS? SEPULTUS Cockerell.

Plate 17, fig. 4.

Juglans? sepultus COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 80, pl. 6, fig. 8.

Juglans costata UNGER. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 190, pl. 39, fig. 5.

A single specimen in the Hambach collection undoubtedly belongs here. It is so preserved as to indicate beyond reasonable doubt that it is really the fruit of *Juglans*.

Family MYRICACEAE.**Genus MYRICA.**

Of the 200 species of plants, more or less, that have been described from Florissant, the greatest number of nominal species, and probably the greatest number of individuals have been referred to the genus *Myrica*. Almost every blow of the hammer is pretty certain to disclose one or more of the forms that have been referred to this genus. The result has been to bring together very considerable collections, and from which it is now possible to draw fairly definite conclusions as to probable specific limitations, though there are of course some points on which the evidence is not yet complete enough for final decisions. Many of the earlier collections, on which Lesquereux based much of his work, were very small and afforded little or no evidence on the range in specific variation, with the result, as we can now

see, that too many species were established. Most of this original material studied by Lesquereux is preserved in the United States National Museum, together with large recent collections, and all has been reviewed in the present connection with as much thoroughness as time permitted. As at present understood, the earlier-described species of *Myrica* from Florissant are disposed of as follows, those in Roman being the accepted species:

- MYRICA ACUMINATA** UNGER. LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1873 [1874], p. 411; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 130, pl. 17, figs. 1-4.
 = *Myrica scottii* (figs. 1, 4).
 = *Myrica drymeja* (figs. 2, 3).
- Myrica amygalina** SAPORTA. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 147, pl. 26, figs. 1-4.
 = *Myrica coloradensis*.
- MYRICA BOLANDERI** LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 133, pl. 17, fig. 17.
 = Excluded; from unknown locality.
- Myrica callicomaefolia** LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 146, pl. 26, figs. 5-14.
 = *Myrica drymeja* (Lesquereux) Knowlton.
- MYRICA COPEANA** LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1873 [1874], p. 411; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 131, pl. 17, fig. 5.
- Myrica diversifolia** LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 148, pl. 25, figs. 6-15.
 = *Sorbus diversifolia* (Lesquereux) Cockerell.
 = *Sorbus nupta* Cockerell.
 = *Ribes?* *florissanti*.
- MYRICA DRYMEJA** (LESQUEREUX) KNOWLTON, Bull. U. S. Geol. Surv. 152, 1898, p. 146.
- Myrica fallax** LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 147, pl. 32, figs. 11-16.
 = *Myrica drymeja* (Lesquereux) Knowlton.
- MYRICA HENDERSONI** COCKERELL, Bull. Torr. Bot. Club, vol. 33, 1906, p. 308, fig. (in text) 1.
- Myrica insignis** LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1874 [1875], p. 312; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 135, pl. 17, figs. 7, 8.
 = *Comptonia insignis* (Lesquereux) Cockerell.
- Myrica latiloba acutiloba** LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1873 [1874], p. 412; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 134, pl. 17, fig. 13.
 = *Crataegus acutiloba* (Lesquereux) Knowlton.
- MYRICA OBSCURA** LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 145, pl. 32, figs. 8-10.
 = *Myrica drymeja* (Lesquereux) Knowlton.
- Myrica polymorpha** SCHIMPER. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 146, pl. 25, figs. 1, 2.
 = *Myrica scottii* Lesquereux.
- Myrica rigida** LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 145, pl. 25, figs. 3, 4.
 = *Myrica drymeja* (Lesquereux) Knowlton.

- MYRICA SCOTTII* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 147, pl. 32, figs. 17, 18.
- Myrica zachariensis* SAPORTA. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 146, pl. 25, fig. 5.
= *Myrica drymeja* (Lesquereux) Knowlton.

MYRICA DRYMEJA (Lesquereux) Knowlton.

Plate 20, figs. 1, 2.

- Myrica drymeja* (LESQUEREUX) KNOWLTON, Bull. U. S. Geol. Surv. 152, 1898, p. 146.
- Rhus? drymeja* LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr. 1873 [1874], p. 416.
- Callicoma microphylla* ETTINGSHAUSEN. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 246, pl. 43, figs. 2-4.
- Myrica callicormaefolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 146, pl. 26, figs. 5-14.
- Myrica obscura* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 145, pl. 32, figs. 8-10.
- Myrica rigida* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8, 1883, p. 145, pl. 25, figs. 3, 4.
- Myrica fallax* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8, 1883, p. 147, pl. 32, figs. 11-16.
- Myrica zachariensis* SAPORTA. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8, 1883, p. 146, pl. 25, fig. 5. [Not pl. 45A, figs. 6-9.]
- Myrica acuminata* UNGER. LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1873 [1874], p. 411; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 130, pl. 17, figs. 2, 3. [Not figs. 1, 4, which = *M. scottii*.]

Most of the type-specimens of *Myrica callicormaefolia*, *M. rigida*, and *M. fallax* are preserved in the United States National Museum, together with a great number of other fine examples that would ordinarily be referred to the first mentioned species. A careful study of this material has failed to disclose any satisfactory line by which they may be essentially separated, and hence, following Cockerell's suggestion, they have all been combined under the name of *Myrica drymeja*, which is the earliest specific name applied to what was later called *M. callicormaefolia*. Lesquereux himself suggested the possibility of his *M. fallax* being referable—perhaps as a variety—to *M. callicormaefolia* or *M. drymeja*, as it is now called. The species may be known by the narrow shape with more or less inequilateral base and numerous regular teeth which may be low or sharp and distinct.

The single specimen from Florissant that was referred by Lesquereux¹ to *Myrica zachariensis* Saporta, has not been found in the collections of the United States National Museum. It is believed to be nothing but a large, nearly equal sided leaf of *M. drymeja*; in any event, it is not to be distinguished from some in the collection that were so referred by Lesquereux himself.

The status of the four leaves from Elko, Nevada, that were described and figured by Lesquereux² under the name of *Myrica zach-*

¹ Lesquereux, Leo, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 145, pl. 25, fig. 5.

² Idem, p. 149, pl. 45A, figs. 6-9.

ariensis Saporta, will have to be settled later. They do not appear to be referable to *M. drymeja*, nor do they seem to be anything like the one above mentioned from Florissant.

The leaves described and figured by Lesquereux under the name of *Myrica acuminata* Unger, are all preserved in the United States National Museum [Nos. 143-145], and appear referable to two species. Figures 2 and 3 [144 and 145] appear to be best referred to *M. drymeja*, while figures 1 and 4 [143, 145a] are referred to *M. scottii*. Shortly after the publication of Lesquereux's Tertiary Flora (1878), Ettingshausen¹ took occasion to change the names of a number of his (Lesquereux's) species, among them being the four leaves referred to *Myrica acuminata* Unger. These Ettingshausen called *Ceratopetalum americanum*, but it seems best to dispose of them as indicated above.

MYRICA COLORADENSIS, new species.

Plate 21, fig. 1.

Myrica amygdalina SAPORTA. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 147, pl. 26, figs. 1-4.

Types.—U.S.N.M., figs. 1 [1,654], 2 [1,655], 3 [1,654a], 4 [1,653], cotypes, Cat. Nos. 1,657, 1,658, U.S.N.M.

I believe this to be a good species and well entitled to recognition. It has small leaves, 2.5 to 5.5 cm. in length, submembranaceous in texture, oblong-lanceolate, enlarged toward the upper part, where they are obtuse or apiculate, and narrowed below to a short petiole. The margin is denticulate or subentire, becoming quite entire below. The midrib is rather slender, while the secondaries are very numerous, at an angle of about 50°, much curved outward, obliquely branching and reticulate, with the nervilles oblique to the secondaries.

This species was referred by Lesquereux to *Myrica amygdalina* Saporta,² from the Eocene of France, and it must be confessed it has a very strong resemblance to at least one of Saporta's figures (fig. 8), though the other figures are perfectly entire and look much more like leaves of *Salix* than leaves of *Myrica*. The teeth in the French species are very slight and remote, and the secondaries emerge at a more open angle than in the Florissant leaves and are curved upward instead of outward.

I have refigured one of the types of the Florissant species,³ which brings out very clearly the differences between it and Saporta's species. The margin is provided with numerous regular, small, sharp

¹ Ettingshausen, C. von, Denks. d. k. Akad. d. wiss. math.—nat. classe, vol. 47, 1883, p. 137 [37]; Geol. Surv. N. S. W., Mem. Pal., No. 2 [Tert. Fl. Australia], 188, p. 58.

² Saporta, Gaston de, Études sur la Vég. sud-est France: Ann. Sci. Nat. (5 ser.) bot., vol. 9, 1867, p. 163 211, pl. 1, figs. 8-10.

³ Lesquereux's fig. 3, Rept. U. S. Geol. Surv. Terr., vol. 8, 1883, pl. 26.

teeth, and as may be seen, the secondaries, while arising at a somewhat more acute angle, are distinctly curved outward, and are often branched. The peculiar oblique nervilles are also well brought out in the new figure.

In view of the above differences, as well as the improbability of a European Eocene species persisting into the American upper Miocene, it has seemed best to separate these leaves under a new name. It has not been observed in any of the later collections.

MYRICA HENDERSONI Cockerell.

Myrica hendersoni COCKERELL, Bull. Torr. Bot. Club, vol. 33, 1906, p. 308, fig. (in text) 1; Univ. Colorado Studies, vol. 3, 1906, p. 176, fig. 7.

Morella hendersoni (COCKERELL) COCKERELL, Univ. Colorado Studies, vol. 3, 1906, p. 173.

It has been found that *Morella* is untenable as a name for certain species of *Myrica*, and as there appears to be so much uncertainty regarding the nomenclature of this genus it seems best to employ the better known term *Myrica*, at least until some agreement can be reached.

I have not seen specimens of this species, which, to judge from the description and rather faint figure, appears to be quite distinct from the other forms of *Myrica*. Concerning it Cockerell says:

At first sight, the leaves seem to be entire, and the plant looks like a *Salix* closely allied to *S. myrtilloides*; on close inspection, however, the apical halves of the larger leaves are seen to be sparingly dentate, irregularly and sharply, not at all in the manner of *Salix*, but entirely as in *Myrica cerifera*.

MYRICA OBSCURA Lesquereux.

Myrica obscura LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 145, pl. 32, figs. 8-10.

Types.—Cat. Nos. 1,630 [fig. 9], 1,629 [fig. 10], U.S.N.M.

Lesquereux described this form as follows:

Leaves linear-lanceolate, coarsely serrate, rounded in narrowing to the petiole, unequilateral at base; nervation obsolete.

Two of the types of this species are in the United States National Museum, and while they have a degree of likeness to *Myrica drymeja*, and incline to retain it as a valid species, they certainly have quite a different facies from *M. drymeja* and may at least be held as distinct until further corroborative information one way or the other.

Since the above was written I have just noted that Cockerell,¹ in a postscript to his largest paper, has reached a similar conclusion. He says:

The collection of 1907 contains good material of *Myrica obscura* Lx., which proves to be a perfectly valid species, probably referable to *Comptonia*.

I have not seen additional specimens, but so far as the types go it does not seem that it should be referred to *Comptonia*.

¹ Cockerell, T. D. A., Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 108.

MYRICA SCOTTII Lesquereux.

Plate 20, figs. 3, 4.

Myrica scottii LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 147, pl. 32, figs. 17, 18.—COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 81.

Myrica polymorpha SCHIMPER. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 146, pl. 25, figs. 1, 2.

Myrica acuminata UNGER. LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1873 [1874], p. 411; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.) 1878, p. 130, pl. 17, figs. 1, 4 [not figs. 2, 3, which = *M. drymeja*].

One of the two type specimens of *Myrica scottii*¹ is preserved in the United States National Museum (No. 1,660), and also one of the two specimens illustrated under the name of *Myrica polymorpha* Schimper,² and as there seems to be no essential difference between them they have been combined as above indicated. The teeth in the original *M. scottii* are perhaps a little longer and sharper than is shown in the figures of *M. polymorpha*, but the latter are not quite correctly shown in Lesquereux's figures, being as sharp in many cases as in the other. This species may be distinguished by the long, very slender shape and the conspicuously sharp teeth.

The Lacoë collection contains a single small narrow leaf (U.S.N.M., 50,239) that was identified by Lesquereux as *Myrica zachariensis* Saporta, but it clearly belongs with *M. scottii*. It is wholly unlike the Florissant leaf referred to *M. zachariensis* by Lesquereux.³

I have also referred here two of the leaves figured by Lesquereux under the name of *Myrica acuminata* Unger, namely figures 1 and 4 of his plate 17. These are Nos. 143 and 145a in the United States National Museum collections. The other two figures are referred to *M. drymeja*. The two leaves here referred to *M. scottii* have been refigured (pl. 21, figs. 3, 4).

MYRICA COPEANA Lesquereux.

Myrica copeana LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1873 [1874], p. 411; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 131, pl. 17, fig. 5.—COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 81.

Type.—Cat. No. 147, U.S.N.M.

This, as Lesquereux stated, is a fine, large, well-characterized species, described originally from a single specimen. It is not contained in any of the collections studied in the United States National Museum, but Cockerell mentions its occurrence at his station 9, so the type-specimen evidently is not unique. It must, however, be considered as a rare species.

¹ Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, pl. 32, fig. 17.

² Idem, pl. 25, fig. 1.

³ Idem, pl. 25, fig. 5.

COMPTONIA INSIGNIS (Lesquereux) Cockerell.

Comptonia insignis (LESQUEREUX) COCKERELL, Univ. Colorado Studies, vol. 3, 1906, p. 173.—BERRY, Amer. Nat., vol. 40, 1906, p. 499.—COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1903, p. 81.

Myrica insignis LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1874 [1875], p. 312; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 135, pl. 65, figs. 7, 8; vol. 8 (Cret. and Tert. Fl.), 1883, p. 150.

The type-specimens of Lesquereux's *Myrica insignis* are preserved in the United States National Museum (No. 538, both being on the same piece of matrix), and apparently remain unique. It is not present in any of the recent collections that have passed under my eyes.

This species is undoubtedly most closely related to *Myrica alkalina* Lesquereux¹ from Alkali Station, a few miles north of Green River, Wyoming, and in fact Berry² has already united them, stating that he is "inclined to think that the leaves which Lesquereux called *alkalina* are simply the young leaves of which *insignis* is the mature leaf, for they are (1) much more variable in lobation, (2) smaller in size and definiteness and in the extent of their lobes, combined with narrower lamina, and (3) they have a much thicker midrib."

Comptonia insignis has also some resemblance to certain of the figures given by Lesquereux³ of his *Myrica diversifolia*, which in this paper is called *Crataegus acutilobus*.

Family SALICACEAE.

SALIX, species.

Plate 13, figs. 4, 5.

The Hambach collection includes three leaves, two of which are here figured, which are obviously those of *Salix*, but which I have hesitated either to identify with a known species, or to describe as new. They are narrowly linear-lanceolate but with a short petiole and long wedge-shaped base. The nervation is nearly obsolete in the smaller specimen, but in the other it consists of a relatively strong midrib and about four or five pairs of slender secondaries at a very acute angle of divergence.

Types.—Cat. Nos. 33,744, 33,745, U.S.N.M.

This form has a resemblance to a number of species, such for instance as a very small, narrow leaf of *S. angusta*, but the nervation differs somewhat.

¹ Lesquereux, Leo, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 149, pl. 45A, figs. 10-15.

² Berry, Edward W., Living and fossil species of *Comptonia*, Amer. Nat., vol. 40, 1906, p. 499.

³ Lesquereux, Leo, Rept. U. S. Geol. Surv. Terr., vol 3, 1883, p. 148, pl. 25, figs. 6, 11, 12, etc.

POPULUS LESQUEREUXI Cockerell.

Populus lesquereuxi COCKERELL, Bull. Torr. Bot. Club, vol. 33, 1906, p. 307; Univ. of Colorado Studies, vol. 3, 1906, p. 172.

Populus heerii SAPORTA. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 157, pl. 30, figs. 1-8; pl. 31, fig. 11. [Not *P. heerii* Saporta].

This common and well-known Florissant species, which has been correctly segregated by Cockerell, is represented by a considerable number of well-preserved examples in the several collections.

POPULUS PYRIFOLIA Kirchner.

Populus pyrifolia KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 185, pl. 15, fig. 4.

Populus oxyphylla SAPORTA. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.) 1883, p. 159, pl. 33, figs. 9-11.

Type of P. pyrifolia.—Cat. No. 33,687, U.S.N.M.

After a comparison of all these specimens I have come to the conclusion that there is only a single species represented. The leaf described by Kirchner as *Populus pyrifolia* is of precisely the same character as the leaves figured by Lesquereux as *P. oxyphylla*, the only difference being in the size, the former being about twice as large as the latter. The margin is not preserved in *P. pyrifolia*, but there is every reason to suppose that it was toothed, as in the others.

The proper name that should be given this species may be briefly considered. If one could be certain that the leaves referred by Lesquereux to *P. oxyphylla* were really Saporta's species, then of course Kirchner's *P. pyrifolia* would become a synonym of it, but, as Cockerell has said,¹ "in view of the general improbability of our species being identical with that of Saporta, I should prefer to use Kirchner's name," I have acceded to this view and have placed these leaves under the name given by Kirchner, where they may remain until evidence to the contrary is forthcoming.

There are two other specimens in the Hambach collection that I refer here, though neither is as well preserved as the one figured.

POPULUS MICRO-TREMULOIDES, new species.

Plate 19, fig. 2.

A branch (4.5 cm. long) bearing prominent leaf scars and indicating a growth of three, and possibly four, seasons; the presence of six leaves is shown by the petioles which are crowded in a short space, and are alternate in insertion; leaves apparently circular or short-elliptical in outline, truncate or slightly heart-shaped at base, and there entire, possibly slightly toothed or undulate above; nervation with a relatively strong midrib and several pairs of opposite, or sub-

¹ Univ. of Colorado Studies, vol. 3, 1906, p. 173.

opposite, thin apparently camptodrome secondaries; finer nervation not preserved.

Type.—Cat. No. 34,738. Counterpart 34,739, U.S.N.M.

This specimen with its counterpart is all that has been observed in the collections, and unfortunately it is not perfectly preserved. It consists of a short stocky branch rather closely set with large leaf-scars, and, judging from its similarity to the living species, indicates the growth of four seasons. No very satisfactory measurements of the leaves can be given. The petioles are about 1.5 cm. long, and the leaves about 2 cm. broad, but the full size and shape of the latter can not be ascertained.

This species is thought to be most closely related to the living *Populus tremuloides* Michaux, the well-known trembling aspen, being especially like the short stunted branches and small leaves of trees or bushes which have grown in very dry situations. The nervation of this species is not quite typical for *Populus tremuloides*, and it is, of course, possible that the characters above set forth may not indicate this genus, but in any event, it seems distinct from described forms, and may stand until more perfect material is obtained. It has some superficial resemblance to *Panax andrewsii* Cockerell,¹ especially in the clustering of the leaves and their size and probable nervation, but the latter is interpreted as being a compound leaf of five leaflets, and moreover, the petioles are provided with prickles.

POPULUS CRASSA (Lesquereux) Cockerell.

Plate 18.

Populus crassa (LESQUEREUX) COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 83, pl. 8, fig. 22; pl. 10, fig. 42.

Macreightia crassa LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 175, pl. 34, figs. 16, 17.

Diospyros cuspidata KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 185, pl. 12, fig. 1.

Type of Diospyros cuspidata.—Cat. No. 33,675, U.S.N.M.

The type and only specimen of Kirchner's *Diospyros cuspidata* is absolutely identical with the figures of *Macreightia crassa* Lesquereux, and it is probable that all were equally four-valved, notwithstanding the appearance of the figures. That they have apparently been correctly referred to *Populus*, is well shown by the splendid specimen figured (U.S.N.M., 50,332), which was contained in the paleobotanical collections donated to the United States National Museum by Mr. R. D. Lacoë. This is an absolutely complete drooping raceme 18 cm. long, with the rachis about 3 mm. thick, and showing about thirty of the capsules attached by the short thick pedicels. The point where the raceme was attached is broad, enlarged, circular

¹Amer. Nat., vol. 42, 1908, p. 581, fig. (in text) 12.

(6 mm. in diameter), and slightly concave, and presents an appearance identical with that to be observed in the twigs and small branches that are so abundantly "cast" by the living cottonwood trees (*Populus monilifera*, etc.).

The appearance of branching to be observed in this specimen is undoubtedly due to the presence of another raceme which lies under the larger example in such a manner as to make it appear as a branch of it.

POPULUS, species.

Plate 16, fig. 4.

Type.—Cat. No. 34,753, U.S.N.M.

The specimen here shown, which is from the Hambach collection, appears to be a large though evidently immature catkin of *Populus*. It is from the base of the catkin, as evidenced by the 1 cm. long portion of the stem below the last or first pair of capsules. The portion preserved is about 5 cm. in length, but it is difficult to decide whether or not it is all present, and it is probable that it was very much longer when perfect.

It is quite possible that this may represent the immature stage of *Populus crassa*, since, as may be seen on comparing the two figures, it is evident that the main rachis is of about the same size, though the individual pedicels are much shorter than they are in *P. crassa*. It is not of very great importance in any event, and is given merely to show that the various stages of the fruits of *Populus* were preserved.

Family BETULACEAE.

CARPINUS ATTENUATA Lesquereux.

Carpinus attenuata LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.) 1883, p. 152, pl. 27, fig. 10.

A single example in the Hambach collection. It is smaller than the figure given by Lesquereux but does not otherwise differ essentially.

CARPINUS FRATERNA Lesquereux.

Carpinus fraterna LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert.) 1883, p. 152, pl. 27, figs. 12-14.

Several fine specimens in both the Scudder and Hambach collections. One in the former collection is much larger than any of the figures given of this species, but it does not otherwise differ.

BETULA TRUNCATA Lesquereux.

Betula truncata LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.) 1883, p. 150, pl. 28, figs. 7, 8. [*Alnus truncata* on plate]

The Hambach collection contains a single leaf of this species, this being of the same shape and nervation as figure 8 (referred to in the synonymy), but is a little longer.

BETULA DELTOIDES, new species.

Plate 19, fig. 3.

Type.—Cat. No. 34,754, U.S.N.M.

Leaf of medium size, membranaceous in texture, deltoid or truncate-ovate in outline, perfectly truncate across nearly the whole base, apex prolonged and slenderly acuminate; margin coarsely toothed, the teeth very sharp, occasionally with smaller teeth on or between the larger ones; petiole slender, one half the length of the blade; nervation 5-ribbed from the top of the petiole, the midrib straight, with 5 or 6 pairs of subopposite, craspedodrome secondaries; lowest pair of secondaries or ribs at an angle of 45° , each with 4 or 5 craspedodrome tertiary branches on the outside, the lowest ones arising at the top of the petiole; nervilles fairly numerous, mainly percurrent.

This leaf is absolutely perfect. Its length is 6 cm. and its width 3.5 cm., while the petiole is slightly less than 3 cm. long. The peculiarly truncate base, sharply, obscurely doubly serrate margin and 5-ribbed nervation mark it exceedingly well.

The present species if correctly allocated, makes the third made known from Florissant, the others being *Betula florissanti* Lesquereux,¹ and *Betula truncata* Lesquereux.² With the first species mentioned the present one has no evident specific relationship; the other is somewhat nearer but differs in its much smaller size, less truncate base, a different marginal dentition and above all in the nervation.

ALNUS PRAECORDATA Cockerell.

Plate 19, fig. 1.

Alnus praecordata COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 84.

Alnus cordata LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert., Fl.), 1883, p. 151. [Homonym of *A. cordata* Desf. 1827.]

Type.—Cat. No. 50,357, U.S.N.M. [No. 83 of Lacoë's cabinet].

The type and only known specimen of this species, which became the property of the United States National Museum through the acquisition of the Lacoë collection, is here figured for the first time.

ALNUS, species.

Plate 16, fig. 2.

Type.—Cat. No. 34761, U.S.N.M.

The Hambach collection contains a single example apparently of the mature strobiles of a species of *Alnus*. It has a very thick pedicel and bears two "cones" about 1 cm. long. The form of the scales of the "cones" can not be made out.

¹ Lesquereux, Leo, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 150, pl. 27, fig. 11.

² Idem, p. 150, pl. 27, figs. 7, 8.

Family FAGACEAE.

FAGOPSIS LONGIFOLIA (Lesquereux) Hollick.

Plate 20, fig. 5.

Fagopsis longifolia (LESQUEREUX) HOLLICK, *Torreya*, vol. 9, 1909, p. 2, figs. (in text) 1, 2.

Planera longifolia LESQUEREUX, *Ann. Rept. U. S. Geol. and Geogr. Surv. Terr.* 1872 [1873], p. 371; *Rept. U. S. Geol. Surv. Terr.*, vol. 7 (Tert. Fl.), 1878, p. 189, pl. 27, figs. 4-6; vol. 8 (Cret. and Tert. Fl.), 1883, p. 161, pl. 29, figs. 1-13.

Fagus longifolia (LESQUEREUX) HOLLICK and COCKERELL, *Bull. Amer. Mus. Nat. Hist.*, vol. 24, 1908, p. 88 (footnote).

Quercus semi-elliptica GÖPPERT. LESQUEREUX, *Ann. Rept. U. S. Geol. and Geogr. Surv. Terr.*, 1871 [1872], p. 286.

This is one of the most abundant plants found in the Florissant deposits, occurring literally by thousands. It is found usually as detached leaves, though branches having leaves attached occur occasionally, and yet in spite of this abundance it was not until a few years ago that specimens were found showing the fruit. From these it becomes plain that it is closely allied to, if not indeed identical with, *Fagus*.

QUERCUS DRYMEJA? Unger.

Quercus drymeja UNGER, *Chloris Prot.*, 1847, p. 113, pl. 32, figs. 1-4.—LESQUEREUX, *Rept. U. S. Geol. Surv. Terr.*, vol. 7 (Tert. Fl.), 1878, p. 157, pl. 19, fig. 19; vol. 8 (Cret. and Tert. Fl.), 1883, p. 154, pl. 28, fig. 12.

The Scudder collection contains a single specimen representing the basal portion of a leaf with its long, slender petiole that is evidently the same as the figure given by Lesquereux in his Cretaceous and Tertiary Floras (pl. 28, fig. 12).

QUERCUS SCUDDERI, new species.

Plate 21, fig. 3.

Leaf of small size, coriaceous in texture, oblong and slightly obovate, about equally rounded at both base and apex; margin entire for lower half of leaf, thence provided with four or five rather large teeth; petiole very short, stout; midrib stout, especially below; secondaries about five pairs, alternate, at an angle of about 45°, little curved upward, crospeodrome and ending in the marginal teeth; nervilles irregular, much broken, producing large irregularly quadrangular areas.

Type.—Cat. No. 34,758, U.S.N.M.

This little leaf, which is evidently thick and coriaceous in texture, is slightly oblong-obovate in shape, being broadest just above the middle. The length is 23 mm., and the width about 9 mm., while the petiole is only 2 mm. long.

This species, which is preserved on the same piece of matrix with *Typha lesquereuxii*, is apparently quite unlike any oak previously

described from Florissant. It belongs evidently to the *Quercus virginiana* group or so-called live oaks, being, for instance, not unlike certain forms of *Q. affinis* (Lesquereux) Knowlton, from the John Day Basin of Oregon. The latter, however, has more teeth and a greater number of secondaries. It also suggests some of the small leaves of *Q. consimilis* Newberry,¹ but here, again, the teeth and secondaries are more numerous.

Family ULMACEAE.

ULMUS TENUINERVIS Lesquereux.

Ulmus tenuinervis LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1873 [1874], p. 412; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.) 1878, p. 188, pl. 26, figs. 1-3.

A single fine leaf in the Scudder collection.

PLANERA MYRICAEOFOLIA (Lesquereux) Cockerell.

Plate 21, fig. 2.

Planera myricaefolia (LESQUEREUX) COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 87.

Planera longifolia myricaefolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.) 1883, p. 161, pl. 29, figs. 15-27.

Podocarpus eocenica? UNGER. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.) 1883, p. 140.

The Lacoë collection of Florissant plants, now the property of the United States National Museum, contains the specimen (U. S. N. M., 50,339; original No. 68, Lacoë collection) referred by Lesquereux to *Podocarpus eocenica?* Heer, and which he says is "narrowly linear-lanceolate, acute, narrowed into a short petiole." A careful examination of this leaf, which is here figured for the first time, discloses that it is not entire, but has several distinct, very sharp teeth near the apex, and two or three obscure teeth along the sides to a point at or below the middle. The nervation consists of the rather strong straight midrib, and numerous thin secondaries at a very acute angle with it which enter the teeth. This of course excludes it from *Podocarpus*, and it is probably a narrow, sparsely toothed leaf of *Planera myricaefolia*, being, for instance, very much like figures 21 and 22 of Lesquereux's plate of this species.

CELTIS MCCOSHII Lesquereux.

CELTIS MCCOSHII LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.) 1883, p. 163, pl. 38, figs. 7, 8.

A specimen in the Scudder collection that undoubtedly belongs here, though the marginal teeth are slightly coarser and more distant. The shape of the leaf and its nervation are identical.

¹ Newberry, J. S., Mon. U. S. Geol. Surv., No. 35, 1898, pl. 43, fig. 4.

Family MORACEAE.

FICUS FLORISSANTIA, new species.

Ficus haydenii LESQUEREUX. KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 179, pl. 12, fig. 3.

Type.—Cat. No. 33,677, U.S.N.M.

After an examination of the originals of both these forms I am convinced that the Florissant leaf referred by Kirchner to Lesquereux's *Ficus haydenii* is not the same as the Black Buttes leaf. The former differs in being more heart-shaped at base and markedly in the secondary nervation. In *F. haydenii* the secondaries are all alternate and emerge at about the same angle, while in *F. florissantia* the three lower pairs are crowded at the base and at very different angles. The second pair is nearly at right angle to the midrib, and the first and third pairs are below, and about equally above, a right angle respectively. The upper pairs of secondaries are about the same in both species, though they appear to arch more strongly in *F. florissantia*. It therefore seems best to consider them as distinct.

Family PROTEACEAE.

LOMATIA INTERRUPTA Lesquereux.

Plate 25, fig. 5.

Lomatia interrupta LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 167, pl. 43, figs. 18, 19.

The Hambach collection includes a single absolutely perfect leaf of this species (U.S.N.M. 33,703), which is here figured as it supplements to some extent the type-specimens.

LOMATITES HAKEAEFOLIA (Lesquereux) Cockerell.

Plate 26, figs. 1, 2.

Lomatites hakeaeifolia (LESQUEREUX) COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 89.

Lomatia hakeaeifolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 166, pl. 32, fig. 19.

Carduus florissantensis COCKERELL, Bull. Torr. Bot. Club, vol. 33, 1906, p. 311, fig. (in text) 6.

The specimen here figured, which comes from the Hambach collection, is undoubtedly identical with the *Carduus florissantensis* of Cockerell, and further, it does not seem to be separable from *Lomatia hakeaeifolia* of Lesquereux. The latter, known only from the single example figured, has plainly the same configuration at the base and only differs in not having the upper lobes large. The long slender terminal lobe is the same in all the specimens.

It is possible that *Quercus balaninorum* Cockerell¹ should also be referred here. The upper portion is the same, but the basal portion is more sharply wedge-shaped.

¹ Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 86, pl. 8, fig. 21.

BANKSITES LINEATUS Lesquereux.

Banksites lineatus LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 165, pl. 32, fig. 21.

There are half a dozen good specimens in the Scudder material.

Family ARISTOLOCHIACEAE.

ARISTOLOCHIA WILLIARDIANA, new species.

Plate 22, figs. 1, 2.

Leaf of medium size and membranaceous texture, broadly ovate-cordate, the basal sinus deep and rounded, the lobes broadly rounded; apex of blade obtuse; midrib strong, straight; secondaries on the midrib 6 or 7 pairs, at an angle of about 45°, parallel, camptodeome, joining the one next above by broad loops just below the margin; a pair of secondary branches or ribs arise at the very base of the blade and turn abruptly downward, with small forking camptodeome branches on either side to supply the basal lobes; nervilles numerous, very distinct, mainly unbroken, but occasionally broken and forked.

Type.—Cat. No. 34,756, U.S.N.M.; cotype, Cat. No. 50,271, U.S.N.M. [No. 30 of Lacoë collection].

The example selected as the type (fig. 1) is a fine leaf lacking only a portion of one side. It is about 9 cm. long, 7 cm. wide, and has the basal sinus a little more than 2 cm. deep. The other specimen (Cat. No. 50,271, U.S.N.M.) is much less perfect, as it lacks practically all of the margin except at the base; its size was about the same as that of the type. This latter specimen had passed through Lesquereux's hands and was indicated by him as a new species of *Cercis*, but it can not belong to this genus.

This species is, in a general way, of the same type as *Aristolochia crassifolia* (Newberry),¹ from the Fort Union formation, but it is of course much smaller and much narrower. It is possible that it may be the same as *Aristolochia mortua* Cockerell,² but that species is described as having the leaf thin and the veins not united (camptodrome) on the lateral margins. The length of *A. mortua* is said to be about 105 mm. and the breadth about 70 mm.³ The figure is so poorly executed that almost nothing can be made out regarding the nervation, and altogether it is impossible to decide whether it is the same as what is here called *A. williardiana*. Leaves that are to be referred to *Aristolochia* are evidently rare as Florissant, since apparently only three have thus far been detected.

¹ Mon. U. S. Geol. Surv., vol. 35, 1898, p. 90, pl. 60, fig. 4.

² Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 90, pl. 8, fig. 25.

³ If this size is correct, the figure of it (pl. 8, fig. 25) is less than half natural size, but no mention is made of the reduction in the explanation of plates or elsewhere. This practice of publishing figures that are less than natural size without mentioning the fact, is certainly to be deplored.

This species is named in honor of Mr. T. E. Williard, of the United States Geological Survey, who has done much efficient work in selecting and preparing the Florissant collections for study.

Family HYDRANGEACEAE.

HYDRANGEA? SUBINCERTA Cockerell.

Hydrangea? subincerta COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 92, pl. 9, fig. 32.

A single example in the Hambach collection that is evidently this species. The original specimen is said by Cockerell to be without nervation, but the present one has faint indications of very thin longitudinal ribs, there being about four in a sepal. The other nervation is obsolete.

HYDRANGEA? FLORISSANTIA Cockerell.

Hydrangea florissantia COCKERELL, Amer. Journ. Sci., vol. 26, 1908, p. 67, fig. (in text) 2; p. 541.

Rhus rotundifolia KIRCHNER, Trans. St. Louis Acad. Sci., vol 8, 1898, p. 184, pl. 12, fig. 2. [Not *Hydrangea rotundifolia* Rafinesque.]

Type of *Rhus rotundifolia*.—Cat. No. 33,676, United States National Museum.

The type-specimen of Kirchner's *Rhus rotundifolia* is so exactly similar to the figure of Cockerell's *Hydrangea florissantia* that the two figures might almost have been made from the one specimen, and there is of course absolutely no question as to their identity. That they are properly referred to *Hydrangea*, however, is by no means so certain. Each of the individual segments, whatever their nature may ultimately be proved to be, is distinctly provided with a short thick petiole 1 or 2 mm. in length, whereas in *Hydrangea* the sepals are sessile or even slightly united at base. In *Hydrangea bendirei* (Ward) Knowlton,¹ from the Mascall formation of Oregon, the the sepals are completely sessile if not indeed slightly united at base. It seems a suspicious circumstance that the only specimens found (or figured) should both lack the fourth "sepal" which was presumably present if it really is a sterile flower of *Hydrangea*. It is just possible that this may be a compound leaf of three leaflets, and not a flower at all.

¹ Bull. U. S. Geol. Surv., No. 204, 1902, p. 60, pl. 9, figs. 6, 7.

Family CUNONIACEAE.

WEINMANNIA HAYDENII (Lesquereux) Lesquereux.

Weinmannia haydenii (LESQUEREUX) LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 178, pl. 42, figs. 1-7.

Rhus haydenii LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 294, pl. 58, fig. 12.

Weinmannia phenacophylla COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 93.

According to Professor Cockerell, *Weinmannia haydenii* as figured by Lesquereux in the Cretaceous and Tertiary Flora is not the same as his earlier *Rhus haydenii*, which, if true, would leave the former without a name. An examination of the type of *Rhus haydenii* convinces me that Lesquereux was right in referring the seven figures in the Cretaceous and Tertiary Flora as *Weinmannia haydenii*; hence *W. phenacophylla* becomes superfluous.

Both the Hambach and Scudder collections embrace well-marked specimens that belong here. [Cat. No. 33,748, United States National Museum.]

WEINMANNIA INTEGRIFOLIA Lesquereux.

Weinmannia integrifolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 178, pl. 42, figs. 8-13.

A single example [Cat. No. 1,809, United States National Museum] is contained in the old Museum collection.

WEINMANNIA OBTUSIFOLIA Lesquereux.

Weinmannia obtusifolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 2878, pl. 41, figs. 4-10.

The Hambach collection includes two good examples of this very characteristic species (Cat. Nos. 33,714, 33,715, U.S.N.M.).

Family SOLANACEAE?.

FLORISSANTIA, new genus.**FLORISSANTIA PHYSALIS**, new species.

Convolvulaceus? flower, KIRCHNER, Trans. St. Louis Acad., vol. 8, 1898, p. 187, pl. 15, fig. 2.

Pedicle very slender, bractless, 2.5 cm. long; corolla rotate, slightly five-lobed, the lobes low and obtuse, greatest diameter 2.5 cm.;ervation of corolla strongly marked, consisting of five straight veins which enter the tips of the lobes, then a pair of veins on either side of the straight ones, which arch into the tip of the lobes, then one or two slender veins between the sets of 3's, in all about 20 veins which divide the corolla into approximately equal areas; numerous cross veinlets pass between the veins.

Type.—Cat. No. 33,686, U.S.N.M.

It is with some hesitation that the present form is described as a new genus and species, but fossil flowers are so very rare in American deposits, though, on the whole, this is so well preserved, that it seems worthy of a name. The specimen that was figured and described by Kirchner, and by him referred to with some doubt as a convolvulaceous flower, undoubtedly has a strong resemblance to the flowers of certain tropical genera of this family, but there is another specimen that was not seen by Kirchner which makes its reference to the Convolvulaceae now questionable. This latter specimen, it will be noted, has a very slender, delicate pedicel which, while not exactly excluding it from the Convolvulaceae, seems to make its reference to another family desirable, and this family, it seems to me, is the Solanaceae. The slender bractless pedicel and the nearly circular, slightly five-lobed corolla, with its peculiar nervation, are strongly suggestive of this family. In size, shape, and nervation, for instance, it is very suggestive of certain species of *Physalis*. That it actually belongs to any living genus of the Solanaceae is difficult to state with positiveness, and to avoid any unwarranted implication of kinship, it has been given a new and noncommittal generic name, though the specific name [*Physalis*] is intended to signify its probable relationship with this living type.

Since the foregoing was written the specimens here described as *Porana similis* have been studied, and it is difficult to escape the conviction that there may be more than merely superficial resemblance between them. The nervation is certainly very similar in these two forms, but otherwise they differ considerably. In *Florissantia* the corolla—if it be such—is regularly rotate and slightly five-lobed, whereas in *Porana similis* the whole organism is much larger and has strong, rounded, or obtusely pointed lobes which are not always of the same size. The presence of a slender pedicel in *Florissantia* is an argument for its corolloid nature. The nature and possible affinities of this form must be left to the future.

Family ANONACEAE.

ANONA SPOLIATA? Cockerell.

Anona spoliata ? COCKERELL, Amer. Journ. Sci., vol. 26, 1908, p. 542, fig. (in text) 7.

A single example in the Scudder collection that seems to belong here, though it is a little smaller and apparently slightly unequal-sided at base.

Family GROSSULARIACEAE.

RIBES? FLORISSANTI, new species.

Myrica diversifolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 148, pl. 25, fig. 13. [Not other figures.]

Leaf of small size, about 4 cm. long and 2.5 cm. broad, broadly deltoid in general outline, deeply 3-lobed, lateral lobes obovate, obtuse, decurrent; central lobe ovate, all lobes few toothed; nervation thin, pinnate.

This species, so far as now known, is represented only by the leaf referred by Lesquereux to his *Myrica diversifolia*.¹ This specimen should be in the United States National Museum collections, but it can not now be located, in fact it is not recorded in the catalogue as ever having been present.

Although this leaf was included by Lesquereux in his *Myrica diversifolia*, it does not seem to me that it can possibly be referred to either of the two forms into which that species is now separated (i. e. *Sorbus diversifolia* and *S. nupta*). Its deeply three-lobed outline with the basal portion decurrent are features that can not be made to fit into either of its companion leaves as shown in Lesquereux's plate.

In some respects this leaf suggests species of *Rhus* in the Florissant flora. Thus, it has the same size and much the appearance of *Rhus vexans* Lesquereux,² but the latter is distinctly trifoliolate instead of three-lobed. It is also quite like some of the leaves referred to *Rhus hilliae* Lesquereux,³ but this is an odd-pinnate leaf.

On the whole it appears to agree best with the genus *Ribes*, being, for example, not greatly unlike *R. aureum* Pursh.

Family ROSACEAE.

ROSA SCUDDERI, new species.

Plate 22, fig. 4.

Leaves of small size, with seven leaflets, the terminal (odd) leaflet narrowly elliptical, equally narrowed to both base and apex, short petioled, length 20 mm., width 6 mm.; upper pair of leaflets oval, sessile, 12 mm. and 15 mm. long and 4 and 6 mm. wide respectively; middle pair of leaflets much smaller, about 8 mm. long and 3 or 4 mm. wide; lowest pair of leaflets minute, 5 or 6 mm. long, about 2 mm. wide; all leaflets entire at base, then coarsely toothed; nervation obscure with apparently about 5 or 6 pairs of secondaries; stipules obscure, apparently minute and narrow.

Type.—Cat. No. 34,765, U.S.N.M.

¹ Rept. U. S. Geol. Surv. Terr., vol. 8, 1883, pl. 25, fig. 13.

² *Idem*, p. 195, pl. 41, fig. 20.

³ *Idem*, p. 194, pl. 41, figs. 12-15.

Three species of *Rosa* have been previously described from Florissant, these being *R. hilliae* Lesquereux,¹ *R. wilmattae* Cockerell,² and *R. ruskiniana* Cockerell.³ The first is characterized by possessing three leaflets, the second by five leaflets and the present species by seven leaflets. In size of leaf and shape of leaflets they do not differ greatly though in the present species the leaflets are all slightly narrower than in either of the others.

This species is named in honor of Samuel H. Scudder, the distinguished authority on fossil insects, who collected the specimens.

ROSA? INQUIRENDA, new species.

Plate 17, fig. 1.

Represented by what appears to be a fruit or "hip," consisting of a thick, circular, capsule-like body about 7 mm. in diameter, and five slender, acute radiating calyx lobes. The greatest spread of the lobes is fully 3 cm., the individual lengths of the lobes being 12 or 13 mm.

Type.—Cat. No. 34,741, U.S.N.M. Hambach collection.

The exact nature of this specimen is not definitely known as it is not clearly preserved, but it has the appearance of being a rose "hip"; it may, however, be a regular-lobed and somewhat coriaceous calyx of another genus.

Family MALACEAE.

AMELANCHIER PERITULA Cockerell.

Amelanchier peritula COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 95, pl. 6, fig. 6.

The Hambach collection contains a single leaf that is referred to this species.

SORBUS DIVERSIFOLIA (Lesquereux) Cockerell.

Sorbus diversifolia (Lesquereux) COCKERELL, Amer. Jour. Sci., vol. 29, 1910, p. 76, fig. 1.

Myrica diversifolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 148, pl. 25, figs. 6, 10-12.

Crataegus acerifolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 198, pl. 36, fig. 10.

Crataegus lesquereuxi COCKERELL, Bull. Torr. Bot. Club, vol. 33, 1906, p. 311; Univ. Colorado Studies, vol. 3, 1906, p. 171.

Onoclea reducta COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 108, pl. 6, fig. 4.

The type-specimens of all of the leaves referred by Lesquereux, to his *Myrica diversifolia* should be preserved in the United States National Museum, but a careful search fails to disclose only five of the 10 leaves. Of the four leaves (figs. 6, 10-12) which it seems to me

¹ Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 199, pl. 40, figs. 16, 17.

² Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 94, pl. 7, fig. 14.

³ Amer. Jour. Sci., vol. 26, 1908, p. 540, fig. 5.

may be properly referred to what Cockerell has separated as *Sorbus diversifolia*, only the original of figures 10 (= 1,651), and 12 (= 1,650) have been found. It would seem that figure 10 might well be a small leaf of the type represented in figure 6, which appears to be the only one transferred by Cockerell to *Sorbus diversifolia*. Figures 11 and 12 both lack the apical portion, which might well have been similar to that in figure 6, and consequently I have placed them with *Sorbus diversifolia*. They might have had an apical portion like that shown in figures 7 and 8, but I do not think so, and it seems best to place them as here indicated.

Perhaps a word of explanation may be given as to certain nomenclatorial complications that threatened to arise on transferring the names above mentioned. Thus, *Myrica diversifolia* Lesquereux, 1883, can not be transferred to *Crataegus* on account of the earlier living *Crataegus diversifolia* Steudel, 1847, or *Pyrus diversifolia* Bong 1864. *Crataegus acerifolia* Lesquereux, 1883, is not the same as *C. acerifolia* Moench, 1785. The ineligibility of *diversifolia* in *Crataegus* was the reason for calling it *lesquereuxi* by Cockerell, but this latter name is unnecessary when the species is placed in *Sorbus*.

The basal portion of a leaf described and figured by Cockerell¹ under the name of *Onoclea reducta*, to judge from the indistinct figure, has been properly transferred to *Sorbus diversifolia* by Cockerell himself.

Professor Cockerell considers *Sorbus diversifolia* to be a hybrid between *S. megaphylla* Cockerell, and *S. nupta* Cockerell, after the manner of certain living forms which are known to produce natural crosses. His reasoning for this belief is set forth at some length in the paper above quoted.

SORBUS NUPTA Cockerell.

Sorbus nupta COCKERELL, Amer. Jour. Sci., vol. 29, 1910, p. 78, fig. 2.

Myrica diversifolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 148, pl. 25, figs. 7, 8, 14.

The description of this species is given by Cockerell as follows:

Leaf-blade about 67 mm. long, and nearly as broad, with short triangular lobes, the margin also sharply dentate.

I have not seen the type of this species, but so far as I can determine from the rather indistinct figure and the above description, it appears to be identical with figure 14 of *Myrica diversifolia* Lesquereux, nor do I see any reason except size for not including also figures 7 and 8 of Lesquereux's plate. These three leaves certainly appear to agree among themselves and also to be different from the other leaves not referred to *Sorbus diversifolia*.

¹ Cockerell, T. D. A., Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 108, pl. 6, fig. 4.

Cockerell considers *Sorbus nupta* to be one of the parents, which, crossed with *Sorbus megaphylla* Cockerell, has produced a hybrid called *Sorbus diversifolia*.

CRATAEGUS, species.

Plate 21, fig. 4.

A single segment of a branch 4 cm. in length showing two oppositely inserted leaves (base of petioles alone preserved) and a single strong, sharp thorn 1 cm. in length, near the base.

Type.—Cat. No. 34,763, U.S.N.M.

This specimen, although a mere fragment, is unmistakably that of *Crataegus*, as shown not only by the presence of a characteristic thorn, but by the alternate insertion of the leaves. It is very much to be regretted that only the petioles are preserved, for otherwise it might be possible to connect it with one of the two species already described from the leaves. These are *Crataegus lesquereuxi* Cockerell (*C. acerifolia* Lesquereux, 1883, not Moench, 1785), and *C. acutiloba* (Lesquereux). It is useless to attempt to work out possible affinities between either of the Florissant species and the thousand (more or less) living species now recognized in North America, and even the propriety of giving a name to such an uncharacteristic portion as a thorny branch, may well be questioned.

Family RUTACEAE.

PTELEA MODESTA (Lesquereux) Cockerell.

Ptelea modesta (LESQUEREUX) COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 98.

Cytisus modestus LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 200, pl. 39, figs. 9-11.

Leguminosites serrulatus LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8, 1883, p. 202, pl. 39, figs. 7, 8.

The Scudder material includes four trifoliolate leaves preserved on two pieces of matrix that apparently belong here. The better of these specimens has three leaflets that exhibit great extremes in size, yet they must all be attributed to the same species, since they are either connected or so lie as to make it practically certain that they were joined when living. The smallest leaf has the leaflets only about 7 mm. long and 3 mm. broad; the next in size has them from 17 to 25 mm. in length and from 5 to 7 mm. in width, while in the largest leaf the leaflets are from 30 to 40 mm. long and about 10 mm. wide. The leaflets in the two smaller leaves are perfectly entire, while in the other they are entire on one side and provided with a few scattered low teeth on the other side. In the leaf not figured, which is about the size of the middle-sized leaf just described, the leaflets are all entire.

There can be no reasonable doubt that the specimens here described are the same as those described by Lesquereux under the name of *Cytisus modestus*. The leaflets in this species are said by Lesquereux to be entire.

Cockerell¹ has expressed the opinion that the two leaves figured by Lesquereux² under the name of *Leguminosites serrulatus* also belong here, and this is possibly true, but they are somewhat larger and the teeth appear to be of a different character.

It seems not impossible that the smaller specimen figured by Lesquereux³ under the name of *Staphylea acuminata* may also belong with this aggregation. This is also suspiciously like *Menyanthes coloradensis* Cockerell.

DODONEA, species, Lesquereux.

Dodonea species, [Seeds of] LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 182, pl. 36, fig. 5.

Cat. Nos. 33,751, 33,752, U.S.N.M.

A single specimen with its counterpart is contained in the Hambach collection.

Family MIMOSACEÆ.

CERCIS PARVIFOLIA Lesquereux.

Plate 25, figs. 1, 2.

Cercis parvifolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 201, pl. 31, figs. 5-7.

This fine species is represented by several examples in the Scudder collection that are of about the size as those figured by Lesquereux. In the Florissant material belonging to the Lacoë collection, I find a single, nearly perfect leaf [No. 50,273, U.S.N.M.], with its counterpart that was identified by Lesquereux, through whose hands this material passed, as *Cercis truncata* Lesquereux. A reference to the literature discloses that *Cercis truncata* was named and described but not figured by Lesquereux⁴ from the Bad Lands of North Dakota, in beds now known to be of Fort Union age. Concerning it, he says:

This leaf has exactly the same form and nervation as the leaves figured on plate 31, figs. 5-7 [Cret. and Tert. Fl.], and described as *C. parvifolia*. But it greatly differs by its size being 8 cm. broad and more distinctly pointed. As the leaves of *Cercis* are extremely variable in size, this may represent a large and more developed form of the species of Florissant.

The specimen under consideration is only about 6 cm. broad and 5 cm. long, which is nearly twice the size of the leaves ordinarily found of *C. parvifolia*, but as it does not differ essentially in any other particular, it seems best to refer it to this species and not to *C. trun-*

¹ Bull. Amer. Mus. Nat. Hist., vol. 24, p. 98.

² Cret. and Tert. Fl., pl. 39, figs. 7, 8.

³ Idem, pl. 36, fig. 4.

⁴ Idem, p. 237.

cata. The present location of the type of *C. truncata* is unknown, though it should not be difficult to identify it if found in Fort Union material, when its identity with, or distinctness from *C. parvifolia* will have to be determined.

VICIA, species.

Plate 23, fig. 4.

The Hambach collection includes a specimen—the one here figured—that appears referable to a tendril-bearing plant of the type of *Vicia*, and it is so referred.

Type.—Cat. No. 34,740, U.S.N.M.

ROBINIA BRITTONI Cockerell.

Plate 24, fig. 2.

Robinia brittoni COCKERELL, Amer. Jour. Sci., vol. 36, 1908, p. 543, fig. (in text) 8.

Cat. No. 34,767, U.S.N.M.

The Scudder collection contains the splendid specimen here figured, which is much more complete than the type.

CYTISUS FLORISSANTINUS Lesquereux.

Plate 21, fig. 5; plate 23, fig. 3; plate 24, fig. 4.

Cytisus florissantinus LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 200, pl. 39, fig. 14.

Cassia fischeri HEER, LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 202.

Cat. Nos. 50,296, 50,297, 50,298, U.S.N.M.

This species is introduced for the purpose of showing that the leaves described by Lesquereux from the Lacoë collection as *Cassia fischeri* Heer, are really leaflets of *Cytisus florissantinus* Lesquereux, which are described and figured on another page of the Cretaceous and Tertiary Floras. There are three specimens representing two leaflets and a counterpart, all bearing the original No. 42 of the Lacoë collection; they are here figured for the first time.

DALBERGIA? MINUTA, new species.

Plate 24, fig. 3.

Leaflet long-petioled, membranaceous, obcordate in shape, cuneate to the slightly decurrent base, deeply emarginate at apex, margin perfectly entire; secondaries about four pairs, the lowest pair arising near the base and ascending along the margin; other pairs above the middle of the blade, at a lower angle of divergence.

Type.—Cat. No. 34,742, U.S.N.M.

This little leaflet, which is nearly perfect, is only 18 mm. long, including the petiole 6 mm. long; the width is 11 mm. It is exactly obcordate in shape, with the base slightly decurrent halfway down the petiole.

I am uncertain as to the generic reference of this specimen. It seems to be most closely related to *Dalbergia cuneifolia* Lesquereux,¹ from which it differs in its smaller size, relatively shorter and broader form with the base decurrent on the slender petiole.

DALBERGIA? COLORADENSIS, new species.

Plate 19, fig. 4.

Fruit a compressed indehiscent pod, elliptical in shape, about equally narrowed below to the stout pedicel and above to the acuminate apex, margin thickened.

Type.—Cat. No. 50,330, U.S.N.M. [Original No. 61, Lacle collection].

The example figured, which was contained in the Lacle collection (No. 61), is the only one observed. It is rather broadly elliptical in shape, being 3.5 cm. in length and 1.4 cm. in width, with about 4 mm. taken up by the basal or attached portion. There is a thickened marginal rim about 2 mm. in width. In the narrowed basal portion there are five little bodies serially arranged that have the appearance of being aborted ovules, but whether the larger expanded portion was one-seeded or not it is difficult to ascertain.

This species does not agree very closely with any of the living species of *Dalbergia* it is possible to consult in the National Herbarium, being perhaps closest to *D. polyphylla* Miquart from the East Indies. Among fossil species, however, it is very much like *Dalbergia primaeva* Unger,² from the upper Eocene of Sotzka, from which it differs in its smaller size, less pointed and toothed apex, and abruptly narrowed basal portion.

Since the above was written Professor Cockerell visited my laboratory and on being shown this specimen immediately called attention to its resemblance to, or possible identity with, his *Acerates fructifer*.³ Superficially the resemblance between these two specimens is rather strong, but this is confined to the shape and size, for the figure of *A. fructifer* is so obscure that nothing can be determined regarding its structure. The specimen under consideration may or may not properly be referable to *Dalbergia*, but it certainly is not a foliicle of *Acerates*.

Family ANACARDIACEAE.

RHUS HILLIAE Lesquereux.

Rhus hilliae LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 194, pl. 41, figs. 12-15.

Several specimens in the Hambach collection [Cat. Nos. 33,734, 33,735, 33,738, U.S.N.M.]

¹ Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 200, pl. 34, figs. 6, 7.

² Terr. Fl. v. Sotzka, 1850, p. 55 [185], pl. 39 [40], figs. 8-10.

³ Amer. Nat., vol. 42, 1908, p. 580, fig. 10.

RHUS? TRIFOLIOIDES Lesquereux.

Rhus trifolioides LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 196.

Type.—Cat. No. 50,325, U.S.N.M. [Original No. 58 of Lacoë's cabinet].

Leaf trifoliolate; leaflets sessile or nearly so, oval, elliptical-oval, or slightly elliptical-obovate, the terminal one slightly the larger, abruptly narrowed to a very short petiolule; margin spinose-serrate nearly to the base of the blade; midrib very strong and hard; secondaries numerous, about a dozen pairs, very thin and delicate, at an angle of about 45°, entering the spinose marginal teeth; finer nervation obscure.

This species had not been previously figured, but as the type came to the United States National Museum through the Lacoë collection this opportunity is embraced to figure it, and also to amplify and perfect the description. For instance, in the original characterization the leaflets are said to be "apiculate and dentate to the middle," but the present figure shows they are rather obtuse and are beset with numerous sharp, spiny teeth which extend almost to the base. The nervation is said to be obsolete, but as shown in the figure it consists of a prominent flat midrib and numerous very thin secondaries, most of which enter the teeth.

The character of the teeth as well as the general appearance incline one to the opinion that this form is not correctly placed in *Rhus*—at least it is unlike any living form with which I am familiar—but in absence of a more positive reference it is left as disposed by Lesquereux. I have, however, ventured to question the generic reference.

COTINUS FRATERNA Lesquereux.

Plate 24, fig. 1.

Cotinus fraterna (Lesquereux) COCKERELL, *Torreya*, vol. 5, 1905, p. 12; *Univ. Colorado Studies*, vol. 3, 1906, p. 170.

Rhus fraterna LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 192, pl. 41, figs. 1, 2.

Andromeda rhomboidalis LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 176.

Type of "Andromeda rhomboidalis" LESQUEREUX.—Cat. No. 50,343, U.S.N.M. [Original No. 70 of Lacoë's cabinet.]

The Scudder collection contains about a dozen finely preserved examples of this species.

Andromeda rhomboidalis Lesquereux was named and described, but not figured, by Lesquereux in 1883. The type of this form came to the possession of the United States National Museum through the Lacoë collection. A comparison of this with the figures of *Rhus fraterna* shows them to be the same, and *Andromeda rhomboidalis* is consequently referred to this species.

Family AQUIFOLIACEAE.

ILEX KNIGHTIAEFOLIA Lesquereux.

Plate 26, fig. 3.

Ilex knightiaefolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 188, pl. 40, figs. 4, 5.

Ilex rigida KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 182, pl. 14, fig. 2.

Type of I. rigida.—Cat. No. 33,683, U.S.N.M.

An examination of the type of *Ilex rigida* Kirchner convinces me that it is referable to *I. knightiaefolia* Lesquereux, as suspected by Cockerell.¹ There is an additional example in the Hambach collection [Cat. No. 33,705, U.S.N.M.].

ILEX PSEUDO-STENOPHYLLA Lesquereux.

Plate 25, figs. 3, 4.

Ilex pseudo-stenophylla LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 185.

Types.—Cat. Nos. 50,326, 50,327; U.S.N.M.

As this species has never been figured, and as the type-specimens have become the property of the United States National Museum through the Lacoë collection, I take this opportunity of figuring the type-specimen which is number 59 of Lacoë's cabinet, and which served as the basis for the species. They are very well described by Lesquereux, and obviously belong to the type of the living *Ilex cassine* Linnaeus. The length is 20 to 26 mm., and the width about 6 mm.

ILEX MICROPHYLLA Lesquereux.

Plate 21, fig. 6.

Ilex microphylla LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 186.

This species, like the last, has never been figured, and as the type is now in the United States National Museum, having come through the Lacoë collection, the opportunity is taken to figure it. It has been well described by Lesquereux.

Type.—Cat. No. 50,329, U.S.N.M. (Original Lacoë No. 60.)

Family CELASTRACEAE.

CELASTRUS FRAXINIFOLIUS Lesquereux.

Celastrus fraxinifolius LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 184, pl. 40, fig. 10.

A specimen in the Scudder collection which seems to belong here, though it is a very little broader and has rather finer teeth.

¹ Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 101.

CELASTRUS LACOEI Lesquereux.

Plate 24, fig. 6.

Celastrus lacoeï LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 184.

Type.—Cat. No. 50,309, U.S.N.M. (Original No. 49 in Lacoë's cabinet.)

Leaf subcoriaceous in texture, obovate or spatulate in shape, obtuse and rounded at apex, narrowed below to a wedge-shaped entire base and a short, thick, petiole, length 3.5 cm., width 1.3 cm.; margin for two-thirds or more of length above the base, undulate-toothed, the teeth relatively large, rounded; midrib relatively thick, straight; secondaries numerous, alternate, at an acute angle, thin, apparently camptodrome but details obscure.

This species, which is here figured for the first time, was named and described by Lesquereux in 1883. The type-specimen, which remains unique, came to the United States National Museum through the collection of R. D. Lacoë.

This species has some resemblance to certain small obtuse leaves of *Fagopsis longifolia* (Lesquereux) Hollick, but may be known by the obtuse apex, undulate-toothed margin and indistinct secondaries.

CELASTRINITES ELEGANS Lesquereux.

Plate 21, fig. 7.

Celastrinites elegans LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 185, pl. 31, figs. 9, 10.

Celastrus greithianus HEER. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 184.

Cat. No. 50,348, U.S.N.M., as *Celastrus greithianus* Heer. Not before figured. Lesquereux referred two leaves from Florissant to Heer's *Celastrus greithianus*, both of which are before me, and which are certainly not con-generic. One specimen [Cat. No. 50,347, U.S.N.M., Lacoë collection No. 74], is a deformed leaf of some kind, probably a leaflet of *Sapindus*, but it is quite impossible to be certain of its affinity and it is not further considered.

The other leaf [Cat. No. 50,348, U.S.N.M., Lacoë collection No. 74], is undoubtedly a small example of *Celastrinites elegans*, or rather it is identical with figure 9¹ referred to this species, for I quite agree with Cockerell that the two figures under this name can not be con-generic. Notwithstanding Lesquereux has said of the leaves referred to *C. greithianus* that they are "very entire," on clearing away the matrix around the margin in the one-figured it is seen to be plainly crenulate, and except for being a little smaller is identical with the figure mentioned.

¹ Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, pl. 31, fig. 9.

I have not seen the types of the two figures of *Celastrinites elegans*, which are said to be in Princeton University, but it is suspected that figure 10¹ will be found to belong to *Cercis parviflora*. The nervation certainly suggests this reference, the only obstacle in the way being the apparently crenulate margin, which may not have been completely exposed.

Family STAPHYLEACEAE.

STAPHYLEA ACUMINATA Lesquereux.

Staphylea acuminata LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv., Terr., 1873 [1874], p. 415; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 267, pl. 48, figs. 4, 5; vol. 8 (Cret. and Tert. Fl.), 1883, p. 183, pl. 36, figs. 1-4.

Specimens of this species are contained in all three of the collections under examination.

Family ACERACEAE.

ACER FLORISSANTI Kirchner.

Acer florissanti KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 181, pl. 11, fig. 1.

Type—Cat. No. 33,673, U.S.N.M.

This splendid species, which is clearly of the type of the eastern silver maple (*Acer saccharinum*), has been well described and figured by Kirchner. Although the leaves of *Acer* appear to be rather rare at Florissant, Cockerell² has reported finding this species at two stations, and the United States National Museum has a very fine specimen [Cat. No. 50,346, U.S.N.M.] from the collection of R. D. Lacey, which was identified by Lesquereux as *Acer trilobatum cuspidatum*.

ACER KIRCHNERIANUM, new species.

Leaf of small size, of the type of *Acer florissanti* but only one-fourth the size, three-lobed, the central lobe large, strongly toothed above; lateral lobes oblong-acute, with several strong teeth; nervation with three ribs arising at the base of the blade, the middle one with about 4 or 5 pairs of secondaries which pass to the sharp marginal teeth, lateral ribs passing to the tips of the lateral lobes, each with 5 or 6 pairs of arching secondary branches which enter the teeth.

Type.—Cat. No. 33,761, U.S.N.M.

This little leaf, which is nearly perfect, has the blade a little over 2.5 cm. long, while the petiole which is complete is slightly over 1 cm. long. Its outline and nervation are well shown in the figure.

It is possible that this is only a very small leaf of *Acer florissanti* Kirchner, but as it is only one-fourth its size and moreover is three-

¹ Cret. and Tert. Fl., pl. 31.

² Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 101.

ribbed instead of five-ribbed, it has been described as new. As lending weight to the idea that it really may be distinct from the larger species, it may be mentioned that there is another example in the same collection that is of exactly the same size; it is not as well preserved as the one taken as the type, hence has not been figured.

This species is named in honor of Mr. Walter C. G. Kirchner, who described the first well authenticated maple from Florissant.

ACER MYSTICUM Kirchner.

Acer mysticum KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 181. pl. 11, fig. 2.

Type.—Cat. No. 33,674, U.S.N.M.

This species, contained in the Hambach collection, is doubtless the fruit of *Acer florissantii* Kirchner, but as they are found in association and not in actual connection, they must be held as distinct. The fruit is hardly to be distinguished from a number of described species, such, for instance, as that referred to *Acer indivisum* by Lesquereux.¹

Family SAPINDACEAE.

SAPINDUS LANCIFOLIUS Lesquereux.

Sapindus lanicfolius LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 182, pl. 32, figs. 3-6; pl. 37, fig. 9.

Several very perfect specimens are contained in the Hambach collection.

SAPINDUS COLORADENSIS Cockerell.

Sapindus coloradensis COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 101, pl. 9, fig. 31.

Sapindus angustifolius LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, pl. 49, fig. 2; vol. 8 (Cret. and Tert. Fl.), 1883, p. xxxvii, figs. 3-5.

Several good specimens in the Hambach collection that must be referred here.

Family RHAMNACEAE.

RHAMNUS KIRCHNERI Cockerell.

Rhamnus kirchneri COCKERELL, Bull. Torr. Bot. Club, vol. 33, 1906, p. 311; University Colorado Studies, vol. 3, No. 3, 1906, p. 170.

Rhamnus ellipticus KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 183, pl. 15, fig. 3 [Not *Rhamnus ellipticus* Swartz, 1788].

Type.—Cat. No. 33,688, U.S.N.M.

The specimen remains unique, at least so far as the present collections are concerned.

¹ Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, pl. 36, fig. 9.

ZIZYPHUS OBTUSA Kirchner.

Plate 16, fig. 3.

Zizyphus obtusa KIRCHNER, TRANS. St. Louis Acad. Sci., vol. 8 1898, p. 182, pl. 13, fig. 1.

Type.—Cat. No. 33,679, U.S.N.M.

As the original figure of this species is rather poor, not being quite correct as regards certain details of the nervation, it has been refigured. It is certainly strongly suggestive of Lesquereux's *Xanthoxylon spireaefolium*,¹ especially his figure 2.

Family VITACEAE.

VITIS HESPERIA, new species.

Plate 26, fig. 4.

Leaf membranaceous in texture, strongly five-lobed, the lobes ovate, acuminate, separated by deep rounded sinuses; base of leaf deeply cordate, the sinus broad and rounded; margins of lobes entire in the sinuses, coarsely toothed elsewhere, the teeth rather obtuse; petiole strong, 3.5 cm. long; nervation palmately 5-ribbed from the top of the petiole, the ribs straight, each ending in a large lobe, and each provided with a few acute-angled secondary branches; finer nervation obscure.

Type.—Cat. No. 33,723, U.S.N.M.

This splendid, nearly perfect specimen is 7 cm. in length, about 8 cm. broad between the tips of the two upper lobes, and 5.5 cm. between the tips of the basal lobes. The strong petiole was at least 3.5 cm. in length, for at this point it passes off the matrix, but doubtless this was nearly or quite the end; it is a little more than 2 mm. thick at the base and for the lower third of its length.

This leaf is by all odds one of the handsomest and best characterized of the many beautifully species from Florissant. It differs from the only previously known Florissant species, *Vitis florissantella* Cockerell,² in being nearly three times the length, and in having five instead of only three lobes. It is just possible that Cockerell's species may be a very small leaf of the present form, but they are so different in size and general appearance that it is undoubtedly best to keep them as distinct until the evidence for uniting them is stronger than at present.

So far as can be made out from the indistinct figure, the leaf described as *Ribes protomelaenum* Cockerell,³ might well belong to *Vitis*.

This leaf is also suggestive of certain leaves of *Morus cannabinus*, etc., but its agreement with *Vitis* is held to overbalance the others.

¹ Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 196, pl. 40.

² Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 102, pl. 7, fig. 18.

³ *Idem*, p. 93, pl. 7, fig. 15.

Family STERCULIACEAE.

STERCULIA ENGLERI Kirchner.

Sterculia engleri KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 180, pl. 14, fig. 3.

Type.—Cat. No. 33,684, U.S.N.M.

An examination of the type of this species, contained in the Hambach collection, shows it to be very clearly related to *S. rigida* Lesquereux,¹ also from Florissant, and it seems not unlikely that a series of specimens, if such should ever be found, would show them to be the same.

The Lacoë collection contains a single example [original Lacoë No. 44, Cat. No. 50,300, U.S.N.M.] that is undoubtedly the same as *S. engleri* Kirchner, although it bears on the back a label reading "*Sterculia rigida* Lesq., Cotype," and had passed through Lesquereux's hands. Leaves of *Sterculia* appear to be very rare in the Florissant lake beds, in fact but three specimens have passed under my notice, one being the type of *S. rigida*, another the type of *S. engleri*, and the other the one under discussion which is, as stated, identical with *S. engleri*. As already pointed out, a series might show them to intergrade as regards size, which is about the only difference, but so far they hold good.

Family EBENACEAE.

DIOSPYROS BRACHYSEPALA Al. Braun.

Diospyros brachysepala AL. BRAUN. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 174, pl. 34, figs. 1, 2.

Diospyros princetonia COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 105, pl. 10, fig. 36.

The Hambach collection includes a single very perfect leaf that is absolutely indistinguishable from *Diospyros brachysepala* as figured and described by Lesquereux. Whether or not it is properly referred to the European species is another matter, but certain it is that it can not be separated from the Florissant leaf so identified. I am also unable to separate *Diospyros princetonia* Cockerell from these leaves.

Family OLEACEAE.

FRAXINUS LIBBEYI Lesquereux.

Plate 24, fig. 5.

Fraxinus libbeyi LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 171, pl. 27, figs. 5-7, 9.

Ostrya betuloides LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 151.

Type of "Ostrya betuloides" Lesquereux.—Cat. No. 50,266, U.S.N.M. [original No. 26 of Lacoë's cabinet].

¹ Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 179, pl. 34, fig. 12.

No specimens referable to *Fraxinus libbeyi* were found in the unworked collection, but in the Lacoë material, now the property of the United States National Museum, was found the type of *Ostrya betuloides* Lesquereux, the careful examination of which convinces me should be referred to this species. As Lesquereux did not figure the type of his *Ostrya betuloides*, this occasion is taken to illustrate it [pl. 24, fig. 5]. It may be seen from this figure that it is practically indistinguishable from the smaller leaflets of *Fraxinus libbeyi*, and consequently it is referred to that species.

FRAXINUS UNGERI Lesquereux.

Plate 22, fig. 3; plate 23, figs. 1, 2.

Fraxinus ungeri LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 171.

Types.—Cat. Nos. 50,321, 50,322, 50,323; U.S.N.M. [Lacoë No. 57.]

This species was described but not figured by Lesquereux, and as the three specimens upon which it is based are now in the United States National Museum, they are here illustrated for the first time. Of these figures, 1 and 3 of the above-mentioned plates are probably conspecific, but it is perhaps doubtful if the other specimens belongs with them. Figure 3 is very much like what Lesquereux¹ has figured as *Diospyros brachysepala* Al. Braun, except it is more wedge shaped at base. It also resembles *Andromeda delicatala* Lesquereux, as figured on the same plate.

Family CONVULVULCEAE.

PORANA TENUIS Lesquereux.

Plate 27, figs. 4-6.

Porana tenuis LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 173.

Type.—Cat. No. 50,344, U.S.N.M. [Lacoë's cabinet, No. 71] fig. 6.

This species was described as follows by its author:

Calyx large, thin; sepals distinct to the base, oblong, obtuse; veins distinct, distantly obliquely branched.

The type of this species, now figured for the first time, is seen to be a very perfect specimen indeed, the 5 oblong, rather obtuse sepals being practically of equal size, and distinct nearly or quite to the base. The individual sepals are about 15 mm. long and about 5 mm. wide, each being provided with about three distinct nerves, which arise at the base and are sparingly once-forked at or above the middle. In the exact center where the sepals come together there is a circular scar about 2 mm. in diameter which may represent the point of attachment to the pedicel or the attachment of the capsule.

¹ Lesquereux, Leo, Cret. and Tert. Flora, pl. 34, fig. 2.

This form was referred to the genus *Porana* of the Convolvulaceae, by Lesquereux on the ground of its undoubted resemblance to certain European Miocene forms, such as *Porana micrantha* Ludwig, *P. oeningensis* (Al. Braun) Heer, etc., in some of which, but especially the last-mentioned species, the characteristic fruit has been obtained. Up to the present time, so far as known to the writer, no American specimen has been recorded which has the fruit preserved, which would prove absolutely the correctness of the generic reference. It is with great pleasure, therefore, that I am able to state that two splendidly preserved specimens in the Hambach collection supply this missing character. As may be seen from the figures (pl. 27, figs. 4, 5), the sepals are identical in number, shape, size, and nervation with *Porana tenuis*, and in addition each has the globular capsule preserved *in situ*. The capsule is about 7 mm. in long, and 6 mm. in short diameter, and was evidently very firm and of considerable strength since the depression in the matrix is fully 1 mm. deep. In one of the specimens (pl. 24, fig. 5) there is some evidence of the presence of seeds, but this may be only an accident of preservation.

This species is, of course, entirely distinct from *Porana speirii* Lesquereux, and *P. similis* Knowlton, being approached only by *P. cockerelli*, the description of which follows.

PORANA COCKERELLI, new species.

Plate 27, fig. 3.

Porana tenuis LESQUEREUX. COCKERELL, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 107, pl. 6, fig. 10.

Similar to *P. tenuis*, but with the sepals shorter, obovate instead of oblong, and with the apices much more obtuse and rounded; capsule oblong, rounded at apex.

Type.—Cat. No. 34,747, U.S.N.M.

The sepals are about 13 mm. long and about 6 mm. wide at the broadest point which is near the apex. They are distinctly obovate in shape and nearly or perhaps quite free at base. The nervation is very distinct, consisting of about 5 veins which arise at the base, about 5 mm. apart, and with one or two branches above. The finer nervation, if present, is now obsolete. The size and character of the capsule is well shown in the figure.

This species is so very closely related to *P. tenuis* that it is perhaps with doubtful propriety that it is held as distinct from it. It differs from *P. tenuis* as above indicated by its slightly smaller size, and obovate, very obtuse sepals.

This form is undoubtedly the same as the example figured by Cockerell under the name of *Porana tenuis*, and by a curious coincidence, which may be with or without significance, each of these specimens has only four sepals as at present preserved. The natural inference

would be that it originally had five sepals, as there is about room enough in the empty space for another sepal the size of the others. There is also some evidence that the sepals in the type-specimen are of two sizes, that is in the figure as now oriented the two lower sepals are slightly smaller than the two upper ones. The specimen figured by Cockerell also shows this tendency, though they are disposed in a little different manner.

I take pleasure in naming this species in honor of Prof. Theodore D. A. Cockerell, of the University of Colorado, who has done so much to extend our knowledge of the plants and insects of the Florissant lake beds.

PORANA SIMILIS, new species.

Plate 27, figs. 1, 2.

Calyx of large size (about 3.5 cm. in diameter), coriaceous in character, strongly 4 or 5 lobed, the lobes unequal size, broadly deltoid, very obtusely pointed or almost rounded; each lobe with 5 or 6 rather thin veins which arise at the central point and converge in the tip of the lobe; cross veinlets at right angles to the veins, somewhat irregular, often broken, producing irregular quadrangular areas.

Type.—Cat. No. 34,736, U.S.N.M.; Cotype, Cat. No. 34,737, U.S.N.M., both from the Hambach collection.

This species is very well represented by the two examples figured. It is obviously very closely related to *Porana speirii* Lesquereux,¹ also from Florissant, from which it differs in the strong and well-marked lobes which are obtusely pointed instead of low and perfectly rounded, and in the nervation. The veins are represented as diverging from the center, often forked and passing straight to the margin, while in *P. similis* the veins are fewer in number, not forked and all converge in the tips of the lobes. The cross veinlets are very much the same in both forms.

The type of *Porana speirii* is preserved in the Princeton Museum, and, so far as known to the writer, it remains unique. It is very different from *P. tenuis* Lesquereux, the only other previously published species from Florissant. In shape the form here described as *P. similis* is intermediate between the two previous species as regards lobation, being more markedly lobed than *P. speirii*, and with broader, less deeply cut lobes than *P. tenuis*.

Family MENYANTHACEAE.

MENYANTHES COLORADENSIS Cockerell.

Menyanthes coloradensis COCKERELL, Amer. Jour. Sci., vol. 26, 1908, p. 543, fig. 9.

Under this name Cockerell has described a so-called crown bearing five leaves, two of which are entire and the others trifoliate. I

¹ Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 172, pl. 28, fig. 15.

have not seen this specimen, and the reproduction of the figure is so poor that little of the nervation can be made out, but I do not believe I should ever have thought of referring it to *Menyanthes*. The sheathing bases of the petioles, so marked a feature in the living species, are certainly not clear in the fossil, and this coupled with the two entire (unifoliate?) leaves make it seem improbable that it has been correctly placed in *Menyanthes*.

In this connection I may say that I am not able to distinguish the trifoliate leaves of *Menyanthes coloradensis* from *Cytisus modestus* Lesquereux¹ now called *Ptelea modesta*.

The types of the latter species are in the National Museum (fig. 9=1915; fig. 10=1914; fig. 11=1913), and all are correctly drawn except figure 9, which has the leaflets entire, instead of toothed, as shown in the drawing. So far as can be made out from the figure of *Menyanthes coloradensis* the leaves are not essentially different from Lesquereux's species.

Family TILIACEAE.

TILIA POPULIFOLIA Lesquereux.

Tilia populifolia LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 179, pl. 34, figs. 8, 9.

The Hambach collection contains one very good leaf of this species.

CARPOLITHES MACROPHYLLUS Cockerell.

Plate 27, fig. 7.

Carpolithes macrophyllus COCKERELL, Torreya, vol. 11, 1911, p. 235, text fig. 1.

The Hambach collection contains a single specimen that, presumably, should be referred to Cockerell's *Carpolithes macrophyllus*, though it differs considerably in size. Thus, Cockerell describes the sepals as being about 16 mm. long and 4 mm. broad in the middle, while in the present specimen the sepals are only 10 or 12 mm. long and 2.5 mm. or 3 mm. wide. The shape of the sepals is the same, and so far as can be made out the nervation is identical. There is no trace of the follicles in the present example, in fact it appears to have the basal side exposed, as there is some evidence of a scar of attachment. It would seem that if the side exposed was the same as in the Cockerell specimen, some trace of the woody follicles would be likely to remain.

In the original figure of *Carpolithes macrophyllus* the follicles appear to be four in number, "so far as can be seen like those of *Lynnothamnus*," Cockerell writes, but according to Sargent's *Sylva* (vol. 4, p. 133) the fruit of *Lynnothamnus* is "composed of two woody ovate four-seeded follicles, dehiscent on the ventral and partially dehiscent on the dorsal suture," which would exclude the fossil from this genus.

¹ Lesquereux, Leo, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 200, pl. 39, figs. 9-11.

There appears to be some uncertainty as to whether *Lyonothamnus* belongs to the Rosaceae or Saxifragaceae. Engler and Prantl place it doubtfully with the former, while Sargent, Rydberg, and other American authors place it in the Saxifragaceae.

LIST OF TYPES OF FOSSIL PLANTS FROM FLORISSANT, COLORADO, IN THE UNITED STATES NATIONAL MUSEUM.

- Acacia septentrionalis* LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1873 [1874], p. 418; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 299, pl. 59, fig. 9 [486].¹
- Acer florissanti* KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 181, pl. 11, fig. 1 [33,673].
- Acer kirchnerianum* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 282 [33,761].
- Acer mysticum* KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 181, pl. 11, fig. 2 [33,674].
- Adiantites gracillimus* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 137, pl. 21, fig. 8 [1,615].
- Alnus cordata* LESQUEREUX,² Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 151 [50,357]. KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 264, pl. 19, fig. 1 = *Alnus praecordata* COCKERELL.
- Alnus*, species, KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 264, pl. 16, fig. 2 [34,761].
- Andromeda rhomboidalis* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 176 [50,343]. KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 279 (as *Cotinus fraterna*).
- Amelanchier typica* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 198, pl. 40, fig. 11 [1,908].
- Antholithes improbus* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 204, pl. 40, figs. 20 [1,566], 21.
- Aristolochia williardiana* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 268, pl. 22, figs. 1, 2 [34,756].
- Banksites lineatus* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 165, pl. 32, fig. 21 [1,781].
- Betula deltooides* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 264, pl. 19, fig. 3 [34,754].
- Betula florissanti* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 150, pl. 27, fig. 11 [1,670].
- Betula truncata* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 150, pl. 28, figs. 6 [1,671], 7 [1,742].
- Bumelia florissanti* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 174, pl. 34, figs. 4 [1,797], 5 [1,798].
- Caesalpinia? linearis* LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1873, [1874], p. 417; Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 300, pl. 59, fig. 7 [526].
= *Mimosites linearis*.
- Callicoma microphylla?* ETTINGSHAUSEN. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 246, pl. 43, figs. 2, 3, 4.
= *Myrica drymeja*.

¹ The number of the type-specimens in the catalogue of the paleobotanical collection is given in square brackets after each figure, e. g., pl. 59, fig. 9 [486].

² A number of species described but not figured in the Cretaceous and Tertiary Floras are here figured for the first time.

- Carpinus fraterna* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 152, pl. 27, figs. 12 [1,673], 13 [1,674], 14 [1,672].
- Carpites ligatus* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 307, pl. 60, fig. 36 [515].
- Carpites pealei* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 306, pl. 60, fig. 31 [509].
- Castanea intermedia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 164, pl. 21, fig. 7 [194]. Locality given as Middle Park, but probable error for Florissant.
- Celastrus fraxinifolius* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 184, pl. 33, figs. 2 [1,856], 3 [1,855], 4 [1,854].
- Celastrus lacoei* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 184 [50,309]. KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 281, pl. 24, fig. 6.
- Cercis parvifolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 201, pl. 31, fig. 7 [1,918].
- Chara? glomerata* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 135, pl. 31, fig. 12 [1,611].
- Crataegus*, species KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 275, pl. 21, fig. 4 [34,763].
- Cytisus florissantinus* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 200, pl. 39, fig. 14 [1,916].
- Cytisus modestus* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 200, pl. 39, figs. 9 [1,915], 10 [1,914], 11 [1,913].
= *Ptela modesta*.
- Dalbergia? coloradensis* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 278, pl. 19, fig. 4 [50,330].
- Dalbergia? minuta* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 277, pl. 24, fig. 3 [34,742].
- Diospyros cuspidata* KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 185, pl. 12, fig. 1 [33,675].
= *Populus crassa*.
- Ficus florissantia* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 267. Based on *Ficus haydenii* LESQUEREUX. KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 179, pl. 12, fig. 3 [33,677].
- Florissantia physalis* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 270 [33,686].
- Fraxinus abbreviata* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 170, pl. 28, fig. 5 [1,796].
- Fraxinus heerii* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 169, pl. 33, figs. 5 [1,794], 6 [1,793].
- Fraxinus libbeyi* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 171, pl. 27, fig. 7 [1,795].
- Fraxinus mespilifolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 169, pl. 33, figs. 7 [1,787], 8 [1,784], 9 [1,785], 11 [1,789], 12 [1,790, 1,791 counterparts].
- Fraxinus ungeri* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 171 [50,321, 50,322, 50,323]. KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 286, pl. 22, fig. 3; pl. 23, figs. 1, 2.
- Hedera marginata* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 177, pl. 40, fig. 8 [1,804].
- Hypnum brownii* KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 178, pl. 12, fig. 4 [33,678].

- Hypnum haydenii* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 44, pl. 5, fig. 14 [37].
= *Juniperus? haydenii* (LESQUEREUX) KNOWLTON.
- Ilex grandifolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 187, pl. 38, fig. 1 [1,868].
- Ilex knightiaefolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 188, pl. 40, figs. 4 [1,861], 5 [1,859].
- Ilex microphylla* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 186 [50,329].—KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 280, pl. 21, fig. 6].
- Ilex pseudo-stenophylla* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 185 [50,326, 50,327].—KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 280, pl. 21, fig. 7.
- Ilex rigida* KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 182, pl. 14, fig. 2 [33,683].
= *Ilex knightiaefolia*.
- Ilex quercifolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 186, pl. 37, fig. 2 [1,862], 3 [1,863], 4 [1,865], 5 [1,867].
= *Ilex leomis*.
- Ilex subdenticulata* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 271, pl. 50, figs. 5 [402], 6 [406].
- Isoetes brevifolius* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 136 [—].
- Juglans affinis* KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 184, pl. 13, fig. 2 [33,680].
- Juglans florissanti* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 190 [50,355].
- Juglans magnifica* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 252, pl. 15 [33,765].
- Lemna penicillata* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 143, pl. 23, fig. 8 [1,628].
= *Spirodella penicillata*.
- Lomatia acutiloba* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 167, pl. 43, figs. 13 [1,747], 14 [1,745], 15 [1,742], 16 [1,748].
- Lomatia spinosa* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 166, pl. 43, fig. 1 [1,779].
= *Lomatites spinosa*.
- Lomatia terminalis* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 166, pl. 43, figs. 2 [1,772], 4 [1,770], 5 [1,771], 6 [1,773], 7 [1,769].
- Lomatia tripartita* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 166, pl. 43, figs. 8 [1,749], 9 [1,775], 10 [1,777].
- Macreighia crassa* LESQUEREUX, Rept. U. S. Geol. Surf. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 175, pl. 34, fig. 17 [1,802].
= *Populus crassa*.
- Muhlenbergia florissanti* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 250, pl. 13, figs. 1-3, [34,750, 34,751].
- Myrica callicomaeifolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 146, pl. 26, figs. 6 [1,640], 8 [1,646], 9 [1,634], 10 [1,639], 11 [1,639], 12 [1,639], 14 [1,636].
= *Myrica drymeja*.
- Myrica copeana* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 131, pl. 17, fig. 5, [147].

- Myrica diversifolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 148, pl. 25, figs. 7 [1,649], 8 [1,647], 10 [1,651], 12 [1,650], 14 [1,648].
 = *Crataegus*.
 = *Sorbus diversifolia*.
 = *Sorbus nupta*.
- Myrica fallax* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 147, pl. 32, figs. 11 [1,665], 13 [1,662], 14 [1,664], 15 [1,661], 16 [1,663].
- Myrica insignis* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 135, pl. 65, figs. 7, 8 [538 both on same stone].
 = *Comptonia insignis*.
- Myrica latiloba acutiloba* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 134, pl. 17, fig. 13 [153].
 = *Crataegus acutiloba*.
- Myrica obscura* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 145, pl. 22, figs. 9 [1,630], 10 [1,629].
- Myrica scottii* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 147, pl. 32, fig. 17 [1,660].
- Ophioglossum alleni* LESQUEREUX, Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., 1872 [1,873], p. 371 [1,617]=*Salvinia alleni* (LESQUEREUX) LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 65, pl. 5, fig. 11 [1,617].
 = *Tmesipteris alleni*.
- Ostrya betuloides* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 151 [50,266].—KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 285, pl. 24, fig. 5.
 = *Fraxinus libbeyi*.
- Palaeopotamogeton florissanti* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 251, pl. 16, fig. 1; pl. 17, fig. 3 [34,748; 34,749].
- Paliurus florissanti* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 274, pl. 50, fig. 18 [415].
- Pimelia delicatula* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 168, pl. 33, figs. 15 [1,782], 16 [1,783].
- Pinus florissanti* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 138, pl. 21, fig. 13 [1,618].
- Plagiopodopsis scudderii* BRITTON and HOLLICK, Bull. Torr. Bot. Club, vol. 42, 1915, p. 10, figs. 1, 2 [34,759].
- Planera longifolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 189, pl. 27, figs. 4 [234], 5 [235].
 = *Fagopsis longifolia*.
- Planera longifolia myricaefolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 161, pl. 29, figs. 15 [1,725], 16 [1,726], 17 [1,727], 18 [1,728], 19 [1,729], 20 [1,730], 21 [1,731], 22 [1,732], 23 [1,733], 24 [1,734], 25 [1,735], 26 [1,736], 27 [1,737].
 = *Planera myricaefolia*.
- Polytrichum? florissanti* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 245, pl. 12, fig. 4 [34,760].
- Podocarpus eocenica?* UNGER, Lesquereux, Rept. U. S. Geol. and Geogr. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 140 [50,339].
 = *Planera myricaefolia*.
- Populus lesquereuxii* COCKERELL, Bull. Torr. Bot. Club, vol. 33, 1906, p. 307, substituted for *Populus heerii* SAPORTA—LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 157, pl. 30, figs. 1 [1,712], 2 [1,695], 3 [1,691], 7 [1,692], 8 [1,697]; pl. 31, fig. 11 [1,690].
- Populus micro-tremuloides* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 261, pl. 19, fig. 2 [34,738, 34,739, counterparts].

- Populus pyrifolia* KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 185, pl. 15, fig. 4 [33,687].
- Porana cockerelli* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 287, pl. 27, fig. 3.
- Porana similis* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1915, p. 288, pl. 27, figs. 1, 2 [34,736],—[3,4737].
- Porana tenuis* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 173 [50,344].—KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 286, pl. 27, figs. 4-6.
- Potamogeton geniculatus* AL. BRAUN. LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8, (Cret. and Tert. Fl.), 1883, p. 142 [.].
- Potamogeton? verticillatus* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 142, pl. 23, fig. 5 [1,626].
- Pterocarya americana* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 290, pl. 58, fig. 3 [476].
- Quercus scudderi* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 265, pl. 21, fig. 3 [34,758].
- Rhamnus ellipticus* KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 183, pl. 15, fig. 3 [33,688].
= *Rhamnus kirchneri*.
- Rhus acuminata* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 194, pl. 42, figs. 14 [1874], 15 [1871], 16 [1872].
- Rhus cassioides* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 193, pl. 41, fig. 11 [1887].
- Rhus hilliae* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 194, pl. 41, figs. 13 [1,892], 14 [1,890], 15 [1,891].
- Rhus rosaefolia* (LESQUEREUX) LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 293, pl. 42, figs. 7 [358], 8 [359], 9 [360].
- Rhus rotundifolia* KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 184, pl. 12, fig. 2 [33,676].
= *Hydrangea? florissantia*.
- Rhus subrhomboidalis* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 195, pl. 41, figs. 16 [1,882], 17 [1,883].
- Rhus trifolioides* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 196 [50,325].—KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 279.
- Rhus vexans* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 195, pl. 41, fig. 20 [1,889].
= *Schmalzia vexans*.
- Rosa hilliae* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 199, pl. 40, fig. 17 [1,912].
- Rosa? inquirenda* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 273, pl. 17, fig. 1 [34,741].
- Rosa scudderi* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1913, p. 272, pl. 22, fig. 4 [34,765].
- Salix amygdalaeifolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 156, pl. 31, fig. 2 [1,682].
- Salix*, species KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 260, pl. 13, figs. 4, 5 [33,744, 33,745].
- Salvinia alleni* (LESQUEREUX) LESQUEREUX, see *Tmesipteris alleni*.
- Salvinia cyclophylla* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 64, pl. 8, fig. 10 [90].
= *Phyllites cyclophyllus* (LESQUEREUX) Hollick.
- Sapindus augustifolius* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 265, pl. 49, figs. 3 [390], 4 [391], 6 [390]; vol. 8 (Cret. and Tert. Fl.), 1883, p. 181, pl. 37, figs. 3 [1,841], 6 [1,839]; pl. 39, fig. 12 [1,840].

- Sapindus lancifolius* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 182, pl. 32, fig. 3 [1,851], 5 [1,852].
- Sapindus stellariaeformis* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 264, pl. 49, fig. 1 [389].
- Sequoia affinis* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 75, pl. 7, figs. 1 [87], 2 [88].
- Sphenopteris guyottii* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 137, pl. 21, figs. 6 [1,613], 7 [1,614].
= *Phegopteris guyottii* (LESQUEREUX) Cockerell.
- Staphylia acuminata* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 267, pl. 48, figs. 4 [387], 5 [388].
- Sterculia engleri* KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 180, pl. 14, fig. 3 [33,684].
- Typha lesquereuxii* COCKERELL, Bull. Torr. Bot. Club, vol. 33, 1906, p. 307. Substituted for *Typha lattissima* Al. Braun.—LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 141, pl. 23, fig. 4 [1,569]. (Type from Uinta County, Wyoming, now Randolph County, Utah; since found abundantly at Florissant.)
- Ulmus hillix* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 160, pl. 28, fig. 1 [1,740].
- Ulmus tenuinervis* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 7 (Tert. Fl.), 1878, p. 188, pl. 26, figs. 1 [231], 2 [232], 3 [233].
- Vitis hesperia* KNOWLTON, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 284, pl. 26, fig. 4 [33,723].
- Weinmannia integrifolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 178, pl. 42, figs. 8 [1,808], 9 [1,810], 10 [1,806], 11 [1,807], 12 [1,809], 13 [1,805].
= *Weinmannia haydenii*.
- Weinmannia obtusifolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 178, pl. 41, figs. 4 [1,814], 5 [1,817], 6 [1,815], 7 [1,813], 9 [1,818], 10 [1,819].
- Widdringtonia linguaeifolia* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 139, pl. 21, fig. 14 [58, 1,621].
= *Sabina linguaeifolia* (LESQUEREUX) Cockerell.
- Zanthoxylon spireaefolium* LESQUEREUX, Rept. U. S. Geol. Surv. Terr., vol. 8 (Cret. and Tert. Fl.), 1883, p. 196, pl. 40, figs. 1 [1,904], 2 [1,906], 3 [1,907].
= *Fagara spereaefolia*.
- Zizyphus obtusa* KIRCHNER, Trans. St. Louis Acad. Sci., vol. 8, 1898, p. 182, pl. 13, fig. 1 [33,679].

EXPLANATION OF PLATES.

NOTE.—The figures on plates 12 and 13 and 16 to 27 were made natural size, but by an unfortunate error they have been reduced about one-tenth. Plates 14 and 15 are reduced about one-half.

PLATE 12.

- FIG. 1. *Phegopteris guyottii* (Lesquereux) Cockerell.
2. *Plagiopodopsis scudderii* Britton and Hollick, $\times 3$.
3. *Pinus wheeleri* Cockerell.
4. *Polytrichum? florissanti*, new species $\times 3$.

PLATE 13.

- FIG. 1. *Muhlenbergia florissanti*, new species.
2, 3. *Muhlenbergia florissanti*, new species $\times 3$.
4, 5. *Salix*, species.

PLATE 14.

Sabina linguaeifolia (Lesquereux) Cockerell.

PLATE 15.

Juglans magnifica, new species.

PLATE 16.

FIG. 1. *Palaeopotamogeton florissanti*, new genus and species.

2. *Alnus*, species.

3. *Zizyphus obtusa* Kirchner.

4. *Populus*, species.

PLATE 17.

FIG. 1. *Rosa inquirenda*, new species.

2. *Juglans florissanti* Lesquereux.

3. *Palaeopotamogeton florissanti*, new genus and species.

4. *Juglans sepultus* Cockerell.

PLATE 18.

Populus crassa (Lesquereux) Cockerell.

PLATE 19.

FIG. 1. *Alnus praecordata* Cockerell.

2. *Populus micro-tremuloides*, new species.

3. *Betula deltooides*, new species.

4. *Dalbergia coloradensis*, new species.

PLATE 20.

FIGS. 1, 2. *Myrica drymeja* (Lesquereux) Knowlton. [Refigured from *Myrica acuminata* Unger. Lesquereux, Tertiary flora, 1878, p. 130, pl. 17, figs. 2, 3.

3, 4. *Myrica scottii* Lesquereux. [Refigured, *Myrica acuminata* Unger. Lesquereux, Tertiary flora, 1878, p. 130, pl. 17, figs. 1, 4].

5. *Fagopsis longifolia* (Lesquereux) Hollick.

PLATE 21.

FIG. 1. *Myrica coloradensis*, new species.

2. *Planera myricaefolia* (Lesquereux) Cockerell.

3. *Quercus scudderi*, new species.

4. *Crataegus*, species.

5. *Cytisus florissantianus* Lesquereux.

6. *Ilex microphylla* Lesquereux.

7. *Celastrinites elegans* Lesquereux.

PLATE 22.

FIGS. 1, 2. *Aristolochia williardiana*, new species.

3. *Fraxinus ungeri* Lesquereux.

4. *Rosa scudderi*, new species.

PLATE 23.

FIGS. 1, 2. *Fraxinus ungeri* Lesquereux.

3. *Cytisus florissantianus* Lesquereux.

4. *Vicia*, species.

PLATE 24.

- FIG. 1. *Cotinus fraterna* Lesquereux.
2. *Robinia brittoni* Cockerell.
3. *Dalbergia minuta*, new species.
4. *Cassia fischeri* Heer.
5. *Fraxinus libbeyi* Lesquereux.
6. *Celastrus lacoeci* Lesquereux.

PLATE 25.

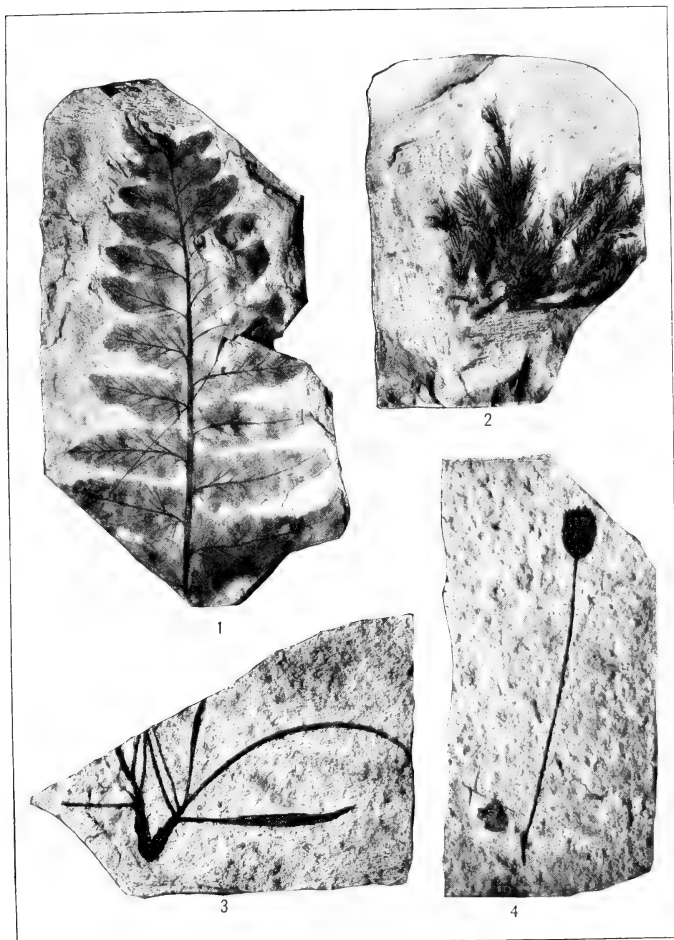
- FIGS. 1, 2. *Cercis parvifolia* Lesquereux.
3, 4. *Ilex pseudo-stenophylla* Lesquereux.
5. *Lomatia interrupta* Lesquereux.

PLATE 26.

- FIGS. 1, 2. *Lomatia hakeaefolia* Lesquereux.
3. *Ilex knightiaefolia* Lesquereux.
4. *Vitis hesperia*, new species.

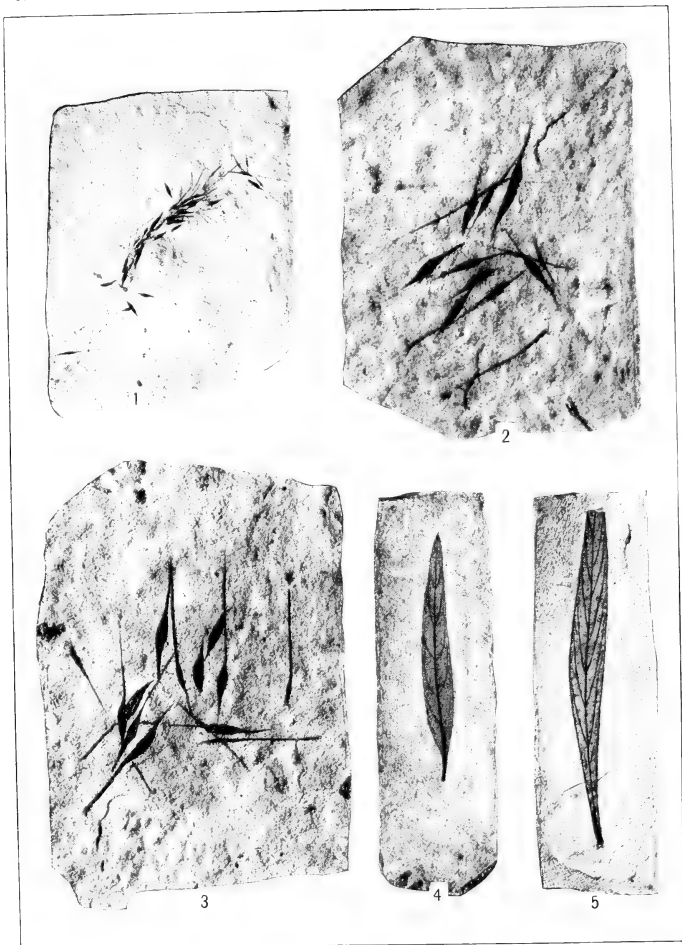
PLATE 27.

- FIGS. 1, 2. *Porana similis*, new species.
3. *Porana cockerelli*, new species.
4-6. *Porana tenuis* Lesquereux. (Fig. 6 is the type).
7. *Carpolithes macrophyllus* Cockerell.



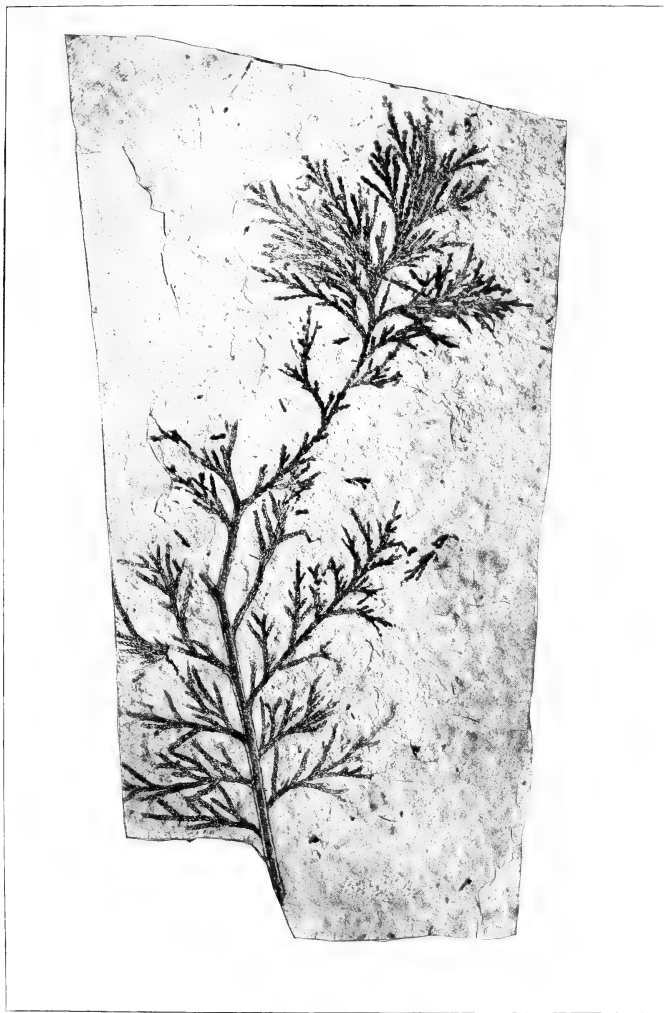
FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 295.



FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 295.



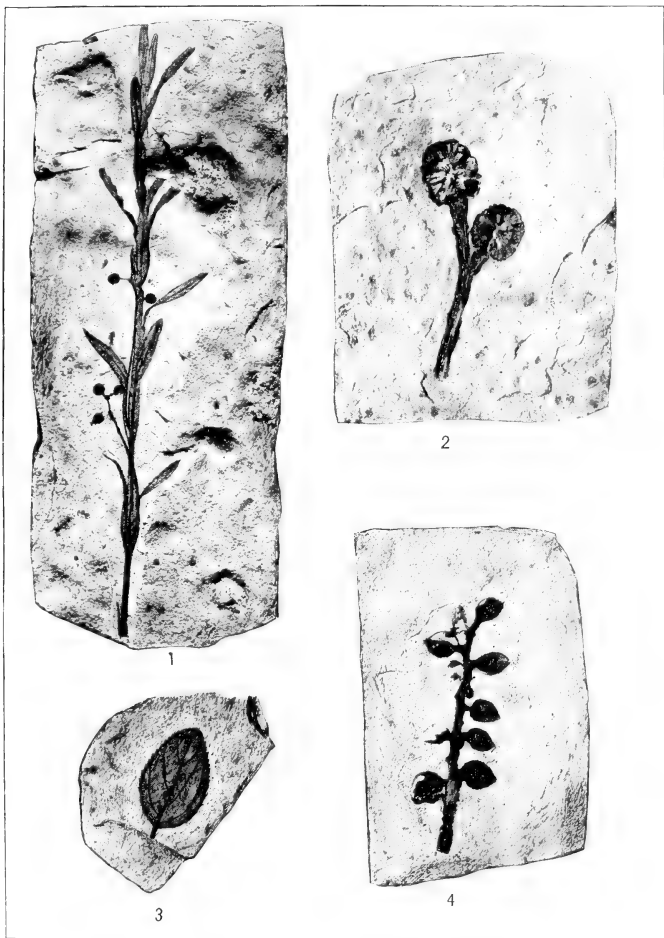
FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 296.



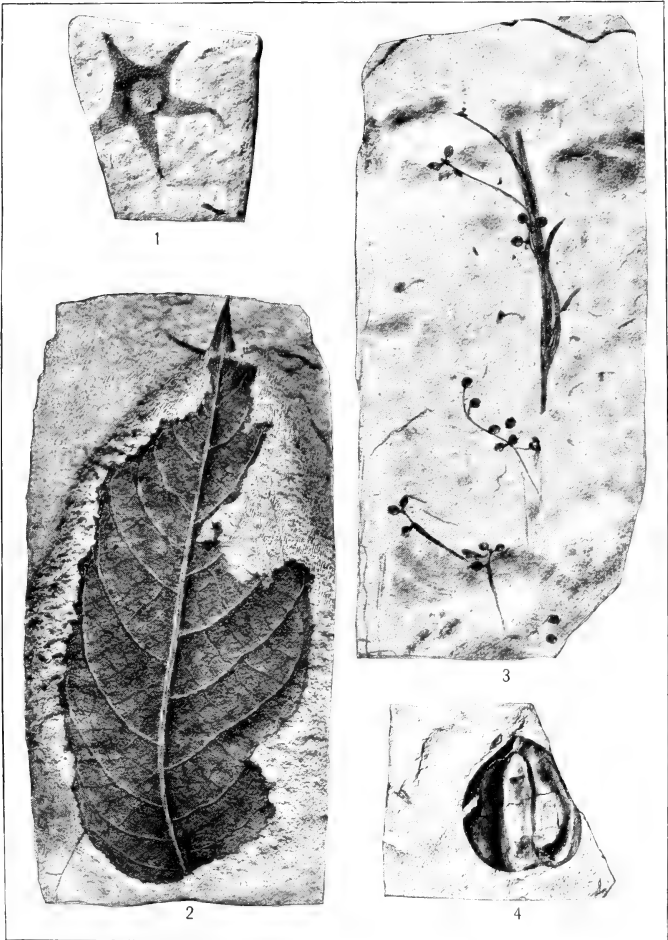
FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 296.



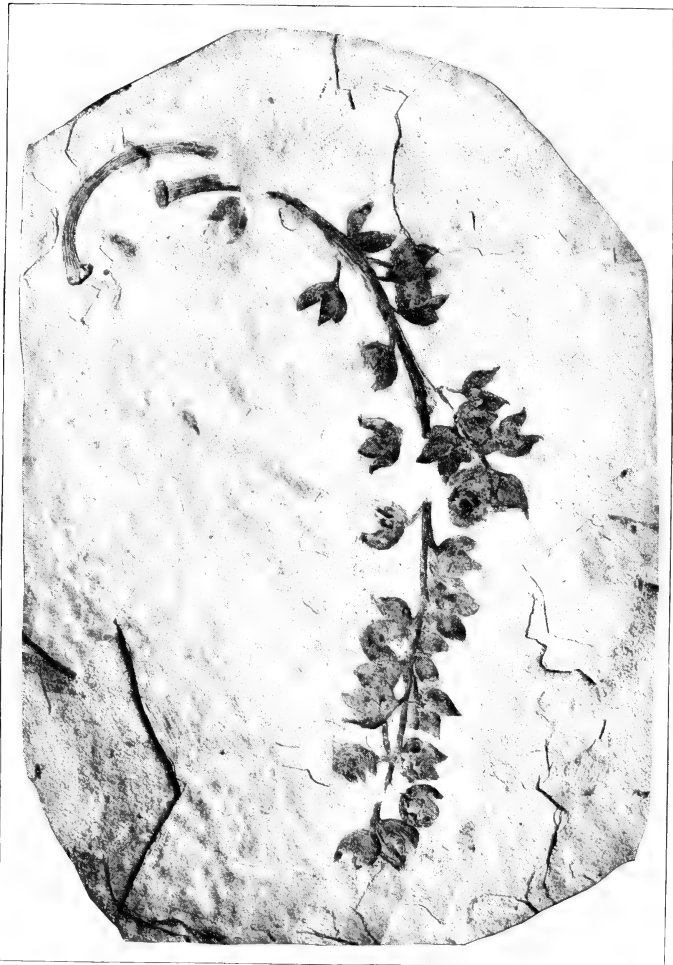
FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 296.



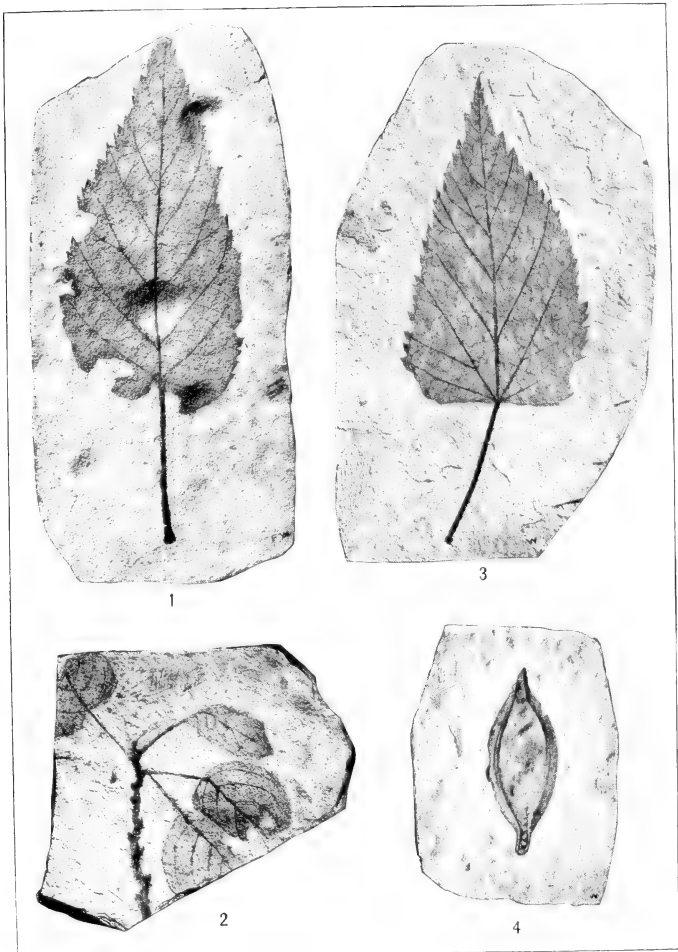
FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 296.



FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 296.



FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 296.



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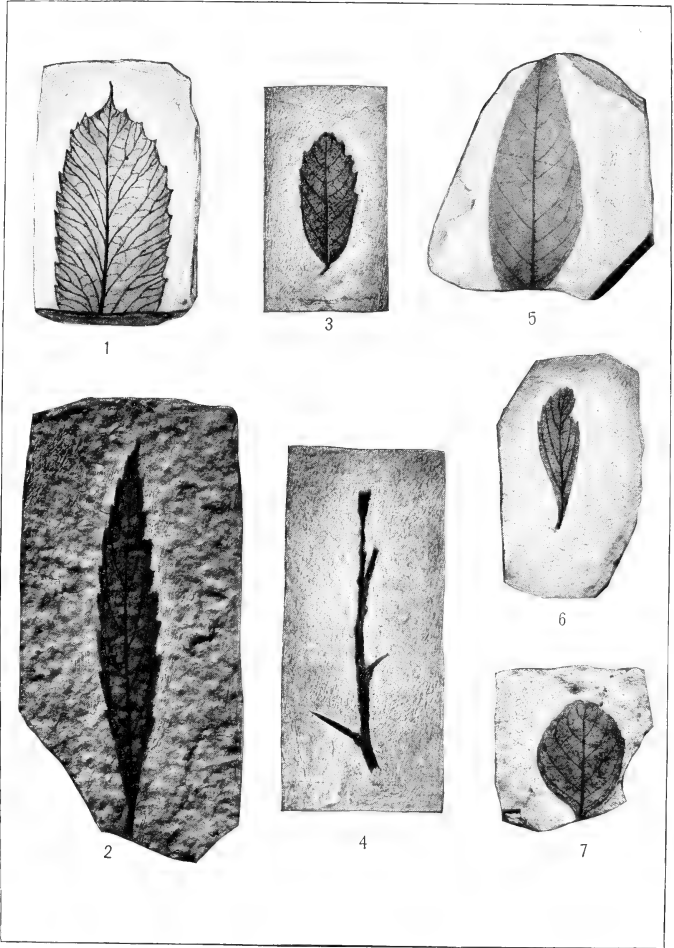
5



4

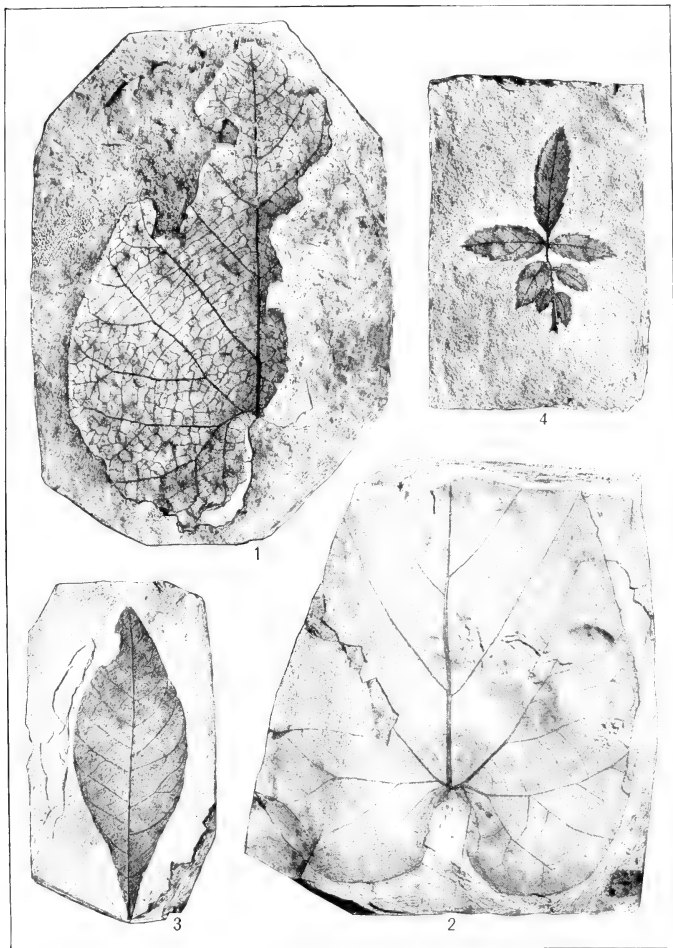
FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 296.



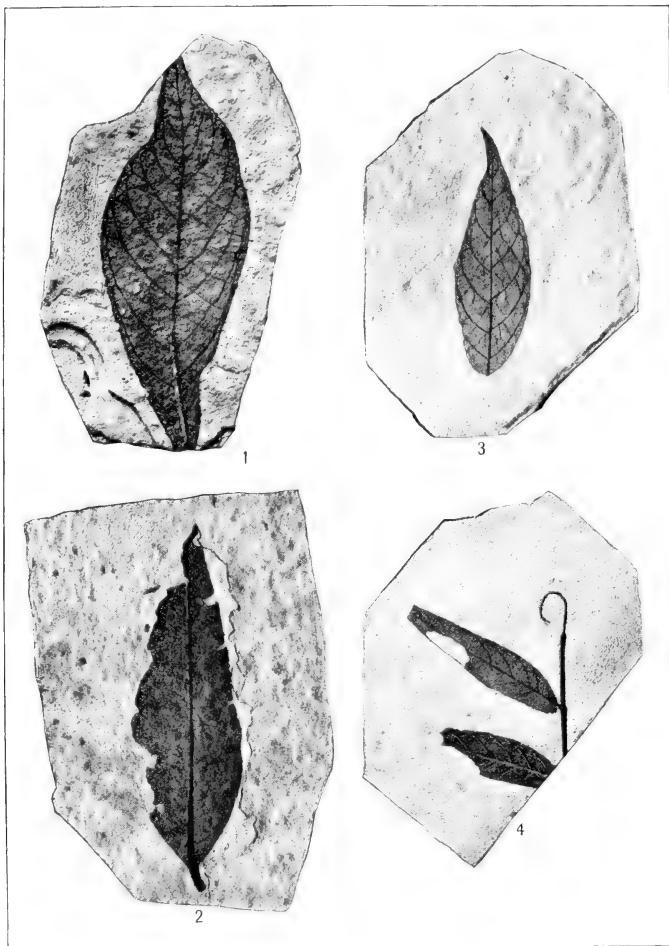
FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 296.



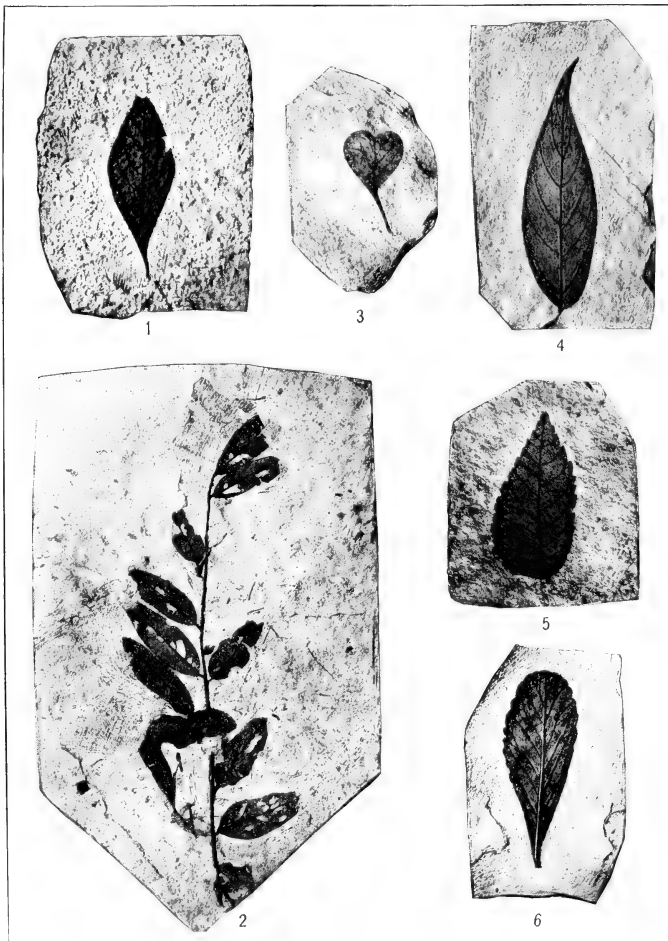
FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 296.



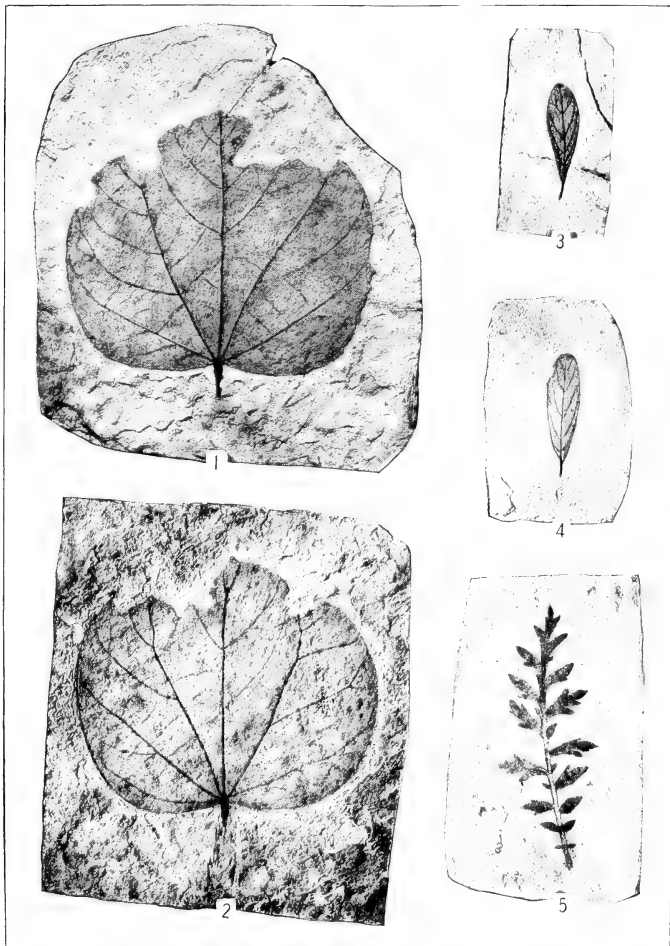
FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 296.



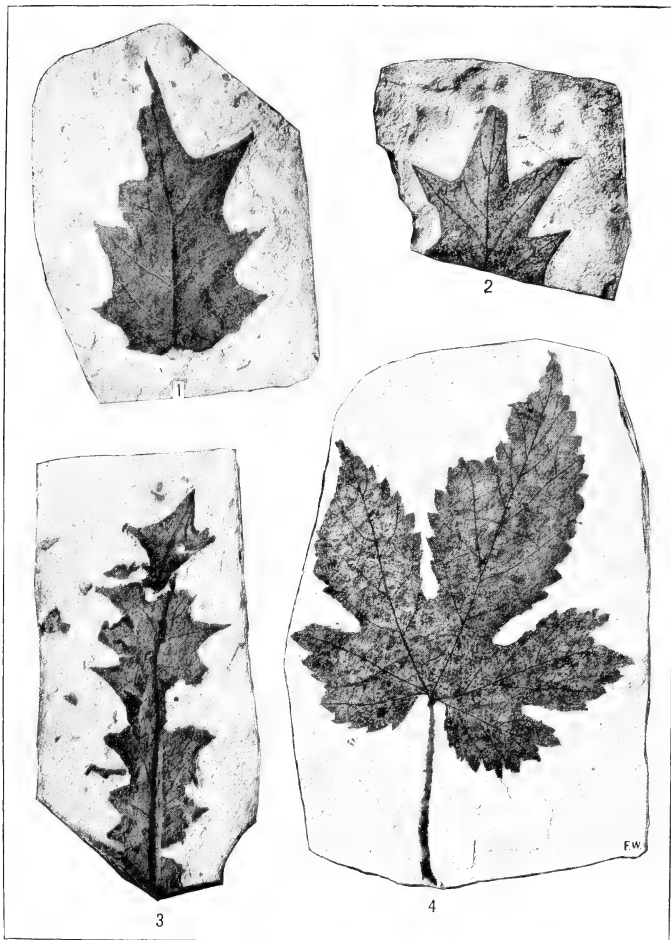
FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 297.



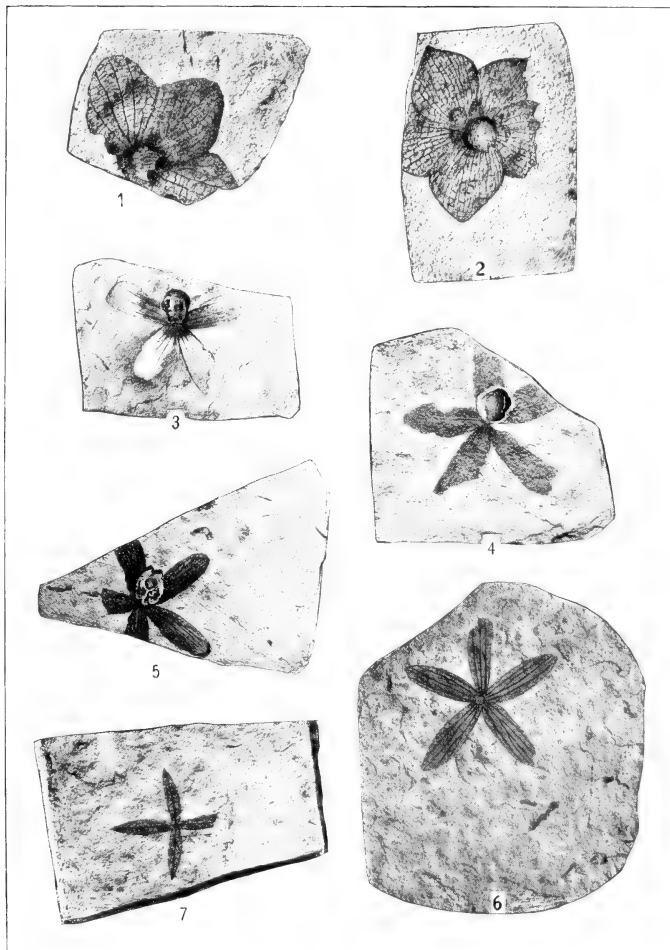
FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 297.



FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 297.



FOSSIL PLANTS FROM FLORISSANT, COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 297.

NEW GENERA AND SPECIES OF MUSCOID FLIES

BY

CHARLES H. T. TOWNSEND

Custodian of Muscoid Diptera, United States National Museum

No. 2152.—From the Proceedings of the United States National Museum,
Vol. 51, pages 299-323

Published October 28, 1916



Oct. 28, 1916

Washington
Government Printing Office
1916

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NEW GENERA AND SPECIES OF MUSCOID FLIES.

By CHARLES H. T. TOWNSEND,

Custodian of Muscoid Diptera, United States National Museum.

During the past year or two many new forms of muscoid flies have been described by the writer, and the manuscripts placed with various serial publications. A large part of the descriptions has already been published, but a considerable portion of them has not yet appeared. The present paper contains descriptions of the most noteworthy remaining new muscoid genera thus far studied in the United States National Museum collection. The forms here treated are from North and South America, Eurasia, and Malaysia, with one from Australia.

Family MUSCIDAE.

TRONGIA, new genus.

Genotype.—*Trongia viridis*, new species.

Seems to approach *Catapicephala*, differing in facialia thickly ciliate with ordinary bristles to a little above middle, and head but slightly broader than the thorax. Strong approximated proclinate ocellar bristles. One strong reclinate inner orbital bristle in male; inner verticals cruciate, outer almost as long as inner. Vertex about one-sixth head-width. Oral margin very prominent; the strong vibrissae practically on same, and not narrowing the facial plate. Third antennal joint six or seven times second, narrow, of even width, rounded apically. Arista plumose almost to tip. Claws slender, extremely long, almost twice last tarsal joint. Two strong median marginal macrochaetae on second segment; marginal row of strong ones on third and fourth segments. Hypopygium not prominent. Cubitus subangular, last section of fourth vein evenly bent in, apical cell open well before wingtip. Proboscis short and fleshy. Tegulae bare.

TRONGIA VIRIDIS, new species.

Length of body, 13.5 mm.; of wing, 11.75 mm. One male, Trong, Lower Siam, February, 1899 (W. L. Abbott).

All metallic green; face and front lightly golden or brassy, cheeks silvery; antennae, palpi and pulvilli pale fulvous, the third antennal

joint fuscous on apical portion; venter, thorax, pleurae and outside of femora silvery, the silvery of venter showing narrowly above on sides of anal segment; thoracic vittae not defined. Tibiae and tarsi black; hind femora also black, middle femora only slightly greenish. Wings broadly smoky on veins. Tegulae white.

Holotype.—No. 20026, U.S.N.M.

HYPOPYGIOPSIS, new genus.

Genotype.—*Hypopygiopsis splendens*, new species.

Allied to *Cynomya* and *Blepharicnema*, differing as follows: Male. Arista plumose nearly to tip. Cheeks broad and yellow. Front of male narrow, with one reclinate fronto-orbital. Ocellars present. Outer verticals absent. Flexor surface of femora and tibiae densely long hairy; hind femora enlarged and bowed. Body elongate. Hypopygium densely hairy, elongate but retracted, apparently very large, hinged from a small seventh segment, which is also pilose. Wings deeply infuscated, lighter area near base. Claws not extra long. Third vein bristled over halfway to small cross vein.

HYPOPYGIOPSIS SPLENDENS, new species.

Length of body, 14 to 17.5 mm.; of wing, 13 to 15 mm. Three males, Trong, Lower Siam (Dr. W. L. Abbott).

Face, cheeks, and parafrontals satiny yellow, light golden pollinose; vertex and ocellar area metallic green to greenish-black. Palpi and third antennal joint deep clear fulvous-yellow. Frontalia, first two antennal joints, and arista brownish-yellow, the former shading to brown posteriorly. Occiput cinereous, with gray pubescence; cheek beard deep yellow. Thorax, scutellum, and abdomen varying from metallic purplish or bluish-green to bright green, the thorax very thinly dusted with silvery, the abdomen showing no pollen; first abdominal segment black. Front and middle femora more or less metallic greenish, rest of legs brown to blackish. Wings subuniformly yellowish-smoky, with subbasal area of pale yellowish. Tegulae pale watery-smoky.

Holotype.—No. 20027, U.S.N.M.

Family CALIRRHOIDAE.

THERESIOPSIS, new genus.

Genotype.—*Theresiopsis ficorum*, new species.

Belongs in *Sardiocera* group. Differs from *Eutheresia* as follows: Female. Face rather longer, the peristomal profile only slightly curved upward in front. Facial carina only slightly developed. Third antennal joint about three times the second. Front narrower, the parafrontals posteriorly only a little over one-half width of fron-

talia. Fronto-orbitals set farther back and close to frontalia. Outer verticals well developed. Parafacials slightly broader below than above. Palpi slender and only faintly thickened at tip. No median marginal pair of macrochaetae on second abdominal segment.

THERESIOPSIS FICORUM, new species.

Length of body, 8 mm.; of wing, 7 mm. One female, Pekalongan, Java, given with query as reared from *Ficus*-borer, March, 1912 (K. W. Dammerman, No. 304).

Pale testaceous to brownish, with satiny-silver pollen. Antennae and palpi fulvorous. Frontalia brown. Head more or less pollinose over a fulvotestaceous ground color. Thorax pollinose, leaving three narrow vittae in middle before suture, and a heavy double-blotch vitta on each side; viewed from in front the posterior blotches are confluent along suture. Scutellum silvery on apical half, rich dark sepia on base. Abdomen rich dark sepia except oblique anterior corners of second segment, and irregular basal half of third and fourth segments, which are rufotestaceous and silvered. Legs brown to blackish. Wings subhyaline, but brown along first vein and basal half of third and fourth veins. Tegulae white.

Holotype.—No. 20028, U.S.N.M.

MESEMBRIOPHYTO, new genus.

Genotype.—*Mesembriophyto magellana*, new species.

Differs from *Arctophyto* as follows: Female. Head more elongate, the front more produced. Antennal and vibrissal axes equal. Vertex not over one-third head width. Frontalia not broader than one parafrontal. Antennae not separated, third joint scarcely longer than second, arista bare. Facial carina scarcely developed, epistoma narrower. Apical scutellar pair of bristles as long as the posterior of the two laterals, decussate at tips. No median marginal bristles on first abdominal segment, a weak median marginal pair on second; discal and marginal on last two segments, the discal of third in straggling row, but the marginal regular and rather strong. Apical cell closed in border a little before tip of wing; hind cross vein not so close to cubitus.

MESEMBRIOPHYTO MAGELLANA, new species.

Length of body, 7 mm.; of wing, 7.25 mm. One female, Sandy Point, Straits of Magellan (Acc. 21699 U. S. Fish Comm.).

Dark brownish, lightly cinereous pollinose. Frontalia, first two antennal joints, clypeus, facialia, and cheek-grooves brownish-rufous; palpi fulvous, third antennal joint and arista black, epistoma brownish. Parafrontals cinereous, parafacials and ocellar triangle dull golden pollinose; occiput and cheeks with grayish bloom. Pollen of mesoscutum and scutellum with a dull gold tinge; four

vittae, the inner pair nearly as heavy as the outer. Abdomen with silvery-gray pollen, most distinct on the broad bases of the two intermediate segments, the hind borders of first three segments with brownish-golden tinge. Legs brownish, the tibiae and tips of femora rufofulvous, the tarsi dark brown. Wings clear. Tegulae nearly white.

Holotype.—No. 20029, U.S.N.M.

This is the specimen mentioned by Doctor Williston¹ in his report on Diptera collected by the United States Bureau of Fisheries steamer *Albatross* in 1887-88, as a *Tachinid* which he could not locate in any genus known to him.

OREOPHYTO, new genus.

Genotype.—*Oreophyto ochreicornis*, new species.

Differs from *Arctophyto* as follows: Male. Vertex about as wide as length of third antennal joint. Two or three pairs of ocellars, the front pair strongest. All macrochaetae strong. Head much longer, parafacials broader; epistoma broader, more widely separating the vibrissal angles; vibrissae more removed from oral margin. Palpi stouter, not markedly thickened apically. Third antennal joint quite twice as long as second. Three sternopleurals; three postsuturals, sometimes a fourth one developed. Two strong lateral scutellars with some weaker ones between them, a strong decussate apical pair, two discal pairs. Last three abdominal segments with strong discals. Legs stouter, and whole body stouter. No long hairs on abdomen. Wings more pointed at tip, the apical cell ending much farther before same. Cubitus forming a right angle, usually with stump, farther removed from hind margin of wing.

OREOPHYTO OCHREICORNIS, new species.

Length of body, 12 to 14 mm.; of wing, 9.5 to 10 mm. Four males; one Corvallis, Oregon, June 12; one Mount Angel, Oregon (F. Epper); two Oregon.

Black, thickly to thinly silvery. Frontalia black. Third antennal joint clear light orange or ochreous, the arista black. Palpi rufous, more or less blackish basally. Parafrontals and parafacials thickly silvery white. Thoracic dorsum and scutellum rather thinly pollinose, outer vittae very heavy, inner ones moderately heavy and more or less confluent with a median one. Abdomen rather thickly silvery all over, as seen with varying light incidence, the segments appearing more or less broadly black from above. Legs black. Wings grayish. Tegulae white.

Holotype.—No. 20030, U.S.N.M. (Corvallis).

¹ Proc. U. S. Nat. Mus., vol. 12, 1889, p. 203.

Genus MYOCEROPS Townsend.

Myocerops TOWNSEND, Ent. News, vol. 27, 1916, p. 178.

Genotype.—*Musca carinifrons* Fallen, 1816, Vet. Acad. Handl. for 1816, p. 243.

Differs from *Phorostoma* as follows: Male and female. Form more narrowed. Proboscis and palpi more slender. Head more elongate, the parafacials proportionately broader. Facial depression not so broad, the vibrissae nearer to oral margin. Front of female much wider, the vertex much exceeding one-third head width. Cheeks wider and longer. Three sternopleurals. Abdominal macrochaetae not so strong; median marginal pair of first segment long in male, vestigial in female. Wings narrower, apical cell less widely open.

Genus SUMICHRASTIA Townsend.

Sumichrastia TOWNSEND, Ent. News, vol. 27, 1916, p. 178.

Genotype.—*Hystriochodezia aurea* Giglio-Tos, 1893, Boll. Mus. Zool. Anat. comp. Univ. Torino, vol. 8, p. 2; and 1894, Ditt. Mess., pt. 3, p. 59.

Differs from *Eudexia* as follows: Female. Abdomen broad-oval, wider than thorax, thickly clothed with long golden-fulvous hair especially conspicuous on last two segments; macrochaetae heavy and spinelike; first segment with only a lateral bunch; second with thickly placed marginal row doubled at sides, and median discal triangle of closely placed ones; third segment with about posterior half covered with three irregular rows; anal with a discal pair or so, sometimes wanting, and marginal ones among the pile. Venter quite thickly set with black spines, except a broad area at base on each side. Coxae thickly set with fulvous hair and bristles, mixed with black bristles; the fulvous bristles predominating on anterior pair. Scutellum with black spines. Peristomal bristles nearly all rufo-fulvous, two or three of the anterior frontals same color. Palpi quite as long as clypeus, very narrow, a little widened on apical third, with long fulvous hairs on apical half. Parafacials very broad, about four-fifths as wide as middle diameter of one eye. The pile of base of abdomen is shorter than the rest; there is some shorter pile on parafrontals, occiput, pleurae, posterior part of mesoscutum and on scutellum. Cheeks nearly as wide as eye height. Arista plumose, third antennal joint nearly twice second. Facial carina moderately prominent, vibrissae well above oral margin, vertex about two-sevenths head width; frontalia very broad, only slightly narrowed posteriorly.

Named in honor of François Sumichrast, the eminent Swiss naturalist, who did so much valuable pioneer work in Mexico in and after

Maximilian's time, and who has been immortalized by Lucien Biart in his fascinating "Adventures of a Young Naturalist."

One female, Real del Monte, Hidalgo, Mexico, 9,000 feet, September (H. T. Van Ostrand), donated by Mr. W. R. Walton. The holotype of *S. aurea* was collected by Sumichrast.

Family SARCOPHAGIDAE.

MELANOPHYTO, new genus.

Genotype.—*Melanophyto maerens*, new species.

Differs from *Brachicoma* as follows: Female. Vertex little over one-fourth head width. Frontalia broader than one parafrontal. Cheeks less than one-half eye-height. Lower breadth of clypeus nearly as great as length of facial plate, epistoma not projected between vibrissæ. Arista more than twice as long as third antennal joint, a little thickened on little more than basal third, short-plumose on thickened portion, the rest bare and hair-like. Antennal axis nearly equal to height of head. Four lateral scutellar pairs of bristles, the hindmost pair longest and widely separated; two discal pairs, no apical. Abdomen flattened, greatly broadened, subrounded in outline from above; first four segments short and of equal length, the first three of nearly equal width, the fifth still shorter. No median macrochaetae on first two segments. Wings long and rather broad; third vein bristled less than halfway to small cross vein; no costal spine. Small cross vein well before end of first vein.

MELANOPHYTO MAERENS, new species.

Length of body, 10 mm.; of wing, nearly 10 mm. One female, Mexico City, January 4, 1915 (R. H. Van Zwaluwenburg, No. Mx4).

Black, head soft deep black. Narrow irregular bar across parafrontals, area of parafacials inclosing the facio-orbital row of bristles, rather broad bar across cheeks deep soft gold. Frontalia, antennæ and palpi ordinary black. The soft black and gold vary with light incidence, the facial plate showing a gold coat in oblique lights. Occiput and hind border of cheeks of ordinary black, with thin coat of silvery. Five vittæ on thorax; the middle one on each side linear, the others heavy. Mesoscutum and scutellum silvery, the pollen in front of suture with marked golden tinge, a gold stripe from humeri to suture, two pale golden vittæ in middle before suture; the pollen thickening on margins of postsutural scutum into varying spots according to light incidence. Front half or so of pleuræ brownish-black, without pollen. Abdomen rather shining; silvery pollinose, most pronounced on bases and middle of segments by direct view, varying with lights. Wings faintly infusate in the region of the basal and small cross veins. Patagia cream-yellow. Tegulae white, margined with black; the front scale glassy, transparent.

Holotype.—No. 20031, U.S.N.M.

Family SALMACIIDAE.

Genus PILATEA Townsend.

Pilatea TOWNSEND, ENT. NEWS, vol. 27, 1916, p. 178.

Genotype.—*Masicera celer* Coquillett, 1897, Rev. Tach., p. 114 (footnote).

Differs from *Masicera* as follows: Male and female. Male vertex barely one-fourth of head width; that of female less than one-third of same. Male frontalia barely one-half as wide as one parafrontal; those of female somewhat less than same. Both sexes with two reclinate orbitals, no proclinate ones in male. Facial profile rather longer than frontal, parafacials long and of nearly even width. Arista thickened on basal half only. Two or three sternopleurals, the middle one weak when present. Discal macrochaetae on intermediate abdominal segments in both sexes.

Named in honor of Mr. G. R. Pilate.

Genus MASICEROPSIS Townsend.

Masiceropsis TOWNSEND, ENT. NEWS, vol. 27, 1916, p. 178.

Genotype.—*Masicera pauciseta* Coquillett, 1897, Rev. Tach., pp. 113-114.

Differs from *Masicera* as follows: Female. All macrochaetae weaker. Head nearly triangular in profile, the lower border very short. Frontal profile distinctly shorter than facial, frontal bristles not descending so low. Parafacials not so broad, of nearly even width, longer. Facialia ciliate over halfway up. Cheeks narrower, the eyes descending lower. Third antennal joint not over three times second; the latter short. The two middle sternopleurals very weak. Abdomen flattened and widened; median marginal pair of macrochaetae of first segment very weak. Cubitus very obtuse; hind and apical cross veins straight and not parallel with each other; the latter parallel with inner margin of wing.

MADREMYIA, new genus.

Genotype.—*Madremyia parva*, new species.

General form of head and its appendages much like that of *Chromatocera*, but evidently not nearly related to that genus. Differs as follows: All macrochaetae heavier. No proclinate orbitals, but some more or less reclinate bristles and long hairs outside frontal row. Face not so broad, widening but little from front. Frontals descending rather over halfway to cheek grooves, the parafacials otherwise bare. Arista sharply pointed, thickened to a little short of tip; second joint elongate, about or nearly half as long as the thickened

portion of third joint. Third antennal joint rather stout, of equal width, about five times as long as the very short second. Palpi moderately stout. Facialia sparsely ciliate to above lowest frontals. Eyes thickly hairy, more elongate dorsoventrally. Cheeks less than one-half of eye-height. Three sternopleurals, four postsuturals. Apical decussate scutellar pair erect. Median marginal pair on first abdominal segment; other segments with erect discals. Apical cell short-petiolate, ending far before wing tip; hind cross vein straight, nearly parallel with apical cross vein. Cubitus without stump, farther removed from hind margin; apical cross vein not so strongly bent in.

MADREMYIA PARVA, new species.

Length of body, 4.5 to 5.5 mm.; of wing, 3.5 to 4.5 mm. Two males. Head of Rio Piedras Verdes, Sierra Madre of Chihuahua, Mexico, about 7,300 feet, August 29, 1899 (Townsend); and Rio Tularosa, Sierra Blanca of New Mexico, about 6,400 feet, October 3, 1896 (Townsend).

Palpi, antennæ, and parafrontals black; last showing thinly silvery from behind; face and orbits more thickly silvery. Frontalia obscure rufous. Thorax and scutellum black, thinly silvery; four narrow vittae; scutellum more or less distinctly testaceous on margin. Abdomen brownish to black; the bases of last three segments distinctly silvery, the pollen spreading posteriorly in oblique lights. Legs blackish; tibiae tinged with brown. Wings clear. Tegulae watery-whitish.

Holotype.—No. 20032, U.S.N.M. (Sierra Madre of Chihuahua).

Genus CNEPHALOGONIA Townsend.

Cnephalogonia TOWNSEND, Ent. News, vol. 27, 1916, p. 178.

Genotype.—*Gonia distincta* H. E. Smith, 1915, Psyche, vol. 22, pp. 99–100.

Differs from *Salmacia* as follows: Female. Front not swollen, no more produced in profile than that of *Cnephalia*. No median marginal macrochaetae on first abdominal segment; no closely set marginal row on third segment. Parafacials below not over one-half greatest eye-width, widening above to nearly eye-width at base of antennae. Front marginal macrochaetae of parafacials sparse, few, and weak. Cheeks hardly one-third eye-height. Ground color of face, front, and cheeks yellow. Anterior part of front wider than lower part of face. Vertex narrowed to about one-half head-width. Abdomen like that of *Cnephalodopsis* and allied genera.

Genus DICHOCEROPSIS Townsend.

Dichoceropsis TOWNSEND, Ent. News, vol. 27, 1916, p. 178.

Genotype.—*Dichocera orientalis* Coquillett, 1897, Rev. Tach., p. 138.

Differs from *Dichocera* as follows: Female. Arista longer and tapered, second joint strongly elongate. Third antennal joint narrow. No discal macrochaetae present on intermediate abdominal segments, no median on first two segments. Cubitus without stump. Four postsuturals. No apical scutellars. The row of heavy macrochaetae on parafacials extending a little lower than eyes, the row on cheeks not so developed.

ATRACTOCEROPS, new genus.

Genotype.—*Atractocerops ceylanica*, new species.

Differs from *Epidexia* as follows: Female. Vertex about one-third head-width, frontalia a little wider than one parafrontal. Two inner reclinate orbitals. Antennae set much higher; cheeks much wider, about one-third of eye-height. Parafacials rather wide, somewhat sprung or bulged, of nearly even width or slightly widening below. Facial plate very long, narrow; facialia finely ciliate hardly halfway up. Second antennal joint not so elongate; the third four or five times as long and well narrowed. Three sternopleurals, four postsuturals. Apical decussate pair of scutellars nearly as strong as the three laterals. No discals on intermediate abdominal segments; no median on first two segments; discal and marginal rows on anal segment. Abdomen ovate. Tarsi short, claws short. Apical cell rather pointed at tip, closed in margin just before wing-tip; cubitus close to inner margin; apical cross vein nearly parallel with same; hind cross vein straight, slightly nearer to cubitus than to small cross vein.

ATRACTOCEROPS CEYLANICA, new species.

Length of body, 5.5 mm.; of wing, 5 mm. One female, Peradeniya, Ceylon, April 14, 1914 (A. Rutherford).

Palpi and antennae fulvo-rufous, the latter infusate apically. Frontalia dark rufous. Parafrontals and face silvery. Cheeks and occiput ashy. Thorax and scutellum silvery, the latter fulvous except base; four vittae, the outer ones heavier; postsutural scutum and narrow base of scutellum appearing blackish from behind. Abdomen dark brown; the last two segments quite widely yellowish-silvery pollinose on base, the second showing only faint line of pollen on incisure. Legs dark brown. Wings clear. Tegulae white.

Holotype.—No. 20033, U.S.N.M.

EPIDEXIOPSIS, new genus.

Genotype.—*Epidexiopsis orbitalis*, new species.

Differs from *Epidexia* as follows: Male. Vertex nearly one-third head-width, front of equal width, face widening gently from same. Frontalia narrower than one parafrontal. Cheeks narrower, the eyes descending nearly or quite as low as vibrissae. Two proclinate orbitals, two reclinate orbitals, frontals less developed posteriorly; parafrontals of nearly equal width. Palpi longer. Three sternopleurals, the middle one weak. Apical pair of scutellars quite strong, longer than discal pair. Marginal macrochaetae of abdomen not so long, the discal rather stronger than in *Epidexia*, all erect; the discal shorter than marginal except that this is reversed on anal segment. Tarsi shorter, delicate; claws very short. Apical cell closed in margin, ending nearer to wing-tip; hind cross vein not straight, almost in middle between small cross vein and cubitus. Small cross vein nearly opposite tip of auxiliary vein.

EPIDEXIOPSIS ORBITALIS, new species.

Length of body, 4.75 mm.; of wing, 3.5 mm. One male, Miami, Florida, October 28, 1908 (Townsend). TD 562.

Black, palpi pale yellowish, second antennal joint rufous at tip. Head silvery, the occiput ashy. Thorax and scutellum thinly silvery; two linear inner vittae, the outer ones of the semicolon type. Viewed from behind the postsutural mesoscutum appears black except the lateral margins and irregular broad hind border. Abdomen shining, the last three segments silvery-white pollinose on base, the silvery fasciae successively broadening slightly from second to anal segments. Hypopygium blackish. Femora and tibiae brownish. Wings clear. Tegulae white.

Holotype.—No. 20034, U.S.N.M.

MIAMIMYIA, new genus.

Genotype.—*Miamimyia cincta*, new species.

Differs from *Houghia* as follows: Male. Face hardly perceptibly widened from front, the vertex hardly one-third of head-width. Face much longer, the antennae set much higher. Frontalia much wider than one parafrontal. Three or four short but strong closely set proclinate orbitals on each side. Arista shorter than third antennal joint, porrect. Second antennal joint very short; the third six or seven times as long as second, much developed, reaching oral margin. Facial plate more than twice as long as wide, equal in width above and below. Facialia thickly ciliate more than halfway up. Palpi rather slender. Parafacials very narrow and elongate. Cheeks wider, the eyes not quite reaching the level of vibrissae below. Two

sternopleurals, three postsuturals. Apical cell ending almost in wing-tip; hind cross vein crooked and nearly in middle between small cross vein and cubitus. Tarsi rather tapered. First and third veins bristled same.

MIAMIMYIA CINCTA, new species.

Length of body, 5 mm.; of wing, 4 mm. One male, Miami, Florida, November 12, 1908 (Townsend). TD869.

Palpi and first two antennal joints fulvous; frontalia dark rufous. Third antennal joint blackish, more or less fulvous on lower border and base. Face, cheeks, parafrontals and orbits silvery, occiput ashy. Thorax blackish, rather thinly silvery, two narrow inner vittae, outer vittae heavy; postsutural dorsum appearing black from rear view, but showing lateral margin and broad hind border silvery-white. Scutellum faintly pollinose, but appearing blackish from behind. Abdomen dark brownish, the anal segment rufous; the narrow bases of intermediate segments silvery-white, the same silvery showing less distinctly on base of anal segment. Legs fulvous; tibiae rufous-brown, tarsi black. Wings nearly clear, the basal and costal cells lightly infuscate. Hind scale of tegulae smoky-translucent; front scale white.

Holotype.—No. 20035, U.S.N.M.

Family MINTHOIDAE.

ZOSTEROPSIS, new genus.

Genotype.—*Zosteropsis rutherfordi*, new species.

Differs from *Zosteromyia* as follows, Male. Vertex and posterior half of front about one-sixth of head-width, the anterior half of front slightly widening from same. Frontalia much narrowed posteriorly, averaging a little wider than one parafrontal. Ocellars hair-like and vestigial; all the other bristles of front and vertex strong, not hair-like. Outer verticals not developed. Four reclinate orbitals on each side in line with frontals and occupying about posterior three-fourths of front; frontals descending about to end of second antennal joint. Third antennal joint narrower. Facial plate and facialia normal, not smoothed; epistoma emarginate. Head more flattened, occiput not bulged below; eyes normal, their posterior margin not beveled off on lower extent. Three sternopleurals, the middle one weak. Middle one of the three lateral scutellars strong, a decussate apical pair of hair-like bristles. No long hairs on abdomen, macrochaetae not so long; no discals on intermediate segments, median marginal of first segment vestigial. Legs not so elongate, more slender. Wings not bulged on costal cells; apical cell very narrowly open to nearly closed well before tip, apical cross vein deeply bowed

in; cubitus at right angle, farther from margin; hind cross vein at about 45° to inner margin, halfway between small cross vein and cubitus. Tegulae not so enlarged.

ZOSTEROPSIS RUTHERFORDI, new species.

Length of body, 6 mm.; of wing, 4.75 mm. Two males, Peradeniya, Ceylon, June 16, 1913, and July 7, 1914 (A. Rutherford).

Black, rather shining. Face, cheeks, and orbits silvery; parafrontals, thorax, and scutellum thinly silvery; four thoracic vittae moderately narrow and nearly equal, the pollen inclosed by the two of each side with a dull golden tinge. Last three abdominal segments rather broadly but thinly silvery on base. Wings deeply smoky except area behind fifth vein, that outside hind and apical cross veins, and the distal half of apical cell. Tegulae dilute smoky, the outer portion of front scale whitish.

Holotype.—No. 20036, U.S.N.M. (July 7).

Named in honor of Mr. A. Rutherford.

MUSCINOTHELAIRA, new genus.

Genotype.—*Muscinothelaira lutzii*, new species.

Differs from *Euthelaira* as follows: Female. Form *Muscina*-like. Eyes only thinly hairy. Head more flattened, the front not prominent in profile. Front and face a little wider in proportion to eye-surface, cheeks a little wider. Palpi bowed, well thickened apically. Second antennal joint rather short; third joint about four times second. Arista sparsely pubescent. Only two sternopleurals. Three lateral scutellars; only a pair of divergent hairs on apex of scutellum. Abdomen short-oval, about same length and width as thorax. Abdominal macrochaetae not so strong. Legs shorter, tarsi delicate, the front tarsi not dilated; claws short. Wings broad, extending far behind tip of abdomen, slightly bulged on costal border.

MUSCINOTHELAIRA LUTZII, new species.

Length of body, 7 mm.; of wing, 7.5 mm. One female, Sao Paulo, Brazil (Dr. A. Lutz).

Parafrontals, face, and cheeks silvery-white pollinose, with a watery uster. Frontalia brown. First two antennal joints dark rufous; palpi rufous. Third antennal joint and vertex black. Thorax and scutellum black, thinly silvery; four vittae nearly equal, the outer ones broadly interrupted. Abdomen brown to dark brown or blackish; very thinly silvery, showing most on sides, faintly on incisures, but apparent in oblique lights elsewhere. Legs dark brown; tibiae brown. Wings nearly clear, a deeply infuscate area extending from small cross vein and tip of auxiliary vein to tip of second vein. Tegulae smoky-translucent, the outer edge of front scale opaque.

Holotype.—No. 20037, U.S.N.M.

Named in honor of Dr. Adolpho Lutz.

ARGYROTHELAIRA, new genus.

Genotype.—*Argyrothelaira froggattii*, new species.

Differs from *Thelaira* as follows: Female. Face and front much narrower, the face of same width as anterior part of front, the front gradually narrowing behind, the vertex hardly over one-fifth head-width. Antennae longer, reaching oral margin, third joint fully three times the second. Arista long, hair-like, bare. Parafacials very narrowed below. Two inner reclinate orbitals, posterior proclinate orbital set much farther forward, no ocellars. Outer vertical developed. Frontalia narrow, not as wide as one parafrontal. Palpi much thickened apically. Four postsuturals. Three strong lateral scutellars. No discals on intermediate abdominal segments. Wings not so broad, cubitus nearer to margin. Third vein bristly only at base, first vein bare. Seems allied to *Euthelaira*, from which it differs in the bare facialia, eyes only very thinly hairy, and other points.

ARGYROTHELAIRA FROGGATTII, new species.

Length of body, 7.5 mm.; of wing, 6 mm. One female, Solomon Islands, July-August, 1909 (W. W. Froggatt). Labeled "*Masicera immersa* Walker," by Coquillett, which species was described from Makassar, Celebes. The description does not apply.

Head black; face, cheeks, parafrontals, orbits, and occiput silvery white; palpi, antennae and frontalia black. Thorax and scutellum black, pleurae and humeri silvery white, the dorsum thinly pollinose leaving a pair of linear vittae. Abdomen black; the sides of intermediate segments broadly burnished silver-white not meeting on median line, the sides of anal segment narrowly silvered. Legs black. Wings smoky on costal border, diminishing along veins. Tegulae nearly white.

Holotype.—No. 20038, U.S.N.M.

Named in honor of Prof. W. W. Froggatt.

MEGISTOGASTROPSIS Townsend.

Megistogastropsis TOWNSEND, Ent. News, vol. 27, 1916, p. 178.

Genotype.—*Megistogaster wallacei*, Brauer and Bergenstamm, 1889, *Musc. Schiz.*, pt. 1, p. 127.

This is Brauer and Bergenstamm's sense of *Megistogaster*. For characters, see Brauer and Bergenstamm.² The authors accredit the species to Doleschall, but I can not find that he described it. It was probably a manuscript name of his.

The type of *Megistogaster* is *fuscipennis* Macquart, which Brauer states is identical with *petiolata* Wiedemann. The genus is thus a synonym of *Cordyligaster*.

¹ *Musc. Schiz.*, pt. 1, p. 127, pl. 8, fig. 210; and pt. 3, p. 129.

Family LARVAEVORIDAE.

DEJEANIOPALPUS, new genus.

Genotype.—*Dejeaniopalpus texensis*, new species.

Differs from *Leskiopalpus* as follows: Female. Palpi elongate, subcylindrical, evenly narrowed on apical three-fifths, fully as long as facial plate; when retracted extending almost the length of third antennal joint beyond epistoma. Proboscis slender, the part below geniculation rather longer than head height. Vertex nearly one-third head width. Frontalia wider than posterior part of one parafrontal, about as wide as anterior part. Ocellars quite strong. First vein bristled completely, third bristled to or beyond small cross vein. Differs from *Leskiomima* principally in the long palpi; from *Spathipalpus* by arista short-plumose and only slightly thickened on basal third, the antennae inserted about on eye-middle; from *Genea* by cylindrical palpi, antennae inserted on eye-middle and arista plumose.

DEJEANIOPALPUS TEXENSIS, new species.

Length of body, 6.5 mm.; of wing, 5.25 mm. One female, Texas.

Light fulvous to pale yellowish, including frontalia, antennae, palpi, proboscis and legs, the tarsi brown to blackish, the middle and front metatarsi yellowish. Parafrontals, face, cheeks and occiput thinly silvery. Third antennal joint faintly infuscate on edge. Pleurae silvery. Mesoscutum blackish in ground color, brassy pollinose, apparently with usual blackish vittae. Scutellum brassy pollinose. Abdomen without pollen, except very faint indications at the incisures. Wings grayish, with only the faintest infuscation; veins yellowish. Tegulae pale yellowish.

Holotype.—No. 20039, U.S.N.M.

GYMNOERYCIA, new genus.

Genotype.—*Gymnoerycia rubra*, new species.

Differs from *Erycia* as follows: Female. Vertex less than one-fourth head width, the front and face widening quite evenly from same; the face inferiorly rather more than twice as wide as vertex. Facial depression not so broad, the facialia not so flattened. Only one reclinate orbital; outer vertical but little longer than orbital fringe. Frontalia a little narrower than one parafrontal. Facialia ciliate halfway up or more. Parafacials narrow, the head shorter. Third antennal joint fully three times second. Apical decussate pair of scutellar bristles fine, erect. Median marginal pair of first abdominal segment vestigial, that of second rather weak. Larvipositor in the form of a short spoonlike lobe, chitinous, broad at base and narrowing apically. Hind tibiae rather closely pectinate, with one longer bristle. Apical cell ending a little nearer to wing tip, cubitus nearer to hind margin, apical cross vein bowed in.

GYMNOERYCIA RUBRA, new species.

Length of body, 6.75 mm.; of wing, 5 mm. One female, Miami, Florida, Nov. 16, 1908 (Mrs. C. H. T. Townsend). TD 957.

Whole head dull golden pollinose except the ashy occiput; the facial depression a little paler than the rest, the cheeks tinged with silvery in some lights; frontalia brown, antennae black, palpi fulvofufous. Thorax black, rather thickly pollinose, the pollen of scutum brassy; four nearly equal black vittae. Scutellum rufous except the blackish base, brassy pollinose. Abdomen rufous, median vitta and tip black; silvery to pale golden pollinose, the pollen most conspicuous on narrow bases of intermediate segments and most of anal segment; larvipositor rufous. Legs brown, tarsi blackish. Wings clear. Hind scale of tegulae watery, with faint infuscation; front scale whitish.

Holotype.—No. 20040, U.S.N.M.

STURMIOPSIS, new genus.

Genotype.—*Sturmiopsis inferens*, new species.

Differs from *Sturmia* as follows: Male and female. Parafacials with minute bristles, their profile full or slightly bulged. Facialia quite strongly ciliate not quite halfway up. Frontalia of female little over half as wide as one parafrontal; those of male narrower than one parafrontal. Eyes rather thickly hairy in male, thinly so in female. Antennae inserted almost on eye-middle; frontal profile slightly more produced. Normally only two sternopleurals; some times two additional very weak ones. Only two lateral scutellars, but the long decussate apical pair with a pair of suberect shorter ones between them. Both sexes with no median macrochaetae on first two segments; no discals on any of the segments; only marginal row on third and anal segments. Hind tibiae ciliate, without longer bristle in either sex. Cubitus much approximated to hind margin of wing, at right to slightly acute angle; the apical cross vein strongly bent in. Hind cross vein more removed from cubitus.

STURMIOPSIS INFERENS, new species.

Length of body, 7 to 8.5 mm.; of wing, 5 to 7 mm. One male and one female, Buitenzorg, Java, Sept., 1913, reared from *Sesamia inferens* (K. W. Dammerman, No. 312).

Dark brown to blackish. Palpi, first two antennal joints and tip of scutellum rufous. Face, cheeks, and orbits silvery pollinose; the parafrontals, thorax, and scutellum rather less thickly so; two linear inner and two heavy outer vittae. Last three abdominal segments broadly but very thinly silvery pollinose. Wings nearly clear. Tegulae white, the hind scale somewhat pearly.

Holotype.—No. 20041, U.S.N.M., female.

XANTHOZONOPSIS, new genus.

Genotype.—*Xanthozonopsis vestita*, new species.

Differs from *Xanthozona* as follows: Male. No proclinate orbitals. Vertex much less than one-third head-width. Second antennal joint not so long; second aristal joint not elongate. Anal segment short, thickly covered with fine appressed vestiture except the tip. No discal macrochaetae on third abdominal segment, none on fourth except fine marginal ones closely set amongst vestiture, four median marginal on second segment, marginal row of heavy spines on third. Abdomen not swollen, not so narrowed apically. Body proportionately broader and head proportionately narrower.

XANTHOZONOPSIS VESTITA, new species.

Length of body, 14.5 mm.; of wing, 12.5 mm. One male, Sapucay, Paraguay, August 25, 1901 (W. T. Foster).

Head yellowish; face and cheeks silvery, a very faint golden tinge to the pollen of cheeks and parafacials; parafrontals shining blackish, with a very thin coat of pollen. Frontalia brown, rufous anteriorly. Antennae blackish. Thorax blackish, rather thinly pollinose; inner vittae narrow, outer ones rather heavy. Scutellum and first abdominal segment rich blackish-brown; the anal segment except tip, and the posterior half of third segment, of same color; rest of abdomen deep yellow. The brown of third segment is polished, and its front border is angular on median line. Venter concolorous with tergum. Vestiture of anal segment black. Legs blackish, the tibiae brownish. Wings lightly infuscate, a little darker at base; four to six closely-placed bristles at base of third vein. Tegulae smoky-blackish.

Holotype.—No. 20042, U.S.N.M.

PSEUDOSERVILLIA Townsend.

Pseudoservillia TOWNSEND, Ent. News, vol. 27, 1916, p. 178.

Genotype.—*Echinomyia flavopilosa* Bigot, 1888, Ann. Soc. Ent. France (6), vol. 8, p. 80.

Differs from *Servillia* as follows: Two facio-orbital bristles present. Head, thorax, abdomen, and legs densely yellow-pilose; the venter, base, and tip of abdomen black-pilose in male.

Brauer states that this is apparently same as *Ech. rufoanalis* Macquart, but such is very doubtful. The two species are perhaps congeneric.

SERVILLIOPSIS, new genus.

Genotype.—*Servilliopsis buccata*, new species.

Differs from *Servillia* as follows: Vertex less than one-third head-width. Front, parafacials and cheeks without the very long hairs,

but with the normal pubescence. Clypeus broadening below, scarcely marked off from facialia; epistoma broad, strongly produced between vibrissæ; latter rather more removed from oral margin. Cheeks less than eye-height, parafacials not as wide as clypeus. Two proclinate and one reclinate orbitals. Proboscis and palpi longer. All macrochaetae strong, those of scutellum and abdomen spinelike. Pile of under parts of body and legs not long or thick, that of abdominal tergum both long and thick. Three to four sternopleurals; four postsuturals. Bunch of erect spines on scutellum. Anal segment narrowed posteriorly, but distinctly though faintly emarginate. Ventral plates with spine bunches. A median discal pair of spines on anal segment, the margin with only a few black bristles among the pile. Front tarsi more distinctly widened.

SERVILLIOPSIS BUCCATA, new species.

Length of body, 15 mm.; of wing, 12.75 mm. One female, Tjibodas, Mount Gede, Java, 9,000 feet (Bryant and Palmer).

Head light golden pollinose all over; frontalia and antennae dark brown or blackish. Palpi yellow. Hairs of front mostly black; those of parafacials, cheeks, and occiput yellow. Thorax blackish, golden pollinose, with golden pile; scutellum rufofulvous, with same pile. Abdomen blackish; the anterior borders of segments yellowish, especially sides; the yellowish parts with golden pollen, the pile reddish-gold. Venter more deeply blackish, the incisures narrowly golden. Legs rufous; the femora black. Wings faintly smoky throughout; tegulae golden-smoky.

Holotype.—No. 20043, U.S.N.M.

Echinomyia rufoanalis Macquart¹ is very distinct from this form. So also is *Tachina fulva* Walker.² See Brauer.³

Family EXORISTIDAE.

Genus SERICOTACHINA Townsend.

Sericotachina TOWNSEND, Ent. News, vol. 27, 1916, p. 178.

Genotype.—*Paratachina vulpecula* Wulp, 1896, Tijdschr. Ent., vol. 39, p. 106, pl. 2, figs. 14–16.

Differs from *Paratachina* principally as follows: Palpi more elongate. Proboscis shorter and stouter, not as long as head-height. Second antennal joint over twice as long as third joint, very slender on basal portion. Head, thorax, scutellum, and base of abdomen thickly clothed with short yellow pile; third and fourth segments with short black pile. Macrochaetae very weak.

¹ Dipt. Ex., Suppl. 4.

² Dipt. Saund.

³ Sitz. Ak. Wiss., Wien., vol. 107, p. 496.

UGIMEIGENIA, new genus.

Genotype.—*Ugimeigenia elzneri*, new species.

Differs from *Macromeigenia* as follows: Male. Vertex distinctly less than one-fourth head-width. Front not nearly so produced in profile; the parafrontals and parafacials not so wide, the latter about the width of clypeus. Frontalia practically same width as one parafrontal, narrowing posteriorly at same rate. Only one reclinate orbital; ocellars very small; hairs of parafrontals microscopic and not descending below frontals. Second antennal joint not so elongate, the third joint about four times as long as second. Eyes bare. Three to four sternopleurals. Apical decussate pair of scutellars very short, weak. No median macrochaetae on first two abdominal segments; no discal on either third or anal segments. Hind tibiae thickly ciliate. Hind cross vein nearly straight, not quite parallel with main course of apical cross vein. Abdomen less bristly, with only short appressed hairs besides the marginal bristles of third and anal segments.

UGIMEIGENIA ELZNERI, new species.

Length of body, 13 mm.; of wing, 10 mm. One male, Banks Island, off Cape York, Australia, 1910 (Elzner).

Head thickly deep golden pollinose, the occiput shading somewhat into silvery. Frontalia very dark velvet-brown. Palpi and first two antennal joints rufous, third joint and arista blackish. Thorax and scutellum rather thickly pale golden pollinose; four equally heavy dark-brown vittae, the two of each side closely approximated, the outer ones hardly interrupted and reaching nearly to scutellum, the inner ones beginning farther in front and reaching only halfway behind suture. Broad base of scutellum dark brown, the pollinose portion forming a perfect and well-defined crescent. Abdomen brown to dark brown, the rather narrow bases of last three segments pale golden pollinose. The ground color of bases of segments shows somewhat rufous. Legs blackish; the tibiae brown. Wings nearly clear; the basocostal portion rather broadly golden-smoky, following the veins more or less distinctly. Tegulae smoky-whitish, with narrow yellow margins; front scale appearing whiter than hind scale.

Holotype.—No. 20044, U.S.N.M.

Named in honor of Herr Elzner, the Malaysian collector.

EUCYRTOPHLOEBA, new genus.

Genotype.—*Eucyrtophloeoba rhois*, new species.

Differs from *Cyrtophloeoba* as follows: Male. Form rather more narrowed. Palpi considerably shorter than third antennal joint, somewhat enlarged apically. Antennae inserted almost on eye-middle, second joint quite short; third joint over two and a half

times second, broadened, strongly and evenly convex on upper edge. Arista slightly longer, thin on apical third or so. Eyes with longer hair, descending barely to bend of facialia. Front at vertex fully one-third to three-eighths head-width; less than half same anteriorly. Parafacialia narrowed below to about one-third their upper width. Facio-orbitals descending nearly as low as the eyes. Cheeks fully one-third eye-height, wider than long. Wings a little shorter. First vein bristled on over the proximal half, ending opposite small cross vein. Third vein bristled far beyond small cross vein, on fully or more than its proximal half. Apical cell very narrowly open, ending as far before tip as length of apical cross vein. Cubitus half-way between front and hind margins and only a little farther from tip, with short stump; apical cross vein rather evenly curved in. Posterior cross vein curved outward, its insertion a little distad of its origin; latter a little nearer to small cross vein than to cubitus. Fifth vein bare, its last section barely half as long as preceding section. Claws shorter than last tarsal joint. Hypopygium somewhat larger.

EUCYRTOPHLOEBA RHOIS, new species.

Length of body, 6.5 to 7 mm.; of wing, 4.75 to 5 mm. Two males, head of Rio Piedras Verdes, Sierra Madre of Chihuahua, Mexico, about 7,300 feet, July 15 and 19, 1899, both on flowers of *Rhus cismontana* (Townsend).

Palpi and first two antennal joints fulvous to pale rufous; frontalia dark rufous to brownish; third antennal joint and arista black. Parafrontals black, thinly silvery to pale yellowish pollinose; face and cheeks thickly yellowish-silvery pollinose, the cheeks almost golden. Occiput ashy. Thorax and scutellum black, moderately silvery pollinose, with more or less of a very faint brassy tinge; four vittae showing, the inner ones narrower. Abdomen shining black, the rather narrow bases of last three segments silvery-white pollinose; the rest very thinly pollinose as seen in oblique view. Legs dark brown; tarsi blackish. Wings nearly clear, the costal border smoky, the cross veins narrowly infusate. Tegulae lightly smoky, the front scale whitish.

Holotype.—No. 20045, U.S.N.M.

ZIZYPHOMYIA, new genus.

Genotype.—*Zizyphomyia celer*, new species.

Differs from *Doryphorophaga* as follows: Male. Vertex fully one-third head-width or rather more, the front and face widening evenly therefrom. Frontalia quite as wide as one parafrontal. Eyes bare. Two closely approximated reclinate orbitals, no proclinate ones. Frontals not so closely set; outside them some microchaetae or short bristles. Parafrontals and parafacialia wide, of about equal width

throughout. Facialia with bristles on not more than lower third. Facial plate not triangular, nearly even in width. Vibrissae near oral margin; arista thickened on more than basal half; third antennal joint about two and a half times second, bulged on upper edge. Four sternopleurals and four postsuturals; apical erect scutellar pair decussate. No discals on any of abdominal segments; the last two segments rather thickly clothed with appressed pile-like hairs. Apical cell quite widely open, ending farther before tip; apical and hind cross veins parallel with each other, but not with hind margin of wing. Tegulae of normal size.

ZIZYPHOMYIA CELER, new species.

Length of body, 6.5 to 7.5 mm.; of wing, 4.75 to 5 mm. Two males, Kenedy, Texas, September 14; and Cuero, Texas, June 9, 1898, on flowers of *Zizyphus obtusifolius* (Townsend).

Blackish; head thickly dull silvery pollinose. Frontalia brown, showing bloom in oblique lights. First two antennal joints faintly rufous in one specimen. Palpi pale rufous. Thorax and scutellum silvery pollinose; four narrow vittae, the outer ones interrupted and but little heavier than inner ones. Abdomen shining brown to dark brown and black; base of second segment broadly silvery, the pollen fading out about halfway to hind margin on median portion, narrowing laterally; third segment with silvery only on median portion of incisure. No pollen on venter. Tibiae brownish. Wings clear. Tegulae white.

Holotype.—No. 20046, U.S.N.M. (Cuero.)

NEOPHRYXE, new genus.

Genotype.—*Neophryxe psychidis*, new species.

Differs from *Phryxe* as follows: Female. Vertex less than one-third head-width. Eyes bare. Antennae inserted on upper two-thirds of eye; third joint not widened, nearly three times second. Arista more delicate, basal joints short. Face below hardly one and one-third times as wide as one eye. Facialia and clypeus narrower, epistoma more bulged. Apical scutellars weaker. No true discals on intermediate abdominal segments. Hind tibiae subpectinate, tarsi short. Apical cell narrowly open, cubitus with strong wrinkle.

NEOPHRYXE PSYCHIDIS, new species.

Length of body, 5.5 mm.; of wing, 4.5 mm. One female, "emerged from Psychid cases coll. on Azaleas from Japan at Riverton, New Jersey, March 25, 1915" (H. B. Weiss).

Black, including antennae and frontalia. Palpi fulvous. Parafrontals, face, cheeks, and orbits silvery; occiput ashy. Thorax and scutellum thinly silvery; five vittae, three narrow ones in middle, two wider ones outside. Last three abdominal segments very broadly silvery on base; especially the intermediate ones, a median

vitta of black on same; second segment broadly rufous on sides. Wings clear. Tegulae nearly white.

Holotype.—No. 20047, U.S.N.M.

EUPTILOPAREIA, new genus.

Genotype.—*Paraplagia erucicola* Coquillett, 1897, Rev. Tach., pp. 77-78.

Differs from *Ptilopareia* as follows: Arista short, thickened nearly to tip. Third antennal joint three times second in both sexes. Face and front almost same width in female, the face widening considerably in male. First and fifth veins bare; third bristled only to small cross vein in female, short of same in male (Julietta, Idaho).

KUWANIMYIA, new genus.

Genotype.—*Kuwanimyia conspersa*, new species.

Related to the *Admontia* group and distinguished as follows: Distinct proclinate ocellar bristles, small, not widely divaricate. Arista short, thickened, second joint long. Female with two proclinate fronto-orbitals; male without, but with wide bristly front, the extra-frontal bristles reclinate on posterior portion. Facial depression long, deep, triangular, very wide below in male and depth better marked than in female. Antennae inserted very high in male. Female front as wide as both eyes, that of male only a little narrower, the face widening but slightly from front. Head rather flattened antero-posteriorly, short; male frontal profile subhorizontal, that of female very sloping. Parafacials wide in female, narrower in male; their profile bowed outward in both sexes. Cheeks in both sexes hardly one-fourth eye-height. Third antennal joint of female much more slender than that of male. Facialia strongly ciliate. No discal bristles on abdominal segments. Apical cell closed a little before wing tip. Hind cross vein in middle. Strong costal spine.

Named in honor of Dr. S. I. Kuwana, of Japan.

KUWANIMYIA CONSPERSA, new species.

Length of body, 7 to 7.5 mm.; of wing, 5 to 5.5 mm. Two males and two females, Tokyo, Japan, reared from larva of *Euproctis conspersa*, July, 1912 (S. I. Kuwana, No. 85).

Head silvery-white pollinose, the black parafrontals and ocellar area largely showing through the pollen. Palpi, first two antennal joints, and basal half or less of third joint rufous. Frontalia rufotestaceous. Thorax, scutellum, and abdomen silvery pollinose, the scutellum yellowish on apex; a median pair of well-separated linear vittae showing on thorax before suture, and two heavy interrupted outer ones. Pollen of abdomen shows most plainly on basal half or less of segments two to four. Legs blackish, femora slightly pollinose. Wings clear, faintly tawny on base. Tegulae white.

Holotype.—No. 20048, U.S.N.M., female. Allotype, male.

DIATRAEOPHAGA, new genus.

Genotype.—*Diatraeophaga striatalis*, new species.

Female. Form narrowed. Front strongly produced in profile, face very receding; head subtriangular in profile. Vertex fully one-third head-width; parafrontals and parafacials wide, the latter narrowed considerably below. One reclinate and two proclinate orbitals. Ocellars present. Frontals descending but slightly below base of antennae. Frontalia narrow. Facial depression very deeply hollowed, vibrissae on oral margin; facialia on edge and forming sides of depression, their crests flush with parafacials, bristled less than halfway up. Antennae about as long as facial plate, second joint short, upper edge of third joint prolonged into a point at tip. Arista swollen on basal three-fifths, second joint well elongated. Epistoma cut off, notched. Proboscis short, palpi normal. Two sternopleurals; four postsuturals, but the front two weak. Three lateral scutellars, a weak divergent apical pair, a weaker discal pair. Abdomen with a weak median marginal pair on second segment, and weak marginal on third and anal segments. Hind tibiae with sparse irregular bristles. Tarsi short, the metatarsi as long as remaining joints taken together. Claws rather short. Apical cell moderately short-petiolate, ending well before tip. Apical and hind cross veins slightly curved and about parallel. Cubitus without stump, right-angled, hind cross vein well removed therefrom. Costal spine present, third vein with one rather long bristle at base.

DIATRAEOPHAGA STRIATALIS, new species.

Length of body, 8 mm.; of wing, slightly over 5 mm. One female, Pasoeroean, Java, August, 1913, reared from *Diatraea striatalis* (K. W. Dammerman, No. 385).

Very dark brown to black. The specimen is badly greased and shows no pollen, but the head, thorax, and bases of abdominal segments are almost certainly silvery to some extent in life. The tips of palpi and base of antennae show faintly rufous, the cheeks and broad margins of parafacials rather more so. Wings nearly clear. Tegulae whitish.

Holotype.—No. 20049, U.S.N.M.

The economic importance of this form justifies its description from this specimen.

METOPOSIYSYROPS, new genus.

Genotype.—*Metoposisyrops oryzae*, new species.

Differs from *Diatraeophaga* female as follows: Male. Front even more strongly produced in profile; the parafacials much narrower below and their profile more bulged, their planes almost at right angles with that of clypeus. Vertex a little less than one-third head-

width, the front scarcely widening from same, the face only slightly widening from front. Head almost evenly triangular in profile. Scars of what are apparently two reclinate fronto-orbitals, but no proclinate ones. Frontals descending to base of third antennal joint. Facial depression not quite so deeply hollowed, facialia not ciliate. Frontalia broad, of even width, wider than middle of parafrontal. Second antennal joint strongly elongate; the third only one and one-half times second, truncate at tip but lower angle rounded while the upper is sharply pointed. Arista shorter than third antennal joint, porrect, thickened on hardly over basal half, the basal joints short. Epistoma not notched. Three sternopleurals. Apical scutellars more hairlike, erect, subdecussate. Median marginal pair of macrochaetae on first and second abdominal segments, median discal pair on second and third segments, marginal row on third and anal, the last also with a discal row. Tarsi elongate, normal; claws quite elongate. Apical cell widely open; the apical and hind cross veins more bent. Same single long bristle at base of third vein.

METOPOSISYROPS ORYZAE, new species.

Length of body, 7.5 mm.; of wing, 6 mm. One male, Bandoeng, Java, August, 1912, reared from "rice-borer?" (K. W. Dammerman, No. 313).

Dark brown to blackish. Parafrontals, face, cheeks, and orbits silvery pollinose; occiput ashy. Antennae and palpi black. Thorax and scutellum silvery, two narrow inner vittae and two very wide and heavy outer ones. Last three abdominal segments broadly silvery-white on base; the pollen broadening in middle on the intermediate segments, but leaving a wide median vitta on second and a narrower one on third. Wings very faintly tinged with smoky, almost clear. Tegulae nearly white.

Holotype.—No. 20050, U.S.N.M.

Genus CHAETONODEXODES, new genus.

Genotype.—*Chaetonodexodes rafaeli*, new species.

Seems allied to *Oestrogastropsis*, the male of which is unknown, differing from the female of that genus as follows: Male. Form very narrowed; the abdomen still narrower than head and thorax, subcylindrical but narrowed apically. Front of even width with vertex, a little over one-fifth head-width; frontalia wider than one parafrontal. Ocellars as strong as frontals. Three reclinate and two proclinate orbitals as in female of that genus. Facialia ciliate. Third antennal joint two and a half times second. Parafacials almost linear. No discal bristles on any of the abdominal segments. Tarsi delicate, claws very short. Wings more narrowed, costal spine distinct. Sternopleural, postsutural, and scutellar bristles same. Eyes descending just as low as vibrissae, less than twice as high as broad.

CHAETONODEXODES RAFAELI, new species.

Length of body, 5.5 mm.; of wing, 5.5 mm. One male, San Rafael, Vera Cruz, Mexico, March 23, 1896 (Townsend).

Brown to dark brown. Parafrontals, face, cheeks, and orbits ashy pollinose. Frontalia velvety dark brown. Thorax and scutellum blackish; the humeri, irregular hind border of presutural area, and broad disk of postsutural area brassy-cinereous; pleuræ ashy. Abdomen faintly ashy on narrow bases of last three segments; rest of tergum rather dark brown, the venter and legs rather lighter. Wings faintly smoky throughout, the tegulae pale smoky-yellowish.

Holotype.—No. 20051, U.S.N.M.

Family RHODOGYNIDAE.

Genus EUTHEROPSIS Townsend.

Eutheropsis TOWNSEND, Ent. News, vol. 27, 1916, p. 178.

Genotype.—*Euthera manni* Mik, 1889, Wien. Ent. Zeit., vol. 8, p. 132, fig.

Differs from *Euthera* as follows: Second antennal joint not so elongate, the third joint over twice to nearly three times as long as second. Basal arisal joints distinct. Parafacials pilose. Facial carina sharp, acute, very prominent. Epistoma very prominent. Palpi clavate. Female with two proclinate orbitals. Male claws short. Female front tarsi flattened. Apical cell short-petiolate, ending far before wing apex. Alulae of wings very large, elliptical.

Genus GEROCYPTERA Townsend.

Gerocyptera TOWNSEND, Ent. News, vol. 27, 1916, p. 178.

Genotype.—*Trichoprosopa marginalis* Walker, 1861, Journ. Proc. Linn. Soc. (London), vol. 5, p. 157.

For characters see Austen,¹ and the original description by Walker.²

FORMICOPHANIA, new genus.

Genotype.—*Formicophania elegans*, new species.

Differs from *Orectocera* as follows: Male. Much more slender, with petiolate abdomen. Cheeks narrower, about one-fourth eye-height. Vertex distinctly narrower. Facialia without sign of bristlets. Two sternopleurals. Two lateral scutellars, and a decussate apical pair; no discals. First two abdominal segments narrowed, second widening a little posteriorly, third widening from second, the fourth widest, the fifth narrowing rapidly behind. Aside from the narrowed basal part, the abdomen is strikingly swollen-suboval in form, the ventral profile nearly straight, the tergal profile very convex. The

¹Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 346.

²Journ. Proc. Linn. Soc. (London), vol. 5, p. 157.

second and third segments are nearly same length, the fourth is much longer; the fifth is shorter than fourth, but with arcuate front border increasing its tergal length on median line. No discal macrochaetae, no median on first three segments. Basal segments of hypopygium exposed with full posterior aspect, not ventral. Claws not much longer than last tarsal joint. Apical cell closed a little before wing-tip, hardly petiolate; cubitus in a broad gentle curve, apical and hind cross veins parallel with hind margin of wing, the hind cross vein very sinuate and close to cubitus. Small cross vein opposite end of first vein. Tegulae small.

FORMICOPHANIA ELEGANS, new species.

Length of body, 12 mm.; of wing, 9 mm. One male, Khow Sai Dow, 1,000 feet, Trong, Lower Siam, Jan.-Feb., 1899 (W. L. Abbott).

Head black, thinly silvery, the parafacials and cheeks showing more heavily silvery-white. Palpi, antennae, thorax, and scutellum black, with thin silvery coat; vittae of mesoscutum coalesced, forming a pair of very wide heavy black vittae before suture and separated by a brassy median vitta, joined in an unbroken black behind suture. Humeri brassy. Posterior margin of first abdominal segment, all of second, and broad anterior border of third deep yellow, the third with silvery-white pollen over the yellow; rest of abdomen soft black, the fifth segment with pale golden pollen visible in oblique view. Hypopygium rufous. Hind legs mostly yellow, the others mostly dark brown; the front tibiae and tarsi mostly yellowish, the middle femora considerably yellow. Wings deeply infusate on costal half, the discal cell and a subcostal streak yellowish. Tegulae whitish.

Holotype.—No. 20052, U.S.N.M.

A RECENTLY FOUND IRON METEORITE FROM
COOKEVILLE, PUTNAM COUNTY, TENNESSEE

BY

GEORGE P. MERRILL

Head Curator, Department of Geology, United States National Museum

No. 2153.—From the Proceedings of the United States National Museum,
Vol. 51, pages 325-326, with Plate 28

Published November 24, 1916



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A RECENTLY FOUND IRON METEORITE FROM
COOKEVILLE, PUTNAM COUNTY, TENNESSEE

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A RECENTLY-FOUND IRON METEORITE FROM COOKEVILLE, PUTNAM COUNTY, TENNESSEE.

By GEORGE P. MERRILL,

Head Curator, Department of Geology, United States National Museum.

The iron described below was first brought to my attention by Dr. T. Poole Maynard of Atlanta, Georgia, who stated that it had been found some three years ago. Nothing is known regarding its fall, but it is obviously very old.

As received, the iron was in the form of a roughly polygonal mass, so badly oxidized that its original form was greatly obscured (pl. 28, fig. 2). The weight, before cutting, was 2,132 grams. A cut surface shows an unusual feature in its very regular octahedral coarse crystallization (pl. 28, fig. 1). Practically the entire mass is made of broad kamacite bands 2 to 6 mm. in width. Between these lie, quite regular and parallel, very thin plates of taenite. Between the broad bands and the taenite is always a thin zone of oxidized material, which may be due, in part, to lawrencite, but probably represents a line of structural weakness along which the oxidation would naturally progress most rapidly. Nowhere are there plessite areas. In a single instance a sulphide (troilite?) nodule some 10 mm. in diameter appears.¹ The kamacite bands are peculiarly pitted by rust spots, which suggest a somewhat spongy condition of the original metal.

¹ Since the above was written the iron has been cut into several slices, one of which shows along the margin an elongated area of what at first sight was supposed to be troilite, but which being magnetic was tested and found to consist mainly of the nonmagnetic sulphide with the usual admixture of schreibersite along the border. To this last was due the apparent magnetic character of the entire mass, which was some 50 mm. in length by 10 mm. in breadth.

An analysis by J. E. Whitfield yielded:

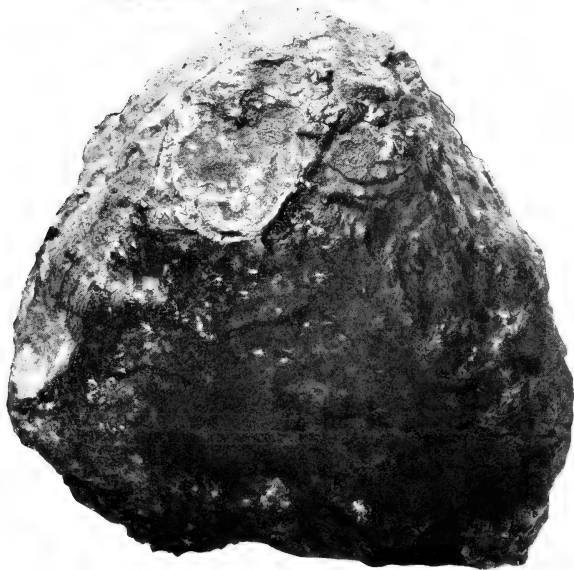
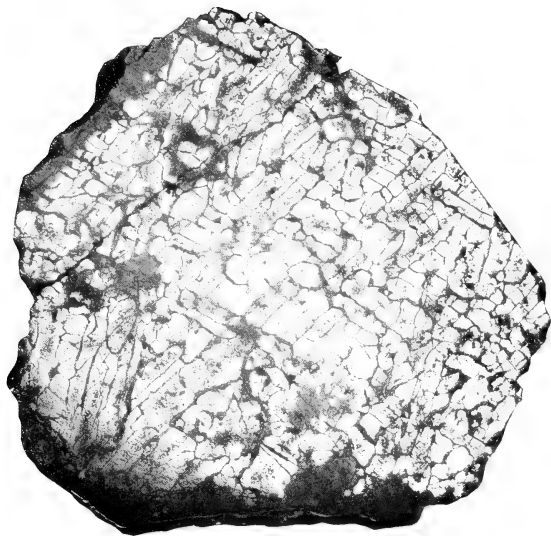
	Per cent.
Phosphorus (P).....	0. 170
Sulphur (S).....	. 377
Nickel (Ni).....	6. 380
Cobalt (Co).....	. 370
Carbon (C).....	. 204
Iron (Fe).....	61. 329
Iron oxide.....	27. 890
Nickel oxide (NiO).....	1. 100
Sulphuric acid (SO ₃).....	0. 085
Ignition.....	2. 750
	<hr/>
	100. 655
Total iron.....	80. 852
Iron in oxides.....	19. 523
	<hr/>
Metallic iron.....	61. 329

The ignition was made independently on a fragment somewhat more highly oxidized than that used for analysis. This doubtless accounts in part for the footing up so much in excess of 100.

The main mass of the iron, weighing 1,570 grams after cutting, is in the possession of Ward's Natural Science Establishment, Rochester, New York. To them I am indebted for material for analysis and a slice for the museum collections.

EXPLANATION OF PLATE 28.

- FIG. 1. Etched slice of the Cookeville, Tennessee, meteoric iron. Natural size. Cat. No. 518. The dark border at the upper left and below is of oxidized material.
2. The Cookeville meteoric iron as found.



THE COOKEVILLE METEORIC IRON.

FOR EXPLANATION OF PLATE SEE PAGE 326.



TWO NEW FOSSIL PLANTS FROM THE TRIASSIC
OF PENNSYLVANIA

BY

EDGAR T. WHERRY

Assistant Curator, Division of Mineralogy and Petrology, United States National Museum

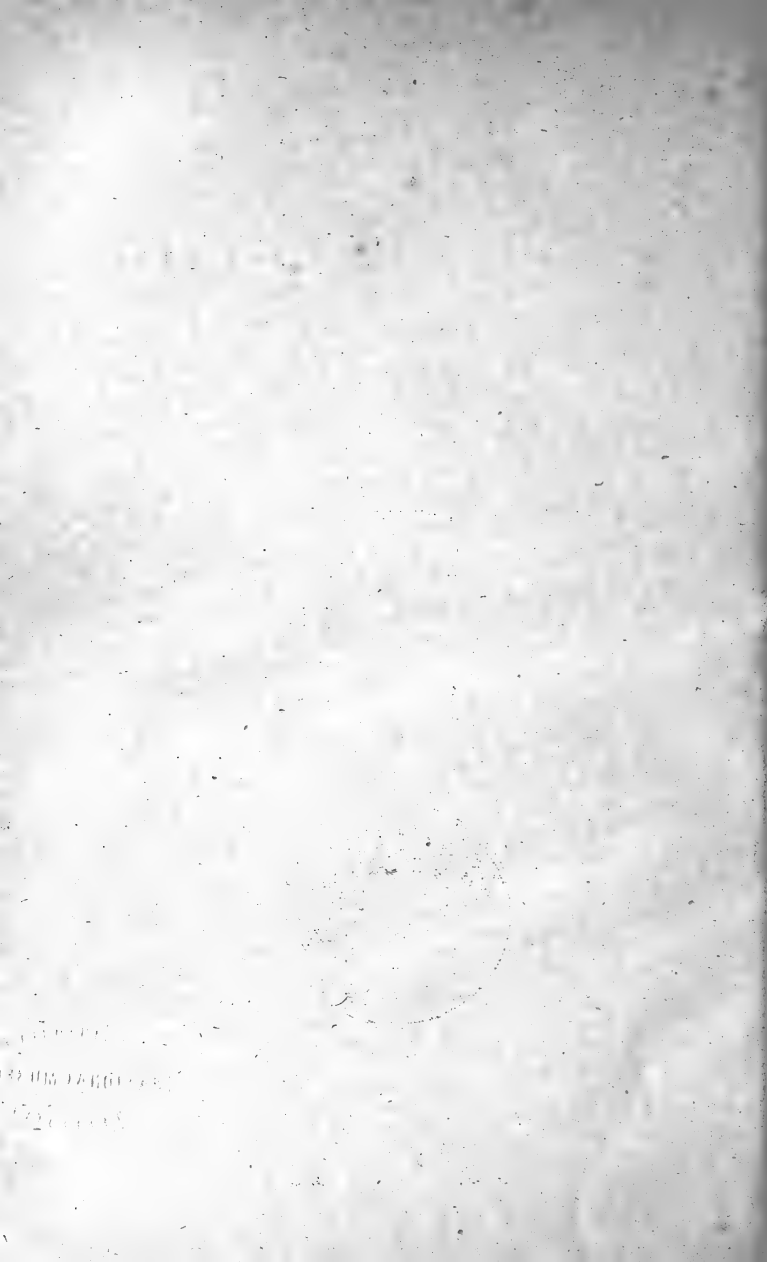
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TWO NEW FOSSIL PLANTS FROM THE TRIASSIC
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TWO NEW FOSSIL PLANTS FROM THE TRIASSIC OF PENNSYLVANIA.

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Assistant Curator, Division of Mineralogy and Petrology,
United States National Museum.

I. A NEW CONIFER FROM CARVERSVILLE.

The occurrence of fossil plants at Carversville, Bucks County, Pennsylvania, was first made known by Prof. Amos P. Brown in 1911.¹ In addition to the two cycads and four conifers described by Professor Brown,² fragmentary remains of several other species of both classes are present at the locality, and one conifer, collected by the writer in 1912, is sufficiently well preserved to justify description. It bears some resemblance to a plant which has been found in the Triassic of other parts of this country, and assigned to *Palissya sphenolepis* (Friedrich Braun) Brongniart,³ but its leaves are too long, slender, widely spaced, and with too obscure a midrib for it to be identified with that or any other previously known form. It appears to belong, however, to the same genus,⁴ and is accordingly described as:

PALISSYA LONGIFOLIA, new species.

Plate 29.

Description.—Stem 6–8 mm. in diameter, striate, with subopposite leafy branches 2–2.5 mm. in diameter at intervals of 5–6 cm., and with scattered leaves between the branches. Leaves of main stem and branches alike, 2–3 cm. long, 1.5–2.5 mm. wide, separated by interspaces of about their own width, inclined at 45–60°, subopposite; linear in outline, gradually and slightly contracted at the base and somewhat decurrent; toward terminations narrowed slightly, but

¹ Proc. Acad. Nat. Sci., Phila., 1911, p. 17, pls. 1–5.

² *Podozamites formosus* Brown, *Zamites velderi* Brown, *Chetrolepis muensteri* (Schenk) Schimper, *C. latus* Brown, *Palissya difflusa* (Emmons) Fontaine, and *P. obtusa* Brown.

³ In York County, Pa., Ward, Status of the Mesozoic floras of the U. S., 20th Ann. Rept. U. S. Geol. Survey, pt. 2, 1900, p. 249, pl. 32; and in North Carolina, Fontaine, idem., p. 305, pls. 44–45.

⁴ Differing from *Voltzia* in having the leaves all alike, and from *Adertia* in the leaves being much longer than broad and in the presence of a distinct (though faint) midrib.

tips obtuse; nerves 4-7, parallel; midrib rather indistinct, yet undoubtedly present in some leaflets.

Type.—Cat. No. 34992, U.S.N.M.

Locality.—Quarry one-fourth mile northeast of Carversville, Bucks County, Pennsylvania; fragments fairly common in the dark gray micaceous-sandy shales at this locality, but mostly poorly preserved.

Horizon.—Lockatong formation;¹ probably within a few feet of the base.

The lack of similarity between most of the plants of this locality and those of York County, Pennsylvania (about 100 miles to the southwest), as well as those of Virginia and North Carolina, is a noteworthy fact. In the absence of exact means of correlation between the beds of the several regions, it is not possible to decide whether this is due to geographic or to stratigraphic separation; but there is nothing about any of the forms occurring here to cast doubt on the correctness of the usual assignment of the Lockatong formation to the Middle Triassic.

2. A PLANT OF UNKNOWN AFFINITY FROM NORTHERN BUCKS COUNTY.

About a mile south of the town of Sellersville a lens of green to black shale some 50 feet in thickness occurs in the midst of the usual soft red sediments (Brunswick shale) of the region. Where cut by the Philadelphia & Reading Railway line this shale contains the remains of a plant which is so definite that it seems worth description, even though its systematic position is indeterminate. Scattered fragments of what is apparently the same form occur in similar beds along this railroad in Lehigh County, three-fourths mile northeast of Coopersburg station. Fragments of what may be the same plant occur in the Cumberland area, North Carolina,² and elongated leaves resembling those of the present plant in York County, Pennsylvania.³ As pointed out by Ward, a generic name which carries with it no systematic implications is desirable for such material, and as it is very unusual to find determinable fossil plants in the Brunswick beds, the name *Brunswickia* seems the most appropriate.

¹ Professor Brown, at the time of the publication of his paper, had not visited the locality, but as the map of the Second Pennsylvania Geological Survey shows the rock, at the point where the quarry was reported to be, as "Norristown shale" (now termed Stockton formation), Professor Brown gave this as the horizon of the occurrence. The matrix of the fossils is, however, like what has been described as the "Gwynedd" (Lockatong formation), and on visiting the quarry in 1912, the present writer found it to lie within that formation, although not far above its base. This correction is here emphasized because of the desirability of locating as exactly as possible the horizons at which fossils occur in the comparatively unfossiliferous Triassic beds.

² Fontaine, Mon. 6, U. S. Geol. Survey, 1883, p. 90, pl. 48, fig. 4.

³ *York tagraminoides*, Wanner and Ward, 20th Ann. Rept., U. S. Geol. Survey, 1900, pt. 2, p. 264, pl. 34.

BRUNSWICKIA, new genus.

Type of the genus.—The following new species:

BRUNSWICKIA DUBIA, new species.

Plate 30.

Description.—Groups of elongate, striate leaves, diverging in a plane, with the following detailed characters: Length, 6 cm. or more; width, 1.5–2 mm.; rather thick and rigid; outline linear; nerves 5–8, equidistant, parallel, somewhat unequal, though without definite midrib; at base sheathing the stems, which are apparently branched, and diverging so that they are ultimately separated by interspaces of about their own width; in one specimen curving upward in a conical mass 1 cm. high, from a structureless base.

Type.—Cat. No. 34993, U.S.N.M.

Localities.—Cut of Philadelphia & Reading Railway three-fourths mile south of Sellersville station, Bucks County, Pennsylvania; also along the same road three-fourths mile northeast of Coopersburg station, Lehigh County, Pennsylvania. At the first fairly abundant, and forming prominent yellow streaks in the black shale.

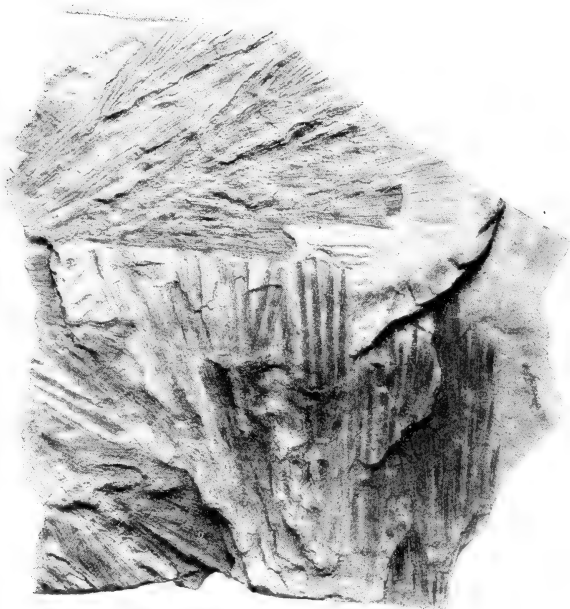
Horizon.—Brunswick formation; the first locality lies approximately 2,800 feet above the base of the formation, the second 7,000 feet higher. This plant has of course no value in determining whether the Brunswick is of uppermost Triassic or lowermost Jurassic age—a question which can only be decided by discovery of more definitely determinable fossils therein.





PALISSYA LONGIFOLIA, NEW SPECIES.

FOR DESCRIPTION SEE PAGE 327.



BRUNSWICKIA DUBIA, NEW SPECIES.

FOR DESCRIPTION SEE PAGE 329.

TWO NEW LAND SHELLS FROM THE
WESTERN STATES

BY

PAUL BARTSCH

Curator, Division of Marine Invertebrates, United States National Museum

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TWO NEW LAND SHELLS FROM THE WESTERN STATES

BY

PAUL BARTSCH

Curator, Division of Marine Invertebrates, United States National Museum

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TWO NEW LAND SHELLS FROM THE WESTERN STATES.

By PAUL BARTSCH,

Curator, Division of Marine Invertebrates, United States National Museum.

While accompanying her husband, the Secretary of the Smithsonian Institution, on a collecting trip through the Northwest, Mrs. Walcott gathered some specimens of *Oreohelix* in Montana. These belong to an undescribed race which I take pleasure in naming for the discoverer.

The second subspecies, *Oreohelix idahoensis baileyi*, here described was collected by Mr. Vernon Bailey of the Biological Survey, in 1896, on a limestone ridge, at an altitude of 700 feet, in the Seven Devils Mountains of Idaho.

OREOHELIX YAVAPAI MARIAE, new subspecies.

Plate 31, figs. 1-3.

Shell decidedly depressed helicoid, almost lenticular, flesh colored, with a narrow brown band on the upper surface, which is a little nearer the peripheral cord than the suture, and a second even narrower one bordering the peripheral cord on the lower surface. Nuclear whorls scarcely differentiated from the succeeding turns, bearing the same sculpture as the adult whorls, but a little less strongly expressed. Periphery of the whorls provided with a cord-like keel, which becomes somewhat weakened on the last quarter of the last turn. Entire surface both above and below marked by slender thread-like incremental lines and fine spiral striations; last whorl slightly descending near the aperture. Base broadly, openly umbilicated, well rounded; a little more convex at the umbilical wall than at the lateral margin. Aperture very oblique, oval; peristome neither thickened nor reflected at the edge; parietal wall strong, rendering the peristome complete.

The type and eight specimens of this subspecies (Cat. No. 215132, U.S.N.M.), were collected by Mrs. Mary Walcott on Squaw Creek near the mouth of Gallatin Canyon, Montana. The type has 5.6

whorls and measures: Altitude, 10.0 mm.; greatest diameter, 22.5 mm.; least diameter, 19.6 mm.

The other specimens yield the following additional measurements

Number of whorls.		Altitude.	Greatest diameter.	Least diameter.
Type	5.6	10.0	22.5	19.6
	5.4	9.3	21.2	18.0
	5.5	9.1	21.1	18.4
	5.3	9.0	20.0	17.3
	5.6	10.0	22.4	18.7
	5.6	8.6	20.5	18.0
	5.6	9.1	20.7	18.5
	5.2	8.2	18.3	15.6
	5.4	9.9	19.5	17.3
Largest	5.6	10.0	22.5	19.6
Least	5.2	8.2	18.3	15.6
Average	5.47	9.24	20.69	17.93

This race of *Oreohelix yavapai* Pilsbry is the most northern one so far reported. It differs from the typical form, which comes from "Purtyman's Ranch on Oak Creek, Yavapai County, about 40 miles from Jerome, Arizona," in being larger, more solid and more acutely keeled. Dr. Henry A. Pilsbry gives the following measurements of his *O. yavapai*: Altitude 8.7-9.5 mm.; greatest diameter 15.2-16.6.

Our race appears nearest related to *Oreohelix yavapai angelica* Pilsbry and Ferriss, which was collected by these authors near the base of the Crossbed Sandstone, Bright Angel Trail, Grand Canyon, Colorado. Of this Doctor Pilsbry has kindly sent me eight specimens for the collection of the United States National Museum (Cat. No. 215085), which yield the following measurements:

Number of whorls.		Altitude.	Greatest diameter.	Least diameter.
Type	4.6	8.0	18.0	15.2
	4.7	7.6	17.4	15.0
	5.0	7.3	17.0	14.6
	4.9	8.0	17.3	14.1
	4.9	8.0	16.9	14.6
	4.8	8.0	17.5	14.5
	4.8	8.0	17.6	14.6
	5.0	8.3	16.4	14.0
Largest	5.0	8.3	18.0	15.2
Least	4.6	7.3	16.4	14.0
Average	4.83	7.9	17.26	14.57

In addition to the differences expressed by the measurements, our shell has the peripheral keel even more compressed than *Oreohelix yavapai angelica* Pilsbry and Ferriss.

OREOHELIX IDAHOENSIS BAILEYI, new subspecies.

Plate 31, figs. 4-6.

Shell depressed, helicoid. Nuclear whorls $2\frac{1}{2}$, marked by somewhat irregularly disposed, crude, axial ridges, and fine spiral striations. The postnuclear whorls are well rounded, marked by very coarse, broad and strong, decidedly retractively slanting axial ribs, of which 23 occur upon the last whorl of the type. These ribs and the spaces between them are crossed by strong incremental lines. In addition to the axial sculpture the whorls are marked by fine closely spaced spiral striations which are best developed in the intercostal spaces of the last whorl. Periphery of the last whorl with a slender keel. Base broadly openly umbilicated, marked by the continuations of the axial ribs which extend well within the umbilicus, and spiral sculpture like the upper surface. Aperture oblique, subcircular, peristome not reflected.

The type and two additional specimens (Cat. No. 133221, U.S.N.M.) were collected on a limestone ridge on the side of a rapid creek, at an altitude of 3,700 feet, in the Seven Devils Mountains, Idaho, by Mr. Vernon Bailey of the United States Biological Survey. This shell is at once distinguished from *Oreohelix idahoensis idahoensis* Newcomb by its much smaller size, more depressed form, decidedly open, funnel shaped umbilicus, and the presence of a slender peripheral keel.





1



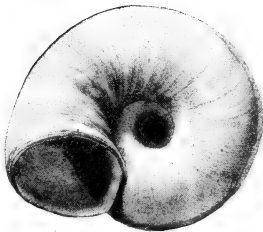
4



2



5



3



6

TWO NEW LAND SHELLS FROM THE WESTERN STATES.

FOR DESCRIPTION SEE PAGES 331 AND 333.





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A CONTRIBUTION TO OUR KNOWLEDGE OF THE
WHITE FLIES OF THE SUBFAMILY ALEY-
RODINAE (ALEYRODIDAE)

BY

A. L. QUAINANCE AND A. C. BAKER

Of the Bureau of Entomology, United States Department of Agriculture

No. 2156.—From the Proceedings of the United States National Museum,
Vol. 51, pages 335-445, with Plates 32-77

Published January 20, 1917



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A CONTRIBUTION TO OUR KNOWLEDGE OF THE WHITE FLIES OF THE SUBFAMILY ALEYRODINAE (ALEYRODIDAE).

BY A. L. QUAINANCE AND A. C. BAKER,

Of the Bureau of Entomology, United States Department of Agriculture.

INTRODUCTION.

The present paper is in continuation of the writers' work on the classification of the Aleyrodidae published as Parts 1 and 2 of Bulletin 27, technical series, Bureau of Entomology, and is based on material in collections of the United States National Museum and the Bureau of Entomology. These collections during recent years have been materially augmented by the receipt of specimens from various parts of the world, especially oriental regions and tropical North America.

Recent years have witnessed considerable activity on the part of entomologists in the study of the Aleyrodidae, and the number of species at present known is considerably in excess of the number at one time thought to exist. It is certain that there are very many as yet unrecognized species, especially in tropical regions, and it is hoped that entomologists and collectors who have opportunity will interest themselves in this comparatively unworked group of insects.

Genus ALEUROCANTHUS¹ Quaintance and Baker.

Aleurocanthus QUAINANCE and BAKER, Tech. Ser. 27, pt. 2, Bur. Ent. U. S. Dept. Agr., 1914, p. 102.

Pupa case medium in size, subelliptic in outline, usually dark brown or black in color; margin of case toothed, the wax tubes very prominent; submarginal area not separated from dorsal disk; dorsum without papillae or pores, though bearing many heavily chitinized spines variously arranged; tracheal folds usually not discernible, though evident in a few species; wax secretion usually present as a narrow fringe from marginal wax tubes. Vasiform orifice small,

¹ *Aleurodes voeltzkowi* Newstead, *Aleurodes citricola* Newstead, *Aleurodes nubilans* Buckton, and *Aleurodes banksiae* Maskell are not included in the following key. Of the first three species the descriptions are so poor that it is impossible to arrive at an understanding of the species. The last we place here doubtfully on the structure of the larva, the slide of pupa case being in such condition that it is impossible to make out any details.

rounded or subcordate in outline, situated on a tubercle-like projection of dorsum; operculum similar in shape and almost entirely filling it, obscuring the lingula.

Adult with one flexure in radial sector of forewing and no spur of media; wings usually blotched or shaded. Males much smaller than females.

Type.—*Aleurocanthus spiniferus* (Quaintance).

KEY TO SPECIES OF ALEUROCANTHUS.

1. Pupa case with 12 spines on anterior half of case only..... *T-signatus*.
2. Pupa case with 100 or more long spines situated close together, forming a submarginal ring; color black; size 2 by 1.6 mm..... *longispinus*.
Pupa case with 50 or less rather long spines forming a submarginal ring..... 3.
3. Pupa case with about 50 spines forming submarginal ring; color yellowish; size 1.33 by 0.99 mm..... *hirsutus*.
Pupa case with less than 40 spines forming the submarginal ring..... 4.
4. Pupa case with 30-36 spines forming submarginal ring..... 5.
Pupa case with 16-26 spines forming submarginal ring..... 7.
5. Pupa case over 2 mm. long; 30 hooked spines forming a ring around the dorsum just within the margin; color black..... *bambusae*.
Pupa case less than 2 mm. long..... 6.
6. Teeth of the margin knobbed, a space of 0.1 mm. occupied by 10 teeth; size 1.39 by 0.88 mm.; submarginal area armed with 34-36 prominent spines... *mangiferae*.
Teeth of the margin not knobbed, but triangular and somewhat acute; space of 0.1 mm. occupied by 14 teeth; pupa case black, submarginal spines arranged in two series; adults with mottled wings..... *citriperdus*.
7. Submarginal spines extending out some distance beyond the margin of case... 8.
Submarginal spines not extending beyond the margin of the case, or but slightly beyond it..... 11.
8. Teeth of the margin of case knobbed, a space of 0.1 mm. occupied by 13 teeth; size 1.09 by 0.68 mm.; color black..... *calophylli*.
Teeth of margin not knobbed..... 9.
9. Teeth of margin very large and rounded, a space of 0.1 mm. occupied by 6 or 7 teeth; spines long and prominent; color black; size of case 1.4 by 0.89 mm.; adults with dark wings and clear markings; bodies reddish brown..... *woglumi*.
Teeth of margin not large, a space of 0.1 mm. occupied by 12 or more teeth.... 10.
10. Teeth of margin not acute, moderate in size, a space of 0.1 mm. occupied by 12 teeth; size of case 1.23 by 0.88 mm.; spines not long; eggs with reticulate markings..... *spiniferus*.
Teeth of margin somewhat acute, the outer spaces shallow; a space of 0.1 mm. occupied by 16 teeth; size 1.168 by 0.75 mm.; egg striated..... *piperis*.
11. Submarginal spines not extending beyond the margin of case, or but slightly beyond it, and split at their apices into a number of fine fimbriations; submarginal area corrugated or granular..... 12.
Submarginal spines very short, becoming mere tubercles; color brown to black, marginal teeth distinctly serrated; size of pupa case 0.752 by 0.512 mm.
dissimilis.
12. Dentition moderately acute, a space of 0.1 mm. occupied by 26 teeth; color on leaf dark brown; yellowish under the microscope..... *spinosus*.
Dentition quite acute, a space of 0.1 mm. occupied by 26 teeth; color on leaf deep black, under microscope dark brown; spines stout, deep black at base; size 1.01 by 0.72 mm.; egg reticulate with stalk nearly twice length of egg
serratus.

ALEUROCANTHUS BAMBUSAE (Peal).

Plate 32, figs. 1-9.

Aleurodes bambusae PEAL, Journ. Asiat. Soc. Bengal, vol. 72, 1903, p. 85.

A. bambusae is a large species, approaching in size *longispinus*. It is also found upon the same host plant which might lead one to believe that the two forms are identical. The number of spines given by Peal for *bambusae* is, however, very different from that found on *longispinus*. In clearing the case sufficiently for study many of the spines are destroyed and their position is indicated only by stubs, or even their tubercles. It is possible, therefore, that Peal may have overlooked a number of them. Since, however, his specimens were destroyed by fire, this can not now be determined, as *bambusae* has not been subsequently described.

Egg.—Length, 0.25 mm. by 0.11 mm.

Color light brown. Surface sculptured with hexagons. Attached in an upright position to leaf by a short peduncle.

Larva, first stage.—Size, 0.35 mm. by 0.2 mm.

Shape elliptical, narrow for its length. Color, deep black; dark brown under the microscope. The dorsum is completely hidden by a quantity of white fluff which is produced by a series of submarginal pores. There is an elevated mesio-dorsal ridge extending anteriorly almost to the margin and posteriorly to the vasiform orifice. Segments of abdomen fairly distinct. Margin crenulated, bearing a series of closely apposed pores which produce a regular but somewhat short horizontal fringe. Ventrad just within the margin a series of pores which produce a scanty white secretion. There are four long setae on cephalic and four on caudal margins. On the dorsum there are four long, stout curved spines which are situated a pair on the cephalic and a pair on the anterior edge of the abdominal region. They are placed on the sides of the medio dorsal ridge. The spines point backwards. Each spine is about half the length of the body, the anterior pair being slightly longer. Two short stout curved spines are situated one on each side of the vasiform orifice. Vasiform orifice large, elevated on a tubercle. It is apparently similar to that in the puparium but owing to the color is difficult to make out.

Larva, second stage.—Size, 0.55 mm. by 0.3 mm.

Similar except in size to larva, third stage.

Larva, third stage.—Size, 1 mm. by 0.55 mm.

Shape elliptical, somewhat broader proportionately than in the first stage. Color, dense black. There is a distinct mesio dorsal ridge which is somewhat slighter than in the preceding stage. Abdominal segments distinct. Area surrounding vasiform orifice

darker than the rest of the abdomen. Margin broad crenulated. Mesad the margin ends at a broad ridge which separates it from the rest of the dorsum. Along its edge are a series of large closely apposed pores which produce a short but abundant horizontal fringe of wax. The upper surface of the margin bears a large number of extremely minute pores. These pores produce a quantity of white fluffy wax filaments which curve inwards and cover the dorsum. Ventrally a little within the margin there are a series of pores which produce a small quantity of wax. The dorsum is covered with a number of stout spines. There are a pair on the cephalic region at end of mesio dorsal ridge and nearly on the margin; two pairs placed fairly close together on the cephalic region; a pair placed widely apart on the thoracic region; immediately behind this pair there are two pairs placed fairly close together on the lower edge of the mesio dorsal ridge; a pair of spines on each of the third, fourth, and fifth abdominal segments; and two stout curved spines, one on each side of the vasiform orifice. There are two short setae, one on each side of the vasiform orifice and two fairly long setae caudad on margin. The vasiform orifice as in preceding stages, but in some specimens the lingula appears large and dumb-bell shaped.

Larva, fourth stage.—Size, 1.4 mm. by 0.9 mm.

Shape elliptical, anterior edge abruptly conical. Color, dense black. Mesio dorsal ridge as in preceding stages. A broad crenulated margin which ends mesad in an elevated ridge which separates it from the rest of the dorsum. The margin ends in a series of large closely apposed pores which produce a short thick marginal fringe of white wax. The upper surface of the margin is covered with a large number of minute pores which produce a quantity of white fluff, which, curving inwards, covers the dorsum. Segments of abdomen distinct. The dorsum is covered with a large number of stout spines which lie—five pairs on the cephalic region; four pairs on the thoracic region, and five pairs on the abdominal segments. There is also a stout curved pair situated one on each side of the vasiform orifice. There are two short setae, one on each side of the vasiform orifice and a slightly longer pair caudad on margin. Vasiform orifice large in proportion to its size as compared to the vasiform orifice in the puparium.

Puparium.—Size, 2.1 mm. by 1.4 mm.

Shape elliptical, broadest caudad. Color, dense black. Distinct mesio-dorsal ridge, which is narrow and sharp anteriorly and broad and rounded posteriorly. From this ridge there are a series of five ridges which mark out the abdominal segments. Margin broad, crenulated, bearing on its upper surface a large number of minute pores which produce a quantity of white wax filaments which curling inwards conceal the dorsum. There are a series of closely apposed

marginal pores which produce a short but abundant horizontal secretion of wax. There are ventrally on margin a series of pores which produce a small quantity of wax. The dorsum is covered with a large number of short but stout spines. These spines are grouped as follows. There are 30 hooked spines forming a ring around the dorsum just within the margin. The other spines are shorter and are situated as follows. A double row of eight spines across the cephalic region; four spines on the thoracic region; 16 spines in a row down the mesio dorsal ridge on the abdominal region; two rows of three spines, one row on each side of the mesio dorsal ridge on first and second abdominal segments; two rows of two spines placed similarly on third and fourth segments and one spine on each side of the mesio-dorsal ridge on the fifth segment. A pair of short stout spines placed, one on each side of the vasiform orifice. Two long setae caudad and two cephalad on margin. The vasiform orifice is situated on a short tubercle at the posterior end of the mesio dorsal ridge; shape, oval. Operculum similar in shape but somewhat smaller, the lower half apparently slightly ridged. Lingula indistinct, shape rectangular, broader than long. It is completely covered by the operculum.

Adult.—Unknown.

This Aleurodid occurs plentifully on various species of bamboo in the vicinity of Calcutta. As a rule only a few leaves in a bamboo clump are attacked by the insect. I have, however, sometimes found it occurring in very large numbers in some bamboo clumps. It then undoubtedly is a rather serious pest as frequently most of the leaves are then killed. The insect is kept in check by a parasite, presumably a chalcidid, as large numbers of dead insects can always be found which have the minute hole on the dorsum made by the parasite for its exit. I have so far obtained no specimens of the parasite. When this Aleurodid is detached from the leaf it will be observed that the portion of the leaf beneath the insect is yellow and discolored. As a rule the exuviae of the preceding stages remains attached to the spines on the dorsum. (Peal.)

ALEUROCANTHUS BANKSIAE (Maskell).

Plate 33, figs. 1-5.

Aleurodes banksiae MASKELL, Trans. N. Zeal. Inst., vol. 28, 1896, p. 423.

It is with some hesitation that we place this species here. The type of the pupa case, which is a solitary specimen in a balsam mount, is in such condition that it is impossible to make out details. The larva possesses numerous spines and is otherwise quite similar to the forms we are placing in this group, and it is on the strength of this larval structure that we place the species in *Aleurocanthus*.

Larva.—Brown, elliptical; length about one forty-fifth of an inch. Margin distinctly crenulated, but bearing no fringe. Abdominal segments fairly distinct. Dorsum bearing, within the margin, a row of longish, strong spines, of which four, on the anterior region, extend beyond the margin; also, on the anterior thoracic region, six other spines in two rows; the extremities of all these spines are dilated into three minute spicules. Vasiform orifice with regularly convex sides and end, the anterior edge concave; operculum moderate, subcircular, lingula obsolete.

Pupa case.—Intense glossy black, flattish, elliptical; length about one twenty-fifth of an inch. Abdominal segments moderately distinct. Margin crenulated, but less conspicuously than in the larva; there is sometimes a small fragmentary waxy fringe. Dorsum bearing rows of short fine hairs in place of the strong spines of the larva.

Adult form unknown.

Habitat in Australia, on *Banksia integrifolia* and on *Callistemon linearis*. My specimens were sent from Melbourne by Mr. C. French.

Larva (fig. 5).—Size 0.64 by 0.432 mm.; shape elliptical; color light brown. The dorsum is armed with a number of spines which are narrow and slightly swollen at the distal extremity. On the submarginal area of the thorax there is an even row of 10 spines, five on each side, and on the median ridge of the thorax there are two other pairs. The abdomen has a row of six spines down each side of the subdorsal area, the most caudal pair of which is situated close to the vasiform orifice. There is also a pair of prominent spines on the median ridge of the second abdominal segment. The vasiform orifice is situated on a slight tubercle-like projection. It is subcordate in outline (fig. 3) and the operculum almost entirely fills the orifice, obscuring the lingula. Just cephalad of the orifice there is a pair of small setae, one on each side, and on the caudal margin of case there is a pair of long hair-like spines. A similar but shorter pair is situated on the latero-caudal margin. The margin of the case is dentate, the teeth being small and situated close together. (Fig. 2.) They are rounded at their tips and irregular in size, some being large and some small.

Types, one pupa and one larva on balsam mounts in the Maskell collection.

ALEUROCANTHUS CALOPHYLLI (Kotinsky).

Plate 33, figs. 6-10.

Aleyrodes calophylli KOTINSKY, Bull. 2, Div. Ent. Brd. Agr. & For. Hawaii, 1907, p. 98.

Pupa case (fig. 6).—Size 1.09 by 0.68 mm.; shape elliptic to oval, with a well-marked median ridge, particularly upon the abdomen, and the subdorsal area not greatly elevated. On the submarginal

area there is a row of spines forming a ring about the case. These are variable in length, the longest being about 0.19 mm. On the subdorsal area there is a row of smaller spines, four on each side of the thorax and four on each side of the abdomen. These are all small but the most caudal pair, which is as long as those of the submarginal ring. On or near the median ridge there are the following spines: One pair of small ones in about the middle of the thorax; one pair of very small ones on the first abdominal segment; one pair of long ones on the second abdominal segment; and just cephalad of the vasiform orifice two pairs of moderately long spines, the spines of the most caudal pair situated close together, and the other one on each side of the median ridge. The vasiform orifice (fig. 8) is situated on a well-marked tubercle which forms the caudal extremity of the median ridge. It is rounded or subcordate, and its inner margin is armed with a series of folds. The operculum almost entirely fills the orifice obscuring the lingula. Just cephalad of the orifice there is a pair of minute setae. The margin is dentate, the teeth being of moderate size and swollen at their tips; in this character resembling those of *mangiferae*. A space of 0.1 mm. is occupied by 13 teeth (fig. 7). Around the margin near the base of the teeth there is a row of minute tubercled setae. The case under the microscope is dark brown, particularly so near the margins. On the leaf it is shining black with little or no dorsal secretion and a narrow white waxen marginal fringe.

Type.—Cat. No. 19106, U.S.N.M.

Paratype material United States National Museum collection, as balsam mounts, and pupa cases upon the foliage.

Habitat.—On *Calophyllum neophyllum*, at Levuka, Fiji, Albert Koebele, collector.

ALEUROCANTHUS CITRICOLUS (Newstead).

Aleurodes citricola NEWSTEAD, Mitteilungen aus den Zoologischen Museum in Berlin, vol. 5, Heft 2, 1911, p. 173.

We have seen no examples of this species.

Puparium.—Elongate ovate; black and slightly glossy when free from exuviae of previous moults. Dorsum may or may not be keeled; with one bilateral, subdorsal row of large spines, and one submarginal row; the latter projecting beyond the secretory margin, in some instances; these spines are generally laden at the tips with irregular nodules of almost colorless secretion. Marginal fringe broad, white, and practically homogenous. In most cases the dorsum is partly hidden by the exuviae of the previous moult; these are paler in color than the puparium of the adult, but they are free from secretory matter. Ventral margin or flange (fig. 1) very narrow, inner edge deeply crenulated, but the crenulations are generally rendered ob-

scure by the density of the chitine; though in some instances portions of the flange become flattened out so that the crenulations appear external. Structure of the vasiform orifice doubtful, as owing to the opacity of the integument it is not possible to determine its characteristics.

Length, exclusive of fringe, 1 mm.

Ovum narrowly reniform or almost crescentic, peduncle very short; pale ochreous or straw-colored, when empty.

Habitat.—D. Ost-Afrika, Dar es Salaam, April, 1902. Auf *Citrus* sp. Prof. A. Zimmermann S. (No. 2).

The puparia occurred in large overcrowded colonies, appearing

to the unaided eye as patches of soot-like deposit upon the under surface of the leaves. They were associated with the Coccid *Aspidiotus aurantii* Maskell, chiefly young forms of the female. (Newstead.)

ALEUROCANTHUS CITRIPERDUS, Quaintance and Baker.

Aleurocanthus citriperdus QUAINANCE AND BAKER, Journ. Agric. Research, vol. 6, 1916, p. 459, fig. 1.

This species is represented in the bureau collection from Java, Ceylon, and India. It seemingly is an abundant species. It has been found on orange and on an unknown tree.

ALEUROCANTHUS DISSIMILIS, new species.

Plate 34, figs. 1-9.

Larva.—The cast larval skins are found attached to the dorsum of the pupa case, and it is therefore difficult to study them with any accuracy. They possess, however, the same serrated marginal teeth found in the pupa case and are thus easily distinguished from the larvae of other species. The spines on the larvae (fig. 9) are not as much reduced as those of the pupa case, but appear more like those normally met with in species of the genus.

Pupa case (fig. 1).—Length 0.752 mm.; width 0.512 mm.; color under the microscope dark brown to black. Dorsum armed with a series of spines, as indicated in the figure. These spines are not prominent as in other members of the genus, but are reduced to mere tubercles (fig. 2). Some of those upon the thoracic area are acute at the tip (fig. 3), while some (fig. 4) are not as much reduced as others. The abdomen is armed with a median dorsal row of twelve pairs of these



FIG. 1.—MARGIN OF PUPA CASE OF ALEUROCANTHUS CITRICOLUS. (AFTER NEWSTEAD.)

tubercles, and the pair on the first abdominal segment is often of fair size and swollen at the distal extremity (fig. 5). In other specimens, however, this pair is short like the other pairs. The thoracic suture is very distinct and curved and extends to the margin of the case. The "eye spots," which are present as in *T-signatus*, resemble quite closely those of that species. The margin (fig. 6) is armed with very prominent teeth, a space of 0.1 mm. being occupied by 6 or 7 of them. These teeth are rather long; are rounded at the tip and covered with numerous distinct serrations (fig. 7). At the base of each tooth there is a semicircular nearly transparent area, and there is an indication of the separation of the submarginal area from the dorsal disk. Caudal margin armed with a pair of long spine-like hairs. Vasiform orifice (fig. 8) situated on a prominent projection, subcircular in outline and almost filled by the operculum; lingula not observable through the operculum.

On the leaf the case is shiny black. There is a broad white lateral fringe composed of a closely appressed series of wax rods, radiating outward upon the leaf. The dorsum is more or less covered with a similar secretion, which, however, is of a more uniform texture, no visible rod structure being present.

Adult.—Unknown.

Type.—Cat. No. 19104, U.S.N.M.

The species was collected by R. S. Woglum on an unknown vine, Mirdon, Lower Burma, Dec. 1910.

ALEUROCANTHUS HIRSUTUS (Maskell).

Plate 34, figs. 10–15.

Aleurodes hirsuta MASKELL, Trans. N. Zeal. Inst., vol. 28, 1896, p. 434.

Larva.—(fig. 14).—The larva is broadly elliptical; size 0.6 mm. by 0.46 mm. The median area is evident, but not distinctly elevated. There are a number of prominent spines present, the position of which is shown in the figure. The margin is dentate, with the teeth evenly rounded; the thoracic tracheal folds are well defined (fig. 15).

Pupa.—(fig. 10).—The pupa case is broadly elliptical with indentations marking the thoracic and caudal tracheal folds. Its size is 2 by 1.6 mm. Color yellowish with a slight brownish shade. The median and subdorsal areas are evenly arched and slightly darker in color than the submarginal area, which is very flat. There is no distinct median ridge, and the vasiform orifice is but slightly elevated. The submarginal area is armed with a row of usually 50 rather long spines, arranged about the case as shown in the figure. These are about 0.2 mm. long and each is split into segments at the tip (fig. 12). On the submarginal area, between the marginal row of spines and the raised central area, there are two more pairs of spines present. The most caudal pair situated about opposite the vasiform orifice and the

other pair not far caudad of the thoracic tracheal folds. On the raised median and the subdorsal area there are about a dozen pairs of prominent spines, the arrangement of which may be seen in the figure. The vasiform orifice (fig. 13) is subcordate in outline with irregular folds showing on the margin. The operculum is of a similar shape with the lateral margins indented and it obscures the lingula. The margin is dentate, the teeth being evenly rounded at their tips (fig. 11). A space of 0.1 mm. is occupied by 24 teeth.

Habitat.—Australia, on *Acacia longifolia*.

Types on slide mounts forming part of the Maskell collection, on which the above description is based.

ALEUROCANTHUS LONGISPINUS, new species.

Plate 35, figs. 1-6.

This species was taken on bamboo at Calcutta, India, during October, 1910, by R. S. Woglum, and also on the same plant at Moulmein, Burma, in December. It is a very large species and in size agrees with *bambusae* Peal taken on bamboo in India. The larger number of spines, however, at once separates it from that species.

Egg (fig. 5).—Size 0.165 by 0.075 mm.; shape subreniform, slightly curved with the stalk situated near the larger extremity, on the concave side; surface covered with hexagonal areas (fig. 6), which are about 0.006 mm. in diameter; color light brown.

Pupa case (fig. 1).—Color black and very heavily chitinized so that it is with difficulty that the details are studied. After boiling for five minutes in aqua regia, the color is dark brown, with a darker median longitudinal area, which broadens somewhat across the abdomino-thoracic suture. Shape broadly oval, broadest across the third or fourth abdominal segment. Its size is 2 by 1.6 mm. On the submarginal area some considerable distance from the margin there is a closely set row of one hundred or more spines. These are not of a uniform length, but extend for a considerable distance beyond the margin. On the dorsum there is also a number of shorter spines, the relative average position of which is indicated in the figure. These, however, show some variation in different specimens. The abdominal sutures are fairly well defined in the aqua regia specimens, though it is almost impossible to distinguish them in other material. On each side the median area and arranged along the abdominal sutures, are a number of small circular dark pore-like areas (fig. 4). It is possible that these areas may have originally been the seats of minute bristles, but we have been unable to distinguish such in any material. The margin (fig. 2) is dentate, the teeth being blunt and evenly rounded. These teeth are situated close together and are small, a space of 0.1 mm. being occupied by 7 or 8 teeth. Just within the margin, extending inward opposite each tooth, is an elongate rounded,

faintly appearing structure of about the same size as the tooth. Within the rounded portion of the inner extremity of this structure a dark area is situated, which may represent the secreting area of the marginal tubes. On the submarginal area between these structures and the row of spines, the surface presents a granular or irregularly striated appearance. The vasiform orifice (fig. 3) is situated on a tubercle. Its shape is that of a rounded triangle and its inner margin in many specimens is irregularly waved or toothed. The operculum almost entirely fills the orifice obscuring the lingula. Near the cephalic lateral margin of the orifice a pair of small spines is situated one on either side.

On the leaf the pupa case is solid black with the spines appearing a dark brown. There is a very slight irregular waxy secretion on the dorsum, mostly on the subdorsal area. When this is present in any quantity the median ridge shines through as a jet black area. On the lateral margin there is a fringe all around of dull white wax which is not even but broken up into plates or sections, some of which are considerably longer than others. In some cases these have a slight woolly appearance, but usually are dull and waxy in appearance.

Adult.—Unknown.

Described from numerous pupa cases in balsam and dry upon the leaf.

Type.—Cat. No. 19097, U.S.N.M.

ALEUROCANTHUS MANGIFERAE, new species.

Plate 36, figs. 1-9.

This species is represented by four different lots of material. The type lot was taken on mango by R. S. Woglum at Bombay, India, in 1909. Another lot was collected from the same plant by Mr. Woglum at Saharanpur, India, in October, 1910, and a third lot was taken by him at Dehra Dun, India, on the same plant in November, 1910. Besides this material there is one slide containing eggs, larvae, and pupae, which was received from Mr. J. G. Sanders and marked "Imported plant, India, October 8, 1908." The pupa case on this slide shows a slight variation from the type in regard to the relative length of the submarginal spines, but as considerable variation occurs between specimens, and even sometimes between the two halves of the same specimen, there seems little doubt that Sanders's material is of the same species.

Egg (figs. 2 and 3).—Length 0.24 mm., width 0.128 mm. Somewhat oval in outline, and curved with the stalk situated near the larger end; color light yellowish brown; stalk short; surface covered with hexagonal markings, the average diameter of which is 0.06 mm.

Young larva (fig. 6).—Length 0.4 mm.; width at greatest diameter 0.208 mm.; shape oval, the caudal end the smaller; median dorsal portion considerably elevated; color dark brown, with here and there lighter transparent areas. On the cephalic extremity there is a pair of slightly curved spines averaging 0.076 mm. in length. Somewhat caudad is another pair of about the same length; slightly caudad of these and situated close together near the median dorsal line is a pair of spines averaging 0.2 mm. in length; caudad of these and situated well out on the submarginal area is a pair of shorter spines averaging 0.112 mm. in length; caudad of these again and situated close together near the median dorsal line there is another large pair about 0.2 mm. long; caudad of this pair is a variable number of one or two pairs of minute spines, and then two pairs of well developed ones about 0.16 mm. long. The most caudal pair of these is slightly the longer. Situated just cephalad of the vasiform orifice is a pair of small bristles, and there is a similar spine on each side of it. There is a pair of long spines, about the same length as the last pair of abdominal ones, situated a spine on either side of the orifice. Just within the caudal margin of the case there is a pair of rather long hair-like bristles, and on the caudo-lateral margin a pair of minute ones is situated. The vasiform orifice is somewhat squarish or often almost circular. It is almost completely filled by the operculum which obscures the lingula. The margin of the larva is bluntly serrate.

Late larva (fig. 4).—Length 0.8 mm.; width 0.48 mm.; shape elliptic; dorsum arched. On the submarginal area there is a row of usually 24 spines. Of these the first and third caudal pairs and the second cephalic pairs are usually considerably longer than the others. On the dorsal and subdorsal areas there are 28 spines. There are three long pairs on the abdomen and one long one on the thoracic area. On the thorax also there is a pair of setae on the dorsal area, a similar pair is situated just anterior to the vasiform orifice, and another pair on the caudal margin of the case. Some specimens show the first and second caudal pairs of submarginal spines long instead of the first and third. The vasiform orifice (fig. 8) is situated on a tubercle-like structure; broadly subcordate in outline and is almost filled by the operculum. The ventral membrane of the orifice is bilobed. The margin is armed with prominent teeth, the tips of which are knobbed. A space of 0.1 mm. is occupied by 12 or 13 teeth.

The interspaces between these are quite acute, though the distal knobbed portion is rounded; a space of 0.1 mm. is occupied by 10 teeth.

Pupa case (figs. 1 and 9).—Size, 1.39 by 0.88 mm. Shape oval; broadest across the abdomen; dorsum with a distinct elevated median

ridge. Suture separating thorax and abdomen much curved, as indicated in figure. Submarginal area armed with a series of 34-36 spines. These vary considerably in relative length, but in most specimens they are as indicated in figure 1, being of nearly equal length on the thorax, but on the abdomen having five of the spines much longer than the others. In the pupa case on slide No. 5234 there is quite a different arrangement, as is shown in figure 9. In this example the spines on the submarginal area of the abdomen are alternately long and short. Those of the long series average 0.48 mm. in length and those of the small series 0.2 mm. On the abdomen there are, as a rule, nine pairs of spines other than those of the submarginal series. Three of these are long and the remaining pairs short. The vasiform orifice (fig. 7) forms the caudal extremity of the median dorsal ridge. It is, therefore, elevated and is somewhat subcordate in outline. The operculum is straight on its cephalic margin and almost entirely fills the orifice, obscuring the lingula. Two pairs of long setae are present on the case, one pair on the caudal margin and the other pair just cephalad of the vasiform orifice. The margin (fig. 5) is armed with prominent knobbed teeth.

On the leaf the specimens are black and shiny, with the dorsum highly arched, and the abdominal segments not distinctly marked. There is almost no dorsal secretion, but occasionally there is a slight woolly patch which seems very lightly attached to the pupa. The small patches of wax are sometimes found sticking upon the spines, which are quite erect. The margin has a narrow fringe of white wax, more or less woolly in appearance, which is on the very base of the case against the leaf. In some specimens this marginal fringe is almost lacking, the cases being completely jet black.

Adult.—Unknown.

Described from numerous pupa cases, larvæ and eggs in balsam mounts, and pupa cases dry upon the leaf.

Types.—Cat. No. 19098, U.S.N.M.

ALEUROCANTHUS NUBILANS (Buckton).

Aleyrodes nubilans BUCKTON, Ind. Mus. Notes, vol. 5, 1903, p. 36.

This species is unknown to us in nature and the description is so indefinite that we are unable to compare it at all satisfactorily with our material from India. We have not been able to secure any similar species from the host, betel, or other plant.

Description.—Legs long and hairy with dimerous tarsi. Antennae rather long and with seven (?) joints in the female, which is a larger insect than the male. Wings four, rounded at the apices, and fringed with minute hairs. A single unforked central nervure, not continued to the margin. Membrane smoky in patches, with a darker blurred

spot. The male smaller, with a large thorax, taper abdomen, and furcate at the apex and with hinder legs longest.

The larvae crowd the undersides of the leaves of the betel in the form of small scales very difficult to detach. They appear like scales of some Coccidae, but these showed no distinct organs such as antennae, legs, or eyes. Their outer surfaces were more or less

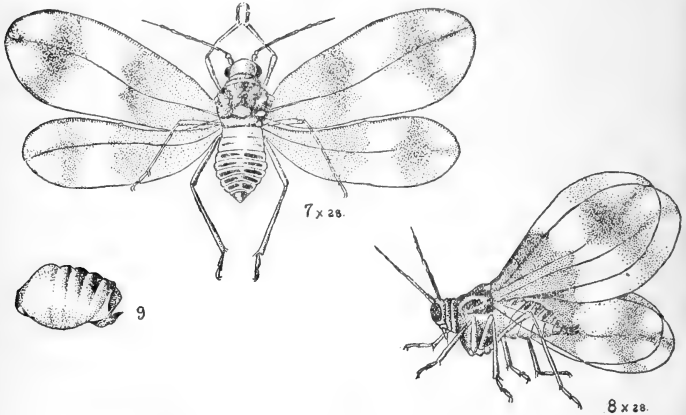


FIG. 2.—*ALEUROCANTHUS NUBILANS*. ADULT MALE AND FEMALE. (AFTER BUCKTON.)

spined, and some larvae were tufted with wooly matter, each thread being formed of a continuous spiracle.

This new Aleurodid was received on betel leaves from the Manager, Court of Ward's Estates, Backergunge, India, who reported that it was doing considerable damage to the plants. (Buckton.)

***ALEUROCANTHUS PIPERIS* (Maskell).**

Plate 37, figs. 1-6.

Aleurodes piperis MASKELL, Trans. N. Zeal. Inst., vol. 28, 1896, p. 438.

Amongst the type material of the Maskell collection this species is represented by one specimen each of larva, pupa case, and pupa extracted from the case. The last is so distorted that it is of little value for descriptive purposes.

Larva (fig. 6).—Length 0.64 mm.; width about 0.5 mm.; shape broadly elliptical. Abdominal segments not distinctly marked and median ridge not pronounced. Color under the microscope brown; submarginal area with the pigmentation irregular, giving it a mottled or granular appearance. Dorsum armed with a number of prominent spines of different sizes, the position and relative sizes of which are best shown in the illustration. These spines are acute at the tip

and each of the larger ones has near its distal extremity a peculiar notch-shaped structure (fig. 4). There are also on the dorsum five pairs of setae—one pair on the caudal extremity, one pair just cephalad of the vasiform orifice, two pairs on the median dorsal portion of the thorax, and one pair, more widely separated, on the cephalic margin of case. Vasiform orifice (fig. 3) subcircular, with the operculum almost entirely filling the orifice and obscuring all but the tip of the lingula; margin armed with moderately rounded teeth.

Pupa case (fig. 1).—Length 1.168 mm.; width 0.75 mm.; shape elliptical, with a moderate median ridge. The type-specimen is much broken and so poorly preserved that it is difficult to make out the dorsal structures; color very dark brown; submarginal area with about 22 prominent spines forming a ring. These extend well beyond the margin, are acute at the tip, and each is armed a short distance from its distal extremity with the same peculiar notch-like structure found in the larva (fig. 4). The caudal pair of these spines is broken off from the type-specimen, but we have figured them longer than the others as described by Maskell. Just below this submarginal row of spines there is a row all around of very many minute, knobbed setae (fig. 5). These are very small, being no longer than the spines are thick at their bases. Each of these little setae has the knob and the distal half transparent, while the basal half is dark brown. The dorsum is armed with a number of spines, but owing to the very poor condition of the type it is impossible to say with certainty either the number or the position of these. As near as we can make out, however, they are shown in the illustration. The submarginal area is irregularly pigmented, giving a very distinct mottled appearance. The margin is dentate with the teeth moderately acute and the interspaces shallow. A space of 0.1 mm. is occupied by about 16 teeth (fig. 2).

Habitat.—Ceylon on *Piper nigrum* (?).

Since the foregoing descriptive notes were made we have received from Mr. Andrew Rutherford a slide marked "Peradeniya 9-8-13." This slide contains a pupa case which is no doubt *piperis*. It has the same knobbed setae, the same notched spines, and the same general characters. The caudal spines are, however, not longer than the others as described by Maskell, but are about the same length. The caudal setae are long, about two-thirds as long as the caudal spines. In the character of the notched spines this species is similar to *citriperdus*.

ALEUROCANTHUS SERRATUS, new species.

Plate 37, figs. 7-10.

This species occurs in two lots of material collected on an unknown tree in the Botanical Gardens, Buitenzorg, Java, by R. S. Woglum January, 1911.

Egg.—Length 0.192 mm.; width 0.15 mm.; form slightly oval; surface marked with hexagonal areas, the diameter of which is about 0.012 mm. This appears to be a network on the exterior of the egg, which may become detached from it. Stalk very long, 0.288 mm., attached evenly at the base of the egg; color light yellowish brown.

Larva.—One specimen of the larva is present, but it is in too poor condition to give any accurate details. It is 0.24 mm. long, pale yellowish, and armed with an uncertain number of long spines.

Pupa case (fig. 7).—Size 1.01 mm. by 0.72 mm.; color on leaf deep black, dark brown under the microscope; shape somewhat oval, with the margin slightly "angled" at several places, as shown in the figure. The abdomino-thoracic suture is distinct; the median dorsal area forms a slightly elevated ridge, and extending from the abdominal segments outward to the margin of the case a number of folds or ridges are noticed. The surface appears more or less unevenly pigmented, giving a granular or mottled appearance to the submarginal area. On the submarginal area, forming a ring around the case, is a row of about 20 spines, all of about the same length, averaging 0.128 mm. in length. In the cleared specimens these spines are of a deep brown color at the base and yellowish toward the tip, which is more or less jagged (fig. 10). Ten of the spines of this row are on the thoracic area and 10 on the abdominal area. On the thoracic region, more mesad than the row of spines just mentioned, are usually six pairs of very small spines forming a row down each side of the median ridge. On the abdomen there are three pairs of spines on the median ridge, two pairs of small ones close together on the cephalic extremity of the abdomen and one pair of rather large spines just anterior to the vasiform orifice. Other than these, there are five pairs of small spines situated on the subdorsal area as shown in the figure. The vasiform orifice (fig. 9) is elevated, forming the caudal extremity of the median ridge. It is somewhat circular in outline, flattened cephalad, and its anterior margin is irregular in outline. The operculum is somewhat similar in shape, though more rectangular, and almost completely fills the orifice, obscuring the lingula. The margin is dentate with the teeth very acute and regular, a space of 0.1 mm. being occupied by about 26 teeth (fig. 8). At the base of these teeth are a number of small, circular, clear pore-like areas, and arranged around the case a short distance from the margin is a series of tubercled setae. A pair of long, rather fine hair-like bristles is situated on the thoracic region near the median line, and a pair of setae is situated just cephalad of the vasiform orifice.

On the leaf the specimens are solid black and shining. There is little, if any, dorsal secretion, but the margin all around has a narrow, white, slightly flocculent waxy fringe. The cases occur very spar-

ingly over the leaf and in the material at hand are associated with a large number of coccids.

Adults.—Unknown.

Described from pupa cases and eggs in balsam mounts and pupa cases dry upon the foliage.

Type.—Cat. No. 19101, U.S.N.M.

ALEUROCANTHUS SPINIFERUS (Quaintance).

Plate 38, figs. 1-6.

Aleurodes spinifera QUAINANCE, Can. Ent., vol. 35, 1903, p. 63.

Egg (fig. 2).—Exclusive of stalk, 0.2 mm. long by about 0.1 mm. wide; yellowish, curved, and marked with rather minute, closely set polygonal areas (fig. 3). Stalk quite short, holding egg in more or less upright position on leaf.

Larva.—Regularly elliptical, appearing brownish on leaf, varying to black, with evident, but short, cottony fringe of wax all around from marginal wax tubes; dorsum without secretion. Size probably in second stage, about 0.4 mm. by 0.3 mm. Margin distinctly crenulated all around; incisions between wax tubes short and acute. Abdominal segments quite distinct, thoracic less so. Dorsum set with very strong, heavy spines as follows: A row on each side about equidistant between the median longitudinal dorsal line and margin of case of seven spines each, or 14 in all. Eight of these occur on the abdomen and six on the thorax. More centrally on the thorax are six equally developed spines in pairs. Vasiform orifice, which is somewhat elevated on a subconical, truncated protuberance, subcircular in outline; operculum subcircular to subcordate, nearly filling orifice. Lingula short, nearly obsolete.

Pupa case (fig. 1).—As seen on leaf, with reflected light, jet black, considerably convex, the strong, dark spines plainly evident. Dorsum without secretion, but there is a compact, short, cottony fringe all around from marginal wax tubes. Size about 1.23 mm. long and 0.88 mm. wide; shape oval; dorsum considerably arched and median area prominent, especially at the vasiform orifice, which is situated on a prominent tubercle. On the submarginal area there is an even row of usually 20 spines (fig. 6) averaging 0.22 mm. in length and extending some distance beyond the margin. On the subdorsal area there is a row of similar but shorter spines, usually five pairs on the thorax and six pairs on the abdomen. On the median area there are three pairs of small spines on the thorax, three similar very small ones on the anterior part of the abdomen, and a moderately long pair a short distance cephalad of the vasiform orifice. The caudal margin of the case is armed with a pair of hairlike bristles and a pair of setae are situated near the cephalic

border of the vasiform orifice. The vasiform orifice (fig. 5) is very prominently elevated. It is subcordate, tending to circular, and is almost entirely filled by the operculum. The margin is dentate, the teeth being rounded at their tips with the interspaces acute. A space of 0.1 mm. is occupied by 12 teeth (fig. 4).

Adult.—Unknown.

Habitat.—Garolt, Java, on *Citrus* sp. and rose. Collected by C. L. Marlatt, Dec. 7, 1901.

Type.—Cat. No. 19102, U.S.N.M.

ALEUROCANTHUS SPINOSUS (Kuwana).

Plate 38, figs. 7-11.

Aleyrodes spinosus KUWANA, Pomona College Journal of Entomology, vol. 3, 1911, No. 4, p. 626.

Egg (fig. 7).—Eggs of this species were found amongst the paratype material in the United States National Museum. They are 0.192 mm. long and 0.08 mm. wide, oval, curved, and with the short stalk situated a short distance from the larger end. The surface is faintly reticulate, the reticulate areas being large, some of them measuring 0.012 mm. in diameter. The color is a light yellowish brown.

Larva.—The larvae are about 0.56 mm. long, yellowish, with brownish central area. The spines are situated in about the same position as those of the pupa, but they are proportionately longer, and often many of them are lacking.

Pupa case (fig. 8).—In general appearance this species resembles *calophylli*, though it can easily be distinguished from it by the position and number of spines and the dentition of the margin. Shape elliptic, broadest across the first or second abdominal segment; median ridge very evident on the abdomen and rather acute on the thorax. Size small, 0.88 by 0.64 mm. Color yellowish brown, darker mesad with sometimes a reddish tint. In the late pupa cases the eye spots are dark brown. Submarginal area unevenly pigmented and appearing granular. On the submarginal area there is a row of 20 spines, 10 on the thorax, and 10 on the abdomen. Those on the thorax are evenly distributed, forming a ring with 5 on each side. On the abdomen, however, this is not the case. Two of the pairs are situated near the margin on the first two abdominal segments. The other three pairs are situated more mesad and caudad, leaving a space between these and the first two, as shown in figure. Opposite the space and on the subdorsal area are two pairs of spines of the same size as the marginal ones. Cephalad of the first pair of these spines, on the subdorsal area, is a pair of smaller ones, and on the thorax there are eight pairs of minute spines, as shown in the figure. On the median abdominal ridge there are seven pairs of

spines forming two longitudinal rows. Of these the most caudal and the most cephalic pairs are longer than the others. Cephalad of the vasiform orifice there is a pair of small setae and on the caudal margin of the case a pair of rather long hair-like bristles are situated. The spines forming the submarginal ring (fig. 9) are fimbriate at their distal extremities. The margin of the case (fig. 10) is dentate, the teeth being rather evenly rounded and the interspaces acute. The teeth are rather small, a space of 0.1 mm. being occupied by about 26 teeth (fig. 10). Just within the margin all around there is a row of minute tubercled setae. The vasiform orifice (fig. 11) is sub-circular in outline, with the lateral and caudal margins armed with a number of folds. The operculum is very similar in shape, but tends more to triangular. It almost entirely obscures the lingula, but as the operculum is somewhat transparent this may be seen below it. On the leaf the cases are black with almost no secretion of any kind, though a very small quantity of wax is sometimes seen about the margin.

The host of this species is unknown. It was found by Kuwana among Coccidae from Formosa in 1909.

Adult.—Unknown.

Paratypes.—Cat. No. 19105, U.S.N.M. Specimens in balsam mounts and on foliage.

ALEUROCANTHUS T-SIGNATUS (Maskell).

Plate 39, figs. 1-9.

Aleurodes T-signata MASKELL, Trans. N. Zeal. Inst., vol. 28, 1896, p. 443.

Egg.—No eggs of this species are present for study, excepting those found within the abdomen of the one adult female comprising the type. These are 0.23 mm. by 0.12 mm. No marking is observable on the surface, but this may be developed later. The eggs are oval tending to crescent shape, with the short stalk situated some distance from the larger end.

Early larva (fig. 5).—Length 0.352 mm.; width 0.24 mm.; color light brown with shading of a darker color; thorax armed with three pairs of rather stout, short spines and one pair of setae on the median cephalic dorsal area. Abdomen with four short, stout spines on each side of the subdorsal area. Vasiform orifice somewhat rounded and almost entirely filled with the operculum; margin minutely crenulate and armed with a pair of setae on the caudal extremity; eye spots wine colored.

Late larva (fig. 6).—Length 0.624 mm.; width 0.448 mm. Color brown, considerably darker than the early larva. Spines arranged as on the figure, 10 on the thorax and 8 pairs on the subdorsal area of the abdomen. Vasiform orifice similar to that of the earlier

larva, but narrower in proportion. Margin with prominent crenulations; the teeth rounded and approximate.

Pupa case (fig. 1).—Size 1.12 mm. by 0.768 mm.; shape oval, broadest across the second abdominal segment. There is a distinct median ridge, most pronounced upon the abdomen, and from this pass outward and caudad three narrow ridges which extend nearly to the margin. On the cephalic portion semicircular transparent "eye slits" are noticeable; color under the microscope rather dark brown. The submarginal area is unevenly pigmented, giving it a striated and more or less granular appearance. The dentate rim is slightly darker than the submarginal area. On the submarginal area of the thorax there are 10 spines forming an even row. These are short (fig. 4) and do not extend to the margin of the case. Just caudad of the thoracic suture on the submarginal area of the abdomen there is a pair of similar spines, but no others on this area. On the median ridge of the thorax there are four pairs of very minute spines and one on the median ridge on the first abdominal segment. On the subdorsal area of the abdomen there are six pairs of spines forming a row down each side near the median ridge. These are of about the same size as those forming the submarginal ring on the thorax. On each abdominal segment upon the median ridge there is a pair of small circular pore-like areas, indicating the position of setae in some of the related species. The vasiform orifice (fig. 2) is small and situated at the extremity of the median ridge. It is subcircular in outline and the caudal and lateral margins present numerous folds. The operculum is similar in shape, but comparatively broad. It fills only slightly over half of the orifice, but obscures the lingula. The margin (fig. 3) is dentate, the teeth being rather close together, making the interspaces very narrow. The extremities of the teeth are evenly rounded and at their bases all around the case there is a row of minute clear pore-like areas. A space of 0.1 mm. is occupied by about eight teeth.

Adult female.—Length from vertex to tip of abdomen 1.168 mm.; color yellowish, shaded on the head, thorax, genitalia, and appendages with dusky. Eyes dark brown; antennae broken from the type specimen; legs dark smoky, hind femur 0.208 mm., hind tibia 0.432 mm. Foot normal, with the paronychium rather broad and hairy. Ovipositor short and acute. Vasiform orifice (fig. 7) surrounded by a dark area, elliptic transverse, 0.045 mm., broad; operculum subcordate with the indentation caudad; lingula observable only near the operculum, the remaining portion having been obscured in making the mount.

Forewing (fig. 9) 1.28 mm. long and 0.49 mm. wide at its widest part. Radial sector rather prominent; cubitus distinct but fine. Wings transparent excepting for two transverse bands of a reddish color. The distal band is some distance from the extremity of the wing

and is broken where it crosses the radial sector. The proximal band consists of an irregular patch above the radial sector and a somewhat distinct T-shaped marking. The proximad portion of the cross of the T is much longer than the distal portion. The margin consists of a series of bead-like projections armed with hairs, of which one is longer than the other. The lower wing appears to be unmarked, though from the position of the mount it is difficult to determine.

This species was collected by Mr. Froggatt on *Acacia longifolia* from Botany, near Sydney, Australia.

Types in balsam mounts in the Maskel collection.

ALEUROCANTHUS WOGLUMI Ashby.

Aleurocanthus woglumi QUAINANCE and BAKER, Journ. Agric. Research, vol. 6, 1916, p. 463, fig. 2.

A. woglumi is a very common species in the Orient and has recently been introduced into the West Indies and the Bahama Islands.

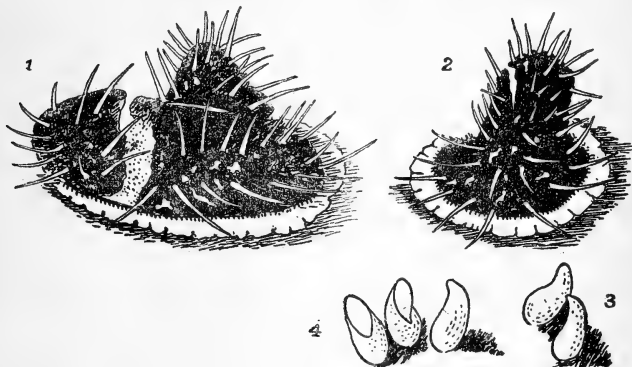


FIG. 3.—ALEUROCANTHUS VOELTZKOWI. 1, PUPA CASE; 2, PUPA CASE SHOWING DEVELOPMENT OF CENTRAL AREA; 3, EGGS; 4, EGG SHELLS SHOWING METHOD OF SPLITTING OF EGG IN HATCHING. (AFTER NEWSTEAD.)

ALEUROCANTHUS VOELTZKOWI (Newstead).

Figure 3.

Aleyrodes voeltzkowi NEWSTEAD, Quart. Journ. Liverpool Univ. Inst. Comm. Research in Tropics, vol. 3, 1908, No. 6, p. 12.

The description of *voeltzkowi* is very inadequate and we have no material of the species. It evidently, however, falls in this group.

Puparium [Fig. 3, 1].—Ovate, black, shining, with numerous long spiniform hairs, arranged in a double row at the sides and in front, but are less regular and more numerous posteriorly. Dorsum with a large subcentral boss, thickly set with long spiniform hairs. Fringe white, broad, continuous basally, but irregularly divided at the edge. Length 1 mm.

Puparium of second stage female [fig. 3, 2] black, shining, more or less circular, clothed with numerous long spiniform hairs, with the central spiny boss and fringe, as in the adult.

Ovum [fig. 3, 3] yellow, pedunculate, curved, swollen basally, bluntly pointed, anteriorly, cuticle finely punctate. After the escape of the larva [fig. 3, 4) it bears a marked resemblance to a univalve shell.

Habitat.—Sainte Marie, Madagascar, August, 1904. On an unnamed plant, the leaves of which were almost completely covered with the black puparia, larvae and eggs. Although so numerous, I failed to find a puparium which had not been ruptured by the escape of the imago. The boss-like process on the dorsum of the puparium is very remarkable, and serves at once to distinguish the species. In most instances it appears to be semidetached, so that in all probability it represents the larval exuviae, though I can not find that any previous author has discovered a similar trait in this family of the Homoptera. The test of the younger individuals are still more remarkable, in that they appear like little black spiny pillars, resembling, in form, some of the succulent Echinocacti.

This species is dedicated to its discoverer, Doctor Voeltzkow. (Newstead).

Genus ALEUROCYBOTUS Quaintance and Baker.

Aleurocybotus QUAINANCE and BAKER, Tech. Ser. 27, pt. 2, Bur. Ent. U. S. Dept. Agr., 1914, p. 101.

Pupa case of medium size, very narrow and elongate; margin toothed, the wax tubes very poorly developed; submarginal area not separated from dorsal disk; dorsum without papillae or pores though there is present on each side of median area of abdomen a row of irregular pit-like structures; tracheal folds not discernible; secretion usually present as a short rim of wax, elevating case from leaf. Vasiform orifice subcordate, the lingula exposed caudad of operculum, usually included, but the tip sometimes exerted.

Adult with a single flexure in radial sector of forewing and no trace of media. Antennae of male with segment VII as long or longer than the other segments combined.

Type.—*Aleurocybotus graminicolus* (Quaintance).

KEY TO SPECIES OF ALEUROCYBOTUS.

1. Pupa case with a submarginal row of prominent vasiform spines. *setiferus*.
2. Pupa case without such row of spines. *graminicolus*.

ALEUROCYBOTUS GRAMINICOLUS (Quaintance).

Plate 40, fig. 1.

Aleurodes graminicola QUAINANCE, Can. Ent., vol. 31, 1899, p. 89.

This species is considerably smaller than *setiferus*, from which it can be easily separated by the absence of the marginal vasiform spines.

The type is composed of eggs, larvae, pupa cases, and an adult male.

Type.—Cat. No. 1478, U.S.N.M.

ALEUROCYBOTUS SETIFERUS, new species.

Plate 40, fig. 2.

Specimens of this species have been received from two localities. The first lot was found on *Imperata* in Java by Edward Jacobson, 1907. The second lot was collected on a grass at Peradeniya, Ceylon, September 8, 1913, by A. Rutherford.

Pupa case.—Size 1.472 by 0.8 mm. Dorsum not arched and with the segmentation distinct; the pit-like structures forming a double row along median portion of abdomen distinct though not so prominent as in *graminicolus*. Vasiform orifice about 0.08 by 0.08 mm. and situated 0.16 mm. in from the caudal margin. Tip of lingula sometimes extending a short way beyond the vasiform orifice. Margin of case entire and just within it a row of about 32 vasiform spines situated on tubercles. Color of case yellowish with a median dark brown area, which sometimes spreads out so as to give the case a mottled appearance. Eyes showing through the case as purple spots. On the leaf there is scarcely any wax apparent, the pupa lying flat upon the surface.

Adults.—Unknown.

Described from pupa cases in balsam mounts and dry upon the leaves.

Type.—Cat. No. 20204 U.S.N.M.

Genus ALEUROLOBUS Quaintance and Baker.

Aleurolobus QUAINANCE and BAKER, Tech. Ser. 27, pt. 2, Bur. Ent. U. S. Dept. Agr., 1914, p. 108.

Pupa case of medium size, subelliptic to oval in outline; color usually dark brown to blackish; margin toothed, the wax tubes only moderately developed; submarginal area separated from dorsal disk and much fluted by suture-like lines; dorsum without papillae, though minute pores may be present; tracheal folds evident in some species, though obscure or wanting in others; when present, terminating on margin of case in a few specialized teeth; vasiform eye-spots usually present on cephalic portion of case; wax secretion usually present as a narrow fringe from marginal wax tubes and also

on dorsum. Vasiform orifice subcordate; operculum similar in shape, almost filling the orifice, obscuring the lingula; orifice surrounded by a definite trilobed figure, the lobes of which form a channel from the orifice caudad to margin of case.

Adult with a single flexure in radial sector of forewing and no spur of media; wings usually marked with reddish. Antennae of seven segments; in the female, III longest. In the male, VII often as long or longer than other segments together.

Type.—*Aleurolobus marlatti* (Quaintance).

KEY TO SPECIES OF ALEUROLOBUS.

1. Submarginal area of pupa case without prominent spines.....2.
Submarginal area of pupa case with prominent spines.....*setigerus*.
2. Pupa case dark brown or black, more or less convex.....4.
Pupa case whitish or yellowish, flat; thoracic tracheal folds distinct.....3.
3. Without waxy secretion; case broadly elliptical; size 1.28 by 0.97 mm.; marginal pore of tracheal fold armed with three prominent rounded tooth-like lobes.
flavus.
- With sparse waxy secretion, a secretion of stout waxy filaments from marginal wax tubes spaced some distance apart, and finer and longer wax threads from submarginal pores. Size 1.86 by 1.52 mm.; marginal pore of tracheal fold armed with fine tooth-like lobes.....*simulus*.
4. Eyespots prominent.....5.
Eyespots not present.....10.
5. Thoracic tracheal folds fairly distinct.....6.
Thoracic tracheal folds not discernible.....7.
6. Pupa case elliptical; size about 1.35 by 1.1 mm.; a short fringe all around of glassy wax rods from marginal wax tubes, and whiter tufts of wax from pores of tracheal fold; a pear-shaped wax figure on dorsum of abdomen, from which run lines of wax along sutures to submarginal rim; marginal pores of tracheal folds on thorax armed with three rounded teeth.....*marlatti*.
- Pupa case subcircular in outline; female size 1.68 to 1.75 by 1.48 to 1.52 mm.; male smaller; a short, more or less broken fringe all around of white wax from marginal wax tubes, and two oblique transverse bands of tufted white wax on marginal part of cephalothorax and a narrow longitudinal line of white wax caudad of the operculum apparently marking position of the tracheal folds...*olivinus*.
7. Between submarginal area and dorsal disk, a band all around (narrowing at each end) of irregular dermal thickenings or markings.....8.
Without such band between submarginal area and dorsal disk.....9.
8. Pupa case broadly oval; size about 1.1 by 0.88 mm.; a short squarely trimmed wax fringe all around from marginal wax tubes.....*taonabae*.
9. Pupa case elliptical; size about 1.08 by 0.78 mm.; dorsum completely covered with secretion of white wax; from marginal tubes there is a loose but abundant secretion of grayish wax threads, and a narrow, square cut rim all around of wax concolorous with wax on dorsum.....*philippinensis*.
- Pupa case very elongate elliptical; size about 2.25 by 1.15 mm.; dense black in color; margin bearing a fringe of rather long snowy white wax rods; dorsum sometimes dusted with white powdery meal.....*barodensis*.
10. Pupa case elliptical; size about 1.4 by 1 mm.; a fringe all around of glossy wax rods, compact basad and spreading distad; dorsum more or less covered with glossy wax scales or plates; tracheal pores on margin indicated by bilobed or trilobed structures.....*solitarius*.

ALEUROLOBUS BARODENSIS (Maskell).

Plate 41, figs. 1-11.

Aleurodes barodensis MASKELL, Trans. N. Zealand Inst., vol. 28, 1896, p. 424.*Aleyrodes barodensis* COCKERELL, Proc. Acad. Nat. Sci. Phila., 1902, p. 281.*Aleurodes longicornis* ZEHNTNER, Archief Java Suikerind., vol. 5, 1897, p. 381.*Aleurodes longicornis* ZEHNTNER, Archief Java Suikerind., vol. 7, 1899, pt. 1, p. 445.

This species is represented in the Maskell collection by two slides—one of a pupa case and the other of a larva. The pupa case is not cleared and is of such a dense black color that it is difficult to make out any detail. The species no doubt, however, falls in this group. Also from a careful consideration of the description and figures of *longicornis* Zehntner, we believe this species to be identical with *barodensis* Maskell.

Larva (fig. 6).—Size 0.5 by 0.3 mm., elongate elliptical; dorsal disk not separated from the submarginal area, though there is a very narrow marginal region of a lighter color than the remainder of the case, which is brown. The margin is almost entire, but there are a large number of irregular indentations varying in depth. These, however, do not constitute a series of teeth. There is a pair of minute setae on the cephalo-lateral margin, and a seta is present on one side of the caudo-lateral margin (fig. 11). (There is none visible on the right side.) Scattered over the dorsum, as indicated, are a number of minute, circular, transparent, pore-like areas. These appear to be the seats of minute spines, but in the specimens at hand it is impossible to verify this excepting in a few cases.

The vasiform orifice (fig. 7) is subcordate in outline with the cephalic margin straight and the caudal extremity produced into a knob-like structure. The operculum is somewhat similar in shape to the orifice, but much shorter proportionately, and about half fills the orifice. The lingula, which is spatulate and setose, has its tip exposed caudad of the operculum. It is armed with two rather prominent spines. Two purplish eye spots are evident on the cephalic portion of case.

Pupa case (fig. 1).—Size 2.25 by 1.15 mm., very elongate elliptical, and by its shape and size easily distinguished from the other species of the group; color dense black, by transmitted light dark brown, with a lighter suture separating the dorsal disk from the submarginal area; vasiform orifice showing lighter than the remainder of the case and the eye spots almost transparent. Margin armed with a series of teeth (fig. 4) with shallow rounded incisions, from which suture-like markings extend mesad across the submarginal area. Vasiform orifice (fig. 3) subcordate, almost entirely filled by the operculum which obscures the lingula. The orifice is surrounded by a lobed area, and from its caudal extremity a furrow extends to the caudal

margin of the case (fig. 5). The distance from the caudal extremity of the orifice to the caudal margin is four and one-half times the length of the orifice. On the dorsum there are a number of minute clear circular spots, but from the condition of the specimen it is difficult to give the number or arrangement of these. The balsam mount still shows traces of a marginal wax fringe. Type in the Maskell collection.

Adult.—Unknown.

Habitat.—In India, on *Saccharum officinale*. The specimens were collected by the late Mr. Cotes, of the Indian Museum, Calcutta, from Baroda, who reported that they were rather damaging to the sugar cane in those parts.

ALEUROLOBUS FLAVUS, new species.

Plate 42, figs. 1-8.

This species was collected by R. S. Woglum on an unknown tree in the Royal Botanic Gardens, Ceylon, in October, 1910, and by A. Rutherford on *Loranthus*, Peradeniya, Ceylon, May 27, 1913. It is represented by pupa cases and eggs only.

Egg.—The egg (fig. 7) is 0.224 mm. long and 0.096 mm. wide. It is stalked at its larger end and slightly curved at the smaller end. It is yellowish brown in color and some specimens are covered with a waxy reticulation, which reticulations are 0.18 mm. in diameter. This apparently may be destroyed in preparing mounts.

Pupa case (fig. 1).—Size 1.28 by 0.976 mm.; form broadly elliptical; color light yellowish brown to almost transparent. There is no waxy secretion of any kind. Dorsal disk separated from the marginal area by a delicate line all around, just within which is a heavily chitinized wavy line (fig. 3); nearer the margin and within the submarginal area some specimens show a delicate line all around, but the presence of this is not constant. The body segments are distinct on the dorsal disk, and the median area of this disk is delineated from the lateral areas by wavy lines, as indicated in the figure. There are also upon the median area of the dorsum four longitudinal rows of minute pores and several others irregularly placed on the marginal portion of the dorsal disk. Three or four pairs of similar pores are also present on the thorax. The submarginal area is marked with a large number of irregular lines, extending mesad from the margin, which is crenulate (fig. 6). The thoracic breathing folds are quite distinct on the margin and terminate in three rather prominent rounded teeth (fig. 2). The vasiform orifice (fig. 4) is triangular, and longer than broad; its inner caudal margin is armed with a number of tooth-like projections. The operculum is similar in shape with, and almost entirely fills, the orifice. The lingula (fig. 5) is elongate, swollen toward the distal end, setose, and armed with two stout

spines. Its tip is scarcely visible caudad of the operculum. The orifice is surrounded by a differentiated lobed area, which forms a channel to the caudal margin of the case. This channel is longer, compared with the length of the orifice, than in the other species of the genus, and terminates in three rounded tooth-like projections (fig. 8). The margin of the case is armed with a caudal and a latero-caudal pair of setae.

Adult.—Unknown.

Type.—Cat. No. 19062, U.S.N.M.

ALEUROLOBUS MARLATTI (Quaintance).

Plate 43, figs. 1-16.

Aleurodes marlatti QUAINANCE, Can. Ent., vol. 34, 1903, p. 61.

Larva, first instar (fig. 2).—Size 0.288 by 0.192 mm.; form elliptical; color yellowish brown. Margin armed with usually 16 pairs of hairs situated on small tubercles, and at each tubercle the case is marked mesad by a small fold or suture. Of the hairs present the first and third caudal pairs are the longest. On the caudal portion of the case there are seven pairs of hairs, these near the middle of the case, and the balance on the cephalic portion. On the dorsum the abdominal segments are fairly distinct. The purple eye spots are visible and there are two pairs of fine setae, one pair on cephalic portion of case, cephalad and mesad of the eye spots, and one pair cephalad of the vasiform orifice. The vasiform orifice itself (fig. 3) is somewhat triangular in shape with rounded corners; the operculum is broad and short, and nearly fills the cephalic half of the orifice. The lingula, which is visible below the operculum, is elongate, with the distal extremity slightly enlarged and setose.

Larva, second instar (fig. 4).—Size 0.416 by 0.32 mm.; shape elliptical, in some specimens regularly oval; color yellowish brown, with orange markings due to the internal structure. Margin (fig. 5) forming a narrow differentiated band which is divided into a number of irregularly sized somewhat rectangular lobes by sutures extending mesad. A pair of long caudal setae and a pair of minute latero-caudal setae are present. On the dorsum the sutures marking the abdominal segments are easily seen and there is a series of minute pores around the submarginal area. The eye spots are dark brown to black. The vasiform orifice (fig. 6) is triangular and the operculum fills about two-thirds of the orifice. The lingula (fig. 7) is almost entirely obscured by the operculum, but when this is removed it is seen to be elongate, with a slightly swollen, setose distal extremity, which is pointed and armed with two prominent spines. The operculum is darker than the rest of the case.

Larva, third instar (fig. 8).—Size 0.656 by 0.544 mm.; outline elliptical, tending to oval; color rather dark brown, with eye spots almost black.

The entire dorsum has a fine irregular mottled appearance due possibly to differences in chitinization. There is a small dorsal median ridge and the abdominal sutures are distinct. Just laterad of the median ridge on each side of the caudal edge of each suture there is a small area of a lighter brown than that surrounding it. There is also on the submarginal area a series of minute transparent pores, the location of which may be seen in the figure. On the median portion of the case several of these pores are present. The margin (fig. 9) is plainly marked off into a series of toothlike sections by sutures extending mesad. These sutures extend farther than those of the second instar, and the divisions are more prominent. Vasiform orifice (fig. 10) triangular; operculum of a similar shape and almost entirely filling the orifice, leaving only the setose tip of the lingula exposed. The differentiated area surrounding the orifice and forming the caudal channel, so distinct in the pupa case, is visible also in this instar, though is not so marked. There is a pair of caudal setae and a smaller pair of latero-caudal ones.

Pupa case (fig. 11).—Size averaging about 1.35 by 1.1 mm.; outline elliptical; color by transmitted light almost black on the dorsum, which is surrounded by a fine yellowish brown line separating this from the brown marginal rim. Eye spots crescent shaped, transparent; structure surrounding the vasiform orifice and extending to the caudal margin almost black, while the channel it forms is light brown. On the dorsum the sutures are distinct and there are scattered over the case a number of very minute transparent pores, the relative positions of which are indicated in the figure. Marginal rim broad and separated from the dorsum by a distinct light line. Marginal rim (fig. 13) marked by a large number of light transparent sutures extending mesad from the margin. The sections marked off by these sutures form by their outer extremities the rounded teeth of the margin. There are on this marginal rim a few scattered very minute transparent pores similar to those on the dorsal area. The vasiform orifice (fig. 12) is triangular, somewhat acute caudad, and the operculum is very much the same shape, nearly filling it. The lower caudal membrane of the orifice is sculptured or folded irregularly. Near the latero-cephalic margin of the orifice a pair of setae is situated, and surrounding the orifice and extending caudad to the margin of the case there is a distinct area, the outline of which is indicated in the figure. This is dark brown, leaving a median, yellowish brown caudal channel. On the cephalic portion of this structure there are three pairs of minute transparent porelike places. The waxen secretion is fully described in the original characterization.

Adult female.—Color yellowish shaded with brownish black. Length about 0.83 mm. Antennae absent in all but one specimen, and on this only distorted portions of one antenna remain. Fore-

wing (fig. 15) about 1.2 by 0.56 mm.; radial sector thick and extending almost to the tip of the wing; cubitus faint but rather long and straight. Wings marked with rusty red as indicated in the figure. In some cases the spots may almost unite to form two irregular transverse bands. Hind wing without marks, but with more or less shading along the rather thick vein. Hind legs with the femora and the proximal portion of the tibiae dusky, the remainder yellowish; tibiae 0.416 mm. long, armed with very stout spines; tarsus, proximal segment 0.096 mm., armed with a few stout spines; distal segment 0.072 mm., covered, especially on the distal portion, with many minute setae, and with a few spines. Claws 0.012 mm.; paronychium long, acute, and curved.

Adult male.—Similar to the female; length from vertex to tip of claspers about 0.79 mm.; antennae absent in the specimen at hand; legs also absent, all except the femora and tibiae of the hind legs. These are colored as in the female, the former measuring 0.18 mm. and the latter 0.32 mm. Forewing about 0.928 mm. long, marked as in the female; hind wing 0.8 mm. long, unmarked. Claspers (fig. 16) brown in color excepting the tips, which are yellowish, 0.135 mm. long, upcurved and armed with a few small spines. Penis yellow, as long as the claspers, bulbous at the base and considerably curved upward.

Material studied, types and paratypes, and material collected by S. I. Kuwana in Japan at Fukuoka, 1907.

Type.—Cat. No. 19063, U.S.N.M.

The food plant is orange. Material was collected by C. L. Marlatt, Hokato, Japan, May 21, 1901. This same species was also taken by Mr. Marlatt at Kumomoto, Japan, May 17, 1901.

ALEUROLOBUS OLIVINUS (Silvestri).

Aleurodes olivinus SILVESTRI, Boll. Lab. Zool. Gen. Agr. della R. Scuola Superiore d' Agricoltura in Portici, vol. 5, 1911, p. 214.

We have seen no examples of this species, but the excellent description and figures given by Doctor Silvestri enable us to place it in this genus with considerable assurance. It is reported by Prof. Silvestri as occurring in central and southern Italy. The host is olive. A translation of the original description is given.

Adult female (fig. 4).—Body cream-colored or whitish ocher sprinkled with a white waxy powder, with a fulvous band upon the pronotum, two submedian bands of the same color upon the mesonotum, and two lateral bands upon the metanotum. The abdomen has upon its first tergite two submedian fulvous spots, from the third to the fifth tergite a median transverse band a little in front of the margin, and upon the sixth tergite another fulvous median spot. The fifth urosternite is almost wholly blackish. The wings are sprinkled with a white waxy powder slightly tending toward a cine-

reous tint and the forewings have fulvous spots disposed in the manner shown in figure 4, and in figure 6, No. 1. Length of body, not including the wings, from 1.60 to 1.70 mm.; with the wings from 2 to 2.10 mm. Width of the thorax 0.58 mm. Length of the abdomen 0.97 mm. and its width 0.74 mm. Length of the antennae 0.71 mm. Length of the forewing 2 mm. and its width 0.93 mm. Length of the hind wing 1.49 mm. and its width 0.71 mm. Length of the legs of the third pair 1.35 mm.

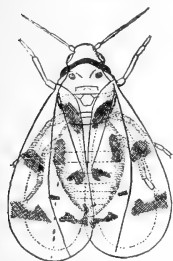


FIG. 4.—*ALEUROLOBUS OLIVINUS*. ADULT. (AFTER SILVESTRI.)

The head (fig. 5) is about as long (measured along the posterior margin) as it is wide. The compound eyes are well developed, and they are divided as they are in other species into an upper and a lower part. The ocelli are in contact with the upper margin of the compound eyes. The antennae (fig. 6, No. 14) consist of 7 joints, the first of these being very short, the second subcylindrical, twice as long as wide, the third much thinner than the second and a little more than three times as long as the second joint. In its distal part the third joint is furnished with four sensory organs, one represented by a somewhat thick and elongated bristle; the three others, on the other hand, by a groove with a short subconical process.

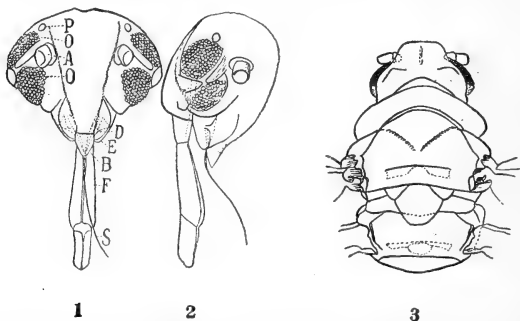


FIG. 5.—*ALEUROLOBUS OLIVINUS*. 1, HEAD OF ADULT, FRONT VIEW; 2, HEAD OF ADULT, LATERAL VIEW; 3, THORAX OF ADULT, DORSAL VIEW. (AFTER SILVESTRI.)

The fourth joint is short, much shorter than all the others and even than the second. The fifth joint is longer than the second and is provided with a sensory pit toward its distal part. The sixth is longer than the fifth, and the seventh about twice as long as the sixth. The seventh joint has a thickish and rather long bristle near its central portion and a slender apical bristle.

The ratio of length between one joint and the other of the antennae may vary somewhat in different specimens.

The upper labrum (fig. 5, Nos. 1 and 2) terminates in an acute and robust point. The rostrum extends with its extremity as far as the base of the third pair of legs; it has three joints, the second joint longer than the third and somewhat enlarged toward the apex. The third is narrowed at the apex and has the shape of a nipple.

The wings have the simple and straight venation characteristic of this genus, as can be seen in figure 6, Nos. 1 and 2. Their margin

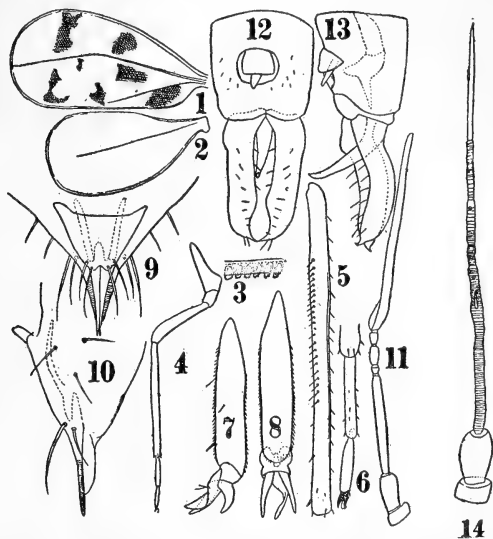


FIG. 6.—*ALEUROLOBUS OLIVINUS*. 1 AND 2, ANTERIOR AND POSTERIOR WINGS; 3, PORTION OF MARGIN OF ANTERIOR WING; 4, THIRD LEG OF ADULT; 5, TIBIA; 6, TARSUS; 7 AND 8, TWO VIEWS OF LAST SEGMENT OF TARSUS, MUCH ENLARGED; 9, OVIPOSITOR OF FEMALE, DORSAL VIEW; 10, LATERAL VALVE OF OVIPOSITOR OF FEMALE; 11, ANTENNA OF ADULT MALE; 12 AND 13, POSTERIOR SEGMENT AND GENITALIA OF ADULT MALE, DORSAL AND LATERAL VIEW; 14, ANTENNA OF ADULT FEMALE. (AFTER SILVESTRI.)

(fig. 6, No. 3) is finely crenulate and furnished with very short and very slender cilia.

The legs (fig. 6, Nos. 4 to 8) are rather long, the tibiae longer than the femora, cylindrical, furnished with a row of very short bristles along the inner upper margin and with six short bristles at the apex, two of which are superior, two internally lateral, one external, and one inferior. The tarsus is cylindrical, with its first joint longer than the second. The pretarsus is composed of two lateral claws and of one median appendix as long as the claws. This appendix is a little wider than the claws and not straight, but in the middle more or less curved in the shape of an arc.

The abdomen is somewhat longer than wide and oval in shape. The anal operculum (fig. 6, No. 12) is somewhat wider than long and its posterior margin is slightly sinuous. The lingula gradually increases in size toward the posterior part and terminates with a rounded margin.

The ovipositor (fig. 6, No. 9) is well developed and its two superior processes are a little longer than the inferior and lateral ones and are greatly attenuated. The lateral processes (fig. 6, No. 10) are finely crenulate.

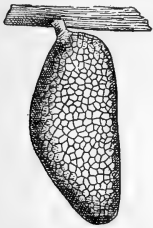


FIG. 7.—*ALEUROLOBUS OLIVINUS*. EGG. (AFTER SILVESTRI.)

Male.—Length of the body, including the wings, 1.49 mm.; without the wings, 1.30 mm. Length of the antennae 0.78 mm.

The antennae (fig. 6, No. 11) have their fourth joint very short; the fifth is a little thicker than and about twice as long as the fourth. The seventh joint is about twice as long as the second.

The last two segments of the abdomen are much narrower than the preceding segments, and the last segment (fig. 6, Nos. 12 and 13) is about as long as it is wide, with an operculum the width of which somewhat exceeds its length, and the "lingula" somewhat longer than the operculum.

The two posterior appendages are about one-third longer than the last segment, with an attenuated apex turned inward. The penis is shorter than the lateral appendages, gradually tapering and curved upward.

Egg.—The egg (fig. 7) is of subelliptical shape, with its free pole more attenuated than the opposite one. One side (the ventral one) is nearly straight; the other is more or less convex. It is furnished at the pole that is less attenuated with a short and thin peduncle by means of which it is fastened upon the leaf. Immediately after its deposition it is of a pale-straw color; subsequently it turns brown. Its entire surface is reticulated. Its length is from 0.247 to 0.253 mm. and its width from 0.117 to 0.123 mm.

Larva, first stage.—The newly hatched larva is of a fumose color. It is not covered with wax. Its length is 0.325 mm. and its width 0.234 mm. The length of the antennae is 0.074 mm. and that of the legs 0.061 mm.

Its body (fig. 8) is greatly depressed and its contour is more or less elliptical, being slightly narrower at the front than at the back.

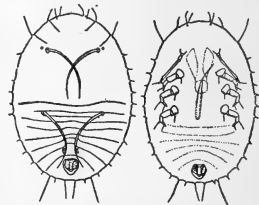


FIG. 8.—*ALEUROLOBUS OLIVINUS*. NEWLY HATCHED LARVA, DORSAL AND VENTRAL VIEWS. (AFTER SILVESTRI.)

The dorsum is provided with four long sublateral bristles, two of which are situated upon the posterior part of the head and the other two upon the second abdominal segment. The margin of the body is very finely crenulate and is provided with 16 bristles on each side and arranged as can be seen in figure 8. In the anterior submarginal part at the side of the first bristle there exists another bristle a little shorter than the adjoining one. The operculum is a little wider than it is long, and a little shorter than the lingula.

The antennae (fig. 9, No. 1) are composed of the three joints, the first of which is short and the second a little longer; the third is thin and about five or six times as long as the second, and ends in a short bristle which might also be considered as a rudimentary fourth joint. The third joint is also provided near the apex with a small external spur to the angle upon which there is attached a very short bristle. Corresponding to this part of the antennae we have not been able to distinguish a division, in contradistinction to that observed by Tullberg¹ and by Trägårdh² in the larvae of other Aleurodes.

The legs (fig. 9, No. 2) are short, scarcely reaching, if spread out, the margin of the body, with all the joints distinct. The tibia carries on its superior surface a little short of the apex a bristle which somewhat exceeds the combined length of both tibia and tarsus. The tarsus consists of one joint only, and it has always seemed to be more or less distinct from the tibia, and much shorter than the latter. The tarsus is provided with an external apical bristle which is longer than the tarsus itself. The pretarsus is short, slender, and widened at the extremity.

The larva of the first stage after it has attached itself begins to secrete white wax all along the margin of its body (fig. 10, No. 1), around the dorsal bristles, and in the space between the anterior dorsal bristles.

Around the body the marginal wax forms a fringe having a width of 0.042 mm. around the dorsal bristles; internally it forms a kind of sheath, and between the dorsal bristles a kind of small plate ("laminetta").

Larvae of the second and third stages.—These two larvae when they have scarcely emerged from the skins respectively of the first and

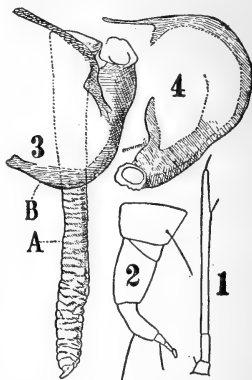


FIG. 9.—ALEUROLOBUS OLIVINUS. STRUCTURAL DETAILS OF JUST HATCHED LARVA: 1, ANTENNA; 2, LEG; 3, ANTENNA OF PUPA CASE; 4, THIRD LEG OF PUPA CASE. (AFTER SILVESTRI.)

¹ Arkiv for Zoologi, vol. 3, 1907, No. 26.

² Zeitschr. Wiss. Insectenbiologie, vol. 4, 1908, pp. 296-297.

second stages are first white, then chestnut-color, then azure black, and finally black.

The second-stage larva (fig. 10, No. 2) measures in length from 0.48 to 0.57 mm. and in width from 0.39 to 0.45 mm., and in the shape of its body comprising that of the legs is similar to the fourth stage of the larva which is described below. Around the margin of its body it has a fringe of wax formed of slender ribbon-like points whose length is 0.084 mm. and whose width is 0.009 mm. These at their apex are less separated from one another, while at the proximal part each of them is in contact with the one preceding and with the one following. The larva of the second stage differs from that of the

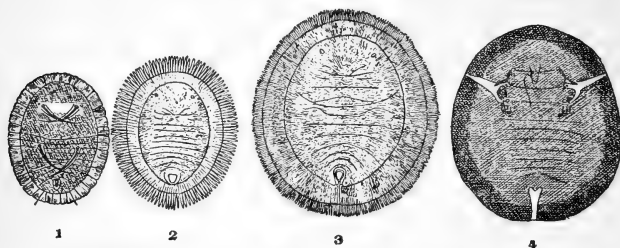


FIG. 10.—*ALEUROLOBUS OLIVINUS*. IMMATURE STAGES: 1, FIRST STAGE; 2, SECOND STAGE; 3, PUPA CASE; 4, VENTRAL VIEW OF PUPA CASE. (AFTER SILVESTRI.)

first stage in color, in size, in the form of the antennae and of the legs, and by the absence of the four dorsal bristles.

The larva of the third stage is similar to that of the second and of the fourth, and presents the following dimensions: Length from 0.75 to 0.93 mm., width from 0.67 to 0.81 mm.

Larva, fourth stage.—(fig. 10, No. 3.) The body is greatly depressed, almost laminate. Its length somewhat exceeds its width. The dorsum is black, provided with two tufted oblique transverse lines formed of white wax upon the marginal part of the cephalothorax some distance behind the level of the compound eyes and one narrow longitudinal line also consisting of white wax upon the median posterior part of the body behind the operculum. Around the margin there is found a fringe of wax like that found on the larvae of the second and third stages; but in this larva of the fourth stage this fringe is more or less broken up, and during the winter for the most part is lost entirely.

The color of the venter (fig. 10, No. 4) is dark green in the central portion and black in the marginal portion, with a narrow lateral waxy area at a level with the base of the second pair of legs. This area close to this same pair of legs bifurcates and its branches join the two stigmata. Another area composed of wax exists in the posterior part of the body. Length of the female from 1.68 to 1.75 mm.;

of the male from 1.20 to 1.35 mm. The width of the female varies from 1.48 to 1.52 mm. and of the male from 1.04 to 1.18 mm. Length of the antennae 0.325 mm.; of the legs 0.143 mm.

The upper part of the body is divided by a furrow into a marginal zone and a central zone. The former shows no trace of division into segments and is a little more than a third as wide as one-half of the width of the whole body. It is variously striated in the proximal part, transversely striated in the distal part, and its margin is minutely lobed, each lobe corresponding to the mouth of the wax-producing gland across which issues a marginal thread of wax. This zone, examined under a high magnifying power, shows also a circular row of small and very short cilia near the base and some small pores which are quite sparse.

The central zone is variously rugose; it shows distinctly the segmental impressions which can be seen accurately reproduced in figure 10, No. 3.

The compound eyes are dorsal; they are situated some distance behind the anterior margin of the body and are represented on the surface each by a cornea.

The antennae (fig. 9, No. 3 A) are entirely ventral, inserted at the side of the beak, scarcely in front of the first pair of legs. They are directly under the same in the rear and join a little on the outside at the level of the posterior margin of the base of the second pair of legs. They appear to be formed of a single joint (at least none can be seen distinctly); they are a little attenuated from the base to the apex and quite irregularly annulated. The apex terminates in a point a little curved, almost unguiform.

The legs (fig. 9, Nos. 3 and 4) are very short, formed of a long and rather wide base which is prolonged into a short subtriangular appendix, truncate at the extremity and provided with a concave membranous disk which constitutes a kind of pulvillus. The anterior legs are distinctly in front, the middle and the hind legs are in the rear.

The operculum is subtriangular; at its base it is a little longer than it is wide, with the apex slightly rounded and covering the whole of the lingua.

ALEUROLOBUS PHILIPPINENSIS, new species.

Plate 44, figs. 1-20.

This species has been received from Manila, Philippine Islands, on several occasions; i. e., June 3, 1904, on cultivated shade tree from Prof. C. H. Tyler Townsend; July 4, 1905, another lot, presumably of this same material, was received from Prof. T. D. A. Cockerell, who suggested that this was the first aleyroidid recorded from the Philippines. In May, 1910, we received from Mr. George Compere

an abundant sending of this species taken at Manila on an unknown tree, and finally the same insect was received June 21, 1912, from D. B. Mackie, Manila, Philippine Islands, on *Murraya exotica*. The type lot is that forwarded by Mr. Compere.

Egg.—Size 0.165 by 0.096 mm.; color yellowish; without reticulations, stalk attached at larger end (fig. 1).

Larva, first instar (fig. 2).—Size 0.165 by 0.258 mm.; shape elliptical; color, by transmitted light, light brown. Margin with usually 17 pairs of fine hairs situated on tubercles, of which the first and third caudal pairs, as well as the third cephalic pair, are longer than the others. Dorsal area with three pairs of stout short spines: One pair near the cephalic extremity between the eye spots, one pair at about the middle of the case and one pair cephalad of the vasiform orifice. Vasiform orifice (fig. 3) broad, triangular, with the anterior margin straight; operculum not half the length of the orifice, leaving the setose lingula exposed; size of orifice 0.027 by 0.024 mm. Antennae (fig. 20) composed apparently of four segments, the proximal irregular and large. The others narrow, cylindric, with the distal one very acute and placed at an angle from the others.

Larva, second instar (fig. 4).—Size 0.357 by 0.27 mm.; shape elliptical; color by transmitted light brown; margin with a series of about 15 pairs of spines, which are thick, short, and spear shaped (fig. 8). The caudal margin has a pair of rather long spine-like hairs. The margin itself (fig. 7) is all around divided into a number of areas by irregular divisions extending a slight distance mesad; dorsal area with three pairs of spines similar to those present in the first instar, and also with a series of minute subdorsal pores, as well as a few other scattered ones. The area around vasiform orifice slightly indicated in this instar. Orifice itself (fig. 5) somewhat triangular, measuring 0.065 by 0.039 mm. Operculum similar in shape and extending a little over two-thirds the distance to the caudal extremity of the orifice. The inner membrane of the orifice below the operculum and lingula appears sculptured, with reticulate, circular, or irregular markings. Lingula (fig. 6) narrow; not swollen at the tip, part of which is seen below the operculum and which is setose and armed with a pair of rather long spine-like hairs.

Pupa case (fig. 9).—Size 1.088 by 0.788 mm.; shape elliptical; color very dark brown by transmitted light, with the sutures separating the abdominal segments and a line marking off the marginal fluted area lighter. Eye spots transparent, with their broadest part caudad. Dorsum of case completely covered with layer of wax, though the body segments are evident. From the submarginal area arises a short square-trimmed fringe of wax of same color as on dorsum, which extends out over margin of case. From marginal wax tubes arises a rather light fringe all around of grayish wax fila-

ments. Dorsum covered with a large number of very minute pores, which show as transparent dots. There is a pair of setae on the second abdominal segment and a pair cephalolaterad of the vasiform orifice. Some of the pore-like spots on the other part of the dorsum may also be the seats of minute setae, but if so we are unable to observe them owing to the dark coloration of the case. The vasiform orifice (fig. 10) is triangular in outline, with the cephalic margin almost straight; the operculum is similar in shape and almost entirely fills the orifice, obscuring all but the tip of the lingula. This last is setose and armed with two spines. The caudal inner membrane of the orifice is sculptured, and this sculpturing is visible below the lingula; surrounding the vasiform orifice is a differentiated area consisting of a rounded portion directly cephalad of the orifice, from which two arms extend caudad, one on each side of the orifice, forming a caudal channel (fig. 10). The legs (fig. 11) are distinctly visible on the under surface of the case. Each is short, thick, and armed with a pad-like structure on the distal extremity. The antennae (fig. 13) are subcylindric, composed apparently of three segments, imbricated, and armed on the distal extremity with a narrow finger-like process, and a distal spine. The margin of case (fig. 12) bears a series of fairly even crenulations. These are not prominent, and the submarginal area is marked by a series of lines extending mesad, which gives it somewhat of a fluted appearance. On each of these sections a light spot may be observed near the margin, which spot seems to be the opening of a pore beneath. Scattered over the submarginal area there are a number of minute transparent spots similar to those on the dorsal area and on some of these small setae are located; on others, however, we are unable to find any.

Adult female.—Length from vertex to tip of ovipositor about 0.960 mm.; color yellowish, shaded with dusky. Eyes dark brown, constricted in the middle. Antennae (fig. 19) of seven segments; II subpyriform, 0.045 mm. long, and usually armed with three stout spines; III subcylindric, 0.114 mm. long, imbricated, and armed with a few faint transverse sensoria, and near the distal extremity there is a circular fringed sensorium with a central process; IV subcylindric, 0.024 mm. long; V similar, 0.033 mm. long; VI similar, 0.036 mm. long; VII subcylindric, tapering distally, armed at about the distal third with a number of minute circular fringed sensoria, and the distal extremity tipped with a spine. Forewing (fig. 15) about 0.95 by 0.38 mm.: radial sector curved, cubitus long, and fairly distinct; wings marked with rusty red, which forms two broken transverse bands, a distal spot over the tip of the radial sector, and a broken proximal one over the cubitus; margin beaded and bearing hairs. Hind wing with only one faint red spot in about the middle, below the vein. Vasiform orifice (fig. 16) broadly cordate, with the cephalic margin

straight; the operculum is rectangular, transverse, about half filling the orifice; lingula elongate, rounded, and slightly swollen at the tip; both operculum and lingula setose.

Adult male.—Length from vertex to tip of genitalia about 0.95 mm.; color similar to that of the female. Antennae (fig. 18) of seven segments. In the specimens at hand these segments are difficult to discover, but in all of them VII seems to be extremely long, much longer than that of the female. Segment II subpyriform, 0.045 mm. long and armed with prominent spines; III subcylindric, 0.084 mm. long, imbricated and armed with several faint, transverse sensoria and a distal fringed sensorium with a central process. Segments IV, V, and VI each about 0.012 mm. long, almost globose on account of their shortness. Segment VII tapering distally, 0.18 mm. long, armed with a number of minute transverse sensoria, and tipped with a spine. Forewing with markings similar to those of the female, length about 0.89 mm., width about 0.37 mm.; hind wing about 0.72 mm. long, with a red spot similar to that of the female. Hind tibiae 0.24 mm. long; hind tarsus, proximal segment 0.066 mm., distal 0.06 mm. Foot (fig. 17) with an acute central paronychium, which is armed near its basal portion with a rather prominent spine. Claspers (fig. 14) 0.12 mm. long and 0.066 mm. broad at the base, tapering, with distinctly curved tips and each armed on its inner margin with a few spines; penis bulbous at the base, not as long as the claspers, and upcurved.

Described from pupa cases on leaves, and other stages in balsam mounts.

Type.—Cat. No. 19061, U.S.N.M.

ALEUROLOBUS SETIGERUS, new species.

Plate 45, figs. 1-6.

Three collections made by Mr. A. Rutherford at Peradeniya, Ceylon, represent this species. The first was taken on *Harpullia pendula*, July 7, 1913, the second on an unknown host, July 25, 1913, and the third on *Harpullia*, September 7, 1913. The species is easily separated from all others in the genus by the row of prominent spines on the submarginal area of the pupa case.

Pupa case (fig. 1).—Size, 1.2 by 0.96 mm.; shape broadly elliptical, in this respect resembling *taonabae*; color black, under the microscope dark brown, with the suture separating the dorsal disk and submarginal area, the eyespots, and the bases of the spines transparent yellowish. Dorsum with the abdominal segments distinctly marked and with a broad rachis-structure on the median area quite similar to that found in *solitarius*. The dorsal disk is armed with four pairs of rather long spines, three of which pairs are on the thorax and one pair on the abdomen. The submarginal area (fig. 3)

is broad and marked with a series of suture-like lines extending mesad, which lines are puckered about the base of each spine. These spines are prominent, extending beyond the margin of the case, are yellow in color, and are situated in the middle of the submarginal area, forming a row on each side of usually eight spines. Just within the margin the submarginal area shows a band composed of minute, closely placed, pore-like structures, and mesad of these there is a series of larger paired pores (fig. 6). The vasiform orifice (fig. 2) is usual for the genus, but it and the operculum are quite acute caudad. The arms of the trilobed area extending caudad from the orifice are relatively short and are swollen near the caudal margin of the case to include a pore-like structure on each side. The central tooth of the caudal pore is a distinct piece and appears as if mosaic. The channel leading from the pore to the caudal portion of the orifice is corrugated. The thoracic pore (fig. 4) ends in a trilobed structure, suggesting that of *solitarius*. It is not, however, so distinctly separated from the submarginal area. The margin (fig. 3) is armed with very flattened divisions which can scarcely be called teeth.

Adult.—Unknown.

Described from pupa cases in balsam mounts.

Type.—Cat. No. 19128, U.S.N.M.

ALEUROLOBUS SIMULUS (Peal).

Plate 46, figs. 1-14.

Aleurodes simula PEAL, Journ. Asiatic Soc. Bengal, vol. 72, pt. 2, 1903, No. 3, p. 81.

We have not seen this species and it is with some hesitation that we include it here. From the description and figures it seems to be fairly closely related to *flavus* which undoubtedly falls within this group. It should be noted, however, that the wing as given for *simulus* is unmarked, a condition not met with in any of the other species of this genus of which the adults are known, and the antenna of the male is nearly twice as long as that of the female.

Egg.—Size, 0.2 mm. by 0.09 mm. Color, light yellow when first laid, afterwards turning brown. Peduncle about one-fourth length of egg. Examined while still within the body of the female the eggs are light yellow. The peduncle is curved inwards and pressed against the egg. Color of peduncle pink; basal end of egg fairly dark yellow.

Larva first stage.—Size, 0.25 mm. by 0.15 mm.

Shape elliptical. Color, semitransparent yellow; two yellow pigment patches in center of abdominal region. There are a series of 34 long hairs right around margin. The four hairs furthest cephalad are grouped in two pairs placed some distance apart. Of the six

hairs on caudal margin the inner pair long, the second pair short, and the third pair long. The 24 other setae are shorter than the long caudal setae; they are situated at equal distances apart on the lateral margins. Vasiform orifice as in the pupa case, but the operculum is larger proportionately, and the lateral margins of the orifice are somewhat incurved posteriorly beyond the operculum. Eyes maroon. Abdominal segments distinct. Antennae and legs present. The artist has drawn the vasiform orifice as seen by him through the transparent body.

Larva second stage.—Size, 0.45 mm. by 0.32 mm.

Shape, elliptical; color, yellow. Two yellow pigment patches in center of abdominal region. Two curved hairs caudad on margin. Vasiform orifice as in the pupa case, but the orifice is situated quite close to the margin. Abdominal segments distinct. Eyes maroon. A marginal fringe of stout, cylindrical, waxy filaments which are placed quite close together.

Larva third stage.—Size, 0.7 mm. by 0.5 mm.

Shape elliptical; margin at thorax angled slightly outwards. Dorsum almost flat. Color yellow. Two setae caudad, and two setae placed caudolaterally on margin. A marginal fringe of stout, cylindrical wax filaments. Eyes maroon. Abdominal segments distinct. Dorsum granular near margin. Margin broad, faintly demarcated mesad, and deeply striated radially. There is a distinct yellow band extending from the posterior extremity of the vasiform orifice caudad to margin. There are faint indications of the two radial thoracic bands so conspicuous in the pupa. They end, as also does the band extending caudad to margin, in five separate brown horizontal pores which secrete a small quantity of brown wax. Dorsum covered with a large number of extremely minute circular pores.

Larva fourth stage.—Size, 1.25 mm. by 1 mm.

Similar to pupa case except in size; it is also flatter.

Puparium.—Size, 1.86 mm. by 1.52 mm.

Shape oval; anteriorly the thoracic margins angled outwards, giving the anterior end a somewhat square appearance. Color bright yellow. Dorsum at first somewhat flat, later turning fairly convex. Three ridges on dorsum, two radiating from thorax to cephalothoracic margins, and one from the posterior end of the vasiform orifice caudad to margin. These ridges are dark yellow, blotched with gray. They end marginally in five stout, distinct, brown pores, which produce a small quantity of brown fluffy wax. Margin broad, demarcated mesad by a fairly broad distinct white band, the inner edge of which is dark brown. Margin with strongly marked radial striations, the dorsum also marked around the central area, but the markings are more granular than striated. A small quantity of

short, stout, waxy filaments, produced from marginal pores, spaced some distance apart. There are also a series of submarginal pores, which produce finer and longer wax filaments. They are also spaced some distance apart. There are two small slender setae on cephalic, and two similar but smaller setae on lateral margins. The surface of dorsum and especially of the margin covered with a very great number of extremely minute circular pores, which tend to form detached groups. These pores are also present over the radial patches, but the grouping does not differ from the rest of the margin, the pores not being arranged in any sort of pattern.

The margin of the pupa case turns quite white a short time before the adult emerges. Vasiform orifice conical, apex pointing caudad. Anterior margin flat. Lateral margins sloping inwards; the sloping surface with six ridges on each side. Operculum rhomboidal; the posterior margin somewhat incurved. The operculum extends to about or a little beyond the center of the vasiform orifice. Surface setose, color light brown. Lingula two-jointed, lower joint short, stout. Upper joint club-shaped. The lingula extends for one-third its length beyond operculum; the surface setose, color brown. Two long hairs spring from near the tip of the lingula and extend for some distance beyond the vasiform orifice.

Pupa extracted from puparium.

Head fairly broad, color yellow; the ocelli lighter in color. Thorax rather dark yellow, abdomen light yellow. Eyes dark maroon. Unfolded wings dark gray. Legs almost transparent, well formed, setose. Sides of abdomen flattened and spread out. Abdominal segments fairly distinct, but the vasiform orifice can not be made out. Antennae not noticeable in the specimen examined. When the adult emerges from the pupa case the dorsum splits up not only from the cephalic margin to thorax and across the thorax, but also right round the inner edge of the margin so that in empty pupal cases the anterior portion of the dorsum is usually missing. I have observed no parasites on this species.

Adult female.—Length, 1.9 mm.; wing, size 1.9 mm. by 0.85 mm.

Body light yellow; antennae and legs semitransparent white. Tip of mentum gray. A lateral gray stripe on each side of the first segment of the abdomen, and dorsally a rather broad diagonal gray patch on each side of the same segment. Dorsally each abdominal segment dark gray nearly the entire width of the body. An oval gray plate situated on the dorsal surface of the last segment of the abdomen. It incloses the vasiform orifice. Ventrally the abdomen covered with fine short hairs. Body and legs covered with white meal. Eyes reniform, almost divided; color dark maroon. Wings immaculate. Vasiform orifice broadly conical, the anterior edge somewhat produced and with a flat indenture in the center. Oper-

culum cordate, apex pointing cephalad. Posterior margin incurved; lateral margins dark and wavy. The operculum extends nearly the whole length of the orifice, but is somewhat narrower. Color dark gray. Lingula cylindrical; it projects to the posterior edge of the vasiform orifice; end almost flat. Only the part which projects beyond the operculum can be made out; color gray. Antennae, length 0.5 mm. Formula (3, 6), (2, 4, 5), 7, 1. Joint 1, short, flat; joint 2, subpyriform, about twice length of joint 1; joints 3 and 6, equal in length, each about twice the length of joint 2; joints 4 and 5, each equal in length to joint 2; joint 7, short, thin, and tapering to a point, about one-third length of joint 6.

Adult male.—Length, 1.7 mm.; wing, 1.5 mm by 0.77 mm.

Color, etc., much as in the female. The antennae, however, are enormously developed, being proportionately about twice as long as those in the female. Length, 0.9 mm. Formula, 5, 3, (6, 7), 2, 4, 1. Joint 5 is very long, being nearly equal to all the others together. Joint 1, short, flat; joint 2, subpyriform, twice length of joint 1; joint 3, fairly long, one and a half times length of joint 2; joint 4, short, less than half the length of joint 3; joint 5, long, almost equal to all the other joints together; joints 6 and 7 equal, together about equal to joints 3 and 4. The antennae are heavily ringed, and it is extremely difficult to make out the joints. The under surface of the abdomen covered with a large quantity of white fluff.

This species occurs in great abundance on the Simul tree (*Bombyx malabaricum*) in Calcutta. The leaves are thickly covered with the insect. They become yellow and spotted wherever an insect is attached and are ultimately killed. Superficially the insect somewhat resembles *A. eugeniae* Maskell. There are the same radiating dorsal patches and the dorsum is similarly striated. They differ, however, in the shape of the pupa case and the shape of the vasiform orifice. *A. simula* has a slight marginal fringe and there are four setae on the margin. The radiating dorsal patches are quite different in the two insects. In *A. simula* these patches are not formed by closely apposed pores, but are yellow bands striated with gray. The thoracic radial patches are also true ridges, being elevated above the surface of the dorsum. All three patches in this species end not in a single aperture or pore opening dorsally, but in five stout brown horizontal pores, which secrete a small quantity of fluffy brown wax. The dorsum in this species is covered with a large number of extremely minute circular pores; the margin is also broad and clearly defined.

Mr. Maskell was mistaken in assuming that the three radial patches were sufficient evidence to prove the close relationship of *A. eugeniae* and *A. eugeniae*, var. *aurantii*. As a matter of fact, many of the Indian Aleurodidae possess this characteristic, however widely different they may otherwise be. (Peal.)

ALEUROLOBUS SOLITARIUS, new species.

Plate 47, figs. 8-13.

This species is of special interest as coming from the United States. Other members of the genus, it will be remembered, come from the Orient. Our material of *solitarius*, though limited to three examples of pupa cases in balsam mounts and one pupa case on leaf, is sufficient to warrant its description, as its characteristics are distinct. The specimens were received from H. O. Woodworth, October 17, 1901, and were sent from Champaign, Illinois, where they were supposedly collected. The host is red-bud, *Cercis canadensis*.

Pupa case (fig. 8).—Size about 1.4 by 1 mm., elliptical in shape, very dark brown to blackish in color under transmitted light. Body segments lighter and quite distinct. The transparent lunar eyespots noted in other dark-colored forms of this genus are in this species not discernible. Dorsal and submarginal areas distinctly demarked by a suture extending all around the case. On dorsal disk are a few transparent dots, as indicated in the illustration. The setae and their arrangement can not be satisfactorily determined in the specimens in hand, due to their dark color, but these are probably placed in the normal way for related forms, as *marlatti*. Vasiform orifice (fig. 12) triangular in outline, with the surrounding lobed area typical of the genus. The operculum corresponds in shape to the outline of orifice, which it nearly fills. The lingula is not observable through the dense brown operculum.

The submarginal area is quite distinct as a fluted zone all around the case. The margin is very faintly beaded by the ends of the wax tubes, the sutures between which near the margin are distinct, but are more or less anastomosed mesad (fig. 13). The marginal area shows many minute transparent dots like those present on the dorsal area. The tracheal pores on margin of case are indicated by a bilobed or trilobed structure (figs. 9, 10, and 11) which is distinct from the tracheal pores in other species of the genus thus far seen.

On the leaf the pupa case appears dense black in color. There is a fringe all around of glassy wax tubes, compact basally and spreading by groups distad. These rods have a length of about one-half of width of pupa case. Dorsal area more or less covered with scales or plates of wax of general color of marginal fringe.

Adults.—Unknown.

Type.—Cat. No. 19103, U.S.N.M.

ALEUROLOBUS TAONABAE (Kuwana).

Plate 47, figs. 1-7.

Aleurolobus taonabae KUWANA, Pomona Journ. Ent., vol. 3, 1911, p. 623.

Egg (fig. 1).—Size 0.16 by 0.99 mm., elliptical, pointed at distal end; pale yellow in color; stalk very short, dark brown. (We

notice that some of the eggs in the paratype material have a reticulate structure of wax, which mostly disappears when mounted in xylol balsam.)

Larva, first instar (fig. 2).—Length 0.03 mm., form elliptical; color pale brownish; eyespots purplish brown, and the vasiform orifice a darker brown than the remainder of larva. On the dorsum the abdominal segments are distinct. There is a pair of minute setae bordering the vasiform orifice, and there are two pairs of very long curved spines situated on tubercles, one pair on the cephalic extremity, just cephalad of the eyespots, and the other on the middle of the larva. The margin (fig. 3) is very minutely toothed, the teeth being rounded at their tips. There are 15 pairs of marginal hairs observable on the paratype specimens, though these are in such a condition that other hairs may be present and not visible. Of the marginal hairs the caudal pair is long and the third caudal pair extremely so. The others are nearly uniform in length. The vasiform orifice (fig. 4) is nearly triangular with the caudal extremity rounded. The operculum is rectangular and about half fills the orifice. The lingula is elongate, extends nearly to the caudal extremity of the orifice, and its tip is setose.

Pupa case (fig. 5).—Length about 1.28 mm., width 1.12 mm., in broad specimens. There is considerable variation in the relative lengths and widths in different specimens; some look rather long and narrow, while others are nearly as broad as long. Color of case by transmitted light very dark brown to black. There is a distinct broad marginal rim evenly marked off from the central dorsal disk. This central dorsal area is divided into two parts: First, a central area with very little sculpturing, on which the abdominal segments are distinctly visible; and, secondly, a subdorsal area forming a band all around, but narrowing at each extremity. This is covered with numerous irregular corrugations, and the sutures of the abdominal segments are not visible upon it. The transparent eyespots are more or less crescent shaped and are located within the subdorsal area. There are also upon the dorsum many minute transparent circular pore-like places arranged in irregular or broken rings about the case. There seem to be two rows of these on each side of the middle dorsal area and one row on the subdorsal area. The vasiform orifice (fig. 6) is somewhat triangular and longer than broad. The operculum is of a similar shape and fills about two-thirds of the orifice. The inner membrane is reticulate as shown in the figure. The orifice is surrounded by an area similar to that present in the other species of the group, consisting of a cephalic and two lateral lobes which form a channel caudad. The marginal rim (fig. 7) is irregularly divided by a large number of sutures extending mesad on the submarginal area. The outer extremities of these form shallow rounded teeth on

the margin. There is a pair of small setae on the cephalic margin at about the same distance from the median line as the eyespots and a similar pair of latero-caudal setae. We have been unable to find any caudal setae similar to those present in the related species, though these may normally be present and not observable in the specimens we have been able to study. On the leaf we have only two specimens. These do not show any secretion from marginal wax tubes, as stated by Kuwana, and it has doubtless been broken off in our material.

Paratype material of eggs, larvae, and pupa cases studied in balsam mounts.

Type.—Cat. No. 19107, U.S.N.M.

This species is closely allied to *marlattii*, but differs in markings of wings of adult and in markings of pupa case. It occurs on grape in Okoga and on grape and *Taonaba japonica* Szyszyłowicz in Tokio.

Genus ALEUROPARADOXUS Quaintance and Baker.

Aleuoparadoxus QUAINANCE and BAKER, Tech. Ser. 27, pt. 2, Bur. Ent. U. S. Dept. Agr., 1914, p. 104.

Pupa case medium in size, elliptic in outline, margin toothed, the wax tubes only moderately developed; submarginal area not separated from dorsal disk; just within margin a series of papilla-like pores and dorsum with numerous irregular shaped pores; tracheal folds present, terminating on margin in a comb of teeth; wax secretion brittle glass-like rods from the submarginal papillae and usually a secretion from the dorsal pores. Vasiform orifice subcordate or triangular, the operculum similar in outline, obscuring the lingua.

Adult with a single flexure in radial sector of forewing and no spur of media. Antennae seven-segmented, IV the longest; distal segments subequal. Sexes nearly equal in size.

Type.—*Aleuoparadoxus iridescens* (Bemis).

KEY TO SPECIES OF ALEUROPARADOXUS.

1. Median dorsal ridge of abdomen with a double row of large pore-like structures, two on each abdominal segment.....*iridescens*.
2. Median dorsal ridge with a row of small pore-like structures, 3 to 5 close together on each abdominal segment.....*punctatus*.

ALEUROPARADOXUS IRIDESCENS (Bemis).

Plate 48, fig. 1.

Aleyrodes iridescens BEMIS, Proc. U. S. Nat. Mus., vol. 27, 1914, p. 487.

This species has been rather fully described by Bemis. A few details of structure may be added in order to separate *iridescens* from closely related forms. The submarginal papillae are about 0.03 mm. long and form a very even row. The pore-like structures

on the dorsum of case are about 0.32 mm. in diameter and are arranged as shown in the figure. Those forming the row of six on the abdomen between the submarginal row of papillae and the double median row are about 0.16 mm. from the outer pores of the double median row. A channel extends from the vasiform orifice to the margin of the case. On either side of the channel is a thickened wrinkled lobe-like ridge between the orifice and the margin.

We have specimens taken on *Arctostaphylos* species, near Camp Rincon, San Gabriel Mountains, California, July 4, 1911, by P. H. Timberlake. These specimens show some differences from the paratypes mentioned above. The most noticeable difference is in the submarginal papillae, which are elongate in these specimens and measure about 0.048 mm. The pores also are somewhat larger.

Paratype.—Cat. No. 7084, U.S.N.M.

ALEUROPARADOXUS PUNCTATUS, new species.

Plate 48, fig. 2.

Two collections of this species are in the Bureau of Entomology. Q. No. 1980 was taken on *Lithraea caustica*, at Santiago, Chile, by Manuel J. Rivera, October 25, 1905, and Q. No. 8821 was taken on *Quillaja sapororia* and sent from the same city by Carlos E. Porter in March, 1905.

Pupa case.—Size 1.44 mm. by 1.12 mm., subelliptical, broadly rounded at the ends. The margin of the dorsal disk shows a very irregular, somewhat thickened line. The median dorsal abdominal ridge is armed on each segment with three to five irregular pore-like areas, which are usually crowded together. These are much smaller than the corresponding ones in *iridescens*. The transverse cephalic row of pore-like areas upon the thorax consists of sometimes as many as 18. On the submarginal area of the abdomen some distance mesad and often occupying a part of the margin of the dorsal disk there is an irregular row of minute pore-like areas. This row is most often of three pores in thickness, but often is only a single irregular row. Sometimes it is scarcely visible at all. The pores forming this row are much smaller than those present on the similar region of *iridescens*. The papillae-like structures forming a row about the case just within the margin are in this species short, extending mesad only about 0.016 mm., but the suture-like markings between them extend considerably farther mesad. In *iridescens*, on the other hand, the sutures between the papillae extend scarcely mesad of the papillae themselves. Comb of the thoracic tracheal fold very similar to that of *iridescens*, consisting of three teeth. Vasiform orifice typical for the genus, about 0.112 mm. by 0.096 mm. in size and about 0.128 mm. from caudal margin. There is a channel

extending from the caudal edge of the orifice to the margin of the case. The thickened area on either side of this channel ends on the margin in two narrow irregular lobes. These differ from the corresponding lobes of *iridescens* in extending to the margin or a little beyond it. The color under the microscope is a very dark brown.

On the leaf the pupae appear as black disks without waxy secretion, excepting short pencils of wax from the pores of the tracheal folds.

Adults.—Unknown.

Described from pupa cases in balsam mounts and upon the foliage.

Type.—Cat. No. 20205, U.S.N.M.

Genus ALEUROPLATUS Quaintance and Baker.

Aleuroplatus, QUAINANCE and BAKER, Tech. Ser. 27, pt. 2, Bur. Ent. U. S. Dept. Agr., 1914, p. 98.

Pupa case usually flat, elliptical, oval, or subcircular in outline, often notched on cephalo-lateral margins; some species are elongate; color varying from a transparent yellowish or whitish to black, but mostly dark brown; many species variously dotted with darker markings; margin toothed, wax tubes moderately developed, incisions shallow; thoracic and caudal tracheal folds present and in most cases plainly visible and ending on the margin in a distinctly differentiated comb of teeth from which arise pencils of waxy secretion, differing from the more or less amorphous secretion of wax surrounding the case, secreted by the marginal wax tubes. Dorsum with the disk not separated from the submarginal area and without prominent pores or papillae, though usually with a number of minute clear pores. (In rare exceptions there are many wax pores.) Vasi-form orifice small, transverse, rounded, or elongate, the inner margin rarely armed with teeth; operculum filling from a third to all of the orifice and obscuring the lingula.

Adults with wings unmarked, clouded, or spotted; the radial sector of forewing with a single flexure; no spur of the media, but the cubitus faintly indicated. Antennae of seven segments, segment III the longest; the other distal ones subequal, with IV, however, usually the shortest. Claspers of male considerably curved at their distal extremities and possessing a number of prominent spines. Proximad of the distal spur of each clasper there is either a lobed structure or other smaller spurs.

Type.—*Aleuroplatus quercus-aquaticae* (Quaintance).

KEY TO SUBGENERA OF THE GENUS ALEUROPLATUS.

1. Vasiform orifice not armed with teeth on its inner caudo-lateral margin.
Subgenus *Aleuroplatus*.
2. Vasiform orifice armed with teeth on its inner caudo-lateral margin.
Subgenus *Orchamus*.

ALEUROPLATUS, new subgenus.

Pupa case flat, elliptical, oval, or subcircular, thoracic tracheal folds ending on margin of case in a comb of teeth; vasiform orifice small, usually transversely elliptic and without teeth upon its inner caudal and lateral margins.

Type.—*Aleuroplatus (Aleuroplatus) quercus-aquaticae* (Quaintance).

KEY TO SPECIES OF SUBGENUS ALEUROPLATUS.

1. Pupa case transparent whitish, never dark brown or black..... 2
Pupa case not transparent whitish, but dark brown to black..... 3
2. Marginal comb of thoracic fold very faint and composed of short rounded teeth.
ficus-rugosae.
Marginal comb of thoracic fold very distinct and composed of long narrow teeth.
translucidus.
3. Marginal comb of thoracic fold composed of distinct differentiated teeth..... 4
Marginal comb and thoracic fold either scarcely distinguishable or the teeth similar to marginal teeth..... 8
4. Marginal comb of thoracic fold composed of one prominent tooth at base of prominent incision in the margin of case..... *incisus*.
Marginal comb composed of more than one prominent tooth..... 5
5. Marginal comb of thoracic fold composed of two prominent teeth.... *gelatinosus*.
Marginal comb of thoracic fold composed of four or five rather prominent teeth. 6
6. Suture between thorax and abdomen curved cephalad on each side beyond the third thoracic segment; body with moderately developed rhachis. *berbericolus*.
Suture between thorax and abdomen not curved beyond the third thoracic segment; rhachis but little developed or absent..... 7
7. Abdominal segments distinct; teeth of thoracic comb with clear areas at base.
plumosus.
Abdominal segments faintly indicated and visible only on middle of dorsum; teeth of thoracic comb without clear areas at base..... *pictiniferus*.
8. Marginal comb of thoracic fold distinguishable, but the teeth little differentiated from adjacent marginal teeth..... 9
Marginal comb and thoracic fold scarcely distinguishable..... 14
9. Size very large, over 2.25 mm. long; dorsum with very distinct rhachis.
sculpturatus.
Size medium, or small, less than 1.5 mm. long..... 10
10. Dorsum somewhat arched possessing distinct rhachis..... *cockerelli*.
Dorsum flat, without rhachis..... 11
11. Suture between thorax and abdomen curved cephalad much beyond the third thoracic segment..... 12
Suture not curved cephalad beyond or but slightly beyond the third thoracic segment..... 13
12. Thorax with two pairs of rather long dorsal spines..... *validus*.
Thorax without such spines..... *quercus-aquaticae*.
13. Suture curved slightly beyond third thoracic segment; color varying in different specimens from a yellow to a smoky brown, some individuals with a yellow submarginal area and a more or less completely brown disk..... *variegatus*.
Suture not curved beyond third thoracic segment; color uniform brown... *cococolus*.
14. Shape elongate oval, greatest width across thorax..... *ovatus*.
Shape nearly elliptical or oval with greatest width across the abdomen..... 15

15. Shape nearly elliptical, not broader at one end than at the other; no distinct eye spots present, margin irregular, a submarginal row of small pores present..... *myricae*.
 Shape oval, the greatest width across the abdomen, the reverse of *ovatus*; dorsum with a submarginal row of small pores..... 16
16. Eye spots of pupa case absent; vasiform orifice elongate, the operculum filling less than cephalic half; submarginal row of pores about 0.016 mm. from margin..... *coronatus*.
 Eye spots of pupa case present; vasiform orifice of medium length, with the operculum almost filling it..... 17
17. Eye spots reniform, moderately large; area between submarginal rows of pores and margin of case not reticulate, this row of pores about 0.03 mm. from the margin..... *oculireniformis*.
 Eye spots circular; area between the submarginal row of pores and margin of case reticulate..... 18
18. Eye spots extremely minute and situated on the same line with the submarginal row of pores; the pores alternating with one another to form a zigzag row around the case; row about 0.048 mm. from margin..... *oculiminutus*.
 Eye spots moderate in size, not situated in the same line with the submarginal row of pores, but more mesad; pores of submarginal row not zigzag, but forming an even row about 0.064 mm. from the margin..... *vinsonioides*.

ALEUROPLATUS (ALEUROPLATUS) BERBERICOLUS, new species.

Plate 50, fig. 1; plate 49, figs. 1-4.

On January 27, 1908, J. W. Cockle collected pupa cases of this species at Kaslo, British Columbia, on *Berberis aquifolium*. Later collections by Mr. Cockle from the same plant proved to represent other species, and adults supposed to be those of *berbericolus*, and taken at another time, are those of a species of *Aleyrodes*. Specimens of *berbericolus* are also in the collection from Mexico City, collector and date unknown, and from Toluca, Mexico, on *Ilex*, collected June 24, 1897, by A. Koebele.

Pupa case (pl. 50, fig. 1).—Size 0.88 by 0.656 mm. Shape elliptical, constricted across the thoracic folds. Dorsum with the abdominal segments quite distinct, thorax with a more or less defined arrow-shaped structure resembling that found in the genus *Aleurotrachelus*. Suture separating the thorax and abdomen curved cephalad beyond the third thoracic segment. Lateral margins of the abdominal segments on the median dorsal area marked with many minute, dark, pore-like spots. These sometimes extend in a row across the edges of the segments. Margin (pl. 49, fig. 1) composed of evenly rounded, moderately shallow teeth from which there extend mesad suture-like markings. Thoracic tracheal comb (pl. 49, fig. 2) composed of three or four rather prominent teeth with serrate margins; caudal comb similar. Submarginal and subdorsal areas with irregularly scattered minute pore-like structures. Vasiform orifice (pl. 49, fig. 3) subcircular in outline with the margins thickened; operculum filling about half the orifice, subtriangular in shape, though

broad and rounded at the apex. The entire orifice is covered on its upper surface with a membrane, the opening in which is smaller than the orifice itself. Color of case yellowish brown, with the median portions darker brown. Eyespots purplish. The case is closely appressed to the leaf and surrounded with a rather narrow glossy wax fringe, in which may be distinguished the pencils of white wax from the thoracic and caudal combs; the marginal area is dark brown and the dorsal disk very dark brown or black. The disk shows a longitudinal keel, and the body segments are quite distinct.

Adults.—Unknown.

Described from pupa cases in balsam mounts. Type lot from Kaslo, British Columbia.

Type.—Cat. No. 19192, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) COCKERELLI (Ihering).

Plate 50, fig. 2; plate 49, figs. 5-6.

Aleurodes cockerelli IHERING, Rev. Mus. Paulista, vol. 2, 1897, p. 393.

Paratype material of this species in the collection of the Bureau of Entomology is composed of pupa cases only.

The description given by Hempel¹ and cited under this species by Kirkaldy in his catalogue of the family refers to quite another insect, *Dialeurodicus cockerelli* Quaintance.

Pupa case (pl. 50, fig. 2).—Size 1.36 by 1.056 mm. Shape oval, with cephalic portion the narrower. (The figure given by Ihering shows the cephalic and caudal portions equally broad. Our specimens, however, are not so shaped.) Dorsum with a distinct rhachis, the segments of the abdomen extending out from it as prominent ridges. Submarginal area with a few small, clear, circular, pore-like areas. Vasiform orifice (pl. 49, fig. 6) somewhat longer than that shown for the type and with the membrane on the inner latero-caudal part sometimes thrown into minute folds. Margin with distinct and, for the genus, rather prominent teeth, between which minute ones are often situated. Thoracic pores ending on margin in an even comb of usually four closely placed teeth (pl. 49, fig. 5). Color on the leaf brownish black; under the microscope, dark brown.

In the development of the rhachis *cockerelli* approaches *sculpturatus*, but the rhachis is not so well developed as in that species, nor is the pupa case so large or of the same shape.

Adults.—Unknown.

Paratype.—Cat. No. 20191, U.S.N.M.

¹ Ann. Mag. Nat. Hist., vol. 8, p. 387.

ALEUROPLATUS (ALEUROPLATUS) COCOCOLUS, new species.

Plate 51, fig. 1; plate 49, figs. 7-10.

Specimens of this form are in the collection of the Bureau of Entomology, as follows:

Locality.	Date.	Collector.	Host.	Bureau No.
Santiago de las Vegas, Cuba.	May 6, 1905	M. T. Cook.....	Coconut.....	Q. No. 233.
Ceara, Brazil....	Jan., 1906	F. Rocha.....	<i>Eugenia michelii</i> Lam.	Q. 748.
Santiago de las Vegas, Cuba.	Sept., 1906	C. F. Baker....	<i>Cocos nucifera</i>	Q. 3261.
Santiago de las Vegas, Cuba.	Mar. 28, 1908	Wm. T. Hume.	<i>Cocos nucifera</i>	Q. 5205.
Trinidad.....	Mar. 27, 1912	F. W. Urich....	Coconut.....	Q. 8071.
Panama.....	Mar. 7, 1913	E. Bethel.....	.....	Q. 8829.

Of this material that collected by Urich in 1912 has been taken as type, for in this lot are examples of eggs and larvae and some fragmentary adult females.

Egg (pl. 49, fig. 7).—Size 0.24 by 0.112 mm.; stalk 0.048 mm. Shape almost hemispherical, the straight side some distance from the stalk. Color yellow, stalk brownish. No sculpturing present.

Larva (second instar?).—Size 0.65 by 0.4 mm. Color light brown; eyespots transparent and near each a red pigmented area; median dorsal region with many dark pore-like markings. Abdominal segments indicated only on the median dorsal area. Thorax with a slight indication of a central ridge, and with three pairs of prominent spines; those on the last two thoracic segments are long and knobbed (pl. 49, fig. 9), while the third pair, between the eyespots, are shorter, thicker, and tapering (pl. 49, fig. 10). Laterocephalad of the vasiform orifice is another pair of these thick, tapering spines of about the same length as the orifice. The orifice itself is situated on a somewhat differentiated area, which extends to the caudal margin of the case. Two long curved spines arise from this, near the margin. The teeth of the margin are prominent.

Pupa case (pl. 51, fig. 1).—Size 0.976 by 0.736 mm. Color dark brown, usually more heavily pigmented on the thorax; yellow specimens or specimens variegated with yellow are, however, not met with as in *variegatus*. There are many black dots scattered over the dorsum, as seen in most members of this genus. The case is flat, and the abdominal segments are distinct only on the median dorsal area. Suture separating the thorax and abdomen not extending cephalad beyond the third thoracic segment, but extending about even with it. Thorax with two pairs of prominent clubbed spines as met with

in the larva, but seemingly lacking the thick tapering spines. Margin composed of moderately sized teeth which are serrate; from these there extends mesad a series of irregular suture-like markings, which, however, do not extend so far as in *variegatus*. There is, on the other hand, the same thickened area mesad of the marginal comb of the thorax, and it is covered with the same minute circular markings, but these also extend mesad from it. A similar thickened area and a similar row of markings are found caudad of the vasiform orifice. Latero-cephalad of the orifice there is a pair of rather short spines. The orifice itself (pl. 49, fig. 8) is subcircular in outline, thickened latero-caudad; the operculum nearly fills the orifice and is striate above.

On leaf the case is jet black and surrounded by a conspicuous fringe of dirty white or yellowish wax, amorphous basally in the more mature specimens, but with numerous lighter pencils or threads of wax radiating from the case, extending well beyond the amorphous portion. In less advanced pupa cases the amorphous basal wax is mostly absent, and the radiating wax pencils are very conspicuous.

Adult female.—The fragmentary condition of the available specimens of the female will not permit of a good description. They are yellow in color with dark brown eyes and unmarked wings. The body is about 0.8 mm. long and the forewings measure about 1.04 mm. in length.

Adult male.—Unknown.

Described from eggs, larvae, pupa cases, and fragmentary females in balsam mounts.

Type.—Cat. No. 19193, U.S.N.M.

The specimens on *Eugenia michelii* are somewhat lighter than typical, have a slightly more pronounced constriction across the thoracic folds, and the abdominal segments are not so distinct.

ALEUROPLATUS (ALEUROPLATUS) CORONATUS (Quaintance).

Plate 51, fig. 2; plate 49, figs. 11, 12.

Aleurodes coronata QUAINANCE, U. S. Dept. Agr., Div. Ent., Tech. Ser. 8, 1900, p. 22.

Aleyrodes coronatus BEMIS, Proc. U. S. Nat. Mus., vol. 27, 1904, p. 497.

This species is present in the Bureau of Entomology collection as follows:

Date.	Collector.	Host.	Locality.	Bureau No.
Mar. 12, 1888	D. W. Coquillett....	<i>Quercus agrifoliae</i> .	Los Angeles, Cal	Q. 3477
Mar. 31, 1888	.....do.....	do.....	do.....	Q. 3478
Sept. 14, 1894	S. A. Pease.....	do.....	Pomona, Cal. . .	Q. 3479
Apr. 19, 1907	E. W. Ehrhorn.....	(?)	San Bernardino.	Q. 3239
May 26, 1911	P. H. Timberlake..	<i>Quercus agrifoliae</i> .	Whittier, Cal . .	Q. 8933
July 30, 1912	A. G. Smith.....	Chestnut.....	Pasadena, Cal..	Q. 8722

Pupa case (pl. 51, fig. 2).—This species has been fully described by Quaintance and by Bemis. The minute pore-like structures forming a submarginal row (pl. 49, fig. 11) as in the species related to *coronatus* are quite similar to those met with in *vinsonioides*, *oculireniformis*, and *oculiminutus*. On the mesal portion of the abdomen of *coronatus* there is usually but one row of pores on each side, and not three rows as in the species just mentioned. On the thoracic region these pores are quite scarce in *coronatus*, whereas they are numerous on the other species mentioned. The eyespots also are not clear, transparent areas as in the related species, but are pigmented and usually dark brown in color. The comb of teeth on the margin of case, at the extremity of the thoracic folds, is not distinct. The vasiform orifice (pl. 49, fig. 12) is unusual. It is very elongate, and the operculum is exceptionally small, filling not half of the orifice.

Type.—Cat. No. 4238, U.S.N.M.

ALEUROPLATUS EURYAE (Kuwana).

This species was included in the genus *Aleuroplatus* in the writers Classification of the Aleyrodidae.¹ It shows considerable variation from the type, and a study of three undescribed species undoubtedly closely related to *euryae* leads us to believe that these four species belong to a distinct genus. *Euryae* is, therefore, not here considered with the species of *Aleuroplatus*.

ALEUROPLATUS (ALEUROPLATUS) FICUS-RUGOSAE, new species.

Plate 49, figs. 13-16.

Only one collection of this species is at hand. It was taken on *Ficus rugosa* at the Royal Botanic Gardens, Calcutta, India, by R. S. Woglum, December, 1910. The pupa case is very like that of species of *Dialeurodes*.

Pupa case (pl. 49, fig. 13).—Size 1.6 by 1.32 mm. Shape elliptical, very slightly narrower on the thoracic portion. Dorsum slightly rounded, segmentation scarcely distinguishable, margin without teeth, but with a number of suture-like markings extending mesad. Thoracic tracheal fold very faintly visible (pl. 49, fig. 16), armed on the margin of case with four or five evenly rounded teeth and showing minute circular markings along the fold. Vasiform orifice (pl. 49, fig. 14) very minute, wider than long, and nearly filled with the operculum. The distal extremity of the lingula is exposed. Caudal tracheal fold (pl. 49, fig. 15) similar to those of the thorax, but broadening toward the vasiform orifice and forming an urn-

shaped structure. Near the caudal margin there are two rather distinct lobes which partially inclose the fold. Color yellow.

Adults.—Unknown.

Described from pupa cases in balsam mounts.

Type.—Cat. No. 19194, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) GELATINOSUS (Cockerell).

Plate 52, fig. 1; plate 49, figs. 17–19.

Aleurodes gelatinosus COCKERELL, Can. Ent., vol. 30, 1898, p. 264.

Aleyrodes gelatinosus COCKERELL, Bemis, Proc. U. S. Nat. Mus., vol. 27, 1904, p. 502.

This species was described by Cockerell, and the different stages were described by Bemis. Several details may here be added:

Pupa case (pl. 52, fig. 1).—The suture separating the thorax and abdomen is curved cephalad to, or perhaps a little beyond, the third thoracic segment. On each of the two caudal segments of the thorax there is a pair of prominent spines situated on tubercles. On the cephalic part of the thorax about on the region where the eyespots are usually located is a pair of tubercles similar to those on which the spines just mentioned are situated. The thoracic tracheal folds are evident and the comb (pl. 49, fig. 17) consists of two prominent teeth with serrate margins, and differing somewhat from the caudal comb (pl. 49, fig. 18). The vasiform orifice (pl. 49, fig. 19) is subcircular in outline with the margin thickened. The operculum fills about half the orifice and the upper surface of the latter is covered with a membrane similar to that found in *berbericolus* and *ovatus*.

On the leaf the case appears jet black and is surrounded with a conspicuous copious secretion of gelatinous, yellowish wax.

Adults.—Unknown.

Type.—Cat. No. 8998, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) INCISUS, new species.

Plate 52, fig. 2; plate 49, figs. 20–21.

The bureau collection contains four lots of this species as follows:

Locality.	Date.	Collector.	Host.	Bureau No.
Roy. Bot. Gardens, Peradenyia, Cey- lon.	October, 1910..	R. S. Woglum..	<i>Ostodes zey- lanica.</i>	Q. 6731.
Do.....	.....do.....	.....do.....	Unknown tree.	Q. 6742.
Do.....	.....do.....	.....do.....	<i>Ostodes zey- lanica.</i>	Q. 6752.
Do.....	September, 1913.	A. Rutherford..	<i>Garcinia specta</i>	Q. 8770.

Of these collections Quaintance No. 6752 has been selected as the type lot on account of the abundance of the material. The species is very striking on account of the large, solitary, indented tooth (comb) of the thoracic and caudal folds and on this account is very easily separated from others in the genus.

Pupa case (pl. 52, fig. 2).—Size 1.36 by 1.04 mm. Color dark brown to black; under the microscope dark brown with median darker pigmentation. The general appearance of dorsum under the microscope is quite similar to that of *coronatus*, owing to the median dark pigmentation. The margin is composed of moderate sized, evenly rounded teeth and from these flutings extend for a short distance mesad. At the base of these flutings there is a row of minute pores similar to those met with in several other members of the genus. The abdominal segments are distinct only on the median dorsal area and each segment possesses a transverse row of pores. The suture separating the thorax and abdomen is short, not extending on each side much more than halfway to the margin; it is very little if at all curved cephalad. The thoracic and caudal tracheal folds are armed at their extremities with a prominent elongate tooth (pl. 49, fig. 20) and this is situated within a distinct sinus. The latero-caudal setae are long. The vasiform orifice (pl. 49, fig. 21) is subcircular in outline with the inner rim thickened caudad, and seemingly lobed; it is nearly filled by the operculum. In some specimens the transverse row of pores on the abdominal segments are not visible and in others the thoracic area is covered with many minute pores.

Adults.—Unknown.

Described from pupa cases in balsam mounts and dry upon the foliage.

Eggs and a few larvae are present in the material, but as other species are also present it is doubtful to which species they belong.

Type.—Cat. No. 19196, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) MYRICAE, new species.

Plate 54, fig. 1; plate 53, figs. 1-4.

Specimens of this species were taken by the senior author at Griffin, Georgia, April 25, 1899. They were living on a plant believed to be a species of *Myrica*.

Pupa case (pl. 54, fig. 1).—Size 0.832 by 0.512 mm. Shape nearly elliptical; dorsum somewhat evenly arched; suture separating the thorax and abdomen very little curved cephalad. Margin (pl. 53, fig. 4) composed of shallow rounded teeth, but somewhat irregular, several teeth or groups of teeth being extended farther than the others. Just within the margin there is a row of minute pore-like structures not unlike those of *coronatus* and related species. Ab-

dominal segments distinct on the median portion of the abdomen. Vasiform orifice (pl. 53, fig. 3) subcircular in some specimens, in others elongate, the rim thickened, particularly on the caudal margin. Operculum about half filling the orifice in some specimens, but in those with the more elongate orifice, it is smaller; caudal spines very stout. Thoracic and tracheal folds scarcely distinguishable and not armed on margin with any special comb.

Adult male.—Color yellow, shaded with brown; eyes dark brown, wings in balsam mounts transparent. Antennae (pl. 53, fig. 2) imbricated, segment III with a circular distal sensorium, and armed with a long spine. In some specimens the spine is absent. Segments IV to VII imbricated; V and VII each with a distal sensorium. Proportions of the segments as follows: I, 0.064 mm.; VI, 0.09 mm.; VII, 0.09 mm. Claspers (pl. 53, fig. 1) 0.112 mm. long, rounded at the distal extremity, and acute. Just within the distal spur there is a bilobed structure, which sometimes shows a small third lobe on the proximal part; spines few and prominent. Length of forewing 0.88 mm., length of body from vertex to tip of claspers about 0.96 mm.

On the leaf the case appears jet black, convex, and without waxy secretion.

Adult female.—Similar in color to the male, but larger. Distal segment of antennae armed with a prominent spine on its proximal third and that part of the segment distad to this tapering. Size variable, from 0.96 to 1.44 mm. Forewings from 0.96 to 1.2 mm.

Described from pupa cases, males and females in balsam mounts, and pupa cases on foliage.

Type.—Cat. No. 19198, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) OCULIMINUTUS, new species.

Plate 54, fig. 2; plate 53, figs. 5-7.

Specimens of this species were received from Mr. F. W. Urich, April, 1913, and were taken on *Ficus* species ("metapel") in Trinidad. This is the only collection of the species that we have.

Pupa case (pl. 54, fig. 2).—Size 0.832 by 0.672 mm.; shape oval, broadest across the abdomen. Suture separating the thorax and abdomen not distinct. Sutures marking off the abdominal segments very faint, not darkened in color as are those of related species. Color black; margin of case (pl. 53, fig. 5) with evenly rounded shallow teeth, each tooth with a clear pore at its base. About 0.48 mm. from the margin of case there is a submarginal row of small pores. These are arranged alternately, forming a zigzag row around the case. Between this row and the margin of the case there is a checkered area somewhat similar to that found in *vinsonioides*, but the present species shows at least two rows of inclosed areas and one

row of open marginal areas, whereas *vinsonioides* shows only one row of inclosed areas and one row of open marginal areas. On the dorsum there are also other minute pores arranged as shown in figure 5, plate 53. The arrangement of these is very similar in *oculiminutus*, *vinsonioides*, and *oculireniformis*. The eyespots are very minute, about equal in size to the pores of the submarginal area. The eyespots may be distinguished at once from the submarginal pores from the fact that they are transparent, whereas the pores are not. They are much nearer the margin than is usual, being on the same line as the submarginal row of pores, or even nearer the margin (pl. 53, fig. 5). The dorsum, mesad of the submarginal ring of pores, is without checkered markings. Vasiform orifice (pl. 53, fig. 7) of about equal width and length, the operculum filling a little more than half of it. Caudad of the orifice near the margin of the case there is a pair of thick spines close together, and the usual pair is present latero-cephalad of the orifice.

On the leaf the cases are shining black. There is no dorsal waxy secretion, but there is an irregular white waxy marginal fringe. In some specimens this mass fuses into a yellow, semitransparent wax, terminating on the periphery in numerous squarish teeth.

Adult female.—The females present are fragmentary and it is impossible to give from them a complete description. Color yellowish, with yellowish or dusky shadings. Eyes dark brown. Forewings with dusky brown markings as shown in figure 6, plate 53. Length of forewing 0.88 mm.; hind wing uniform dusky. The markings of the forewing of this species are very similar to those of *oculireniformis*.

Adult male.—Unknown.

Described from pupa cases and females in balsam mounts and pupa cases dry upon the foliage.

Type.—Cat. No. 19199, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) OCLIRENIFORMIS, new species.

Plate 55, figs. 1-10.

One lot only of this species is in the bureau collection. It was taken by F. Rocha at Ceara, Brazil, in January, 1906, on *Passiflora*. Two other species are very closely related to the present one, namely *vinsonioides* Cockerell and *oculiminutus*. The separation of these species is made on the pupa case, as adults of *vinsonioides* in the collection are fragmentary females only.

Egg (pl. 55, fig. 1).—Color yellow, in a few cases brownish; shape oval with one side flattened; stalk not exactly at the base, but farther from the flattened than the rounded side of the egg. Surface without apparent sculpturing; length 0.192 mm.

Pupa case (pl. 55, fig. 2).—Shape oval, broadest across abdomen. Size 0.912 by 0.72 mm.; some specimens smaller. Color dense black, with eyespots sometimes showing a clear transparent

area, while in other specimens these are brown in color. These eye-spots are reniform and are much larger than those of the two related species (pl. 55, fig. 9). Margin (pl. 55, fig. 3) composed of closely set and evenly rounded teeth, each one with a minute circular pore at its base. Dorsum with many small circular pores arranged as shown in the figure. The submarginal row of pores forms a fairly even line around the case. That part of the dorsum between these pores and the marginal teeth is not striate (pl. 55, fig. 3), though the mesal portion of the dorsum is. Suture separating the thorax and abdomen evenly rounded on each side. Vasisform orifice (pl. 55, fig. 4) usual, longer than broad, and almost entirely filled by the operculum. On the leaf the case is jet black and there is apparently no waxy secretion of any kind.

Adult male.—Color yellowish or slightly brownish, with dusky appendages and dark brown eyes. Eyes not divided, but the upper and lower eyes joined by six or eight lenses in pairs or triplets (pl. 55, fig. 8). Antennae with proportions as shown in figure 7, plate 55; segment III imbricated and with two distal sensoria; each of these is usually armed with a central process. Segment V with a distal sensorium and segment VII with a sensorium near its middle. Forewing with smoky brown markings, as indicated in the figure (pl. 55, fig. 10). Hindwing uniform pale smoky. Claspers 0.128 mm. long, slightly curved, somewhat pubescent, and armed with a number of stout spines, as shown in plate 55, figure 6; outer distal edge forming a rather distinct prong, and the inner portion with a distinct double lobe. Penis (pl. 55, fig. 5) with a distinct shoulder. Length from vertex to tip of claspers 0.72 mm. to 1.04 mm.

Adult female.—Similar in general character to the male. Length of antennae 0.396 mm. Average length from vertex to tip of cauda 0.92 mm.; length of forewing about the same.

Described from males and females, pupa cases, and eggs in balsam mounts.

Type.—Cat. No. 19200, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) OVATUS, new species.

Plate 56, fig. 1; plate 53, figs. 8, 9.

One lot only of this species is in the collection. It was taken on *Berberis trifoliata* at College Station, Texas, by Wilmon Newell, in March, 1912.

Pupa case (pl. 56, fig. 1).—Size 0.96 by 0.624 mm. Shape oval, broadest across the thorax; caudo-lateral margins more or less straight. Abdominal segments distinct, reaching almost to the margin. Suture separating the thorax and abdomen recurved cephalad about on line with the third thoracic segment. Margin composed of evenly rounded shallow teeth; comb of the thoracic

folds scarcely separable from the adjacent teeth of the margin (pl. 53, fig. 8). Vasiform orifice (pl. 53, fig. 9) subcircular in outline, with the margin somewhat thickened, the operculum filling about two-thirds of the orifice, which latter is covered with a membrane. Color dark brown to black, darker across the sutures of the abdomen. On the abdominal segments there are also minute, dark, pore-like markings. The developing eyes within the body are seen as large black patches near the cephalic margin, and on some specimens there are small yellowish semitransparent eyespots. Cephalad of the vasiform orifice there is a thickened area darker than that which surrounds it.

On the leaf the case is surrounded with a copious secretion of gelatinous, semitransparent wax. Around margin of case the wax is whitish, and a pencil of white wax extends caudad from caudal end of case.

Adults.—Unknown,

Described from pupa cases in balsam mounts.

Type.—Cat. No. 19201, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) PECTINIFERUS, new species.

Plate 56, fig. 2; plate 53, figs. 10-14.

This species is in the collection of the Bureau of Entomology in six different collections as follows:

Locality.	Date collected.	Collector.	Host.	Bureau No.
Lahore, India ..	(?).....	R. S. Woglum..	<i>Morus</i> sp.....	Q. 8026
Do.....	July, 1911.....	do.....	Euphorbiaceous tree	Q. 8027
Do.....	do.....	do.....	<i>Morus</i> sp.....	Q. 8028
Do.....	June, 1911.....	do.....	do.....	Q. 8030
Do.....	July, 1911.....	do.....	do.....	Q. 8032
Do.....	June, 1911.....	do.....	do.....	Q. 8037

Of this material Quaintance No. 8027 has been selected as type, as it contains specimens of males and females.

Pupa case (pl. 56, fig. 2).—Size 0.912 by 0.72 mm.; many specimens considerably smaller; color dark brown or black. Outline oval, narrowest across cephalic portion, slightly constricted across the thoracic folds, and very slightly at the caudal fold. Dorsal sutures indistinctly marked. Margin with shallow rounded teeth and within margin on the submarginal area there is a series of minute pores irregularly arranged. Thoracic folds distinct, the comb on the margin of these composed of four or five long, prominent teeth (pl. 53, fig. 10). Caudal comb of a similar character. The teeth on the combs of this species are much more prominent than those of any other dark form thus far known, and are quite distinctive.

Vasiform orifice (pl. 53, fig. 11) subcircular in outline, with the rim somewhat thickened. The operculum is small and fills only about the anterior third of it in some specimens, while in others it fills about half. It tapers caudad. The usual setae latero-cephalad of orifice are absent. Color dark brown to black; under the microscope varying shades of brown.

Adult male.—Color yellowish red, shaded with black; forewings maculate as shown in plate 53, figure 14; hindwings uniform pale dusky; legs dusky, excepting the joints, which are yellowish; claspers and tip of abdomen dusky. Eyes and tip of labium brown to black. Antennae absent from the specimens in hand with the exception of one antenna of one specimen. From this it is impossible to make out the relative proportions of the segments, as the specimen is much shrunken. The condition, however, is sufficient to make out that many distinct transverse ring-like imbrications cover the segment. The third segment possesses a long, stout spine. Each clasper (pl. 53, fig. 12) is armed at its extremity with prong-like projections. The two distal ones of these are rather long and acute, whereas the more proximal one is short and conical. A number of spines are present, and the clasper is minutely pubescent. The penis (pl. 53, fig. 13) is enlarged at its distal extremity into a disk-like structure, which seems to have an opening or depression within it. Length of claspers 0.108 mm.; length of insect 0.8 mm.; length of forewing 0.64 mm.

Adult female.—Similar to the male; color of body almost wine colored; costal margin of forewing distinctly wine colored. Length of insect 0.88 mm. In some specimens the dark markings of the wings are more extended than in the figure. Antennae absent from all the specimens.

Described from pupa cases and males and females in balsam mounts.

Type.—Cat. No. 19202, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) PLUMOSUS (Quaintance).

Plate 57, fig. 1; plate 53, figs. 15-16.

Aleurodes plumosa QUAINANCE, Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., 1900, p. 33.

This species was described from Florida by the senior author and was inadvertently included in *Tetraaleurodes* by the present writers in Classification of the Aleyrodidae.¹ The species is very abundant on cranberries, and many collections from these plants were received from the late Dr. C. W. Hooker, taken at Cranmoor, Wisconsin, in 1910. In these collections a large percentage of the pupa cases

¹ Bulletin 27, Tech. Ser. Bureau of Entomology.

represent a species of *Tetraleurodes*. It is evident, however, that these bear no relation to the present species. Specimens have been received also from H. B. Scammell from New Egypt, New Jersey, May 21, 1914, on cranberry, and from Pemberton, New Jersey, July 18, 1914, on blueberry.

Pupa case (pl. 57, fig. 1).—Size 0.96 by 0.704 mm. Shape oval, narrowest across the thorax. Abdominal segments not distinctly seen on account of the dark color, but in specimens which are sufficiently clear they are seen to extend almost to the margin of the case. Suture separating thorax and abdomen considerably curved cephalad, but not past the third thoracic segment. Margin composed of evenly rounded, very shallow teeth, from which suture-like markings lead mesad and give the appearance of a pore-like structure. Thoracic tracheal comb distinct; composed of usually four prominent teeth, which are evenly rounded and have at their bases clear areas similar to those at the base of the marginal teeth (pl. 53, fig. 15). Caudal tracheal fold armed with a comb similar to those on thoracic margin. Vasiform orifice (pl. 53, fig. 16) elongate, with the rim much thickened, the operculum filling about half the orifice. Setae latero-cephalad of orifice and about halfway between orifice stout and long. Dorsum with a few minute pores irregularly arranged. Transparent eyespots absent; color dark brown to black.

Adult male.—Color yellow, shaded with reddish brown on the thorax; eyes and tip of labium dark brown; wings transparent, the costal margins yellowish. Antennae imbricated; segment III 0.128 mm.; segment IV 0.02 mm.; segment V 0.032 mm.; segment VI 0.046 mm.; segment VII 0.05 mm. Segment III is armed with a distal, circular, fringed sensorium, and segment VII is armed near its middle with a prominent spine which extends beyond the distal extremity of the segment. Clasper 0.112 mm. long, slightly pubescent distad, and armed with a few stout spines; distal spur of the claspers acute, and just mesad of the spur is a double-lobed structure. Length of insect from vertex to tip of claspers 1.152 mm.; length of forewings 0.96 mm.

Adult female.—Similar to the male in general appearance. Much larger than the female characterized in the original description.

Type.—Cat. No. 19195, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) QUERCUS-AQUATICAE (Quaintance).

Plate 57, fig. 2; plate 53, figs. 17, 18.

Aleurodes quercus-aquaticae QUAINANCE, Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., 1900, p. 35.

This species was fully described by Quaintance. Several species of the genus are very closely related to it, especially *validus*, in which

the suture separating the thorax and abdomen is similarly curved. *Quercus-aquaticae*, however, has no dorsal spines on the thorax as has *validus*, and the pupa case is more constricted across the thorax.

Pupa case (pl. 57, fig. 2).—Shape oval, quite distinctly constricted across the thorax in the region of the thoracic folds. Suture separating the thorax and abdomen curved cephalad and almost reaching the margin of case on each side near the thoracic breathing pore. Abdomen on the dorsal disk with two rows of small clear pores at the lateral margins of the indications of segments. Lateral thoracic and caudal breathing folds indicated by dark areas, the combs consisting of usually four small, rounded teeth (pl. 53, fig. 17). Vasi-form orifice (pl. 53, fig. 18) short and broad. Thorax with variable pigmentation, but without distinct spines. Size variable, larger specimens about 1.12 mm. long.

Type.—Cat. No. 14782, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) SCULPTURATUS, new species.

Plate 58, fig. 1; plate 59, figs. 1-4.

This remarkable species was taken on *Helicornia* at Panama by Mr. August Busck, April 5, 1911. It shows the most prominently developed rhachis in the genus, having this structure much more developed than has *cockerelli*. The pupa case is also very large, being nearly twice as long as in some other species of the genus.

Pupa case (pl. 58, fig. 1).—Size variable, about 2.4 by 1.76 mm. Shape elliptical; dorsum arched and possessing a very distinct rhachis, from which very prominent sutures extend laterad, marking the abdominal segments, and from which a large expanded portion extends cephalad. Color dark brown to black with this median area of a bright yellow, sometimes shaded with brown. Margin (pl. 59, fig. 2) composed of very shallow, evenly rounded teeth. From these suture-like markings extend for a very short distance mesad. Within these are three or four rows all around the case of small rounded papilla-like pores, mesad of which there are no pores until the edge of the rhachis is reached. On each side of the rhachis on most of the abdominal segments there is a group of three or four small circular pores (pl. 59, fig. 1), and a group of six or seven similar ones is situated on each side of the median line on the enlarged median thoracic structure. Laterad of these there is a reniform thickening of the integument. Thoracic tracheal folds evident, the combs being composed usually of two teeth (pl. 59, fig. 4). Vasiform orifice (pl. 59, fig. 3) broad and short, the operculum filling almost the entire orifice. Setae usually found latero-cephalad of the orifice absent.

Adults.—Unknown.

Described from pupa cases in balsam mounts.

Type.—Cat. No. 19203, U.S.N.M.

This species is in many ways quite different from others in the genus. The rows of papillae-like pores on the submarginal area are not met with in any other species and the huge size and prominent rhachis are very distinctive. *A. cockerelli*, however, seems to show affinities with the present species.

ALEUROPLATUS (ALEUROPLATUS) TRANSLUCIDUS, new species.

Plate 58, fig. 2; plate 60, figs. 8-14.

Two collections by R. S. Woglum prove to be this species. Both were made from orange. The first collection was made at Lahore, India, date unknown, while the second lot was taken at Wazirabad, India, in November, 1910. This species is the only one in the subgenus, so far as known, which has an almost colorless transparent case.

Pupa case (pl. 58, fig. 2; pl. 60, figs. 8 and 9).—Size 0.912 by 0.72 mm.; shape nearly elliptical, slightly constricted across the region of the thoracic folds; color semitransparent, whitish yellow; eyespots reddish brown. Dorsum with the sutures very indistinct. Margin (pl. 60, fig. 12) with evenly rounded shallow teeth, from which suture-like markings extend for a short distance mesad. Thoracic folds distinct, the comb composed of three or four rather prominent teeth (pl. 60, fig. 11). Vasiform orifice (pl. 60, fig. 10) subcircular in outline, with the latero-caudal margin thickened. These margins are covered with numerous dot-like markings or possibly very minute setae. The operculum nearly fills the orifice and is similar to it in shape, though much more compressed on the lateral margins. The pair of setae usually present near the cephalo-lateral margins of the orifice are in this species a pair of spines of about the same length as the orifice.

On the leaf the case is surrounded with a liberal, semitranslucent wax, in which may usually be distinguished many fine radiating lines of lighter wax. Owing to the evident adhesiveness of the wax the entire insect often becomes covered with dirt, appearing on the leaf as a dirty brown spot.

Adult male.—Color reddish, becoming yellow on the vertex, legs, and genital segments. Forewings with dark maculations as shown in figure 14, plate 60, the costal margins red. Hindwings uniform smoky; legs dusky, excepting at the joints; genitalia also dusky; eyes dark brown. Antennae absent from the specimens in hand; claspers (pl. 60, fig. 13) with numerous prominent spines, the distal extremity with two prongs, one long and one short one, and with a somewhat conical projection; proximad of these a slight pubescence visible. Penis usual; length of claspers 0.144 mm. Length of insect from vertex to tip of claspers 0.96 mm.; length of forewing 0.64 mm.

Adult female.—Similar in color to the male. The hindwings sometimes have transparent patches. Length 0.96 mm.; forewing 0.848 mm. The females, as in the males, lack the antennae.

Described from pupa cases, males and females in balsam mounts, and pupa cases dry on foliage.

Type.—Cat. No. 19204, U.S.N.M.

The adults of this species are very similar in many ways to those of *Aleurocanthus citriperdus*. The red color met with in this species as against the yellow color in *citriperdus* is not always a good distinction. In *citriperdus*, however, the claspers of the male possess fewer spines, and are less curved at their distal extremities.

ALEUROPLATUS (ALEUROPLATUS) VALIDUS, new species.

Plate 61, fig. 1; plate 59, figs. 5-7.

This species was received from Prof. S. F. Ashby on April 30, 1914, marked Hope, Kingston, Jamaica, host unknown. It is more nearly related to *quercus-aquaticae* than to any other species of the genus, but may be distinguished from it by the presence of prominent dorsal thoracic spines and by the character of the suture between the thorax and abdomen.

Pupa case (pl. 61, fig. 1).—Size 0.96 by 0.72 mm. Shape almost elliptical, with a slight constriction across the thorax at the region of the thoracic folds. Color brown, sometimes with a darker pigmentation along median area and around suture separating thorax and abdomen. Eyespots irregular, smaller than in *quercus-aquaticae*; extremities of thoracic folds not heavily pigmented. Form flat, the abdominal segments distinct only on the median dorsal area. Suture separating thorax and abdomen curved cephalad almost to the marginal extremities of the thoracic folds. In this character the species is similar to *quercus-aquaticae*. The suture is curved as far cephalad as in the type-species, but after leaving the median suture it is not curved as much caudad before its cephalic recurve as in that form. Thorax with two pairs of prominent clubbed spines, one pair on the median portion of each of the two caudal segments. Pores of the submarginal area arranged in groups very similar to those of *quercus-aquaticae*. Comb of the thoracic fold (pl. 59, fig. 7) armed with usually four teeth, which are very little larger than the other marginal teeth (pl. 59, fig. 5). Vasiform orifice (pl. 59, fig. 6) usual, if anything slightly more elongate than in *quercus-aquaticae*. Other characters, including waxy secretion, quite similar to those of that species.

Adults.—Unknown.

Described from pupa cases in balsam mounts.

Type.—Cat. No. 19191, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) VARIEGATUS, new species.

Plate 61, fig. 2; plate 59, figs. 8-11.

This species was taken in the gardens of the National Museum at San José, Costa Rica, by Ad. Tonduz, April 3, 1914. It was collected from the leaves of a species of *Psidium*. It is remarkable on account of the variegated character of several of the pupa cases.

Pupa case (pl. 61, fig. 2).—Size 0.96 by 0.72 mm. Shape tending to oval, narrowest across the cephalic portion and slightly constricted in the regions of the thoracic pores or combs, form flat. Abdominal segments distinctly separated only on the median dorsal region. Suture separating the thorax and abdomen extending in some specimens not at all and in others a very short distance cephalad of the suture of the caudal thoracic segment. Color varying from a yellow to a smoky brown. In specimens that are only partially dark this dark area is on the median dorsal region. Specimens showing the entire dorsum dark have the marginal teeth all around, the pores and the tubercles on which the spines are located transparent yellow; these structures then stand out very clearly. The thorax is armed with a pair of prominent clubbed spines on the median portion of the second and third segments (pl. 59, fig. 9), and another less prominent pair between the eyespots, which last are transparent and irregular. Scattered over the dorsum there are many minute clear pores. Vasiform orifice (pl. 59, fig. 11) subcircular in outline, with the margin thickened at its caudal part and armed within by minute striations; operculum straight on its cephalic portion, rather elongate, nearly filling the orifice. Just caudad of the vasiform orifice, and nearly to the margin of the case, there is a thickened area which extends to form the caudal comb of two teeth. On each side of this thickened area arise the spines which form the caudal pair, and the area itself is connected with the caudal margin of the orifice by a series of minute markings. In the dark specimens this small dotted region is outlined with a row of larger clear pores (pl. 59, fig. 11). The pair of spines latero-cephalad of the vasiform orifice are as long as the orifice itself. Region of the thoracic tracheal fold with a similar thickening some distance from the margin, which thickening is covered with similar minute markings (pl. 59, fig. 8). Teeth of the margin rather short, not acute, but rounded and covered with minute serrations (pl. 59, fig. 10). Extending inward from these teeth are irregular suture-like markings which meet a second series of such markings on the subdorsal area.

On the leaf the case appears black and is surrounded with a dirty white waxy secretion, with many conspicuous radiating threads of wax.

Adults.—Unknown.

Described from pupa cases in balsam mounts and dry upon foliage.

Type.—Cat. No. 19205, U.S.N.M.

ALEUROPLATUS (ALEUROPLATUS) VINSONIOIDES (Cockerell).

Plate 59, figs. 12-14.

Aleyrodes vinsonioides COCKERELL, Psyche, vol. 8, 1898, p. 225.

Two type slides of this species received under different dates are in the Bureau of Entomology collection. The species is also in the collection from Matanzas, Cuba, and was collected by N. L. Britton and Percy Wilson, September 9, 1903, and forwarded by Prof. F. S. Earle. It was taken on *Nectandra*.

Pupa case.—Size 1.056 by 0.832 mm. Shape oval, broadest across the abdomen. Abdomen distinctly marked off from the thorax, the suture separating them not curving distinctly cephalad, as in some other members of the subgenus. Abdominal segments flat. Color under microscope brownish black, with a pair of small, clear, circular eyespots on the cephalic portion of the case. Dorsum of case with a number of minute clear circular pores arranged as shown in the figure. The submarginal row of these pores is a considerable distance from the margin (0.096 mm.) and in this character is distinct from the two other closely related forms, *oculireniformis* and *oculiminutus*. The submarginal area between this row of pores and the margin of the case is marked with a series of lines and checks (pl. 59, fig. 14). The outer part of this lined area is more than twice the width of the inner, while on the cephalic portion of case there is sometimes part of a third series. Mesad of this submarginal row of pores there is no checked area as in *oculireniformis*. The margin itself is armed with a closely appressed series of evenly rounded shallow teeth, and the teeth of the comb at the ending of the thoracic folds are scarcely distinguishable from the remainder of the margin (pl. 59, fig. 13). Vasiform orifice (pl. 59, fig. 12) usual, more elongate than that of the type.

Adults.—Unknown.

Type.—Cat. No. 19207, U.S.N.M.

ORCHAMUS, new subgenus.

Pupa case flat, thoracic and caudal folds more or less distinct; vasiform orifice rounded, and armed with a series of teeth on its inner, caudo-lateral margin. Shape of case usually elliptical, not twice as long as broad.

Type.—*Aleuroplatus (Orchamus) mammaeferus* Quaintance and Baker.

ALEUROPLATUS (ORCHAMUS) MAMMAEFERUS, new species.

Plate 60, figs. 1-7.

This species is represented in the bureau collection by only one lot of material taken on *Codiaeum variegatum* Linnæus in January, 1911, by R. S. Woglum. It was collected at the Botanical Gardens, Buiten-

zorg, Java. So far as is known it is the only representative of the subgenus. The prominent combs on the margin of case are approached only by those of *pectiniferus*.

Pupa case (fig. 1).—Size 0.768 by 0.56 mm. Shape nearly elliptical. Abdominal segments not distinct. Margin (fig. 6) armed with very shallow rounded teeth; just within the margin all around a row of prominent papillae is situated. These are usually knobbed (fig. 7), but some are cleft (fig. 2). Thoracic marginal comb very prominent and armed with long narrow teeth, those in the middle being longer than those at the sides of the comb (fig. 4). Caudal fold armed with a similar comb (fig. 3), the teeth of which stand out if anything more distinct on account of the fact that this comb is never depressed as is often the thoracic comb. Vasiform orifice (fig. 5) broadly rounded, with the interior margin straight and the inner, latero-caudal margins armed with a series of distinct teeth; operculum filling about one-third of the orifice. Color transparent, tinged with yellowish. On the leaf the case is dirty white or yellowish in color, and is surrounded with an irregular flat plate of translucent yellow wax.

Described from pupa cases in balsam mounts.

Type.—Cat. No. 19197, U.S.N.M.

Genus ALEUROTHRIXUS Quaintance and Baker.

Aleurothrixus QUAINANCE and BAKER, Tech. Ser. 27, pt. 2, Bur. Ent., U. S. Dept. Agr., 1914, p. 103.

Pupa case medium to small in size, elliptic; margin sometimes angled; color variable, ranging from yellow to almost black; margin of case usually with an apparent double row of teeth, the wax tubes well developed; submarginal area not separated from the dorsal disk; dorsum without papillae or pores, but bearing along median line a few pairs of prominent spinelike hairs; tracheal folds not discernible; wax secretion usually copious, flocculent, or woolly, secreted by marginal wax tubes. Vasiform orifice small, transversely elliptic; lingula obscured by the operculum, which nearly fills the orifice.

Adult with one flexure in radial sector of forewing and no spur of media. Antennae of seven segments, of which III is longest. Sexes nearly equal in size.

Type.—*Aleurothrixus* (*Aleurothrixus*) *howardi* (Quaintance.)

KEY TO SUBGENERA OF ALEUROTHRIXUS.

1. Margin of case with apparent double row of wax pores, or teeth.....*Aleurothrixus*.
2. Margin of case without apparent double row, but with single row of wax pores, or teeth.....*Philodamus*.

Subgenus ALEUROTHRIXUS.

Pupa case with margins usually angled, color variable, margin of case with an apparent double row of teeth, wax tubes well developed; wax secretion flocculent or woolly; vasiform orifice small, transversely elliptic; lingula obscured by operculum.

Type.—*Aleurothrixus* (*Aleurothrixus*) *howardi* (Quaintance).

SPECIES OF SUBGENUS ALEUROTHRIXUS.

1. Pupa case with a row of distinct spines all around case on the submarginal area *æpim*.
- Pupa case without such row of spines..... 2.
2. Pupa case with a row or comb of spinelike projections on the caudal margin of the vasiform orifice..... *howardi*.
- Pupa case without such comb of spines..... 3.
- Spines latero-cephalad of the vasiform orifice and on caudal margin of pupa case very long and prominent; color of case varying from yellow to brown... *floccosus*.
3. Spines latero-cephalad of vasiform orifice and those on caudal margin of case short and vasiform; color dark brown..... *porteri*.

ALEUROTHRIXUS (ALEUROTHRIXUS) AËPIM (Goeldi).

Plate 62, figs. 1-7.

Aleurodes æpim GOELDI, Mitth. Schweiz. Ent. Gesell., vol. 7, 1886, p. 250.

This species was described from "mandioca doce" at Rio de Janeiro. The one character given in the description which would make the recognition of the species possible is the row of submarginal bristles. In the collection of the Bureau of Entomology there is a species showing submarginal bristles. It was taken on cassava (*Manihot utilissima* Pohl) at Rio de Janeiro by F. Noack, date unknown. There seems little doubt, therefore, that this is the species described by Goeldi.

Egg (fig. 1).—Length 0.144 mm.; considerably curved, the stalk arising near the base on the convex side; color yellowish brown, without sculpturing.

Early larva (fig. 2).—Size 0.304 by 0.176 mm.; shape elliptic; dorsum not arched, abdominal segments distinct; median dorsal area with two pairs of vasiform spines similar to those on the larvae of *floccosus*; submarginal area with a row of prominent spines which are longer than the vasiform spines on the middle of the dorsum. There are six pairs of these on the thoracic region and only three pairs on the abdominal region of the specimens we have for study. The caudal pair of these is very long and the latero-caudal pair delicate.

Pupa case (fig. 3).—Size 0.752 by 0.482 mm. Shape similar to that of *floccosus*; dorsum not arched, but vasiform orifice slightly elevated. Submarginal area with at least eight pairs of prominent spines, six pairs being situated on the thoracic region and two pairs upon the

abdominal region. It is possible that other pairs are present on the abdominal submargin, but the condition of the specimens is poor. Spines latero-cephalad of vasiform orifice and on the middle of the dorsum, as well as the caudal pair of the case, very long; vasiform orifice (fig. 7) as usual and nearly filled by the operculum; margin composed of evenly rounded teeth, though sometimes irregular, some teeth being longer than others.

Described from eggs, larvae, and pupae in balsam mounts.

ALEUROTHRIXUS (ALEUROTHRIXUS) FLOCCOSUS (Maskell).

Plate 62, fig. 14.

Aleurodes floccosa MASKELL, Trans. New Zealand Inst., vol. 28, 1896, p. 432.

Aleurodes horridus HEMPEL, Psyche, vol. 8, 1899, p. 394.

Aleurothrixus floccosus QUAINANCE and BAKER, Journ. Agric. Research, vol. 6, 1916, p. 466, fig. 3.

In 1895 Maskell described this species from *lignumvitae*, from Jamaica. Three years later Hempel described his *horridus* from Guava from Brazil, and in 1907 the senior author described the woolly white fly of the orange under the name of *howardi*. Since these descriptions were made we have had an opportunity to study a large series of specimens from different regions and we have also had available Maskell's type slides of *floccosus*. There seems little doubt that Maskell's material and that described by Hempel represent the same species. With *howardi*, however, there is one point of difference. This is the comb of hair-like projections on the caudal margin of the vasiform orifice of the pupa case. In collections from orange from different regions both types are found side by side upon the same leaf. Some have the comb and some do not. The relation between these two forms, so closely associated, can be shown only by careful rearing experiments and comparison of all stages. In the meantime, therefore, we use the name *floccosus* for those pupa cases lacking the comb, and *howardi* for those cases possessing it.

Floccosus was first recorded upon orange by T. D. A. Cockerell¹ from Zapotlan, Mexico, collected by C. H. T. Townsend, July 5, 1902. This is also the first record for Mexico. It is, however, in the bureau collection from Laguna, Mexico, on orange, collected by Townsend, April 24, 1896.

Since complete descriptions of the species have been given by the authors mentioned, nothing further will be added here, excepting the records of the color phases. The typical phase and that represented by the types of *floccosus* and by *horridus* is the yellow one. All of the pupa cases are a uniform yellow. This phase is by far the most

¹ Synopsis of the Aleyrodidae of Mexico, in Mem. y. Riv. Soc. Cient. "Antonio Alzate," vol. 18, p. 202.

abundant in the collections, being represented by 25 lots of material from different parts of the Americas. Two lots—one from Jamaica and one from Mexico—show a median dark brown stripe more or less developed. One collection from Brazil, of which the host is unknown, is remarkable in that the thorax of all the pupa cases is yellow, whereas the abdomen is uniform dark brown. This phase is very striking and so far has not been met with in any of the other collections. A fourth phase, and a fairly common one, has the dorsal disk dark brown and the submarginal area, together with the marginal tubes, yellow. It has been received from Florida, Brazil, and Costa Rica. Still another phase has the entire dorsum brown with the exception of the marginal tubes, which are yellow. This has been received from Argentina and Paraguay.

A. floccosus is common in the islands of the West Indies and occurs also in Florida, Mexico, British Guiana, Brazil, Argentina, Canal Zone, Chile, and Paraguay. In addition to the orange, lime, grapefruit, etc., *floccosus* has been taken on the sea grape (*Coccoloba uvifera*), *Plumeria* species, *Baccharis genistelloides*, guava, a coarse grass, and a climbing vine.

ALEUROTHRIXUS (ALEUROTHRIXUS) HOWARDI (Quaintance).

Plate 62, figs. 12, 13.

Aleyrodes howardi QUAINANCE, Tech. Ser. 12, Bur. Ent., U. S. Dept. Agric., 1907, p. 9.

Aleurothrixus howardi QUAINANCE and BAKER, Journ. Agric. Research, vol. 6, 1916 p. 466.

This species occurs upon the same hosts and in the same regions as *floccosus*. It was first recorded for the United States by Prof. P. H. Rolfs, September 25, 1900, at Miami, Fla., on sea grape.

Type.—Cat. No. 10823, U.S.N.M.

ALEUROTHRIXUS (ALEUROTHRIXUS) PORTERI Quaintance and Baker.

Plate 62, figs. 8, 11.

Aleurothrixus porteri QUAINANCE and BAKER, Journ. Agric. Research, vol. 6, 1916, p. 466, fig. 3.

This species has been treated by the writers in their recent paper on the white flies attacking citrus plants. It is a common species in Chile.

Type.—Cat. No. 20190, U.S.N.M.

PHILODAMUS, new subgenus.

Pupa case with margins usually not angled; margin without an apparent double row of wax pores or teeth, but with a single row.

Type.—*Aleurothrixus (Philodamus) interrogationis* (Bemis).

ALEUROTHRIXUS (PHILODAMUS) INTERROGATIONIS (Bemis).

Aleurodes interrogationis BEMIS, Proc. U. S. Nat. Mus., vol. 27, 1904, p. 510.

This species has been fully described and figured by Bemis. The margin does not present an apparent double row of wax pores as in subgenus *Aleurothrixus*, but has a single row of teeth, the sutures between them extending a good way mesad. The operculum is very small and somewhat triangular, filling only a small portion of the orifice.

Paratype.—Cat. No. 7092, U. S. N. M.

Genus DIALEURODES Cockerell.

T. D. A. Cockerell, in his Classification of the Aleyrodidae¹ published in 1902, established the subgenus *Dialeurodes* and pointed out several important characteristics of the group. *Aleurodes citri* Riley and Howard was indicated as type and *A. eugenixæ* and *A. aurantii* were also referred to this subgenus.

In a subsequent paper, The White Fly (*Aleurodes citri*) and its Allies,² Cockerell cites as additional examples of *Dialeurodes*, *Aleurodes croceata*, *A. fodiens*, and *A. piperis*. Some of the species referred to *Dialeurodes* by Cockerell do not belong to the group, as understood by us—i. e., *cotesii*, *piperis*, and *croceata*. The writers believe that *Dialeurodes* is of generic rank and have so indicated.³

While the species of *Dialeurodes* present a general uniformity in the presence of certain prominent characters, there are to be recognized several minor groups for which it has seemed necessary to erect subgenera. Species of this genus are largely oriental, and some of them are of especial interest by reason of their injuries to plants, as *D. citri*, *citrifolii*, etc.

Pupa case variable in size, elliptic to subcircular in outline; color usually yellowish, varying in some species to brownish; margin of case toothed, the wax tubes irregular in outline and but little developed; submarginal area not separated from dorsal disk; dorsum usually without papillae or pores; tracheal folds evident, in some species very conspicuous, terminating on margin of case in a pore, the folds often showing dot-like, linear, or polygonal markings; wax secretions absent or very scant. Vasiform orifice relatively small, transversely oval or subcircular, with or without comb of teeth on inner lateral and caudal margins; operculum large, mostly filling the orifice and obscuring the lingula.

Adult with one flexure in radial sector of forewing and no trace of media. Antennae of seven segments; segment VII not distinctly

¹ Proc. Acad. Nat. Sci. Phila., 1902, p. 250.

² Bull. 67, Fla. Agric. Exp. Sta., 1903, p. 662.

³ Tech. Ser. 27, pt. 2, Bur. Ent., U. S. Dept. Agr., 1914, p. 97.

ment VII not shorter than segments IV, V, and VI, but usually longer than any of these; segments III to VII armed with a series of transverse or annular sensoria. Sexes nearly equal in size. Species tropical or subtropical, originally oriental, though now rather widely distributed.

Type.—*Dialeurodes (Dialeurodes) citri* (Ashmead).

KEY TO SPECIES OF SUBGENUS DIALEURODES.

1. Pupa case yellowish or whitish (without blackish coloration).....2.
 Pupa case with more or less dark brown or blackish coloration.....3.
2. The three tracheal folds covered with minute circular dots; size about 1.52 by 0.99 mm.; tracheal pores situated just within margin of case, margined mesad with a few blunt teeth and distad, with two claw-like lobes, the ends of which are almost in contact; adult with wings unmarked; eggs yellowish, without reticulations.....*citri*.
 Thoracic tracheal folds with minute circular dots, caudal fold furrowed and marked with squarish or polygonal areas; shape elliptical; size about 1.76 by 0.32 mm.; tracheal pores opening just within margin of case; forewing of adult with a distal clouded area; eggs dark, covered with reticulate waxy markings.....*citrifolii*.
3. Tracheal folds faintly evident; shape broadly elliptical, pale yellowish except dorsal area, which is dark brown, with conspicuous light cross stripes along body segments; size about 0.8 by 0.74 mm.; vasiform orifice longer than broad; operculum about half filling the orifice.....*fodiens*.
 Tracheal folds and pores distinct.....4.
4. Color pale yellowish, almost transparent, with dorsal area dark brown.....5.
5. Vasiform orifice armed within with about 24-28 teeth; outline of case elliptic; size about 1.84 by 0.84 mm.; yellowish except a variable narrow longitudinal dark brown stripe on center of dorsum, more pronounced on thorax; tracheal folds well developed, covered with dot-like markings; pores opening just within margin of case, surrounded with chitinized ring; wings of adult unmarked; eggs yellowish, without sculpturing.....*kirkaldyi*.
 Color pale yellowish, almost transparent, but with a median dark gray or light-brown shading.....6.
6. Color of submarginal area lemon-yellow, within this a dark irregular band; dorsal disk orange; margin white; shape subcircular, about 1.28 by 1.08 mm; tracheal folds distinct, dusky in marginal rim; pores opening within margin and surrounded with a chitinized ring; dorsum covered with granular spots, marginal rim with minute white dots; vasiform orifice armed within with about 12 prominent teeth.....*tricolor*.
 Vasiform orifice armed within with about 12 distinct teeth; size 1.44 by 1.32 mm.; thoracic tracheal folds distinct, broadening rapidly from margin, the three folds thickly covered with rather large dots.....*radiipunctata*.

In regard to the position of the species *fodiens* Maskell, which is placed in the subgenus *Dialeurodes*, some statement is necessary. We know the species only from the one specimen in the Maskell collection, which is in rather poor condition. Two possibilities occur: First, it may not be a normal specimen of the species, and, second, it may not be the final pupal stage. In the specimen the tracheal thoracic folds and pores are hardly suggested. Since all other species similar to it show these characters very distinctly, the possibility of

the abnormality of the individual becomes greater. It seems wisest, therefore, to leave it in *Dialeurodes* until more material comes to hand for study.

The species *tricolor*, placed in this subgenus, also deserves mention. It is scarcely a typical *Dialeurodes* and possibly may represent a distinct subgenus; nevertheless, on account of the structure of the orifice and nature of the pores of the thoracic folds it is left here for the present.

DIALEURODES (DIALEURODES) CITRI (Ashmead).

Plate 63, figs. 1-14; plate 64, fig. 1.

Aleyrodes citri ASHMEAD, Florida Dispatch, new ser., vol. 11, 1885, p. —.

Aleyrodes citri RILEY and HOWARD, Insect Life, vol. 5, 1893, p. 219.

Aleurodes eugeniae var. *aurantii* MASKELL, Trans. N. Zealand Inst., vol. 27, 1896, p. 431.

Aleyrodes aurantii COCKERELL, Bull. 67, Fla. Agr. Exp. Sta., 1903, p. 666.

Dialeurodes citri (Ashmead) QUAINANCE and BAKER, Journ. Agric. Research, vol. 6, 1916, p. 469.

The orange white fly was first described and named by Ashmead. Later a more complete and detailed description was given by Riley and Howard, and these authors have since been credited with the name. According to the rules of zoological nomenclature, however, Ashmead is to be considered as author of the species. In the same year that Riley and Howard's description appeared, H. A. Morgan published the description of another species on orange under the name *citrifolii*. This species was later confused with Ashmead's species. In 1896 Maskell published his description of *aurantii*, placing it as a variety of his *eugeniae*. As pointed out by the senior author, however, no difference can be noted between the specimens of *aurantii* in the Maskell collection and specimens of *citri*; and, subsequently, *citri* has been collected from numerous localities in India, the home of Maskell's *aurantii*. In the Florida Agricultural Experiment Station Bulletin 67 Cockerell raised *aurantii* to specific rank, and further expressed the opinion that the home of *citri* would probably be shown to be in the Orient. This has been fully substantiated by the collections of Messrs. Ehrhorn, Karnes, and Woglum. The specimens from which the original description of *citri* was made were probably secured from orange in Washington, District of Columbia, though specimens had previously been collected in several localities in the Gulf States. The species is now represented in the collection of the bureau from the following States in the United States: Alabama, California, Colorado, Florida, Illinois, Louisiana, Mississippi, North Carolina, Texas, and District of Columbia. The occurrence of the insect in Colorado, Illinois, and the District of Columbia is probably confined to conservatories. Specimens have been received from foreign countries as follows: India (Lahore; Gujranwala; Dehra Dun; Wazirabad; Am-

ritsar; Khasia Hills; Assam; Saharanpur); Japan (Nagasaki); China (Canton; Peking; Shanghai). It is stated, on good authority, to occur in Chile; Mexico and Brazil are also given for the species by G. W. Kirkaldy.

In the original description of the first larval stage 38 marginal bristles are given. This seems evidently due to the fact that the margin possesses a series of small tubercles, some of which possess spines and some of which do not. The Riley and Howard slides of this instar show the correct number of spines for *citri*, but it was evidently supposed by those gentlemen that the tubercles not possessing spines had lost them and thus the full number of spines was described and figured. This fact led Morrill and Back to conclude that Riley and Howard's description was based on specimens of *citrifolii* (*nubifera*), for they remark:

"In the text the description of the first stage or instar of the larva was evidently based on a specimen of the spotted winged white fly and the illustration of the first instar was also based on the species with little doubt."

Egg (pl. 63, fig. 9).—The eggs are placed irregularly upon the under surface of the leaf and are greenish yellow in color, either polished or pruinose, due to the deposition of mealy wax by the adults. The surface is without the reticulate covering observed on the eggs of *citrifolii* Morgan. The stalk is situated at the larger end of the egg and is about as long as the egg is wide. Average size, 0.21 by 0.085 mm.; shape subelliptical. In hatching the egg splits almost its entire length and the two halves of the empty shell do not remain widely apart, as is the case with the eggs of *citrifolii*.

Larva, first instar.—Color light yellowish, with sometimes orange areas in the abdomen showing through; eyespots dark brown; shape oval, broadest across the anterior abdominal segments, flat upon the leaf. There is no lateral or dorsal secretion. Size 0.32 by 0.2 mm. Margin entire, armed with 17 small tubercles on each side, 14 of these bearing bristlelike hairs, as shown in figure 6, while 3 do not have these hairs. On the cephalic extremity there is another pair of short hairs situated somewhat ventrad of the margin. This makes in all a row of 30 hairs encircling the margin. Of these the second cephalic pair and the first and third caudal pairs are long, the others short. Antennae (pl. 63, fig. 8) of three segments, the third being lashlike and showing two angled spurlike portions, one at the extremity and one about a quarter of the way from the distal end. Legs (pl. 63, fig. 7) with a swollen portion at the distal extremity, the median segment and the proximal one each armed with a long curved spine.

Second instar.—Color pale yellowish, in some specimens with almost transparent areas; eyespots dark purplish brown. Shape oval, broadest across the first of the abdominal segments; size 0.4

by 0.26 mm., but varying considerably. Margin with minute irregular incisions and devoid of all hairs or bristles excepting a cephalo-lateral pair, one large caudal pair, and a smaller caudo-lateral pair. There is a slight constriction in the region corresponding to the tracheal pores of the pupa case, and sometimes there are a number of regular toothlike projections therein. The vasiform orifice is rounded cordate, the operculum similar in shape, with the exception that the lateral margins are somewhat constricted. The lingula is not visible. The dorsum is covered with numerous granular markings.

Third instar.—Color similar to that of the second instar; shape oval; size 0.59 by 0.432 mm. Margin with minute indentations and with three pairs of bristle-like hairs similar to those of the second instar. In this instar the three tracheal folds are evident and are marked within with a large number of minute circular transparent areas similar to those present in the folds of the pupa case. The vasiform orifice is similar in shape to that of the second instar.

Pupa case.—On the leaf the pupa cases are yellowish in color, sometimes slightly brownish. They are devoid of either dorsal or lateral secretion, are lighter toward the margin than on the median dorsal area, and the entire case when in certain lights often shows very beautiful hues and iridescent colors. The cases are placed upon the leaf without any definite arrangement as to the veins, but are nearly always situated on the under surface. There is a very narrow, acute, dorsal keel extending down the middle of the thorax and joining the transverse suture, which divides it from the abdomen. On the central dorsal area, that part immediately above the body of the developing adult, the segments of the body are distinctly marked, somewhat rounded, and the entire surface perfectly smooth and highly polished. The lateral area of the dorsal disk, however, is very minutely and irregularly striate, in some cases giving almost the appearance of minute punctures. The thoracic tracheal breathing folds are raised above the surrounding area, and the operculum and caudal tracheal areas are usually slightly elevated. On the submarginal area the striations which show considerable irregularity on the dorsal area become more even, extending in from the margin. The marginal area is somewhat rounded, being curved downward slightly to meet the margin, which is considerably nearer the leaf than the highest point of the case. In some specimens the median area of the case collapses as the insect within dies, owing to drying upon the leaf. These are generally paler in color than those which have not shrunk.

Under the microscope (pl. 64, fig. 1) the color is pale yellowish, almost transparent on the margins and often somewhat darker on the median area, owing to the color of the viscera. In shape the case is subelliptical, tending toward oval in some specimens, and often

slightly constricted just caudad of the thoracic tracheal pores. Average length of case 1.52 mm. The margin (pl. 63, fig. 3) is armed with a series of minute tooth-like divisions from which suture-like markings extend mesad on the case. These markings are not of equal length, but usually every third one extends farther mesad than the others, giving the effect of a double series—a longer and a shorter one. The submarginal area, with the exception of that portion very close to the margin itself, is similar in structure to the dorsal disk. The sutures are evident upon the dorsum, but not strongly marked in mounted specimens. There are no dorsal spines. The tracheal folds (pl. 63, fig. 2) are prominent, their pores being situated either on the margin or very close to it. The ring of the pore is not armed with fimbriæ, or teeth, but is entire. It is, however, covered with series of minute circular markings. The fold itself is without any sculpturing of the dorsal derm, but on focusing down into the case a large number of minute transparent circular areas are visible, as shown in the figure. They are present on both of the thoracic and on the caudal tracheal folds. The vasiform orifice (pl. 63, fig. 4) is almost circular in outline; the inner caudal margin is armed with a varying number of short, acute, irregular teeth. The lingula is not visible, as it is obscured by the operculum. This latter is somewhat semicircular in outline, with the lateral margins constricted and the cephalic margin straight. The color of the orifice is somewhat darker than that of the remainder of the case, with somewhat more of a greenish cast.

Adult female.—The female is yellowish and dusted with white powdery wax. When at rest the wings are laid back against the sides of the abdomen. The head, which is covered with fine wax, is on this account white, with the exception of the eyes, which are chocolate brown. The basal segments of the antennae are white, pruinose, while the distal ones are usually yellow tinged with pale red. The wings, owing to their waxy covering, are white and opaque, the thorax and abdomen, as viewed from above, amber colored. There are occasionally seen on the thorax small brown markings. When viewed from below the body is yellow or amber colored, more or less dusted with white wax. The legs are sometimes tinged with red and the labium is tipped with dark brown. Under the microscope the color is yellow, with the eyes dark brown and the ocelli dusky. Length from vertex to tip of ovipositor 1.36 mm. The forewing (pl. 63, fig. 11) is 1.408 by 0.64 mm., clear transparent without any shading or marking; radial sector slightly curved and extending almost to the margin. Cubitus fine, but long and distinct; media rarely represented by a faint shading near the base of the radial sector; remnant of the vein as in species of *Aleyrodes*. Margin (pl. 63, fig. 14) armed with numerous teeth on which are small hairs. Hind tibia armed with a circle of prominent spines on its distal extremity and

with several longitudinal rows; length 0.48 mm. Proximal segment of hind tarsus armed with two longitudinal rows of spines, one composed of four spines and one of five spines. Other smaller hairs are present and a thicker spine is present on its distal extremity; length 0.16 mm. Distal segment armed with four spines; length 0.042 mm. Foot (pl. 63, fig. 12) with a central hairy paronychium and short curved claws. Antennae of seven segments (pl. 63, fig. 10). Segment II subpyriform, 0.06 mm. long, armed on its distal extremity with three or four prominent spines and numerous smaller hairs. Segment III subcylindric, tapering proximad and distad; the proximal half possesses imbrications, the distal half has usually six prominent transverse annular sensoria, and one distal circular fringed sensorium; length 0.114 mm. Segment IV 0.042 mm., subcylindric and armed with three or four transverse sensoria. Segment V 0.045 mm., subcylindric, and with usually four transverse sensoria. These are very fine and not prominent, as upon the other segments. Segment VI 0.054 mm., subcylindric, with four rather prominent transverse sensoria. Segment VII 0.06 mm., subcylindric, rather narrower than the other segments and armed with three or four transverse sensoria and two or three minute circular fringed ones; distal extremity tipped with a prominent bristle.

Adult male.—Similar to the female in general appearance, but smaller. Length from vertex to tip of claspers 1.28 mm. Antennae similar to those of the female. Segment II 0.054 mm.; III 0.111 mm., with usually six transverse sensoria; IV 0.045 mm., with about four transverse sensoria; segment V 0.045 mm., with three or four transverse sensoria; segment VI 0.051 mm., with five or six transverse sensoria; segment VII 0.06 mm., with four or five sensoria. Hind tibia 0.368 mm. long; hind tarsus 0.128 mm. for the proximal segment, and distal 0.08 mm. long. Claspers (pl. 63, fig. 13) 0.102 mm. from the distal extremity to the shoulder, and 0.084 mm. across to the shoulder, tapering, upcurved, and armed each with three large spines and a series of smaller hairs on its inner distal margin. Penis nearly as long as the claspers, tapering and upcurved at the tip, and bulbous at the base. Length of forewing 1.86 mm.

DIALEURODES (DIALEURODES) CITRIFOLII (Morgan).

Plate 65, figs. 1-14.

Aleyrodes citrifolii MORGAN, Spec. Bull. Louisiana St. Exp. Sta., 1893, p. 70.

Aleyrodes nubifera BERGER, Bull. 97, Florida Agr. Exp. Sta., 1909, p. 67.

Aleyrodes nubifera MORRILL and BACK, Bull. 92, Bur. Ent., U. S. Dept. Agric., 1911, p. 86.

The species described and figured by Morgan is easily separated from *citri*, redescribed by Riley and Howard in the same year, by the characters of the egg, pupa case, and of the adult. The egg in

particular easily separates the two species, and this stage was well described and figured by Morgan. It seems unnecessary, therefore, to discard Morgan's name for *nubifera*, which was proposed by Berger in 1909. In proposing this name Dr. Berger says "the reticulate egg was figured in 1893 by H. A. Morgan," but he makes no mention of the fact that descriptions of the pupa case and adults were also given. Morrill and Back in following Berger state that the description of the pupa and adult given at the same time were "evidently * * * based on specimens of *A. citri*." There seems, however, nothing in Morgan's description which would not be true for *citrifolii*, and as the egg definitely fixes the identity of the species, Morgan's name should be retained. *Dialeurodes citrifolii* is known from the following States: Florida, California, Louisiana, Mississippi, and North Carolina. No specimens of this species were taken by Mr. R. S. Woglum in the Orient, though it will probably be found to be native to that region. It is also known from Mexico and Cuba.

Egg (fig. 9).—The eggs are laid without any definite arrangement upon the under surface of the leaf. The egg is elliptical-elongate in shape, and in hatching the opening does not extend more than half way down the egg. This slit remains open, being different in this respect from the egg of *D. citri*. In size it is about 0.256 by 0.088 mm., and when first laid it is cream color, later changing to a slate or bluish black. It is pruinose and covered with a waxy coat in the form of hexagonal meshes (fig. 10). This may become dissolved in preparing mounts and is often broken from the egg in the dry state. This waxy covering and the dark color serve easily to separate the egg of *citrifolii* from that of *citri*. The stalk is attached to the base of the egg, is pale yellowish in color, and usually about as long as the egg is wide, though in some cases it is much longer.

Larva, first instar.—Color light-yellowish green, sometimes whitish, due to slight particles of wax on the ventral surface. At first there is neither lateral nor dorsal secretion, but soon an irregular waxy fringe, as wide as the length of the marginal hairs, is secreted. Shape elliptical; size 0.3 by 0.2 mm.; margin almost entire and armed with 18 pairs of hairlike bristles. Of these the first and third caudal pairs are much longer than the others, as is also the second cephalic pair. The antennae and feet are similar to those of *D. citri*.

Pupa case.—On the leaf the pupa cases are pale yellowish in color, rather white when the adult has emerged, and lack both dorsal and lateral secretion. They are much evener in shape than the cases of *D. citri*, being elliptical. They are extremely flat and thin and in this respect also differ from *citri*. In the character of the surface there is little difference between the two species, as *citrifolii* possesses the same almost smooth condition of the median portion of the dorsal disk and the same striations on the submarginal area. The

striations, however, seem to be a little more regular in most specimens of *citriifolii* than in those of *citri* and light is not so much reflected from the surface. The cases collapse when the adult has emerged. Balsam mounts by transmitted light show the cases yellowish in color, almost transparent; size 1.76 by 1.32 mm. (fig. 1). The margin (fig. 12) is very minutely serrate, and extending inward from it is a closely set series of narrow pointed wax tubes, which broaden as they extend mesad and collectively form a marginal band all around. The dorsal derm is closely set with irregular more or less circular markings which seem to be arranged more or less concentrically from the median dorsal area to the margin. On the submarginal area the thoracic and caudal tracheal folds are distinct, the openings of the thoracic pair (fig. 2) being near the margin and armed with six or eight rather distinct fimbriae. The caudal fold (fig. 3) is marked with numerous large and small irregular reticulations with differentiated centers. These are much larger and more irregular in size than the minute dots present within the folds of *D. citri*. The thoracic tracheal folds seem to lack these markings. The vasiform orifice (fig. 4) is subcordate, 0.051 mm. wide, and 0.048 mm. long. The inner caudal margin is armed with a rather large number of fairly distinct teeth directed cephalad; operculum similar in shape, with the anterior margin straight and the sides slightly compressed. It almost entirely fills the orifice. On each side of the vasiform orifice a minute seta is situated and a pair is present on the latero-caudal and cephalic margin.

Adult female.—Color very similar to that of *D. citri*, with the exception of a dusky spot on the distal extremity of the forewing, this being one of the characteristics by means of which it is easily distinguished. Length from vertex to tip of ovipositor 1.28 mm.; color in balsam mounts yellow, shaded with brown; forewing when mounted almost transparent with the exception of the shaded area before mentioned; venation similar to that of *citri*; size of the forewing 1.2 by 0.64 mm.; legs yellow in color; hind femora 0.304 mm.; hind tibia 0.432 mm.; armed with a longitudinal row of about 12 spines, with another row of similar spines placed about the same distance apart as those of the first row, and with still a third row of smaller spines placed very close together. Hind tarsus with the proximal segment 0.126 mm. long and armed with a longitudinal row of four spines, of which the distal one is the largest (fig. 13). Foot with claws not greatly curved and with the paronychium rather broad (fig. 14).

Antennae (fig. 5) of seven segments. Segment I subglobose; II subpyriform, 0.06 mm. long and armed with a few prominent spines; III subcylindric, somewhat tapering distad and proximad, 0.126 mm. long, armed with 25 or 30 very fine annular sensoria, and near

the distal extremity with two circular sensoria. These last (fig. 6) are composed of a central thumb-like process surrounded by a ring on which three or four stout bristles are situated. Somewhat proximal of these two sensoria is a rather long but not easily distinguished spine. Segment IV 0.021 mm. long, subcylindric, and armed with four or five fine transverse sensoria; segment V subcylindric, about 0.036 mm. long and armed with seven or eight transverse sensoria and a distal circular sensorium. Segment VI subcylindric, about 0.03 mm. long, armed with six or seven transverse sensoria, and at about its middle with a long spine. Segment VII 0.057 mm. long, tapering considerably distad, and armed on its proximal portion with a number of faint transverse sensoria. On the basal third there is situated a long spine, and the distal extremity is tipped with a very prominent spine measuring 0.027 mm. in length; the long spines arming the segments, with the exception of the distal spine, are very difficult to see in some specimens and in some do not appear to be present at all. The antennae of the adult are considerably different from those of *citri*—first, as regards the length of the respective segments; secondly, the sensoria are much more numerous and smaller; and thirdly, the distal spine is about as long as in *citrifolii*.

Adult male.—Similar to the female in general appearance, but somewhat smaller; length from vertex to tip of claspers from 0.88 to 1.04 mm.; forewing, length 0.96 mm.; hind tibiae 0.336 mm.; hind tarsus, proximal segment 0.112 mm., distal segment 0.08 mm. The claspers (fig. 8) are about 0.12 mm. long, and 0.075 mm. broad at the shoulder. They are tapering, upcurved, and armed with a few spines and hairs. The penis is about as long as the claspers, is curved dorsad, bulbous at the base, and narrowed distad.

DIALEURODES (DIALEURODES) FODIENS (Maskell).

Plate 66, figs. 1-4.

Aleurodes fodiens MASKELL, Trans. N. Zealand Inst., vol. 28, 1896, p. 433.

Pupa case (fig. 1).—The pupa case of this species is the smallest in the genus thus far known, measuring only 0.8 by 0.72 mm.; the margin is entire, though faint sutures are evident, extending mesad through a narrow, evident submarginal area. There are no distinct caudal or thoracic tracheal folds or pores, and in this regard it differs from the other species. The remaining characters and general appearance, however, undoubtedly place it here. The thoracic and abdominal segments are plainly marked off by light yellow sutures on a median dark brown area; derm of dorsal disk shagreened; the remaining portion of the case is yellow to almost transparent; the eyespots are large, granular, and purple in color; the vasiform orifice (fig. 2) is elongate cordate; the rim thick and the cephalic

margin slightly curved caudad. The caudal and lateral margins inside are armed with a number of short, acute fimbriae; the lower inner lining of the orifice is coarsely reticulate, giving it an irregular serrate appearance. The operculum is semicircular or slightly crescent shaped, and about half fills the orifice, obscuring the lingula, which is setose and armed with two fine bristles (fig. 3).

Represented by one pupa case in balsam in the Maskell collection.

Habitat.—New Zealand, on *Drimys axillaris*, on the leaves of which it produces a characteristic pitting.

DIALEURODES (DIALEURODES) KIRKALDYI (Kotinsky).

Plate 67, figs. 1-13; plate 64, fig. 2.

Aleyrodes kirkaldyi KOTINSKY, Bull. 2, Bd. Agr. and Forestry, Hawaii, 1907, p. 95.

Paratypes of this species are in the bureau collection and consist of eggs, larvae, and pupa cases. We have also for study specimens of pupa cases and adults taken by Mr. G. E. Bodkin, on leaves of jasmine, Georgetown, Demerara, British Guiana, February, 1912.

Egg.—Size about 0.178 mm. long by about 0.096 mm. wide a short distance from the unstalked end, narrower at the stalked end; color yellowish. In hatching the egg splits downward for 0.09 mm. and spreads open considerably; surface without sculpturing; stalk attached near the middle.

Larva, first instar (pl. 67, fig. 11).—Size 0.24 by 0.16 mm.; regularly elliptical; color light yellow, with dark brown eyespots. There are on the margin of the specimens at hand 14 pairs of hairs, the position of which is best shown in the figure. It will be noted that there are a number of marginal papillae on which no hairs are shown, while in one of our specimens there are no hairs on any of the papillae of the cephalic half. This absence of hairs from some tubercles may be due to imperfect specimens, but this occurs in *citri* Ashmead, where it is normal.

Pupa case (pl. 67, fig. 1).—Much resembles *citri*; size about 1.84 by 0.846 mm.; many of the cases, however, are smaller than the above dimensions; shape elliptical, with slight indentations on margin at the pores of the tracheal folds; form flat, thoracic sutures plainly visible as transparent lines on the dark brown median area; abdominal segments not distinct. Color transparent or yellowish, with a median brown longitudinal area. This sometimes occurs only on the thorax, and again it extends caudad to the vasiform orifice. Tracheal folds (pl. 67, fig. 3) marked with minute dots, the pore located near the margin and being without fimbriae, though with a distinct rim. Vasiform orifice (pl. 67, fig. 2) cordate, somewhat rounded, with the cephalic margin straight. The caudal margin is armed with 25 or 30 rather well-defined fimbriae or teeth; size of orifice 0.039 by 0.039 mm.

The operculum is of very much the same shape as the orifice, but indented on the lateral margins. It almost fills the orifice and obscures the lingula, which is spatulate. On either side of the vasi-form orifice a small seta is situated. Margin of case marked by a large number of closely appressed sections formed by the sutures of wax tubes.

Adult male.—Length from vertex to tip of claspers 0.85 mm.; color yellowish, with a slight tinge of brown on the thorax; ocelli dusky; eyes dark brown, almost black; vertex rounded; antennae (fig. 10) of seven segments. Segment I subcylindric, short and thick, 0.018 mm. long; II 0.045 mm., subpyriform, armed on its distal extremity with a number of hairs; III 0.096 mm., subcylindric, narrow proximad, where it is covered with numerous imbrications, distal two-thirds armed with about 15 narrow transverse sensoria, or annulations, the distal extremity also armed with a circular fringed sensorium the marginal fringe of which is composed of three or four stout hairs; IV 0.012 mm., with three annular sensoria; V 0.012 mm., also with three annular sensoria, and a circular fringed sensorium; VI 0.063 mm., subcylindric, narrower and imbricated proximad, the distal two-thirds armed with 10 or 12 annular sensoria, and the distal extremity with a fringed sensorium; VII 0.06 mm., subcylindric, armed with about 10 annular sensoria, and near the distal extremity one or two small circular fringed ones; distal extremity tipped with a rather stout spine. Legs almost transparent; distal extremity of the hind tibia armed with two prominent spines on its inner edge; proximal segment of tarsus armed on its distal extremity with a large spine (pl. 67, fig. 9). Five other spines, somewhat shorter, are present on the median portion of the segment in two rows, one row of two spines and one row of three; distal segment of tarsus with three prominent spines on its inner margin, and also a large number of fine hairs; proximal segment of hind tarsus 0.088 mm.; distal segment 0.06 mm.; foot 0.015 mm. (pl. 67, fig. 8), with a median hairy paronychium. Forewing (pl. 67, fig. 6) 0.72 mm. long and 0.24 mm. wide; radial sector bent very slightly in its median part and extending almost to the distal margin; media sometimes faintly indicated by a shading, but usually this is not evident; cubitus fine and distinct, rather long and in the usual position; margin of wings with a series of bead-like structures, on which hairs are situated; color clear without spots or shading; claspers (pl. 67, fig. 7) 0.1 mm. long and 0.06 mm. broad at shoulder, tapering, upcurved, acute at the distal extremity, and armed with about five spines on each. Penis elongate, acute, and upcurved distally, bulbous at the base. The testes may be seen through the abdomen as orange-yellow masses composed of globular-like bodies. The rectum leads from the vasiform orifice as a narrow tube, which extends the full length of the genital

segment. In the next abdominal segment it is enlarged (pl. 67, fig. 13) and contracts again as it is leaving this segment.

Adult female.—Color of specimens preserved in alcohol pale yellowish to almost white, with a large dusky area on the dorsum of abdomen; wings transparent, colorless, with sometimes a faint dusky shading; eyes dark brown.

Length from vertex to tip of ovipositor 1.12 mm.; forewing 1.28 mm. by 0.56 mm.; hind tibiae 0.432 mm.; proximal segment of tarsus armed with two longitudinal rows of stout spines, of which the distal one of the rows is especially stout. There are also on the segment, particularly on the distal part, a large number of fine hairs. The distal segment is armed with two pairs of stout spines and numerous fine hairs; claws not strongly curved; paronychium long, acute, and hairy; vertex rounded. Antennae of seven segments, the first subcylindric, short, and thick; second subpyriform; third and distal ones subcylindric and armed with annular sensoria. These are more prominent on segments VI and VII than on the others. Segments III and VII are each also armed distad with a circular, fringed sensorium, and VII is tipped with a bristle. Length of segments as follows: I 0.021 mm.; II 0.048 mm.; III 0.105 mm.; IV 0.015 mm.; V 0.024 mm.; VI 0.045 mm.; VII 0.06 mm. The radial sector is prominent in the forewing and curved on its distal part, while the cubitus is faintly represented; the margin of wings is armed with knob-like projections on which minute hairs are situated. The ovipositor is acute, distinctly three-cleft, and dark in color. It is armed with stout spines, the distal ones of which are long, extending almost to the tip of the ovipositor itself.

DIALEURODES (DIALEURODES) RADIPUNCTA, new species.

Plate 66, figs. 5-7.

Pupa cases of this species were received from Mr. A. Rutherford, and marked Memexylon, Peradeniya, Ceylon, November 10, 1913. The species is interesting as it shows the ring of teeth present on the inner margin of the vasiform orifice, as in the typical subgenus *Dialeurodes*, whereas the other characters are those of that group of the genus (*Rusostigma*) wherein these teeth are lacking.

Pupa case (fig. 5).—Size 1.44 by 1.312 mm.; color pale yellowish, almost transparent, with a median dark gray or light brown shading. Suture separating the thorax and abdomen distinct and extending to the margins; margin almost entire, the wax tubes being represented by very shallow irregular teeth; submarginal area closely striate, with suture-like markings forming a distinct zone around case. Tracheal pores (fig. 7) distinct, situated a short distance from the margin and armed within with four or five very irregular teeth; tracheal fold marked with many small circular dots forming a band,

which broadens as it reaches the subdorsal region. Vasiform orifice (fig. 6) broadly subcordate with the cephalic margin almost straight; rim of the orifice thick and its inner caudal and lateral margin armed with about 12 distinct teeth. Cephalic margin armed with a peculiar thickened area which clasps the orifice at the sides like the cup of an acorn; operculum similar in shape to the orifice and nearly filling it, obscuring the lingula; latero-caudad are two ridges which approach one another, suggesting the caudal channel present in some other forms.

Adults.—Unknown.

Type.—Cat. No. 19049, U.S.N.M. Described from pupa cases in balsam mounts.

DIALEURODES (DIALEURODES) TRICOLOR, new species.

Plate 66, figs. 8-13.

Foliage of a myrtaceous plant infested with this insect and collected at Eubato, Brazil, was received by the Bureau of Entomology in July, 1898, from Dr. F. Noack. A balsam slide mount containing five pupae is all of this material which we now have. The species, however, is quite distinct and is easily recognizable.

Pupa case (fig. 8).—Under reflected light the case appears brownish in color and is apparently void of waxy secretion. Examined under the microscope, the coloring is found to be about as follows: All around margin is a rather narrow border, the inner margin showing an interrupted line of pale yellow. The submarginal area is lemon yellow and the dorsal disk orange in color. Surrounding the dorsal disk is an irregular band of dark brown covering the vasiform orifice and extending cephalad to the transparent marginal rim, where it spreads out, forming a broad arrow-shaped figure (fig. 8). The shape is subcircular, margin flattened, and dorsum somewhat convex; size 1.28 by 1.088 mm. Margin (fig. 9) minutely incised; the sutures between wax tubes are quite distinct, extending mesad to the yellow subdorsal area. Derm thickly marked with granular spots, very evident under reflected light. Transparent marginal area with rather numerous, large, more or less circular markings. This rim is very generally sprinkled with minute lighter colored dots. On inner margin of transparent marginal rim is an interrupted row all around covered by rather prominent subcircular brown spots. Thoracic segments distinct; abdominal segments moderately so. Tracheal folds evident toward margin of case, ending just within margin in the transparent rim or band. The pore (fig. 10) is bordered all around with brownish. There appear to be no fimbriae or teeth around pore orifice, but the derm is marked with closely set radiating lines.

Vasiform orifice (fig. 11) subcordate, the inner caudal margin armed with 12-14 prominent teeth or fimbriae. Operculum about half filling orifice and of same general outline, minutely setose on caudal margin. Lingula (fig. 12) lingulate and setose, with a pair of spines on distal end.

Adults.—Unknown.

Described from 5 pupa cases in balsam mount.

Type.—Cat. No. 19050, U.S.N.M.

RUSOSTIGMA, new subgenus.

This group is represented by species from India, Japan, and the East Indies.

Pupa case broadly elliptical or subcircular, yellowish, with sometimes a median brownish or blackish area; marginal wax tubes represented somewhat as in subgenus *Dialeurodes*; wax secretion usually absent; dorsal disk without large pores or a distinct rhachis, but often marked with minute semicircular or polygonal markings in the derm; thoracic tracheal folds prominently sculptured with polygonal markings, and opening, usually a short distance within the margin, in a distinct pore which is armed with a number of teeth; vasiform orifice broadly subcordate, its inner caudal and lateral margins without a comb of teeth; adults with forewings rather broader than in *Dialeurodes*, usually somewhat heavily and more or less irregularly clouded, veins somewhat thickened and often possessing sensoria. (Antennae absent from the specimens in hand.)

Type.—*Dialeurodes* (*Rusostigma*) *radiirugosa* Quaintance and Baker.

KEY TO SPECIES OF SUBGENUS RUSOSTIGMA.

1. Median dorsal area without dark brown coloration.....2.
 Median dorsal area dark brown with conspicuous cross stripes along body segments; remainder of case yellowish; tracheal folds distinct and marked with polygonal areas, pores some distance within the margin; case elliptical; size about 0.8 by 0.74 mm.; margin entire; vasiform orifice longer than broad; operculum more than half filling orifice *eugeniae*.
2. Thoracic tracheal folds brownish, the polygonal markings broadening on the subdorsal area forming a T-shaped figure; dorsum of case with faint polygonal markings; outline subcircular; size 1.6 by 1.4 mm.; mesal margin of tracheal pores with several more or less curved fingerlike processes..... *radiirugosa*.
 Thoracic tracheal folds concolorous with case, the markings not broadening out on subdorsal area into a T-shaped area; submarginal area with semicircular, notched markings in derm which graduate into polygonal markings toward dorsal area; color of case yellowish, elliptical in outline and rather convex; size about 1.52 by 1.28 mm.; eggs small, brown..... *tokyonis*.

DIALEURODES (RUSOSTIGMA) EUGENIAE (Maskell).

Plate 68, figs. 1-5.

Aleurodes eugeniae MASKELL, Trans. N. Zealand Inst., vol. 27, 1896, p. 430.

This species is represented by one pupa case in balsam mount in the Maskell collection. It is in rather poor condition, being more or less covered with a fungous growth.

Pupa case (fig. 1).—Size 1.38 by 1.04 mm. Outline regularly elliptical; median dorsal area dark brown, on which the prominent thoracic sutures show clearly transparent. The abdominal sutures are not so distinct. The tracheal folds (fig. 3) show very prominently owing to a reticulate sculpturing with which they are covered. The pores (fig. 2) are situated some distance in from the margin and are armed with about 16 rather distinct teeth. The fold is delineated by fine ridges, which border the sculptured area and encircle the outer margin of the pore. The vasiform orifice (fig. 4) is subcordate in outline, with the cephalic margin but little rounded. The inner margin of the orifice is devoid of teeth common to *citri* and *citrifolii*. The operculum is of much the same shape as the orifice and nearly fills it. The tip of the setose lingula appears to protrude below the caudal margin of the operculum for some distance, but this may be due to the preparation of the mount. The marginal area of case is marked by sutures running a considerable distance mesad, forming a zone all around case, about one-third diameter of case.

Adults.—Unknown.

Habitat.—India, on *Eugenia jambolana*.

DIALEURODES (RUSOSTIGMA) RADIRUGOSA, new species.

Plate 69, figs. 1-9.

This species is represented by two lots of material. One lot was taken on mango by R. S. Woglum, Brilliton Isle, Dutch East Indies, February 5, 1911, and the other was taken on a "woody shrub" by C. L. Marlatt at Gerolt, Java, December 7, 1901. The material in both cases is composed of pupa cases only. The species suggests *eugeniae*, owing to the distinct reticulate areas of the tracheal folds. It is readily distinguished from this species, however, by the extent of the reticulate area, and the unsculptured, circular area immediately surrounding the marginal pore.

Egg.—Short, ovate, with short stalk, the eggs being held upright on leaf; color dark brown, apparently without reticulation.

Pupa case (fig. 6).—As seen on leaf the color is dirty white or yellowish. The dorsal disk is but little elevated, and the submarginal area is rather clearly delineated as a radiate band all around, this appearance resulting from the sutures of the wax tubes. The case is void of any waxy secretion; under the microscope the color

is yellowish, or nearly colorless, with brownish shading over the tracheal pores; shape elliptical to subcircular; size 1.6 by 1.4 mm. (Parasitized specimens are of quite a different color, being more or less shaded with dark brown on the dorsal disk. This is often very dark and extends almost to the cephalic extremity of the case.) The dorsum is very slightly elevated, but more so in parasitized individuals, and the abdominal segments are quite distinct. The thoracic and caudal tracheal folds are very distinct; the pore itself (fig. 8) is situated a short distance mesad of the margin, and is armed with seven or eight rounded processes. Surrounding these is a clear area without sculpturing and inclosed by a distinct ring. Outside of this ring, surrounding it and extending for a considerable distance mesad, is a series of dark sculptured areas, irregular in size and shape. The band of these sculptures extending from the caudal breathing fold reaches the vasiform orifice and extends around on both sides, though the markings are not present cephalad of it. The bands extending from the thoracic breathing folds are crossed by similar longitudinal ones on the outer margin of the dorsal disk. The entire dorsum excepting the extreme central portion of the dorsal disk is covered with faint irregular coarse sculpturing (fig. 9). The vasiform orifice (fig. 7) is somewhat rounded cordate, with the cephalic margin straight. Entad of the lateral and caudal portion of rim the surface is minutely spinose. The operculum is similar in shape to the orifice and almost completely fills it, leaving the extreme setose tip of the lingula exposed. The margin of case is almost entire, being marked with minute indentations between wax tubes, the sutures extending mesad as faint markings, which gradually merge into the faint dorsal sculpturing above mentioned.

Adult female.—Color light brownish, darker on the thorax and on dorsum of abdomen. There is a dark circular marking around the vasiform orifice. The legs are brown. We are unable to give the length of the insects, as the specimens we have are shrunken and broken. The antennae, too, are either absent or so shrunken in the specimens at hand that no description can be given. Forewing (fig. 1) 1.54 by 0.80 mm., covered thickly with white meal-like powder and appearing rather bluish in color. When mounted and examined under the microscope the wing appears rather uniformly brown or smoky in color. The radial sector is thick and irregular, and on its proximal portion and in about the middle two circular sensoria (fig. 2) are noticed. Each of these is surrounded by a clear irregular transparent area. Toward the distal extremity the radial sector is strongly curved. There is a clear, unshaded, narrow band which seems to represent the cubitus and another shorter line of a similar nature. Although the body of the wing is uniform smoky, there are a number of darker areas represented. These are generally situated

about the veins, as may be seen in the figure. A distinct dark area is present between the two transparent lines before mentioned. The margin (fig. 3) is armed with a large number of toothlike projections armed with hairs. The hind wing (fig. 4) is similar in color but more uniform than the forewing. The vein is armed with one or sometimes two sensoria similar to those in the radial sector of the forewing. The proximal portion of the costal margin is armed with a series of stout hairlike spines situated on small tubercles. These are in two series—one on the outer and one on the inner portion of the vein. The vasiform orifice (fig. 5) is somewhat cordate in shape, with the anterior margin straight.

Described from specimens on foliage and in balsam mounts.

Type.—Cat. No. 19051, U.S.N.M.

DIALEURODES (RUSOSTIGMA) TOKYONIS (Kuwana).

Plate 68, figs. 6-10.

Aleyrodes tokyonis KUWANA, Pomona Journ. Entom., vol. 3, 1911, p. 622.

Egg.—Short, stout, smoky brown in color, and without reticulations; stalk quite short, holding egg on leaf in upright position.

Pupa case (fig. 6).—Size 1.52 by 1.28 mm.; outline almost entire, with slight indentures at the pores of tracheal folds; dorsum slightly rounded, with the sutures not very distinct; color transparent, slightly yellowish. The dorsal disk is granular, being covered with a series of small polygonal markings which graduate on submarginal area into more or less concentrically arranged, but disconnected, thickenings in the derm, the individual thickenings showing one or two acute incisions, as shown in figure 7. Tracheal pores covered with irregular markings quite similar to those found in *eugeniae*, but they are much more numerous toward the pores (fig. 8), which are surrounded very thickly by them. In the thoracic folds the sculptured area does not extend so far mesad as in the caudal fold, where it reaches the vasiform orifice and partially surrounds it. The pore of each fold is small and irregular and there are no distinct processes, though blunt, tooth-like projections are sometimes noticeable. The vasiform orifice (fig. 9) is subcordate in outline, with the anterior margin straight. The caudal inner margin is devoid of teeth, but is covered with a series of fine hairs. The operculum is somewhat the same shape as the orifice, though with straighter sides. It nearly altogether covers the lingula, only the tip of which protrudes from below it; both the lingula and the caudal portion of the operculum are setose. The margin is minutely serrate, but it is marked by a large number of ridges or sutures extending irregularly mesad, so that in some specimens there appears to be a marginal rim.

Host.—*Ilex integra* Thunberg, and the locality Shibuya, Tokyo.

The above description is based on a study of paratype material kindly furnished by Mr. Kuwana.

DIALEURONOMADA, new subgenus.

In some characters the type-species is related to those of the subgenus *Rachisphora*, and in others related to the typical *Dialeurodes*. So far as our present knowledge goes it is the only example of this type.

Pupa case elliptic or oval, pale yellowish white in color, with visible visceral markings of bright red-orange or bright yellow; marginal wax tubes evident as distinct, but shallow, irregular tooth-like divisions of the margin, the sutures between which extend a considerable distance mesad; dorsal disk without sculpturing, but near its margin all around one or more rows of moderate sized pores; no rachis present, and on submarginal area no series of large pores; margin all around armed with a series of spines; thoracic tracheal folds distinct, either unsculptured or covered with minute dots; the pore armed within with usual lobe-like projections; vasiform orifice very broadly subcordate, almost semicircular, its inner caudal and lateral margin armed with prominent teeth; operculum almost entirely filling orifice.

Type.—*Dialeurodes* (*Dialeuronomada*) *dissimilis* Quaintance and Baker.

DIALEURODES (DIALEURONOMADA) DISSIMILIS, new species.

Plate 70, figs. 1-4.

This species was collected by R. S. Woglum on *Phyllanthus myrtifolium* at Saharanpur, India, November, 1910. It is represented in the Bureau of Entomology collection by pupa cases only.

Pupa case (fig. 1).—Size 0.98 by 0.66 mm.; shape oval, with considerable constriction along sides of thorax, and broadened across the cephalic abdominal segments; form flat. On the leaf only a few specimens are available for study. They lack either dorsal or lateral secretion and are white or grayish in appearance. Under the microscope the cases which are empty are transparent; those, however, which contain the pupa are pale yellowish, with a large irregular central dorsal patch of bright red. A number of circular or oval areas, varying in size, some transparent and others not, are present in this red area. The margin of case (fig. 3) is composed of a series of closely placed wax tubes, from which there extend mesad suture-like markings on the derm. Some of these, on the average every third, extend much farther mesad than the others, in this respect resembling considerably those of *citri* Ashmead. A series of 12 spine-like hairs is present on each side of the case.

The suture separating the abdomen from the thorax is not distinct in all specimens and the thorax is remarkable in being of about the same length as the abdomen. On the outer margin of the dorsal disk, extending all around the case, there is a ring composed of one or two rows of papilla-like pores (fig. 1). The vasiform orifice (fig. 2) is considerably broader than long, measuring the orifice proper, but the outer margin of the orifice extends cephalad, making the depth of the entire structure almost equal to the width. The inner lateral and caudal margin of the orifice is armed with usually 16 prominent rounded fimbriae, or teeth. The cephalic margin of the orifice proper is straight; the operculum almost entirely fills the orifice, being somewhat triangular in shape. The tracheal pore (fig. 4) has no distinct fimbriae, but has an irregular rim. The fold is marked with a number of suture-like markings extending mesad, and a large number of dots similar to those on the folds of *citri* are visible. These, however, are not upon the dorsal derm of the fold, but on the ventral portion as seen by focussing through.

The species can be easily distinguished from others in the genus by the marginal hairs, the ring of papilla-like pores on the border of the dorsal disk, and by the large bright red dorsal marking.

Adults.—Unknown.

Type.—Cat. No. 19052, U.S.N.M.

RABDOSTIGMA, new subgenus.

Somewhat related to the subgenus *Rusostigma* is the species *radiilinealis* from Ceylon. This species is as yet the only example of this type, wherein the polygonal areas of the tracheal fold, as shown in the species of *Rusostigma*, are replaced by linear thickened lines.

Pupa case.—Subcircular, usually yellowish, margin almost entire, the wax tubes being merely portions of the margin which are separated by sutures extending mesad; waxy secretion usually absent; dorsal disk without sculpturing or large pores and with no development of a rhachis; thoracic tracheal fold ending near the margin in a pore which is armed within with several teeth; fold marked with thickened linear lines; vasiform orifice roundly subcordate to subcircular; comb of teeth absent; operculum similar in shape and almost entirely obscuring the lingula.

Type.—*Dialeurodes* (*Rabdostigma*) *radiilinealis* Quaintance and Baker.

DIALEURODES (RABDOSTIGMA) RADIIINEALIS, new species.

Plate 70, figs. 5-8.

This form is represented in the Bureau of Entomology collection by the pupa case only, which was taken by Mr. C. L. Marlatt, on mistletoe, at New Ava Eliya, Ceylon, January 26, 1902. The species

is quite distinct by the presence on the tracheal folds of long, linear thickenings of the derm. The immature stages make pits on the lower surface of the leaf, resembling in this way *fodiens* and some psyllids.

Pupa case (fig. 5).—Size 1.76 by 1.6 mm.; outline almost circular, form flat; color in normal specimens almost transparent, but in parasitized individuals there are often two brown areas, extending over the thorax and abdomen on each side of the median area, which latter is pale transparent yellowish white, like the submarginal area. The suture separating the thorax and abdomen is very distinct and transparent. It does not extend to the margin, but curves cephalad and joins two somewhat similar transverse sutures, the three all being very prominent and inclosing two elongate transverse areas. The abdominal segments are not distinctly marked off. The tracheal folds (fig. 6) are easily distinguished, and are marked by a series of fine longitudinal ridges. The pore is situated a slight distance in from the margin of case, and is armed with eight or nine rather distinct projections. The ridges which mark the fold encircle this opening on its outer edge, but leave a small, smooth area mesad of it. The vasiform orifice (fig. 7) is subcordate in outline, tending to circular; the cephalic margin is almost straight and the inner caudal margin is without the fine teeth. The operculum is similar in shape to the vasiform orifice, but the sides are compressed. It almost entirely fills the orifice and almost altogether obscures the lingula. The margin (fig. 8) is entire, but the marginal area is marked off by a series of fine sutures extending mesad.

Type.—Cat. No. 19053, U.S.N.M.

GIGALEURODES, new subgenus.

Related to subgenus *Rabdostigma* in several characters is a small group of species for which is erected the above-named subgenus. Two of the largest known species of the subfamily belong here.

Pupa case.—Oval to subcircular, color usually yellowish; marginal wax tubes represented by irregular, somewhat shallow corrugations; waxy secretion usually absent; dorsal disk without distinct sculpturing and without large pores though numerous minute ones may be present; no rhachis development; thoracic tracheal folds ending on or near the margin in a pore the inner margin of which is often irregularly notched or toothed; fold not sculptured, or sometimes covered with minute circular dots; vasiform orifice small, subcordate, without a comb of teeth; operculum similar in shape and obscuring the lingula.

Type.—*Dialeurodes* (*Gigaleurodes*) *maxima* Quaintance and Baker.

KEY TO SUBGENUS GIGALEURODES.

1. Pupa case yellowish, without dark coloration on median dorsal area..... 2.
 Pupa case with more or less dark brown coloration on dorsum..... 3.
2. Subcircular in outline, very large, 2.4 by 2.4 mm.; dirty yellowish white; tracheal folds well developed, marked with minute white dots; tracheal pore surrounded by a distinct chitinized circular ring within which are several blunt tooth-like projections; vasiform orifice relatively small, about one-fourth length of case from caudal margin; eggs dark brown with coarse polygonal markings.. *maxima*.
 Oval or elliptic in outline, medium in size, 1.59 by 1.28 mm.; yellowish in color; tracheal folds well developed, marked with minute dots; pore opening just within margin, armed with a few acute teeth or lobes (much resembling *citri*, except as to character of vasiform orifice)..... *buscki*.
3. Size large, 2.20 by 1.9 mm.; margin of case all round dark brown in color; sub-circular in outline; a broad semicircular or linear spot of light yellow on cephalic end, remainder of case brown; tracheal folds not discernible; pores distinct and within margin of case, armed with several blunt stout processes; each pore surrounded by a conspicuous oval light yellow area; margin of case entire, but wax tubes conspicuous as corrugations on submarginal area..... *struthanthi*.
 Size medium, 1.6 by 1.3 mm.; broadly elliptical in outline, flat; entire surface brownish, the dorsal region dark brown; pore a deep sinus on the margin; margin of case crenulated; the lobes rounded; incisions acute; immature stages secreting from marginal pores a rim of wax..... *cerifera*.

DIALEURODES (GIGALEURODES) CERIFERA, new species.

Plate 71, figs. 1-4.

This species was received by the Bureau of Entomology April 10, 1901, from Mr. C. W. Mally, Cape Town, South Africa. The host is *Celastrus buxifolius*.

Egg.—Length 0.24 mm., elongate, curved; stalk shorter than width of egg at point of attachment; dirty white to brownish in color; surface densely covered with minute sculpturing.

Pupa case (fig. 1).—As seen on leaf the pupa case is yellowish brown, with dorsal disk dark brown, and is quite conspicuous in contrast with the light-colored lower surface of the leaf of the host plant. There is a fringe all around of glossy wax rods from marginal wax tubes, compact basally, but the rods separating distally. On numerous specimens this fringe is absent, having apparently weathered off. The dorsum is without secretion. The case is flattish and closely applied to leaf, there being no vertical wax fringe; dorsum slightly raised. This species, though plainly of the *citri* type, differs in the development of the marginal wax tubes and the presence of the fringe of wax rods.

Under the microscope the dorsal disk is brown in color, the balance of case being rather uniformly yellow; the shape is broadly elliptical to subcircular; size 1.6 by 1.3 mm.; margin of case beaded by the distinct and functional wax tubes; the incisions shallow and acute. Thoracic and caudal tracheal folds fairly evident, the latter fur-

rowed. The pores of these folds open close to margin and have the appearance shown in figure 2. There are no dorsal wax pores, but on each side of median line of each abdominal segment are a few clear white dots. From the region of the dorsal disk to the periphery a radiate pattern is evident, due to the mesal extension of the marginal wax tubes.

Vasiform orifice (fig. 3) subcordate in outline, the cephalic margin straight. The caudal rim is without teeth or fimbriae as are present in *citri*. Operculum with about the same outline as orifice, which it nearly fills, almost obscuring the lingula, the tip of which protrudes (fig. 4).

Adults.—Unknown.

Type.—Cat. No. 19054, U.S.N.M.

DIALEURODES (GIGALEURODES) BUSCKI, new species.

Plate 71, figs. 5-12.

Several leaves infested with this species were collected by Mr. August Busck, January 15, 1899, at Bayamon, Porto Rico. The host plant is stated as "a climbing vine." The immature stages occur on both surfaces of the leaf.

Pupa case (fig. 5).—The insect in this stage much resembles in general appearance *citri*. Many of the individuals, however, have the dorsal disk dark brown. However, this character appears not to be constant, as many colorless specimens are to be found from which the adults have emerged. There is no waxy secretion evident. As observed under hand lens, the dorsum is seen to be much wrinkled by the body sutures and the submarginal area is marked with fine radiating lines extending from dorsal disk all around to margin of case.

The margin is marked with many minute, acute incisions between the wax tubes, the sutures between which are more or less evident well toward the dorsal disk and give the radial appearance noted under the hand lens. All around margin there is a narrow and not well delineated light-colored band. Many apparently normal individuals have the dorsal disk brown in color, and there are gradations from this condition to individuals colorless throughout; the shape is oval and flattened, broadest across the second and third abdominal segments; size about 1.59 by 1.28 mm. The three tracheal folds evident marked with minute dots, as in *citri*. Tracheal pore opening almost on margin of case (fig. 6), the opening with a few teeth or fimbriae; body sutures distinct; along each side of median line of abdomen, a pair to each segment, and here and there on the thorax, are minute white dots in the derm, quite evident against the surrounding dark brown color of this region. The case is quite void of

wax pores, though the derm shows the granular appearance usual in these forms.

Vasiform orifice subcordate in outline (fig. 7); the anterior margin almost straight. The inner caudal margin is a thickened rim and is without the teeth so usual in species of this type. The operculum is similar in shape to orifice, almost completely filling it and covering the lingula. This latter (fig. 8) may be seen through the operculum and is elongate, slightly enlarged distally, setose, and bearing two long spines. On ventral surface the antennae (figs. 9 and 10) are quite evident, subcylindrical, and armed distally with a prominent stout spine (fig. 11); legs plainly visible, the feet (fig. 12) terminating in a disk-like structure usual for species of this type.

Adults.—Unknown.

Type.—Cat. No. 19055, U.S.N.M.

DIALEURODES (GIGALEURODES) MAXIMA, new species.

Plate 72, figs. 6-9.

Specimens of this very large species were collected by Mr. George Compere, at Manila, Philippine Islands, in 1910. The host is *Ficus* species.

Egg.—Length 0.21 mm. by about 0.1 mm., wide, subovate; stalk very short; color dark brown; covered with coarse polygonal markings.

Pupa case (fig. 6).—General color dirty yellowish white on leaf, without secretion; quite flat, infesting both upper and lower leaf surfaces. Shape circular or nearly so; in size very large, measuring about 2.4 by 2.4 mm. By transmitted light the color is yellowish, the evident marginal rim transparent. Dorsal area more or less marked with orange, which color is faintly present on the breathing folds. The margin is practically entire, though somewhat incised by the irregular ending of wax tubes. From the margin extend inward the usual sutures marking the position of the functionless wax tubes. A marginal area all around is faintly evident. Dorsum but little convex; the derm is figured with a network of polygonal markings; sutures not distinct; the tracheal folds are quite evident, tinged with yellow, and marked with minute dots; tracheal pores opening just within the margin of case, each with a subcircular chitinized ring, within which the margin is serrated (fig. 9), there being no distinct finger-like processes or fimbriae; vasiform orifice (fig. 7) subcordate in outline, the cephalic margin straight, about as broad as long, and distant from the caudal margin about 0.592 mm. The rim of the orifice is thickened, and the inner lateral and caudal margin is minutely setose; the operculum has about the shape of the orifice, which it nearly fills, its caudal portion and protruding tip of lingula setose. On the ventral surface the legs are distinct and normal.

This species is noteworthy by reason of its large pupa case, in this respect resembling *struthanthi* Hempel, but easily separated from that species by its coloration, shape, and other details, as will be noted on comparison. This species is freely parasitized, four to five parasites being found in a single individual—a degree of infestation unusual in related forms.

Adults.—Unknown.

Type.—Cat. No. 19056, U.S.N.M.

DIALEURODES (GIGALEURODES) STRUTHANTHI (Hempel).

Plate 72, figs. 1-5.

Aleurodes struthanthi HEMPEL, Ann. Mag. Nat. Hist., (7) vol. 8, 1901, p. 387.

Pupa case (fig. 1).—Size 2.08 by 2 mm.; form almost circular; dorsum not greatly elevated; thorax marked off by a fine but very distinct suture; abdominal segments marked off only on the median area and there not distinctly so; color light yellowish brown, marked with dark brown. The subdorsal area is dark brown and this color extends more or less over the dorsal region. A band of dark brown extends across the thorax just cephalad of the suture separating it from the thorax, and is particularly dark just caudad of the opening of the thoracic tracheal folds. A band of dark brown extends around the margin, but this is sometimes broken by lighter areas. The pores of the tracheal folds are situated in the center of somewhat oval yellow areas. The surface of the case is corrugated, and the dark markings follow these corrugations, or sometimes take the form of reticulate areas. The pore of the tracheal folds (fig. 4) is situated almost on the margin and is armed with about nine rather blunt teeth. The fold itself is without sculpturing, but is irregularly wrinkled. The vasiform orifice (fig. 2) is very small, not much larger than the pores of the breathing folds. It is somewhat semicircular in outline, with the cephalic margin straight. The operculum is of the same shape, and almost fills the orifice, obscuring the lingula, which, when the operculum is removed, is seen to be elongate, setose, and armed with two spines (fig. 5). Submarginal area of case prominently fluted by sutures of wax tubes, the sutures extending well mesad (fig. 3).

The above description is based on material received from Dr. H. von Ihering and collected at Saõ Paulo, Brazil.

Habitat.—Parnahyba and Saõ Paulo, Brazil, on *Struthanthis flexicaulis*, orange, *Mechilia flava*, and on an unidentified forest tree.

RHACHISPHORA, new subgenus.

Within the genus *Dialeurodes* there are a few species which differ from all others in having a marginal row of spines, and this character is united with others which easily distinguish these forms from the

typical *Dialeurodes*. Such species fall into two groups. Those of the first group lack teeth on the vasiform orifice and a rhachis is more or less prominent. At first glance the most extreme of these shows little relation to the typical *Dialeurodes*. There is no doubt, however, that *fijiensis* is so related, and this species shows the first indication of the development of a rhachis, which has reached its culmination in *trilobitoides*. In *fijiensis* there is a marginal row of 26 vasiform spines and other intermediate smaller ones. In *trilobitoides* there is the same row of spines similarly placed, though they are not swollen to the same extent, and the presence of the rhachis suggested in *fijiensis* is here very strongly marked. In *rutherfordi* the same vasiform spines are present as in *fijiensis*, though they are not so numerous, and the dorsal structure is midway between *fijiensis* and *trilobitoides*. These species are evidently closely related and may well form a distinct subgenus.

Pupa case.—Elliptical or oval, light brown to blackish in color; marginal wax tubes represented by rounded or irregular short tooth-like projections; waxen secretion usually absent, though sometimes peculiar waxen dorsal figures present; dorsal disk with a more or less prominent rhachis and often with thickened ridges radiating from it, representing the body segments; no large pores present. Thoracic tracheal folds distinct; the pore area is composed of an outer ring, and within this is the smaller pore opening, which is usually armed with teeth; vasiform orifice broadly subcordate, without comb of teeth, but its caudal margin sometimes showing a projection; submarginal area armed with a row of spines, and other spines also sometimes present on the margin.

Type.—*Dialeurodes (Rhachisphora) trilobitoides* Quaintance and Baker.

KEY TO SPECIES OF RHACHISPHORA.

1. Spines on margin of case only about 26 in number and of uniform character, *trilobitoides*.
 Spines very numerous and differing in character, some slightly knobbed and others somewhat vasiform.....2.
2. Vasiform spines about 26 in number and prominent, remaining spines not distinctly knobbed; color pale brown and dark brown; no distinct rhachis evident.....*fijiensis*.
 Vasiform spines about 14-16 and not prominent; remaining spines distinctly knobbed; color dark brown; distinct rhachis present.....*rutherfordi*.

DIALEURODES (RACHISPHORA) FIJIIENSIS (Kotinsky).

Plate 73, figs. 1-4.

Aleyrodes fijiensis KOTINSKY, Bull 2, Bd. Agr. and Forestry, Hawaii, 1907, p. 100.

Paratypes of *Dialeurodes fijiensis* are in the collection of the Bureau of Entomology. This species forms a connecting link between those

species exhibiting the typical dorsal structures of the genus and such species as have a prominently developed rhachis.

Pupa case (fig. 1).—Size 1.5 by 0.95 mm.; outline oval, rather flat; abdominal segments distinct and indicating the development of a rhachis so prominent in other species of the subgenus; color straw yellow or pale brownish; margin (fig. 2) almost entire, the wax tubes being represented by irregular flattened tooth-like sections separated from one another by lines extending mesad; submarginal area armed with a series of spines composed of two kinds: The first large and vasiform, the second small and lanceolate. The vasiform spines form a row about the case as shown in the figure and are 26 in number. The smaller spines are placed in several more or less concentric rows around the margin. The vasiform orifice (fig. 3) is roundly subcordate, with the margin rather heavily chitinized; the operculum somewhat similar in shape, though narrower caudad; lingula almost obscured by the operculum. Thoracic tracheal pores very prominent, composed of a distinct, even, and heavily chitinized ring, which is present upon the dorsum, and within this ring is the rather elongate irregular opening of the pore proper. Tracheal folds quite distinct, extending mesad from the opening of the pore and not from the margin of the ring. The caudal pore is similar in construction to the thoracic marginal ones (fig. 4), but the dorsal ring is not so distinct. A rather well differentiated area extends from the vasiform orifice to the caudal margin, and on the median dorsal area there are a number of vasiform spines similar to, though smaller than, those upon the submarginal area.

On the leaf the cases are light to dark brown in color and without marginal secretion of any kind. Dorsal waxen secretion very peculiar, forming, according to Kotinsky, a perpendicular column. It is fragmentary in the specimens at hand.

Adult female.—According to Kotinsky this is as follows:

Body (excepting head, which was bent under), 1.12 mm. long. Forewing, 1,406 microns long, 700 microns wide. Immaculate, mealy, yellowish white. Abdomen, legs, and antennae, except first two joints of the latter, testaceous; thorax, head, and first two antennal joints, straw color. Eyes slightly constricted, upper lobe considerably broader; reddish brown in color. Abdomen with about a dozen eggs distinctly seen ventrally; abdomen 750 microns long by about 325 microns wide.

Only pupa cases are available to us for study.

Habitat.—Rewa, Fiji, on pods and leaves of a leguminous plant.

DIALEURODES (RACHISPHORA) RUTHERFORDI, new species.

Plate 75, figs. 1-5; plate 74, fig. 1.

A collection of this species on *Loranthus* was made by A. Rutherford, at Peradeniya, Ceylon, in June, 1913. The species is remarkable in the character of the dorsum of the pupa case. In this respect it

is a connecting link between *fijiensis* and that very peculiar aleyroid *trilobitoides*.

Pupa case (pls. 74 and 75, fig. 1).—Size 1.731 by 1.44 mm., elliptic in outline; dorsum with a distinct but broad rhachis; transverse ridges of the abdomen representing the sutures between the abdominal segments; color of case under the microscope yellowish brown, the ridges showing dark brown with lighter yellowish areas between them. Dorsum covered with a large number of minute transparent tubercle-like structures, on which spine-like projections are situated, and also very many minute, more or less circular, dark brown markings. The margin is covered with numerous irregular tooth-like projections, many of which are armed with knobbed spines (pl. 75, fig. 5). Just within the margin there is a series on each side of seven or eight spatulate spines, like those seen in *fijiensis*, one spine being situated near where each dorsal ridge reaches the margin. The vasiform orifice (pl. 75, fig. 2) is subcordate in outline, with the anterior margin straight and the caudal portion of the rim extended. A very distinct furrow extends from the caudal extremity of the orifice to the margin of case, and here there is no distinct pore as is usual in the genus, but a comb of teeth (pl. 75, fig. 4). This character approaches very closely the condition met with in species of the genus *Aleuroplatus*. Thoracic tracheal folds distinct and ending in a faint, somewhat circular pore (pl. 75, fig. 3). On the margin of the case adjacent to the pore there is a semi-circular sinus, which is armed with about a dozen minute teeth.

Adults.—Unknown.

Type.—Cat. No. 19057, U.S.N.M.

DIALEURODES (RACHISPHORA) TRILOBITOIDES, new species.

Plate 75, figs. 6–11; plate 74, fig. 2.

Pupa case.—Pupa cases of this species were taken by Mr. A. Rutherford on *Harpullia* at Peradeniya, Ceylon, August, 1913. What seems to be the same species was taken by Mr. Rutherford on *Eugenia operculata* at the same place July 27, 1913, and also by Mr. R. S. Woglum, at Royal Botanic Gardens, Ceylon, on an unknown plant, October, 1910. The species shows a remarkable dorsal structure. The ridges of the abdominal segments have become interrupted, leaving a distinctly elevated and entire rhachis-shaped structure not unlike that met with in certain trilobites. The species show affinity with *rutherfordi*, and through this with *fijiensis*.

Pupa case (pl. 75, fig. 6).—Size 1.04 by 1 mm.; shape oval, broadest across the second abdominal segment; color brown to almost black, darker along the median dorsal area; dorsum with numerous prominent ridges, as shown in the figure. These ridges are covered with fine hexagonal dark areas, and the submarginal area and the spaces

between the ridges are covered with irregular rows of semicircular dark markings. Submarginal area armed with 26 spines mounted on tubercles, 13 on each side (pl. 75, fig. 7). Thoracic tracheal folds covered with small, dark, somewhat hexagonal markings similar to those present in other species of the subgenus; tracheal pore apparently composed of two parts—a dorsal, which is evenly pyriform in outline, and a ventral, which is contained within it, and is subcircular and toothed (pl. 75, fig. 9). Pore of the caudal tracheal fold appearing as a mere slit-like structure, having lost nearly all the characters shown by the thoracic pores (pl. 75, fig. 11). Vasiform orifice (pl. 75, fig. 10) subcordate in outline, with the cephalic margin straight. It is situated in the caudal angle of a somewhat heavily chitinized U-shaped structure; its rim well chitinized and armed at its caudal extremity with a prominent nipple-shaped projection. Operculum similar in shape to the orifice and almost entirely filling it, obscuring the lingula. On the leaf the pupa case shows no waxy secretion, appearing as shining, brownish-black disks, much ridged on the dorsum.

Adults.—Unknown.

Type.—Cat. No. 19058, U.S.N.M. Described from pupa cases in balsam mounts, and dry upon the foliage.

DIALEUROPORA, new subgenus.

There is in the collection an aleyrodid from India and Ceylon which is quite similar to the typical *Dialeurodes* in regard to the structure of the tracheal folds and pores, and which has an orifice resembling that met with in some of the other subgenera of this genus. This form is remarkable, however, in possessing on the submarginal area a series of very large pores. On account of this and other noticeable characters it is placed in a separate subgenus.

Pupa case elliptical in shape, yellowish or transparent whitish in color; marginal wax tubes represented by irregular, somewhat flattened, shallow, tooth-like corrugations; vertical waxen fringe absent; dorsal disk without sculpturing or rhachis; submarginal area with a series all around of a few very large simple pores; thoracic tracheal folds without sculpture or with a few minute dot-like markings; pore a ring-like opening near the margin; vasiform orifice broadly subcordate, the inner lateral and caudal margins without a comb of teeth; operculum similar in shape and nearly filling the orifice.

Type.—*Dialeurodes (Dialeuropora) decempuncta* Quaintance and Baker.

DIALEURODES (DIALEUROPORA) DECEMPUNCTA, new species.

Plate 76, figs. 1-7.

This species was taken by R. S. Woglum, in the Royal Botanic Gardens, Ceylon, on cinnamon, October, 1910, and also on mulberry at Lahore, India.

Egg (fig. 4).—Elongate elliptical, yellowish in color, without reticulations; size 0.17 by 0.077 mm.; stalk about one-half as long as the egg.

Pupa case (fig. 1).—Color on leaf dirty yellow; dorsum moderately convex; no dorsal or lateral secretions, except from submarginal area usually some 10 to 12 short waxen rods.

Under the microscope the case is seen to be almost transparent, the segments moderately distinct. Size about 0.95 by 0.65 mm., sub-elliptic in outline, narrowing cephalad. Margin of case faintly crenulate (fig. 3), surrounded by a narrow zone paler than adjacent submarginal areas and separated from it by a more or less evident yellowish, thickened line. Within the margin there is a series of rather short spines, and along median line of case are several pairs of setae, as shown in figure 1. On each side of case, in submarginal area, are five large pores (figs. 1 and 2). Tracheal folds fairly evident and sparsely marked with dots (figs. 2 and 3). Vasiform orifice broadly subcordate, without teeth on inner margin. Operculum similar in outline, nearly filling orifice (figs. 2 and 6).

Adult.—Unknown.

Type.—Cat. No. 19059, U.S.N.M. Described from numerous specimens on foliage and in balsam mounts.

DIALEUROPLATA, new subgenus.

This species was taken by C. H. T. Townsend in 1904, in the Philippine Islands. In general appearance it has many of the characters of typical species of the genus *Aleuroplatus*. It has somewhat the same shape and color. It possesses numerous minute pores in the same regions, and the abdominal divisions are somewhat similar. It is much more completely a *Dialeurodes*, however, than it is an *Aleuroplatus*, and we erect for it the above subgenus. It seems further to confirm the apparently close relation of the two genera, *Dialeurodes* and *Aleuroplatus*.

Pupa case.—Elliptical, broadest across the abdomen, slightly constricted at the thoracic tracheal pores; color brownish; marginal wax pores represented by shallow somewhat irregular tooth-like corrugations; submarginal area with an irregular series of minute, circular, pore-like structures; dorsum with a slight rhachis development, particularly upon the abdomen, and with a number of minute pores. Thoracic tracheal folds not distinct; tracheal pores irregularly lobed or toothed within; vasiform orifice broadly subcordate, inner caudal and lateral margins without teeth; operculum similar in shape, nearly filling the orifice.

Type.—*Dialeurodes* (*Dialeuroplata*) *townsendi* Quaintance and Baker.

DIALEURODES (DIALEUROPLATA) TOWNSENDI, new species.

Plate 73, figs. 5-9.

Specimens of this species are in the collection of the Bureau of Entomology from Lucerna, Tayabas, Philippine Islands, and were collected by C. H. T. Townsend on April 24, 1904. They were forwarded to the Bureau by T. D. A. Cockerell. The host is stated to be a "fern."

Egg (fig. 5).—Size 0.144 by 0.112 mm.; oval in shape with a short, curved stalk. Surface rugose and marked with peculiar circular areas giving it a very beautiful appearance. This egg sculpturing is different from that of any other in the family so far observed.

Pupa case (fig. 6).—Size 1.39 by 1.12 mm.; shape oval, flat, with a somewhat distinct median ridge; color yellowish brown with the median ridge dark brown. All about the submarginal area of the case and longitudinally along either side of the median ridge there are a large number of small transparent pores. The abdominal segments are well marked off, and the sutures separating them unite to form a distinct rhachis. A distinct suture from the middle of each segment of the rhachis extends across the dorsal disk. The margin is divided by a large number of fine lines extending a short distance mesad. The vasiform orifice is broadly subcordate in outline and is almost completely filled by the operculum, which is setose on its distal extremity (fig. 7). Cephalad of the orifice there is a pair of minute setae and caudad of it the integument is thrown into a large number of fine transverse ridges. These merge into elongate polygonal markings which extend to the caudal pore along the tracheal fold (fig. 8.) The pores of the thoracic tracheal folds are small and irregularly lobed (fig. 9), and mesad of each is a large pyriform structure, the interior of which is divided into a number of areas. The cephalic margin of case is armed with a pair of small setae.

On the leaf there appears no waxy secretion, the insects showing as yellowish or brownish disks.

Adults.—Unknown.

Type.—Cat. No. 19060, U.S.N.M. Described from pupa cases and eggs in balsam mounts and dry upon the leaf.

Genus NEOMASKELLIA Quaintance and Baker.

Neomaskellia QUAINANCE and BAKER, Tech. Ser. 27, pt. 1, Bur. Ent. U. S. Dept. Agric., 1913, p. 91.

Neomaskellia was erected by the writers to include an aleyrodid found in the Maskell collection of Aleyrodidae which presents numerous points of difference from other groups in the family, as will be noted from the generic diagnosis. Further study of the material in the collection of the Bureau of Entomology permits us to add another

species to the genus—namely, *Aleyrodes bergii* Signoret. A comparison of the type of *Aleyrodes sacchari* Maskell with *bergii* leads us to believe that Maskell's species is the same as *bergii* Signoret. Below are given the characteristics of *Neomaskellia* and a key to the two known species of the genus, followed by a description of *bergii*. A revised description of *comata* was given in Technical Series 27, part 1, of the Bureau of Entomology, United States Department of Agriculture, on page 92.

Pupa case.—Elliptic, with reflexed edges; margin with row of prominent spines. Papillae and dorsal pores absent. Vasiform orifice on a tubercle-like elevation, transverse, elliptical; operculum short and broad, about half filling the orifice; lingula similar in shape and visible caudad of the operculum. Adult males much smaller than the females; forewing with only radial sector present. Females with radial sector and traces of the cubitus; vertex depressed mesad and with the lateral margins elevated. Antennae short, thick, and hairy, composed of seven segments, of which the third is the longest; second segment spherical; claspers of male short, thick, and hairy.

Type.—*Neomaskellia comata* (Maskell).

KEY TO SPECIES OF NEOMASKELLIA.

1. Pupa case with 12 pairs of spines arising from submarginal area, the cephalic two pairs short and hair-like. Forewing of adult with four faint brownish patches *comata*.
2. Pupa case with 16 pairs of spines arising from submarginal area, the cephalic two pairs equally developed with the others. Forewing of adult mottled and dotted with dark brown..... *bergii*.

NEOMASKELLIA COMATA (Maskell).

Aleyrodes comata MASKELL, Trans. N. Zealand Inst., vol. 28, 1896, p. 426.

Neomaskellia comata (MASKELL) QUAINANCE AND BAKER, Tech. Ser. 27, pt. 1, Bur. Ent., U. S. Dept. Agric., 1913, p. 91.

NEOMASKELLIA BERGII (Signoret).

Plate 77, figs. 1-14.

Aleyrodes bergii SIGNORET, Ann. Soc. Ent. France, (4) vol. 8, 1867, p. 395.

Aleyrodes sacchari MASKELL, Trans. N. Zealand Inst., vol. 22, 1890, p. 171.

We have specimens of this species from Java, received from Dr. L. Zehntner, February 1, 1897 (host not stated), and also specimens collected by Mr. George Compere at Manila, Philippine Islands, on a wild grass.

Egg (fig. 1).—Length 0.272 mm.; form oval, with the stalk attached a short distance from the base and about half as long as the egg itself. We are unable to make out any surface sculpturing in the specimens at hand.

Pupa case (fig. 2).—Length from 0.72 to 0.8 mm.; width from 0.432 to 5.52 mm.; shape elliptic, rather strongly arched; abdom-

inal segments distinct; median ridge not plainly evident excepting at vasiform orifice, which is situated on a prominent tubercle. Color varying from a dark to a very pale brownish, with the median area in some specimens more deeply shaded than the remainder of the case. Submarginal area armed with a row of prominent, curved spines situated on tubercles. These are usually 32 in number, but there are sometimes fewer. The margin itself (fig. 4) is rolled under the case somewhat after the manner of the species in the subgenus *Lecanoideus*. It is very minutely and irregularly serrate, but there are nothing like the prominent teeth which are present in some other forms. Vasiform orifice (fig. 3) strongly elevated upon a tuberclelike structure, subcircular to elliptic in outline, with the longest axis lying transversely. Operculum somewhat semicircular in outline, the caudal margin straight or irregularly curved; lingula very broad, with only the distal extremity showing below the operculum; both operculum and lingula setose. On each side of the orifice there is a large spine similar to those upon the margin, and there is a pair of spines on the cephalic portion of the thorax on the lower surface. Antennae and legs evident.

Adult female.—Length from vertex to tip of ovipositor 1.84 mm.; color brown, deeper on the thorax, appendages and ovipositor, lighter on the abdomen. Eggs in the abdomen appearing yellowish brown and numerous small bright red areas visible. Vertex as viewed from above rounded, rather broad, covered with a number of small, clear papillae or porelike structures, from below (fig. 7) depressed, with lateral elevations and the median area covered with numerous bristles. Ocelli rather large, clear, and situated close to the compound eyes. These latter have large facets, are constricted in the middle, and are deep brown in color. Antennae (fig. 8) short, thick, strongly imbricated, and covered with numerous fine hairs. Segment I 0.036 mm. in length, subcylindric; II 0.055 mm., almost globose, and covered with many bristles and many fine hairs; III 0.1 mm., subcylindric, strongly imbricated and covered with transverse rows of fine hairs; IV 0.03 mm., similar; V 0.055 mm., imbricated, hairy, and with a few small distal sensoria; VI 0.033 mm.; VII 0.033 mm., with a few sensoria near distal extremity. Thorax dark brown, covered all over with very many minute fine dots, which may be punctures, and with several small, clear, pore-like areas similar to those on the head. Legs brown; fore tibiae 0.32 mm. in length; fore tarsi, proximal segment 0.095 mm., distal segment 0.096 mm.; hind tibia 0.448 mm., armed on its distal extremity with a ring of rather stout spines and along its inner margin with a double row of similar ones; hind tarsus, proximal segment, 0.112 mm., distal segment 0.065 mm. Foot (fig. 13) about 0.032 mm. long; claws curved; paronychium narrow and generally curved. Forewing (fig. 5) 1.36 mm. long and

0.608 mm. wide at its greatest width; radial sector rather thick, sometimes almost straight and in other specimens with one or two curves; cubitus present only at the very base of the wing, its position, however, being indicated by a light area; wings mottled and spotted with dark brown, as shown in the figure. This is most prominent in two transverse areas, one near the distal extremity of the wing and the other a little proximad of the middle. Margin (fig. 12) armed with a series of rather broad teeth, on which minute hairs are situated. Hindwing (fig. 5) 1.088 mm. long and 0.48 mm. wide; vein almost straight; color uniform smoky. Abdomen broad and large; ovipositor dark brown, armed with numerous prominent spines; vasiform orifice (fig. 6) elliptic, transverse, and surrounded by a dark area which extends back to the ovipositor. Operculum somewhat semicircular, about half filling the orifice; lingula very broad and long, exerted for some distance; both operculum and lingula with numerous fine hairs.

Adult male.—Much smaller than the female, being 0.84 mm. long. Color much the same, but with more of a reddish tint on the abdomen. Antennae (fig. 10) similar to those of the female. Segment I 0.03 mm. long, subcylindric; II 0.045 mm.; III 0.08 mm.; IV 0.03 mm.; V 0.036 mm., with two small distal sensoria; VI 0.02 mm.; VII 0.021 mm., and armed near its distal extremity with a long, spiked sensorium and two circular ones (fig. 14). Segments III to VII strongly imbricated and covered with transverse rows of minute hairs. Forewing (fig. 9) straight, with radial sector straight and thick; cubitus not present, though in some specimens there is a faint shading indicating it. Length of wing 0.64 mm.; width 0.208 mm.; marking very similar to that of the female, as shown in the figure. Hind wing 0.48 mm. long and 0.24 mm. wide; vein straight, uniform dusky in color. Hind tibiae 0.35 mm. long; hind tarsi, proximal segment 0.08 mm., distal segment 0.064 mm. Abdomen very long in some specimens as compared to the wings and claspers, measuring, exclusive of claspers, 0.512 mm. in length. Claspers (fig. 11) 0.144 mm. long, dark brown in color, not acutely pointed at distal extremity, thick and armed with numerous hairs.

EXPLANATION OF PLATES.

PLATE 32.

Aleurocanthus bambusae.—1, insects in place on plant; 2, larva, first stage; 3, ventral pores near margin of larva, first stage; 4, larva, second stage; 5, larva, fourth stage; 6, margin of case of fourth-stage larva; 7, pupa case; 8, margin of pupa case; 9, vasi-form orifice of pupa case. (After Peal.)

PLATE 33.

Aleurocanthus banksiae.—1, outline of pupa case; 2, margin of pupa case; 3, vasiform orifice; 4, spine of larva; 5, larva.

Aleurocanthus calophylli.—6, pupa case; 7, margin of pupa case; 8, vasiform orifice; 9, egg; 10, polygonal markings of egg.

PLATE 34.

Aleurocanthus dissimilis.—1, pupa case; 2-5, different types of spines of pupa case; 6, margin of pupa case; 7, marginal tooth of pupa case, greatly enlarged; 8, vasiform orifice; 9, spine of larva.

Aleurocanthus hirsutus.—10, pupa case; 11, margin of pupa case; 12, enlarged spine of pupa case; 13, vasiform orifice; 14, larva; 15, thoracic tracheal pore of larva.

PLATE 35.

Aleurocanthus longispinus.—1, pupa case; 2, margin of pupa case; 3, vasiform orifice; 4, showing spines and dermal markings on abdominal segments; 5, egg; 6, polygonal markings of egg.

PLATE 36.

Aleurocanthus mangiferae.—1, pupa case; 2, egg; 3, polygonal markings of egg; 4, late larva; 5, margin of pupa case; 6, early larva; 7, vasiform orifice of pupa case; 8, vasiform orifice of late larva; 9, showing variation in spines in pupa case of other individuals of this species.

PLATE 37.

Aleurocanthus piperis.—1, pupa case; 2, margin of pupa case; 3, vasiform orifice of pupa case; 4, tip of spine of pupa case; 5, minute knobbed spine occurring in row within margin of pupa case; 6, larva.

Aleurocanthus serratus.—7, pupa case; 8, margin of pupa case; 9, vasiform orifice of pupa case; 10, spine of pupa case.

PLATE 38.

Aleurocanthus spiniferus.—1, pupa case; 2, egg; 3, polygonal markings of egg; 4, margin of pupa case; 5, vasiform orifice; 6, spine of pupa case.

Aleurocanthus spinosus.—7, egg; 8, pupa case; 9, spine of pupa case; 10, margin of pupa case; 11, vasiform orifice of pupa case.

PLATE 39.

Aleurocanthus T-signatus.—1, pupa case; 2, vasiform orifice of pupa case; 3, margin of pupa case; 4, spine of pupa case; 5, early larva; 6, late larva; 7, vasiform orifice of adult; 8, claw of adult; 9, forewing of adult.

PLATE 40.

1. *Aleurocybotus gramtnicolus*, pupa case. 2. *Aleurocybotus setigerus*, pupa case.

PLATE 41.

Aleurolobus barodensis.—1, pupa case; 2, latero-cephalic margin of pupa case; 3, vasiform orifice and surrounding trilobed area; 4, margin of pupa case; 5, caudal margin of pupa case; 6, young larva; 7, vasiform orifice of larva; 8, lingula of larva; 9, portion of submarginal area of larva showing pore; 10, submarginal area of larva; 11, caudo-lateral margin of larva showing spine.

PLATE 42.

Aleurolobus flavus.—1, pupa case; 2, thoracic tracheal pore of pupa case; 3, thickened lines separating submarginal and dorsal areas of pupa case; 4, vasiform orifice and surrounding trilobed area of pupa case; 5, lingula of pupa case; 6, margin of pupa case; 7, egg; 8, caudal margin of pupa case.

PLATE 43.

Aleurolobus marlatti.—1, egg; 2, larva, first instar; 3, vasiform orifice of larva, first instar; 4, larva, second instar; 5, margin of case of larva, second instar; 6, vasiform orifice of larva, second instar; 7, lingula of larva, second instar; 8, larva, third instar; 9, margin of case of larva, third instar; 10, vasiform orifice of larva, third instar; 11, pupa case, dorsal view; 12, vasiform orifice and surrounding trilobed area of pupa case; 13, margin of pupa case; 14, thoracic tracheal comb of teeth of pupa case; 15, forewing; 16, male genitalia, lateral view.

PLATE 44.

Aleurolobus philippinensis.—1, egg; 2, early larva; 3, vasiform orifice of early larva; 4, late larva; 5, vasiform orifice of late larva; 6, lingula of late larva; 7, margin of late larva; 8, spine of late larva; 9, pupa case; 10, vasiform orifice and surrounding trilobed area of pupa case; 11, leg of pupa case; 12, margin of pupa case; 13, antenna of pupa case; 14, genitalia of male adult; 15, forewing of adult; 16, vasiform orifice of adult; 17, claw of adult; 18, antenna of adult male; 19, antenna of adult female; 20, antenna of early larva.

PLATE 45.

Aleurolobus setigerus.—1, pupa case; 2, vasiform orifice and surrounding trilobed area of pupa case; 3, Margin of pupa case; 4, thoracic pore of pupa case; 5, lingula of pupa case; 6, paired pores of submarginal area.

PLATE 46.

Aleurolobus simulus.—1, egg as seen in body of female; 2, peduncle of egg; 3, larva, first stage; 4, antenna of larva, first stage; 5, pupa case; 6, vasiform orifice of pupa case; 7, thoracic tracheal pore or comb of pupa case; 8, margin of pupa case showing circular pores on dorsum; 9, pupa extracted from pupa case; 10, genitalia of male; 11, wing of female; 12, vasiform orifice of male; 13, antenna of male; 14, antenna of female. (After Peal).

PLATE 47.

Aleurolobus taonabae.—1, egg; 2, early larva; 3, margin of case of early larva; 4, vasiform orifice of early larva; 5, pupa case; 6, vasiform orifice and trilobed area of pupa case; 7, margin of pupa case.

Aleurolobus solitarius.—8, pupa case; 9, thoracic tracheal pore of pupa case showing trilobed structure; 10, same showing structure with but two lobes; 11, caudal tracheal pore of pupa case; 12, vasiform orifice and surrounding trilobed area of pupa case; 13, margin of pupa case.

PLATE 48.

1, *Aleuroparadoxus iridescens*, pupa case; 2, *Aleuroparadoxus punctatus*, pupa case.

PLATE 49.

- Aleuroplatus berbericolus*.—1, margin of pupa case; 2, comb of thoracic tracheal fold of pupa case; 3, vasiform orifice of pupa case; 4, variation in comb of thoracic tracheal fold of pupa case.
- Aleuroplatus cockerelli*.—5, comb of thoracic tracheal fold of pupa case; 6, vasiform orifice of pupa case.
- Aleuroplatus cococolus*.—7, egg; 8, vasiform orifice of pupa case; 9, clubbed spine of larva; 10, tapering spine of larva.
- Aleuroplatus coronatus*.—11, margin of pupa case; 12, vasiform orifice of pupa case.
- Aleuroplatus ficus-rugosae*.—13, pupa case; 14, vasiform orifice of pupa case; 15, comb of caudal tracheal fold of pupa case; 16, comb of thoracic tracheal fold of pupa case.
- Aleuroplatus gelatinosus*.—17, comb of thoracic tracheal fold of pupa case; 18, comb of caudal tracheal fold of pupa case; 19, vasiform orifice of pupa case.
- Aleuroplatus incisus*.—20, comb of thoracic tracheal fold of pupa case; 21, vasiform orifice of pupa case.

PLATE 50.

- 1, *Aleuroplatus berbericolus*, pupa case; 2, *Aleuroplatus cockerelli*, pupa case.

PLATE 51.

- 1, *Aleuroplatus cococolus*, pupa case; 2, *Aleuroplatus coronatus*, pupa case.

PLATE 52.

- 1, *Aleuroplatus gelatinosus*, pupa case; 2, *Aleuroplatus incisus*, pupa case.

PLATE 53.

- Aleuroplatus myricae*.—1, clasper of male; 2, antenna of male; 3, vasiform orifice of pupa case; 4, margin of pupa case.
- Aleuroplatus oculiminutus*.—5, margin of pupa case showing reticulate area; 6, wing of adult; 7, vasiform orifice of pupa case.
- Aleuroplatus ovatus*.—8, margin of pupa case; 9, vasiform orifice of pupa case.
- Aleuroplatus pectiniferus*.—10, comb of thoracic tracheal fold of pupa case; 11, vasiform orifice of pupa case; 12, clasper of male; 13, penis; 14, wing of adult.
- Aleuroplatus plumosus*.—15, comb of thoracic tracheal fold of pupa case; 16, vasiform orifice of pupa case.
- Aleuroplatus quercus-aquaticae*.—17, comb of thoracic tracheal fold of pupa case; 18, vasiform orifice of pupa case.

PLATE 54.

- 1, *Aleuroplatus myricae*, pupa case; 2, *Aleuroplatus oculiminutus*, pupa case.

PLATE 55.

- Aleuroplatus oculireniformis*.—1, egg; 2, pupa case; 3, margin of pupa case; 4, vasiform orifice of pupa case; 5, penis; 6, clasper of male; 7, antenna of adult; 8, portion of compound eye of adult showing lenses; 9, eye spots of *oculiminutus*, *vinsonioides*, and *oculireniformis*, showing relative size; 10, wing of adult.

PLATE 56.

- 1, *Aleuroplatus ovatus*, pupa case; 2, *Aleuroplatus pectiniferus*, pupa case.

PLATE 57.

1, *Aleuroplatus plumosus*, pupa case; 2, *Aleuroplatus quercus-aquaticae*, pupa case.

PLATE 58.

1, *Aleuroplatus sculpturatus*, pupa case; 2, *Aleuroplatus translucidus*, pupa case.

PLATE 59.

Aleuroplatus sculpturatus.—1, dorsal pores of pupa case; 2, margin of pupa case; 3, vasiform orifice of pupa case; 4, comb of thoracic tracheal fold of pupa case.

Aleuroplatus validus.—5, margin of pupa case; 6, vasiform orifice of pupa case; 7, caudal comb of pupa case.

Aleuroplatus variegatus.—8, comb of thoracic tracheal fold of pupa case; 9, clubbed spine of pupa case; 10, margin of pupa case; 11, vasiform orifice of pupa case.

Aleuroplatus vinsonioides.—12, vasiform orifice of pupa case; 13, margin of pupa case; 14, margin of pupa case showing reticulate areas.

PLATE 60.

Aleuroplatus mammaeferus.—1, pupa case; 2, submarginal protuberances of pupa case; 3, comb of caudal tracheal fold of pupa case; 4, comb of thoracic tracheal fold of pupa case; 5, vasiform orifice of pupa case; 6, margin of pupa case; 7, knobbed protuberance of pupa case.

Aleuroplatus translucidus.—8, pupa case showing adult within; 9, pupa case; 10, vasiform orifice of pupa case; 11, thoracic tracheal fold of pupa case; 12, margin of pupa case; 13, clasper of male; 14, wing of adult.

PLATE 61.

1, *Aleuroplatus validus*, pupa case; 2, *Aleuroplatus variegatus*, pupa case.

PLATE 62.

Aleurothrixus äepim.—1, egg; 2, early larva; 3, pupa case; 4, dorsal spine of larva; 5, submarginal spine of larva; 6, spine of pupa case; 7, vasiform orifice of pupa case.

Aleurothrixus porteri.—8, clasper of male; 9, early larva; 10, vasiform spine of pupa case; 11, vasiform orifice of pupa case.

Aleurothrixus howardi.—12, vasiform orifice of pupa case; 13, spine of pupa case.

Aleurothrixus floccosus.—14, vasiform orifice of pupa case.

PLATE 63.

Dialeurodes citri.—1, pupa case, dorsal view; 2, thoracic tracheal fold and pore; 3, margin of case; 4, vasiform orifice of pupa case; 5, larva, third instar; 6, larva, first instar; 7, leg of larva, first instar; 8, antenna of larva, first instar; 9, egg; 10, antenna of adult; 11, wing; 12, claw of adult; 13, male genitalia; 14, margin of forewing.

PLATE 64.

1, *Dialeurodes citri*, Pupa case; 2, *Dialeurodes kirkaldyi*, Pupa case.

PLATE 65.

Dialeurodes citrifolii.—1, pupa case, dorsal view; 2, thoracic tracheal pore; 3, sculpturing on caudal tracheal fold; 4, vasiform orifice; 5, antenna of adult; 6, circular sensoria of segment III of antenna; 7, wing of adult; 8, male genitalia; 9, egg; 10, sculpturing of egg; 11, larva; 12, margin of pupa case; 13, hind tarsus of female; 14, hind claw of female.

PLATE 66.

Dialeurodes fodiens.—1, pupa case; 2, vasiform orifice; 3, lingula of pupa case; 4, margin of pupa case.

Dialeurodes radiipuncta.—5, pupa case; 6, vasiform orifice; 7, thoracic tracheal pore.

Dialeurodes tricolor.—8, pupa case; 9, margin of pupa case; 10, thoracic tracheal pore; 11, vasiform orifice; 12, lingula of pupa case; 13, caudal margin of pupa case.

PLATE 67.

Dialeurodes kirkaldyi.—1, pupa case; 2, vasiform orifice; 3, thoracic tracheal pore; 4, pupa case showing pupa within; 5, egg; 6, wing; 7, male genitalia; 8, claw of adult; 9, distal extremity of tarsus; 10, antenna of adult; 11, larva, first instar; 12, testes of male; 13, vasiform orifice of male showing rectum.

PLATE 68.

Dialeurodes eugeniae.—1, pupa case; 2, margin of pupa case; 3, thoracic tracheal pore and sculpturing of adjacent area; 4, vasiform orifice; 5, tracheal pore on caudal margin of pupa case.

Dialeurodes tokyonis.—6, pupa case; 7, sculpturing of derm of pupa case; 8, thoracic tracheal pore and sculpturing; 9, vasiform orifice; 10, polygonal markings on dorsal disk of pupa case.

PLATE 69.

Dialeurodes radiirugosa.—1, forewing of female; 2, sensoria on radial sector of forewing; 3, costal margin of forewing; 4, hind wing of female; 5, vasiform orifice of female; 6, pupa case; 7, vasiform orifice of pupa case; 8, thoracic tracheal pore and sculpturing of tracheal fold; 9, polygonal sculpturing of dorsum of pupa case.

PLATE 70.

Dialeurodes dissimilis.—1, pupa case; 2, vasiform orifice; 3, margin of pupa case; 4, thoracic tracheal fold and pore.

Dialeurodes radiilinealis.—5, pupa case; 6, thoracic tracheal pore and sculpturing of tracheal fold; 7, vasiform orifice; 8, margin of pupa case.

PLATE 71.

Dialeurodes cerifera.—1, pupa case; 2, thoracic tracheal pore of pupa case; 3, vasiform orifice; 4, lingula.

Dialeurodes buscki.—5, pupa case; 6, thoracic tracheal pore; 7, vasiform orifice; 8, lingula; 9, ventral aspect of pupa case showing organs; 10, antenna of pupa case; 11, distal end of antenna of pupa case; 12, distal end of leg of pupa case.

PLATE 72.

Dialeurodes struthanthi.—1, pupa case; 2, vasiform orifice; 3, margin of pupa case; 4, thoracic tracheal pore; 5, lingula.

Dialeurodes maxima.—6, pupa case; 7, vasiform orifice; 8, margin of pupa case; 9, thoracic tracheal pore and sculpturing of tracheal fold.

PLATE 73.

Dialeurodes fijiensis.—1, pupa case; 2, margin of pupa case; 3, vasiform orifice; 4, thoracic tracheal pore.

Dialeurodes townsendi.—5, egg; 6, pupa case; 7, vasiform orifice; 8, caudal margin of pupa case; 9, thoracic tracheal pore.

PLATE 74.

1, *Dialeurodes rutherfordi*, pupa case; 2, *Dialeurodes trilobitoides*; pupa case.

PLATE 75.

Dialeurodes rutherfordi.—1, pupa case; 2, vasiform orifice; 3, thoracic tracheal pore; 4, caudal margin of pupa case; 5, margin of pupa case.

Dialeurodes trilobitoides.—6, pupa case; 7, marginal spine of pupa case; 8, sculpturing on dorsum; 9, thoracic tracheal pore and sculpturing of tracheal fold; 10, vasiform orifice; 11, pore of caudal tracheal fold.

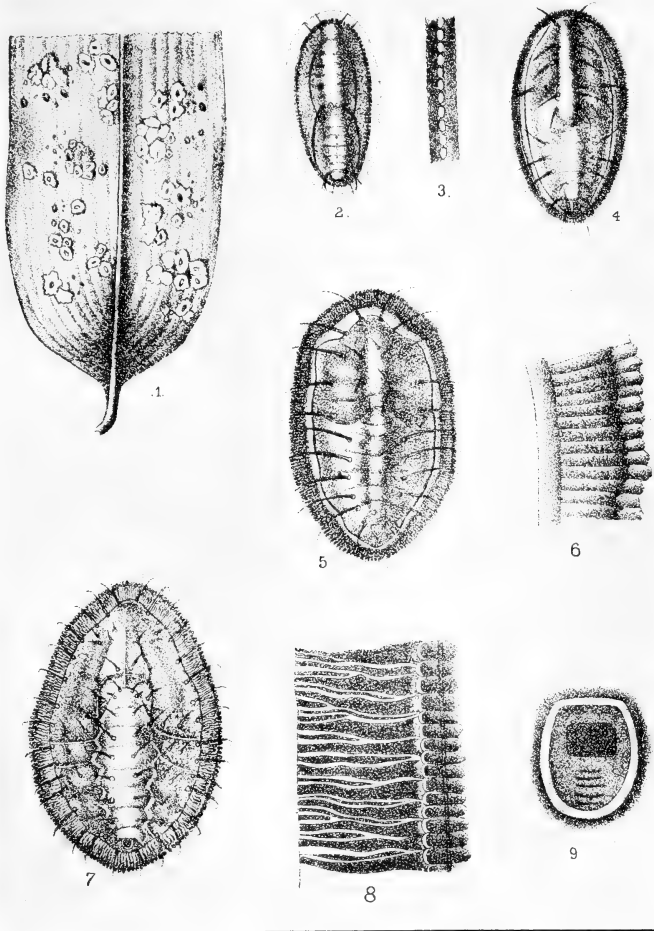
PLATE 76.

Dialeurodes decempuncta.—1, pupa case; 2, caudal segment of pupa case; 3, thoracic tracheal pore and margin of pupa case; 4, egg; 5, larva; 6, vasiform orifice; 7, larva, first instar.

PLATE 77.

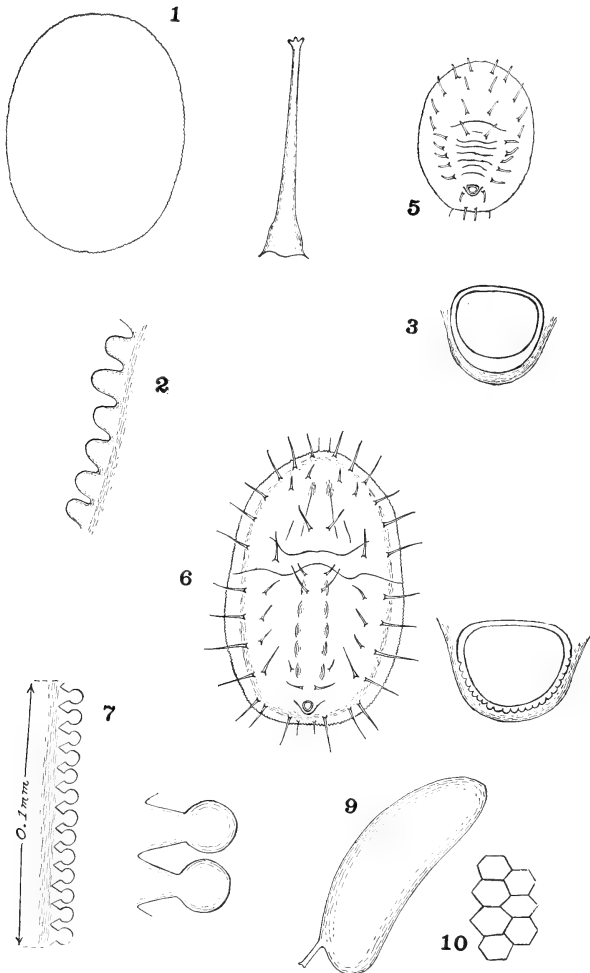
Neomaskellia bergii.—1, egg; 2, pupa case; 3, vasiform orifice of pupa case; 4, margin of pupa case; 5, wings of female; 6, vasiform orifice of adult; 7, head of adult; 8, antenna of female; 9, wings of male; 10, antenna of male; 11, genitalia of male; 12, margin of wing; 13, claw of adult; 14, distal end of antenna.





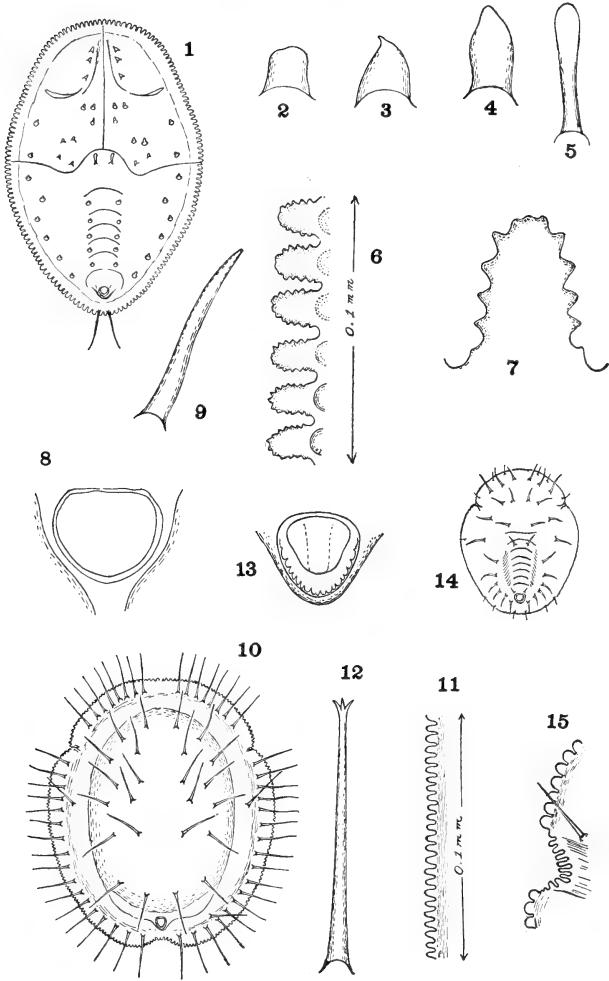
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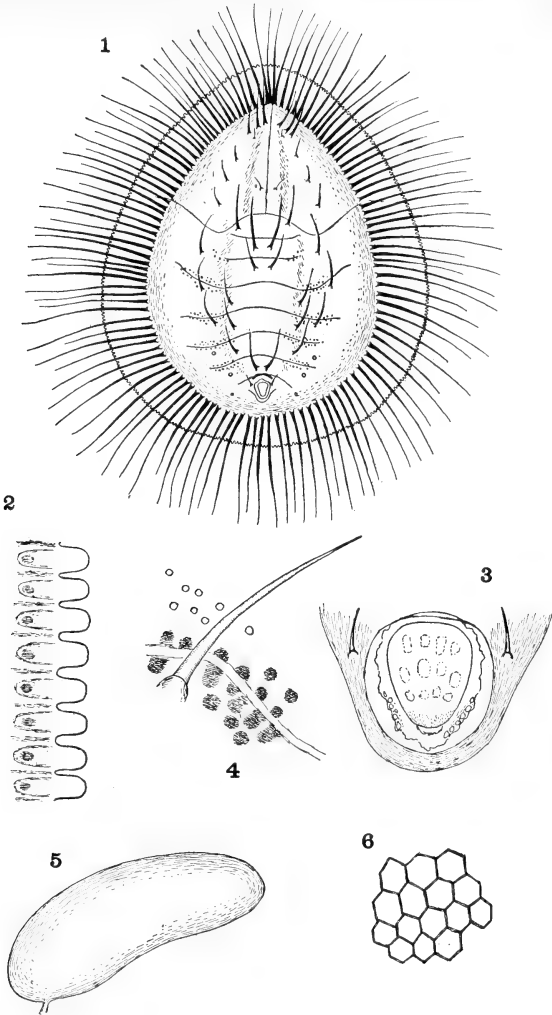
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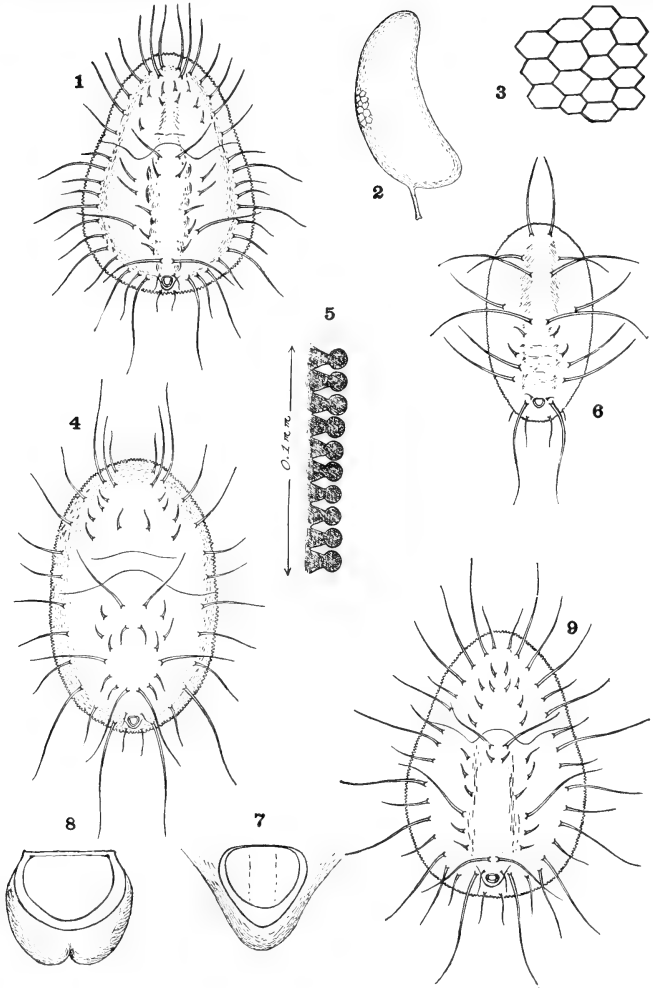
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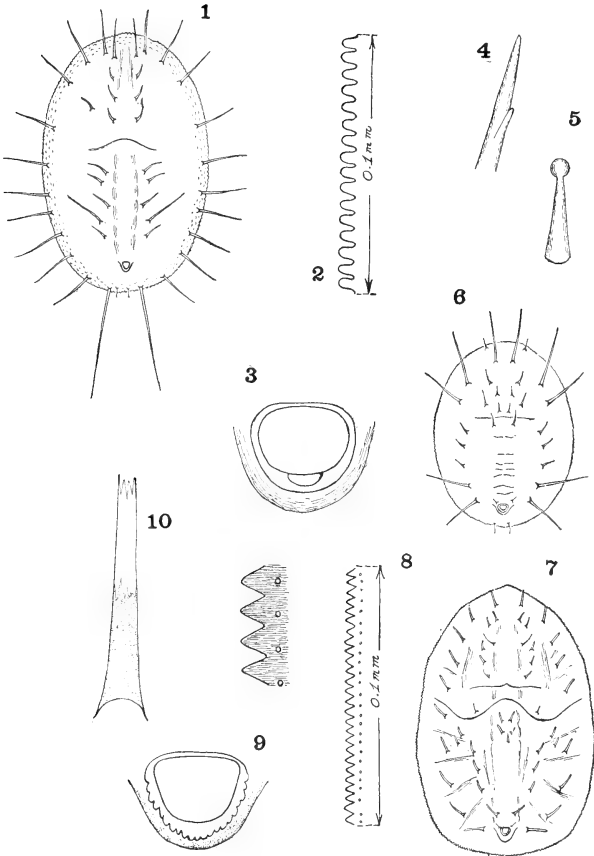
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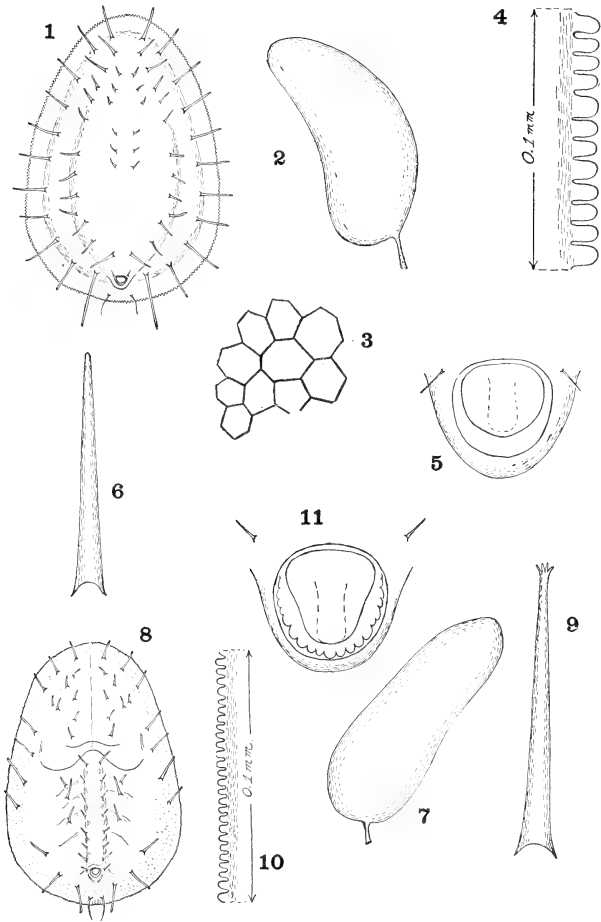
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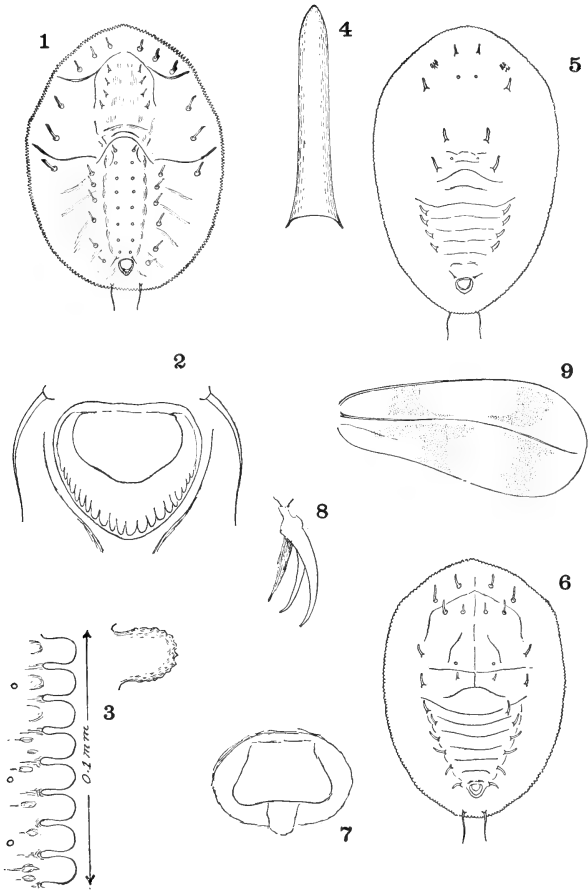
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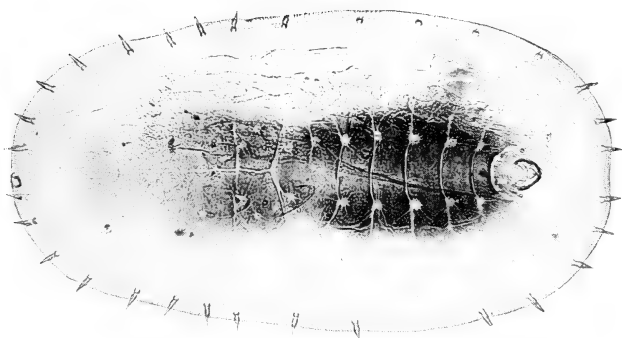
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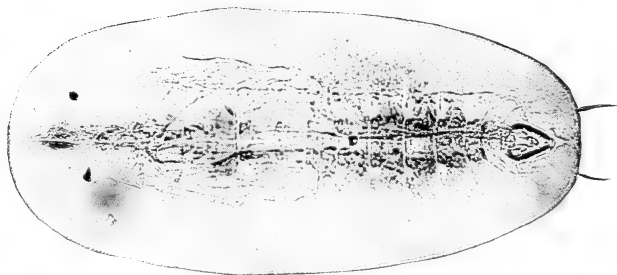


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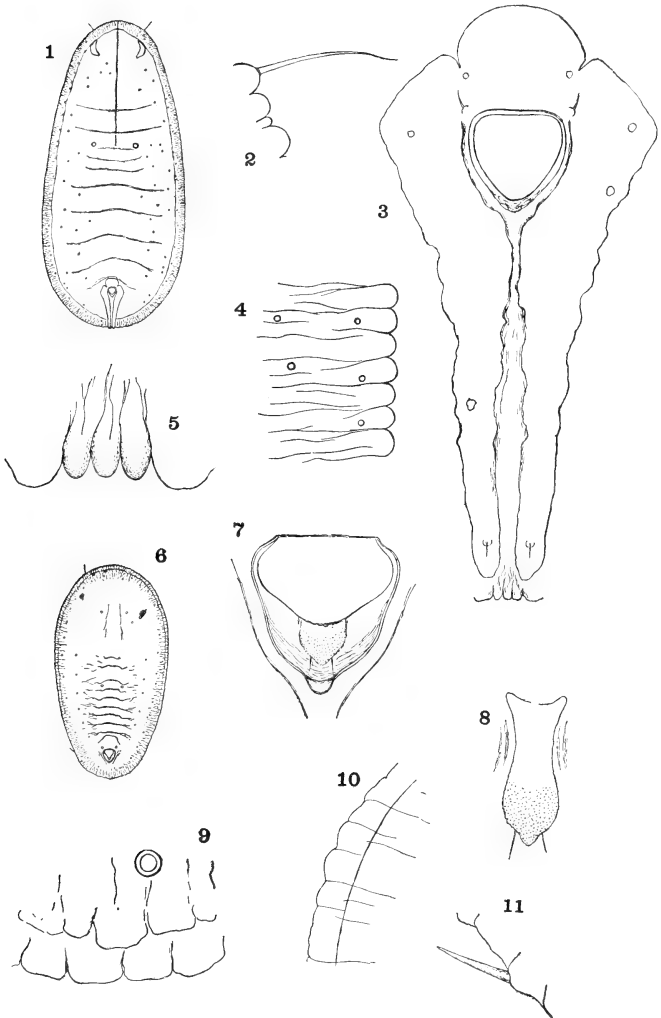
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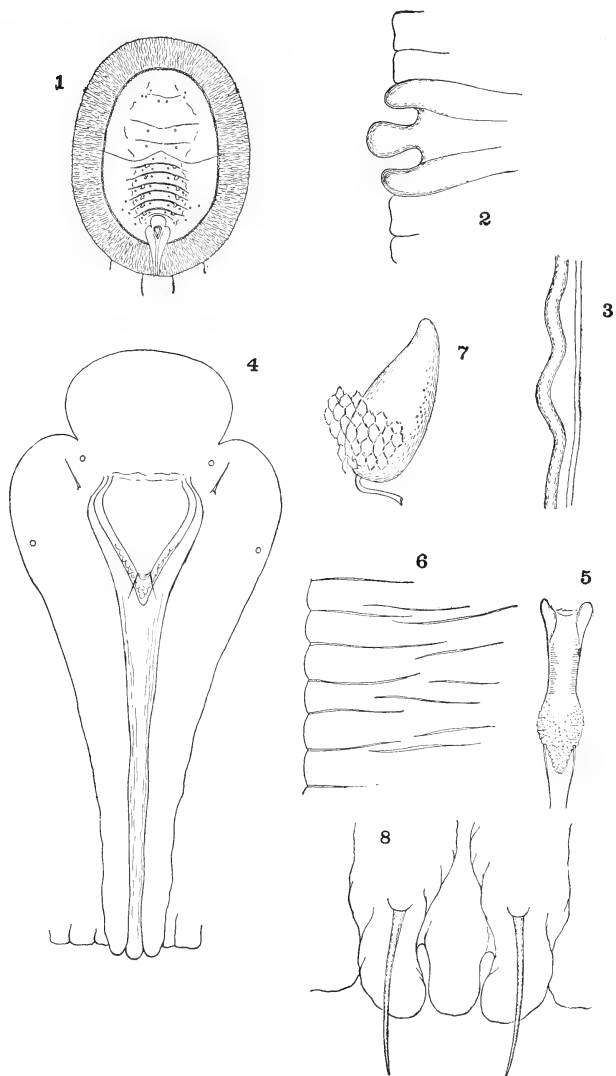
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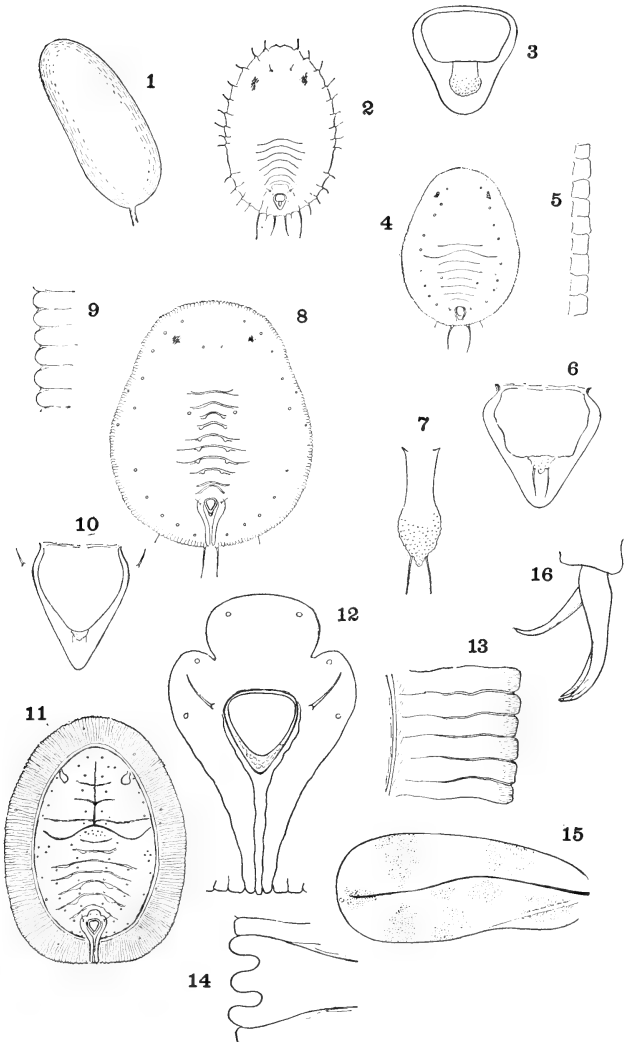
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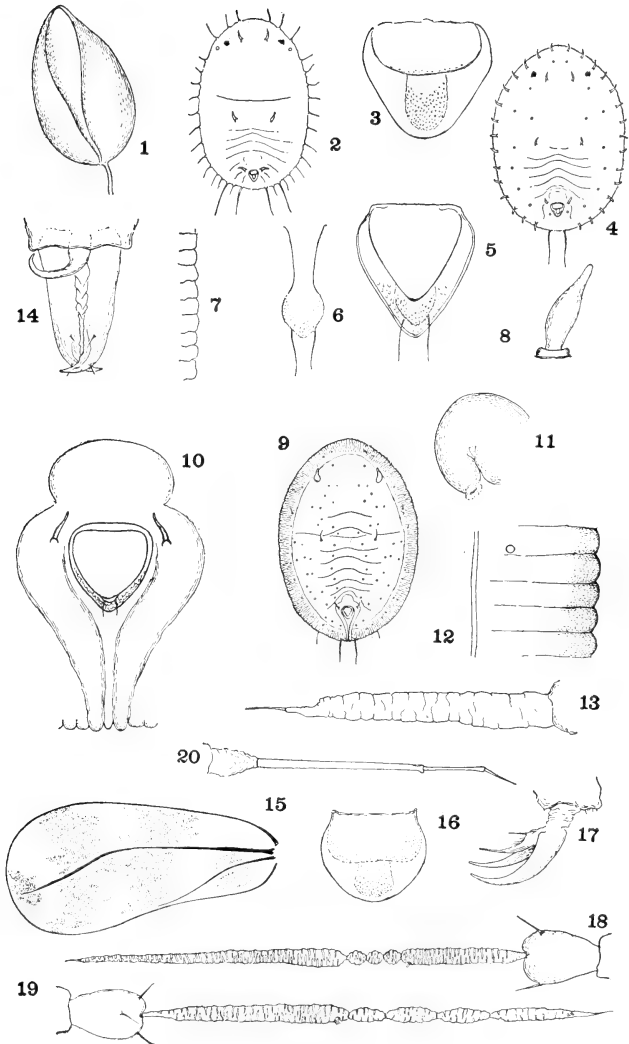
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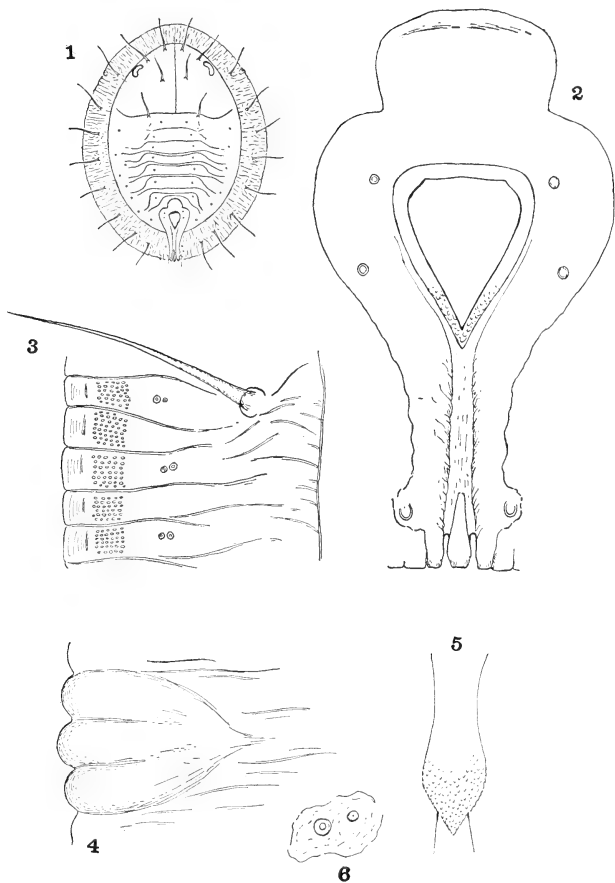
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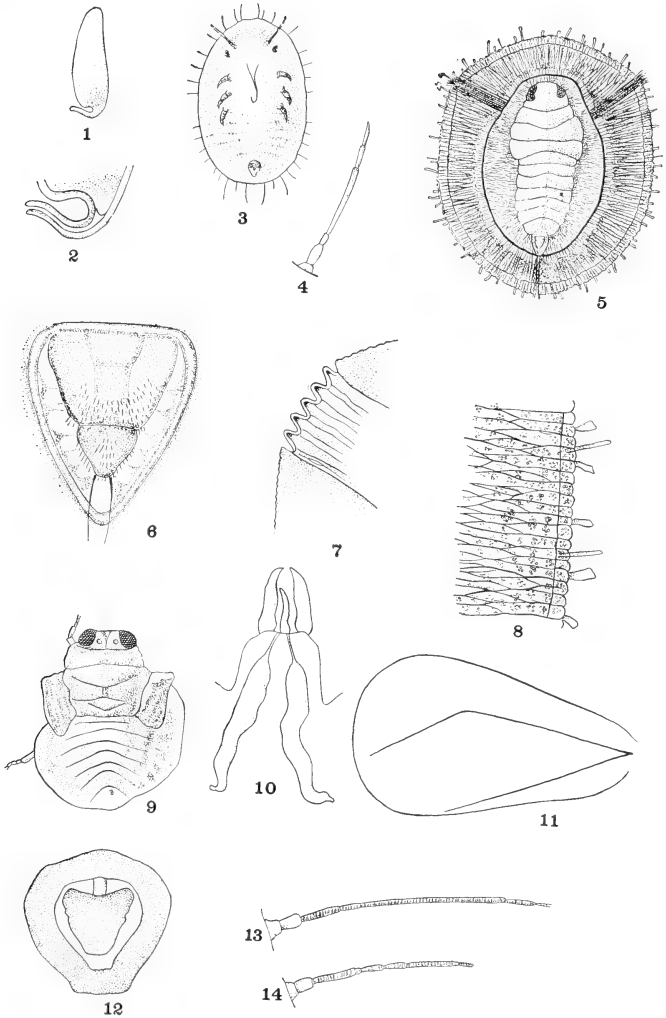
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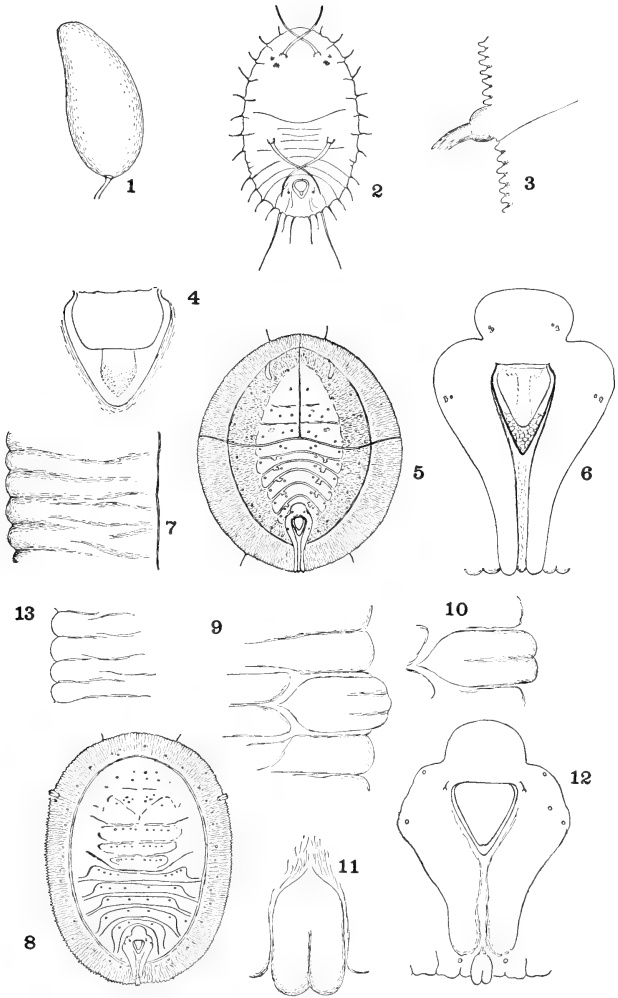
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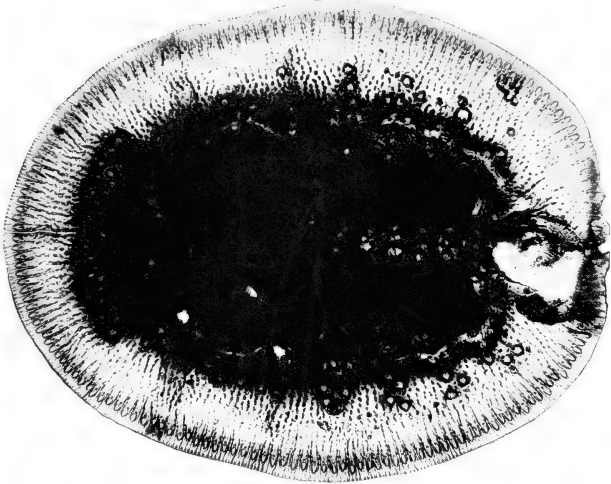
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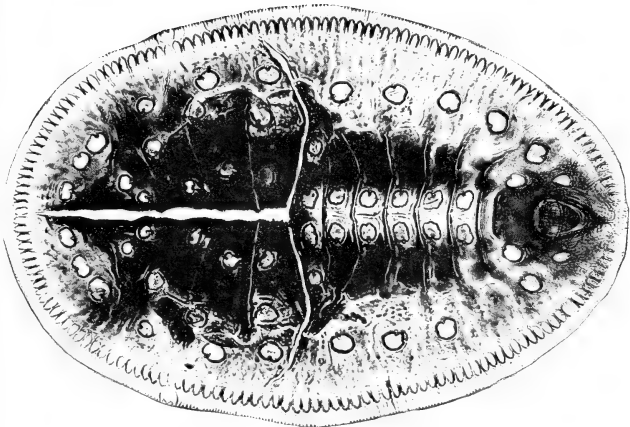


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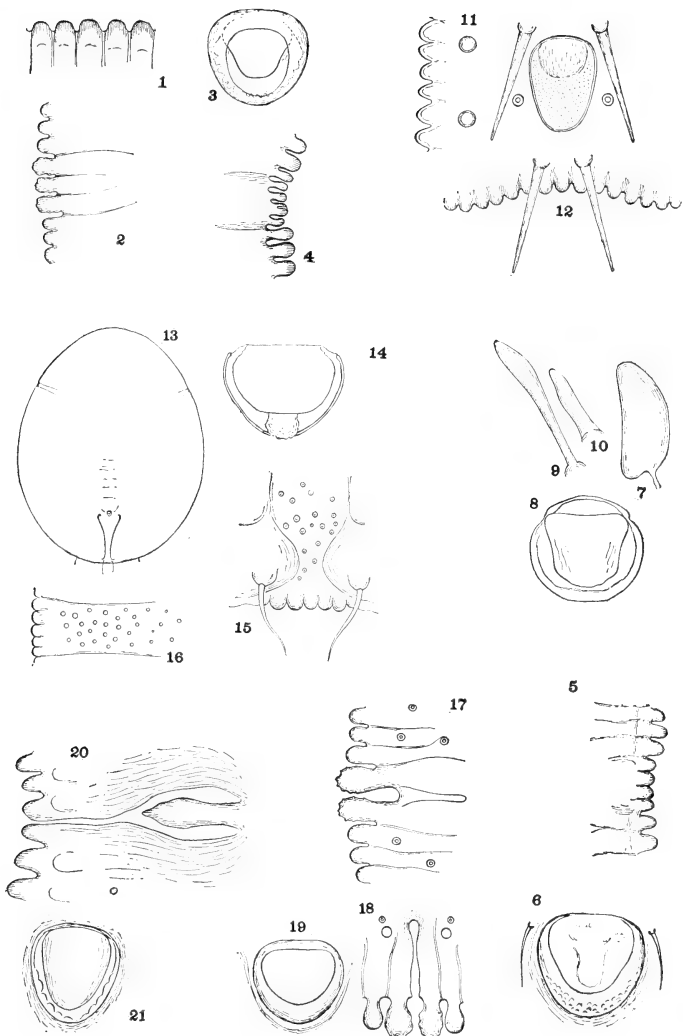
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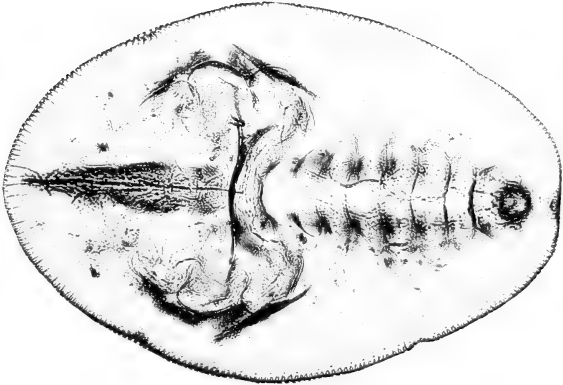
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 441.

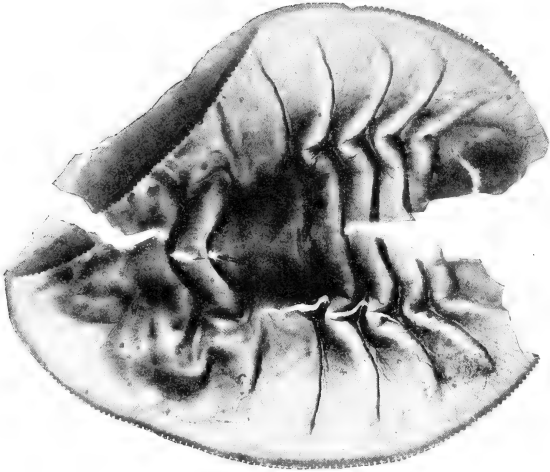


WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 442.



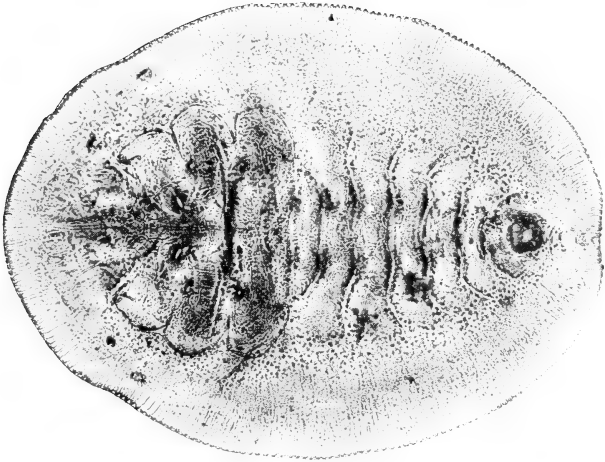
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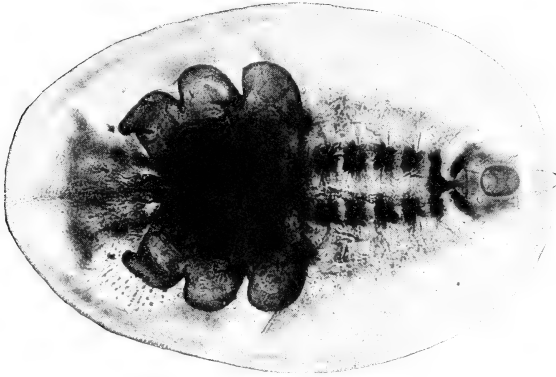
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WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 442.



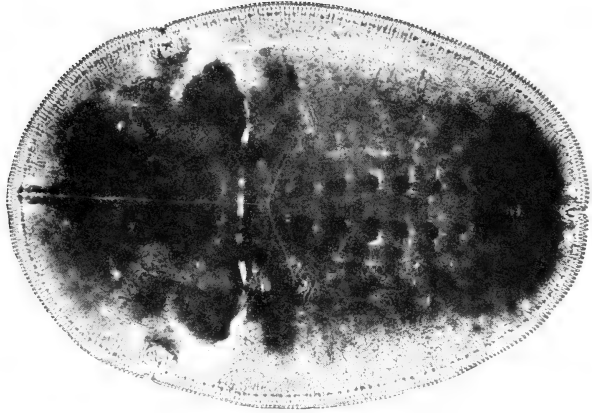
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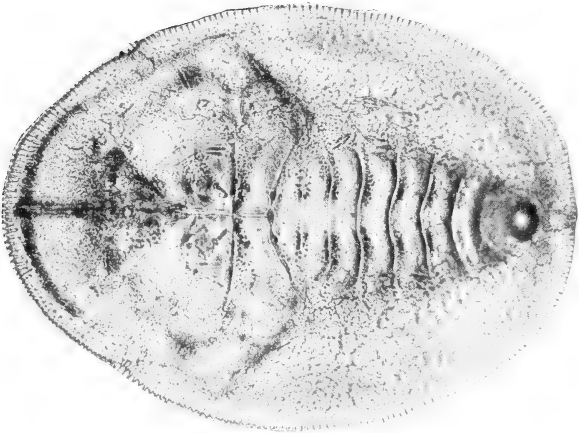
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WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 442.



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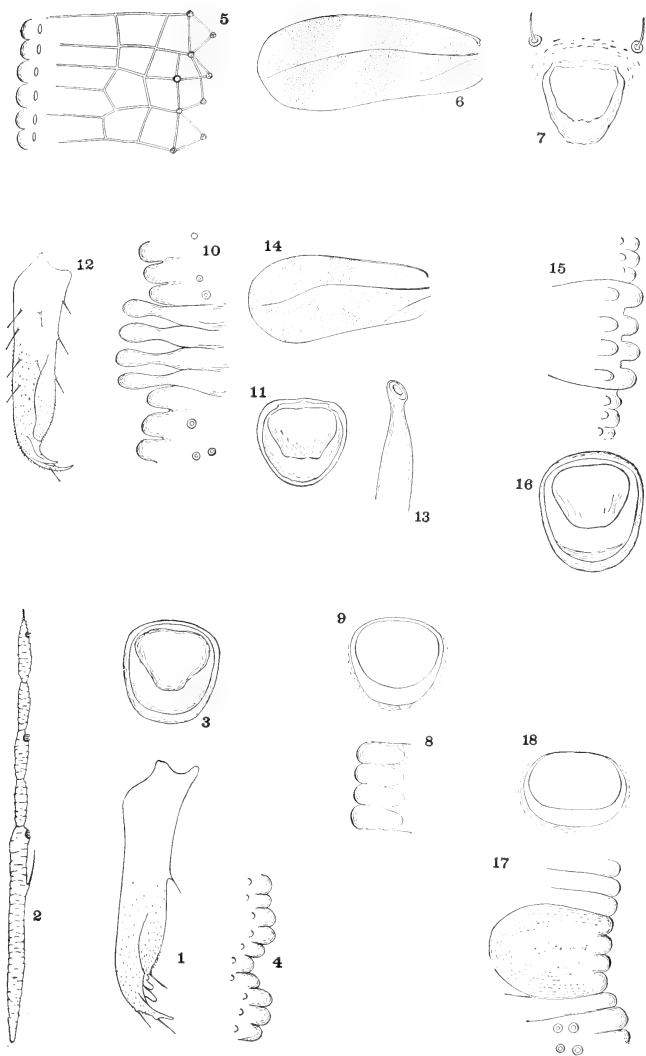


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WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 442.

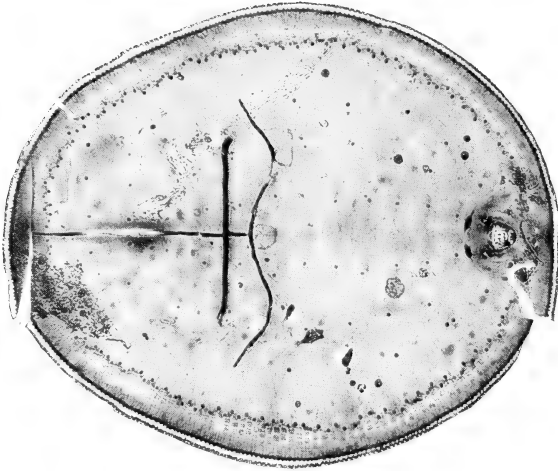




WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 442.

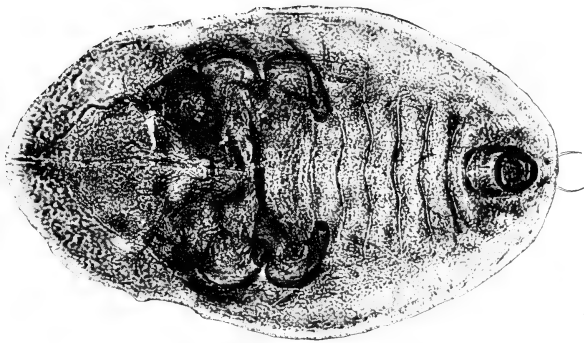




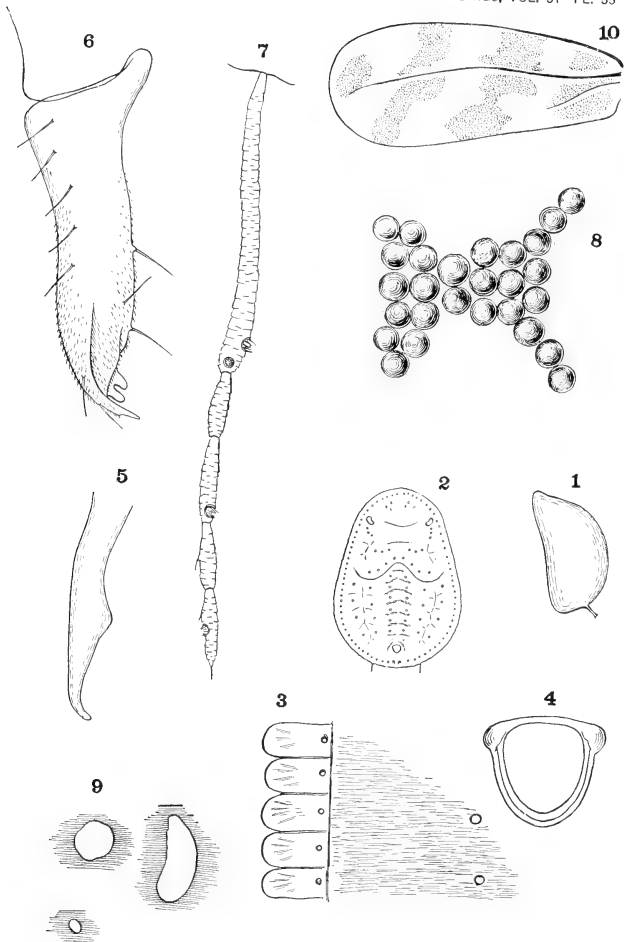
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WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 442.

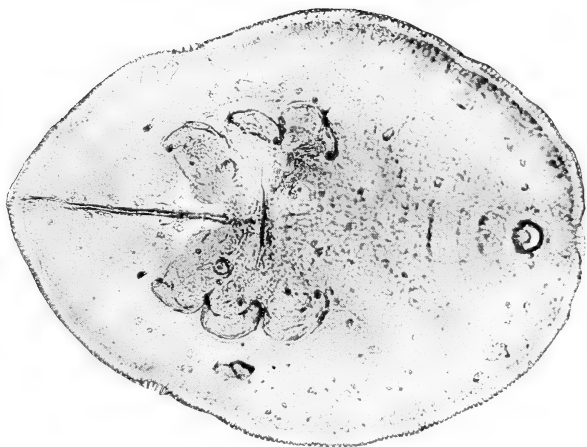


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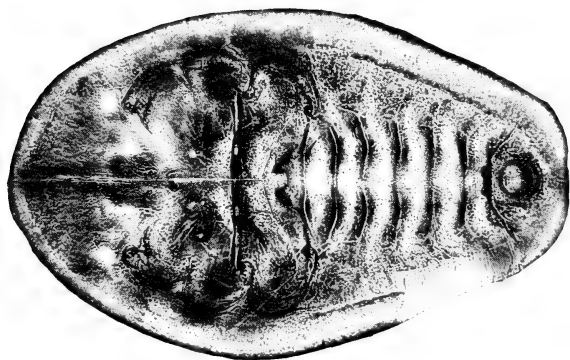


WHITE FLIES OF THE SUBFAMILY ALEYRODINAE

FOR EXPLANATION OF PLATE SEE PAGE 442.



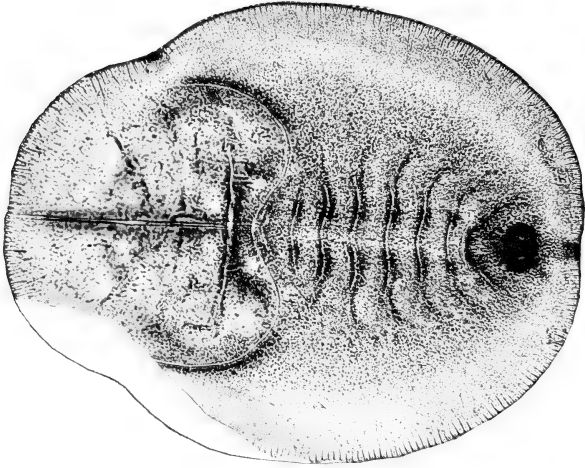
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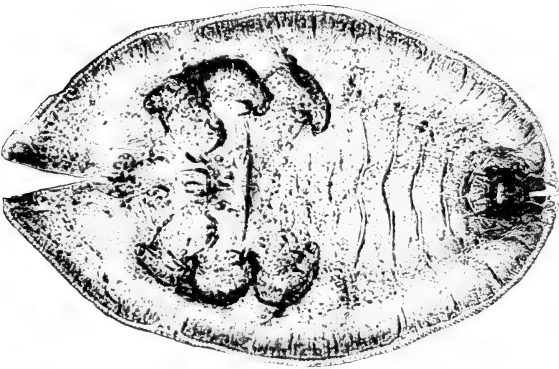
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WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 442.



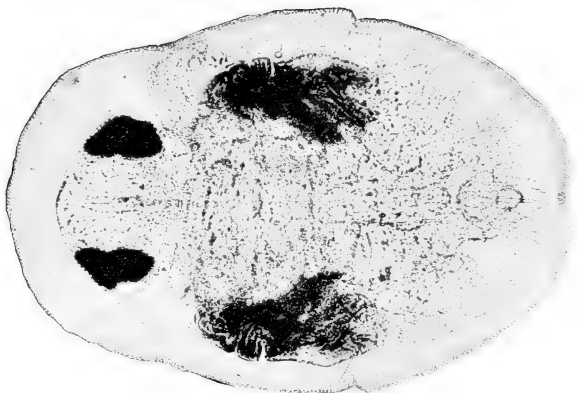
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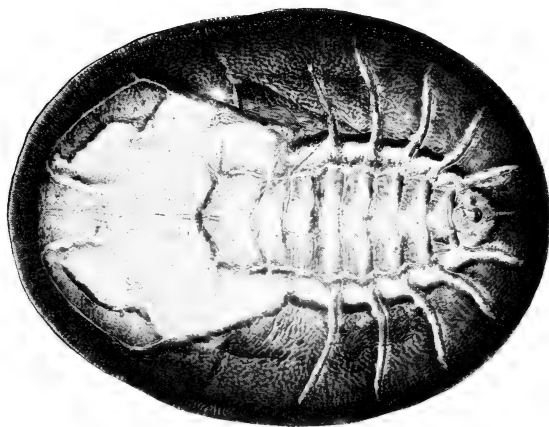
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WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 443.



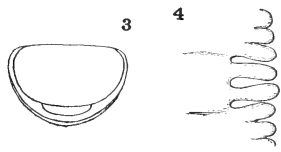
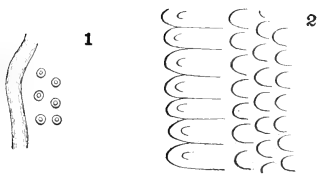
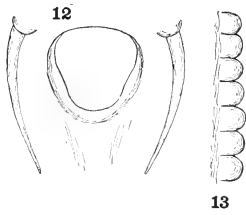
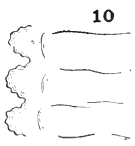
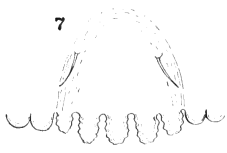
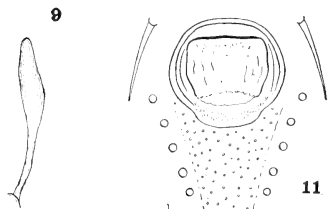
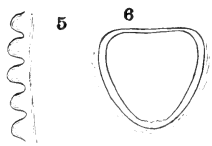
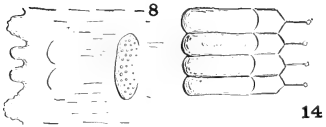
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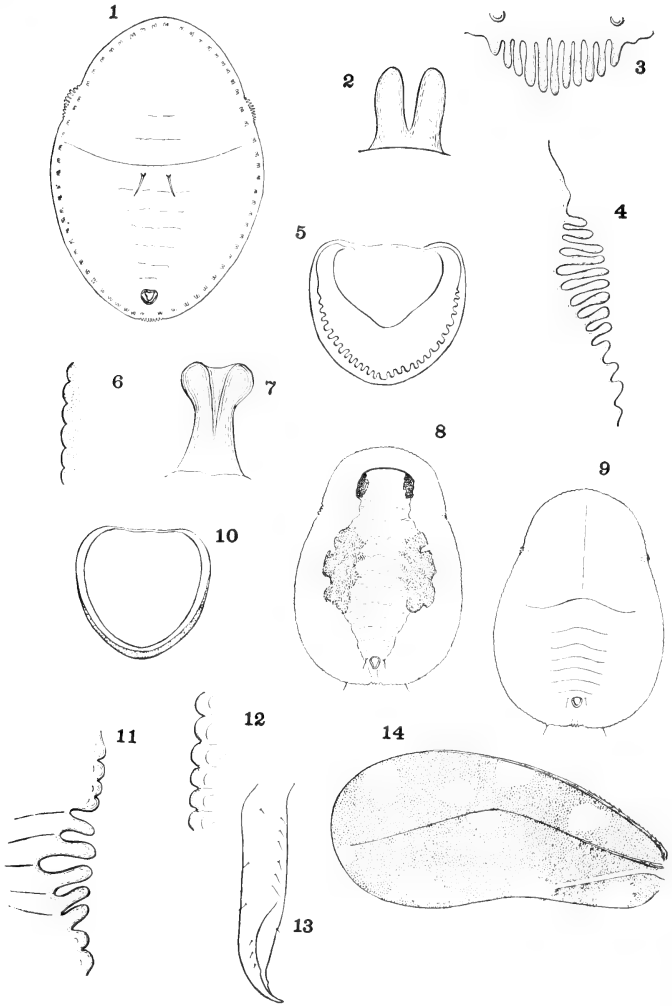
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 443.



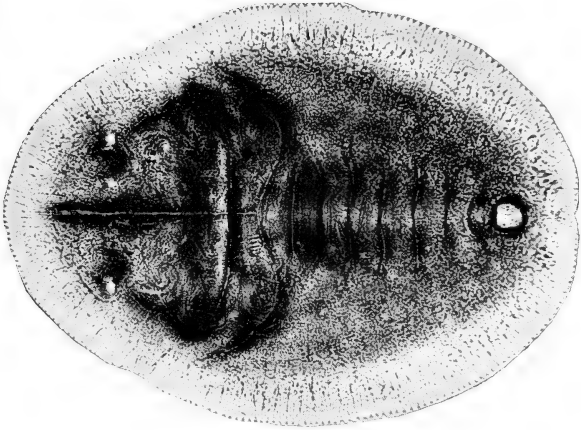
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 443.

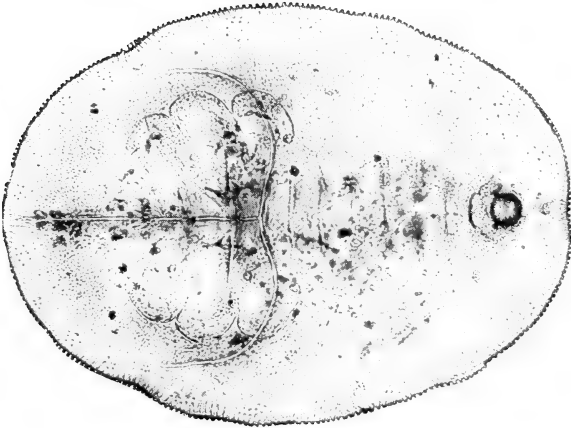


WHITE FLIES OF THE SUBFAMILY ALEYRODINAE

FOR EXPLANATION OF PLATE SEE PAGE 443.



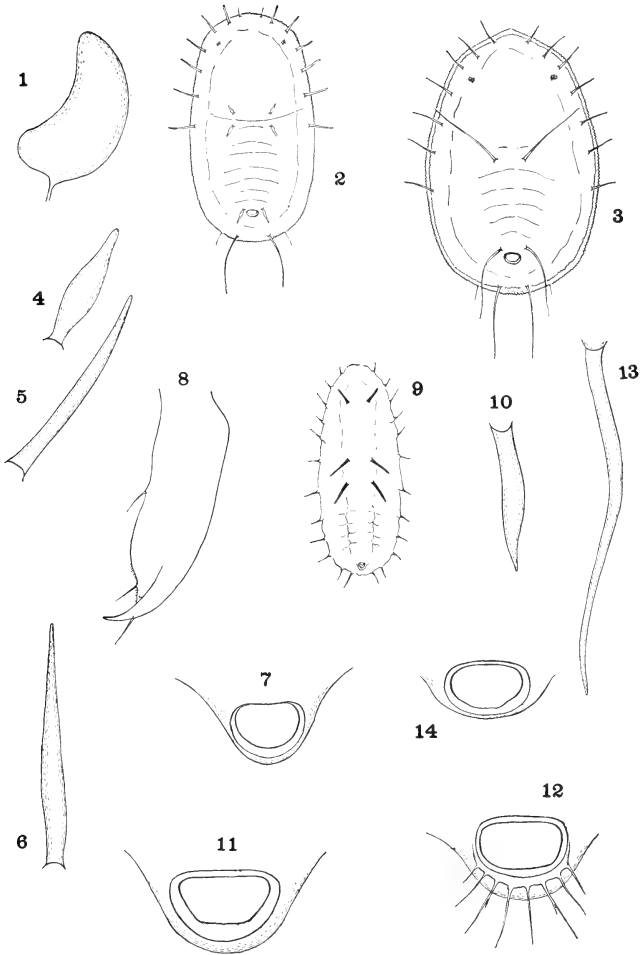
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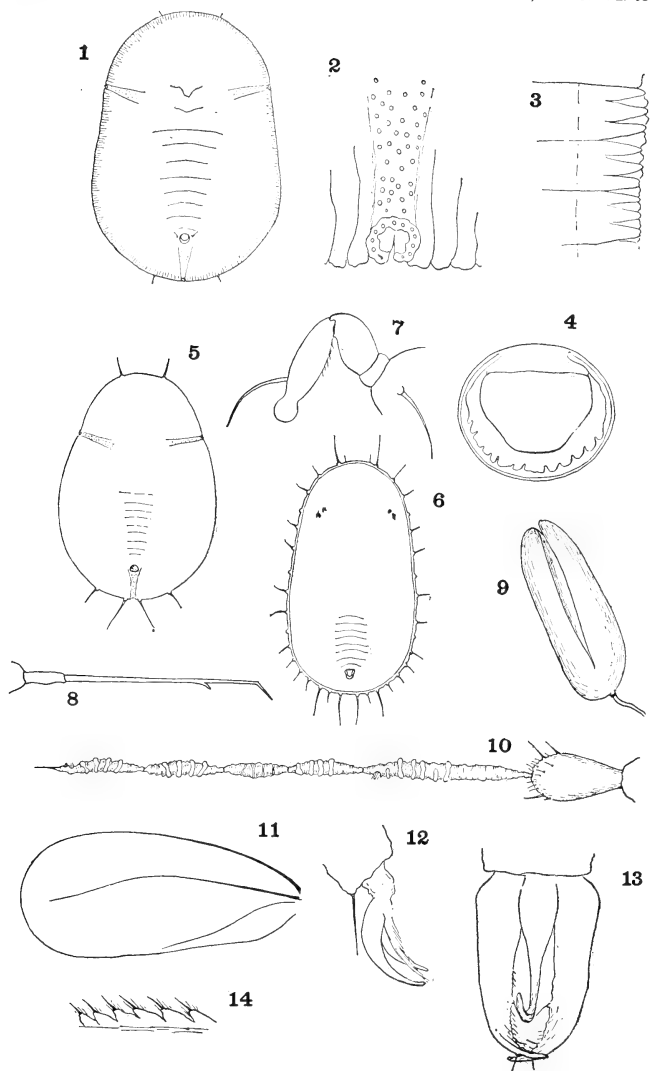
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 443.



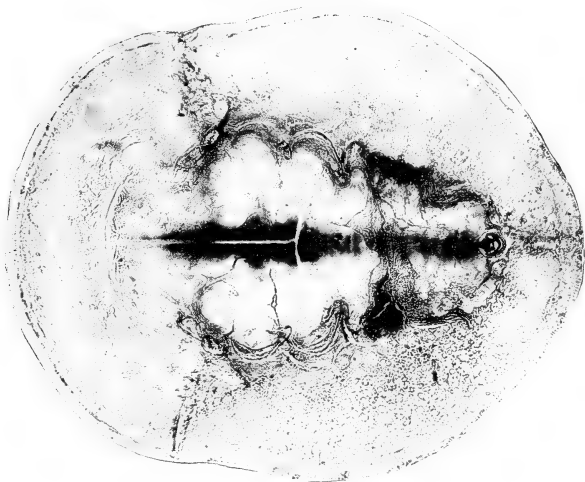
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 443.

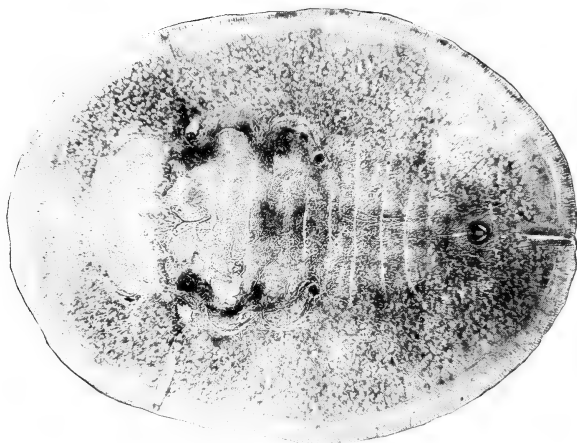


WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 443.



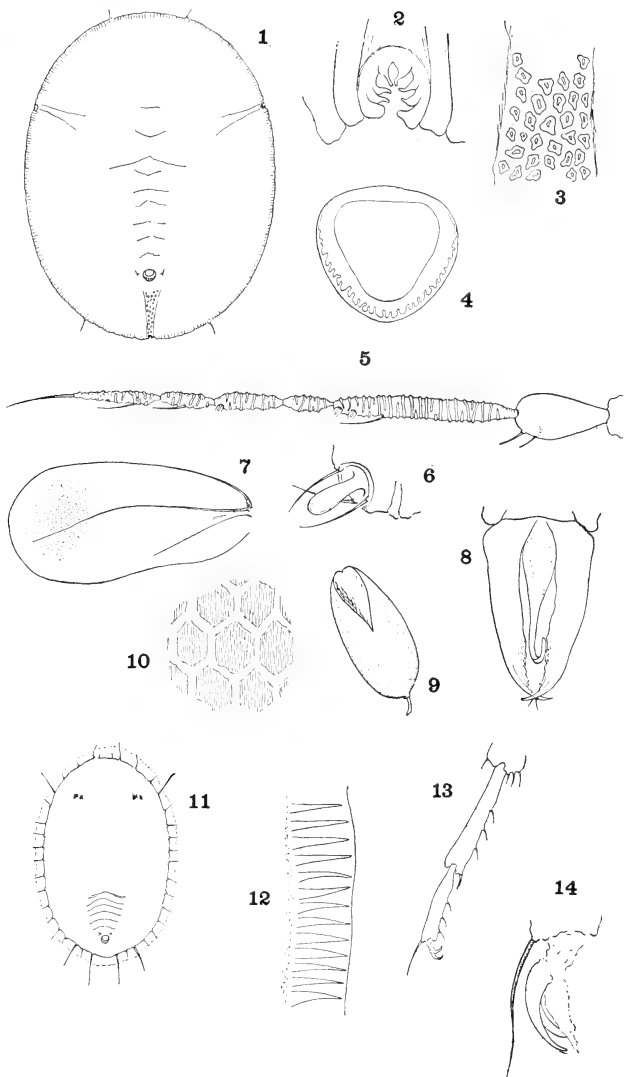
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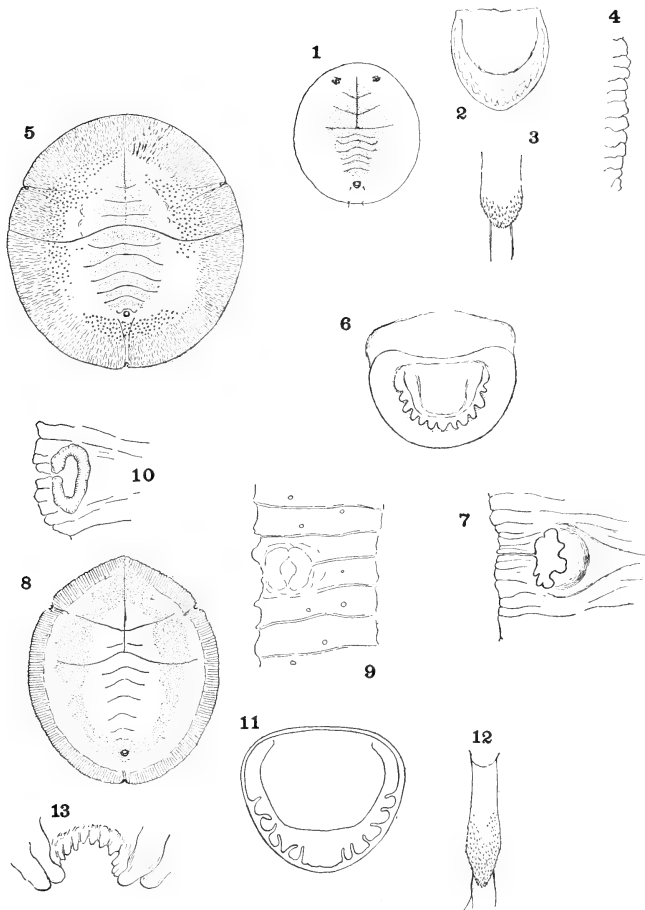
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 443.



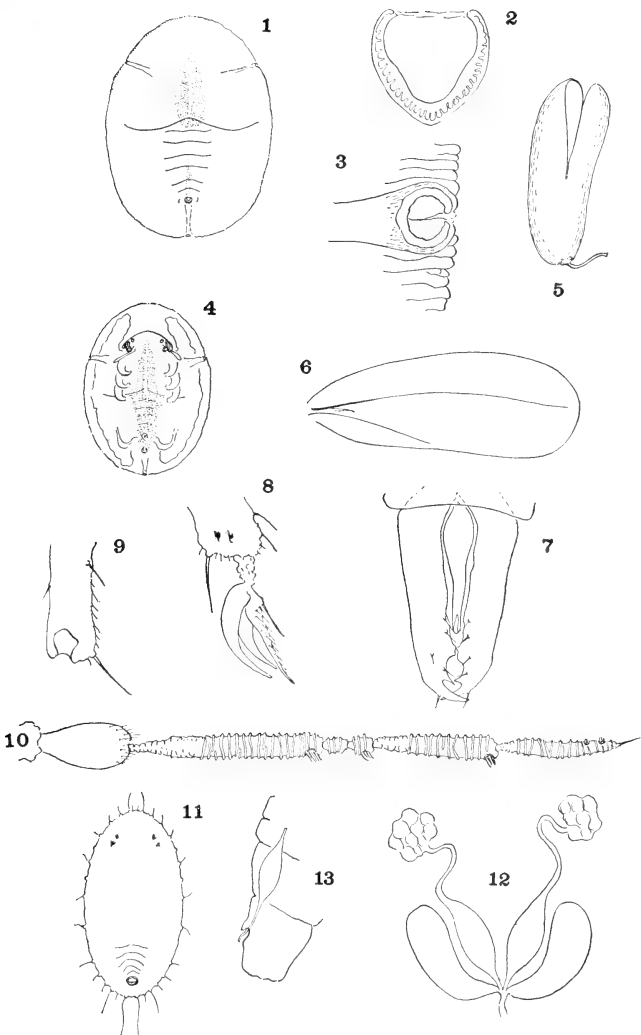
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 443.



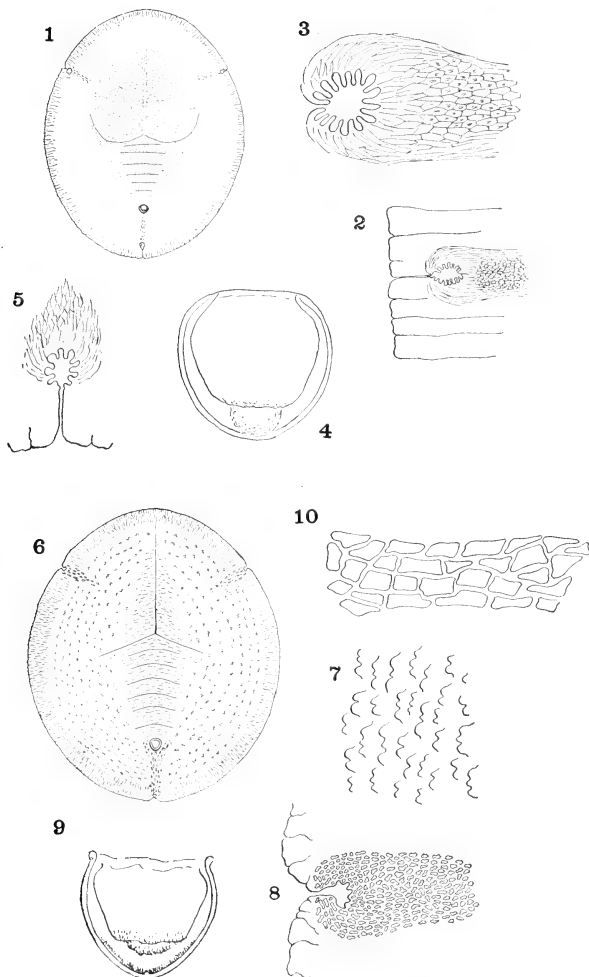
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 444.



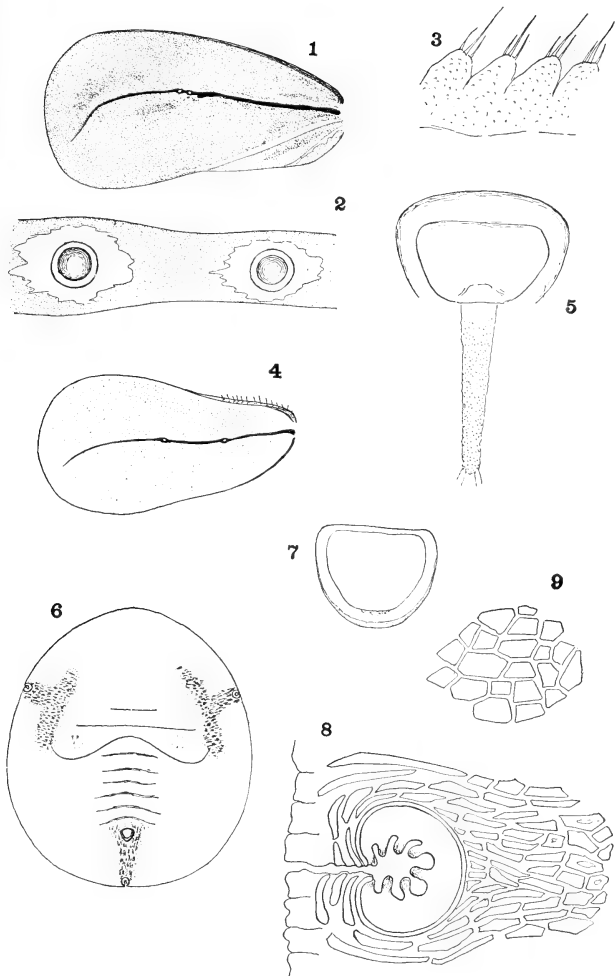
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 444.



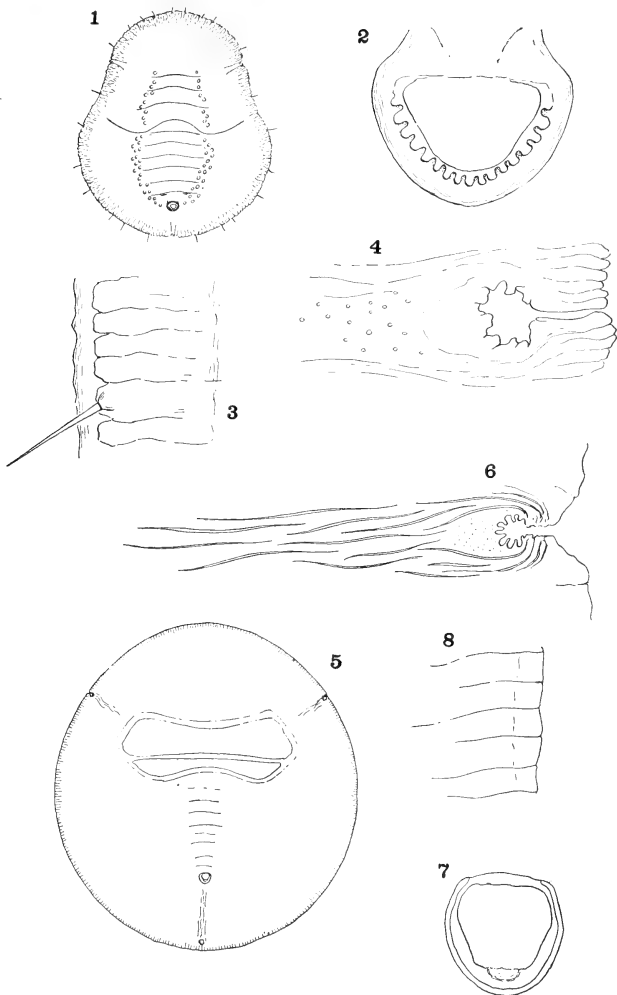
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 444.



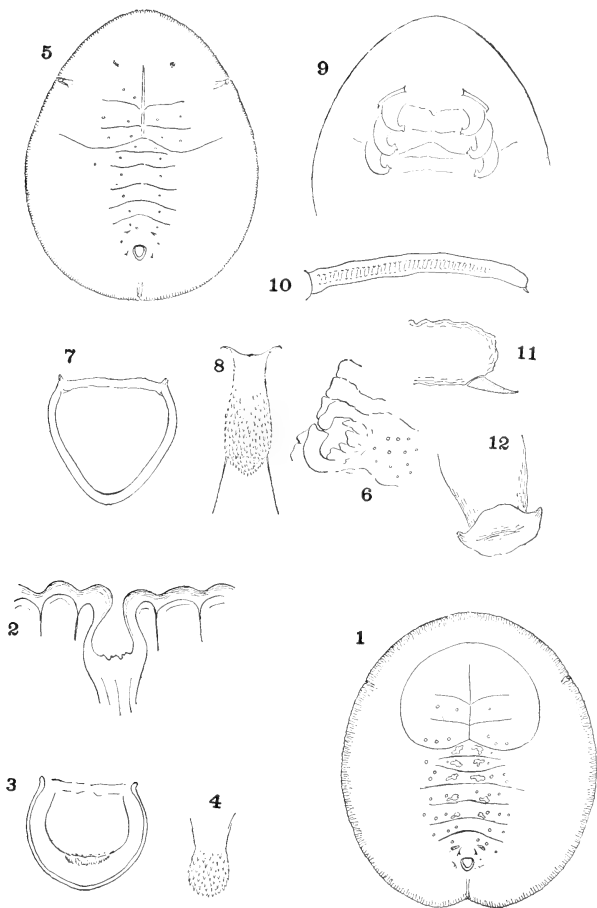
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 444.



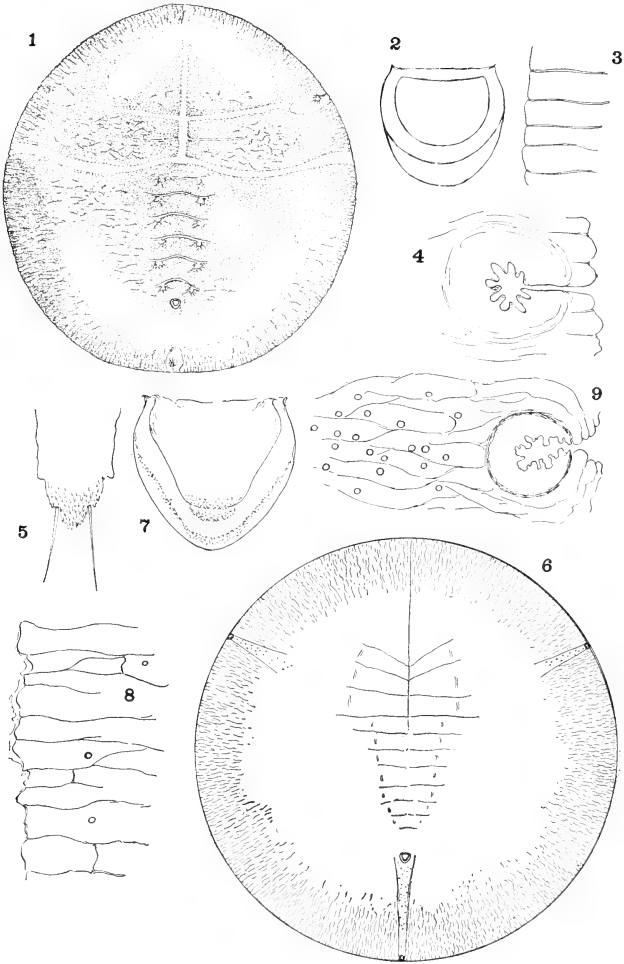
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 444.



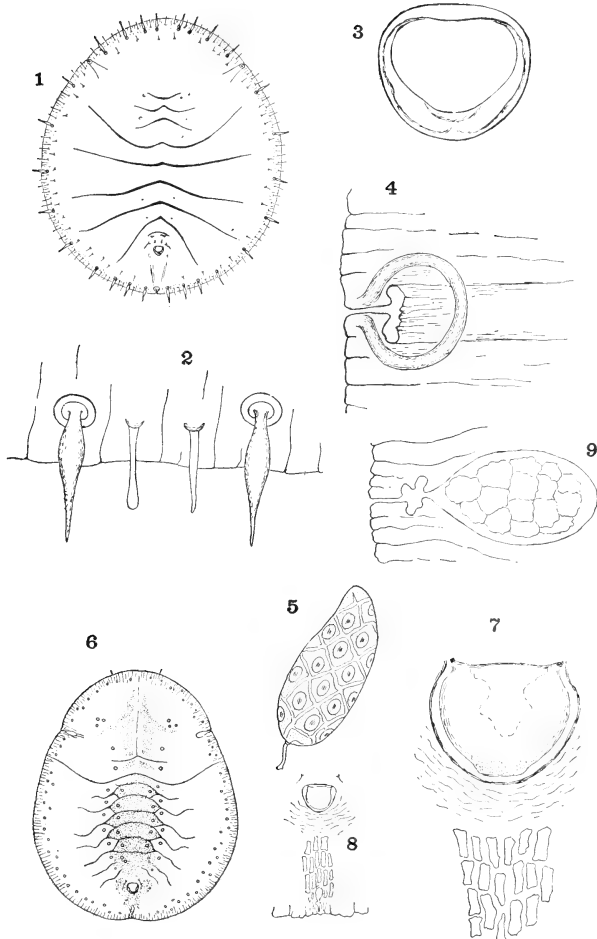
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 444.



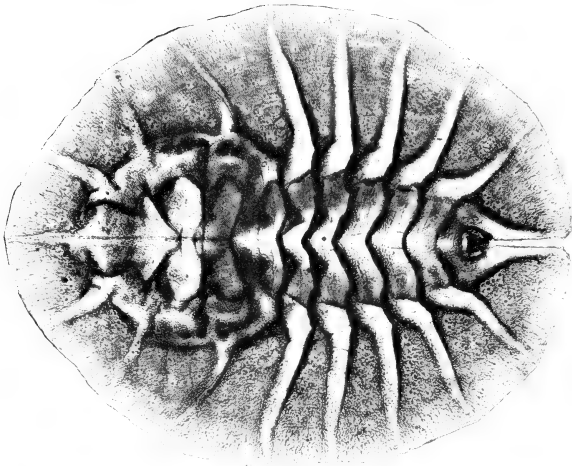
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 414.

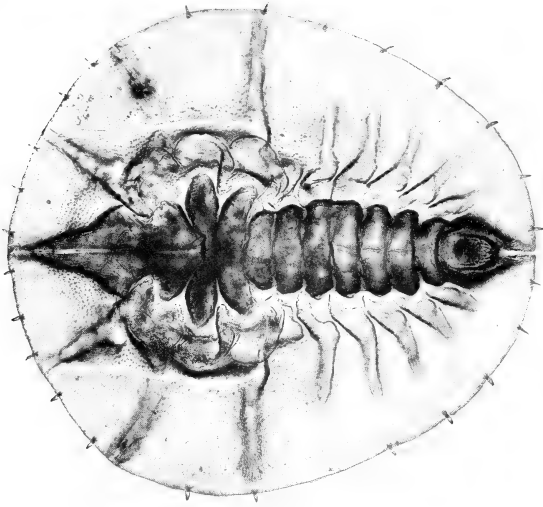


WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 444.



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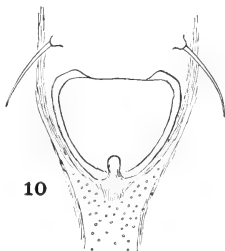
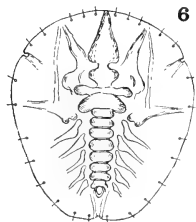
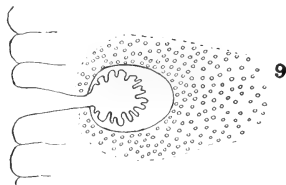
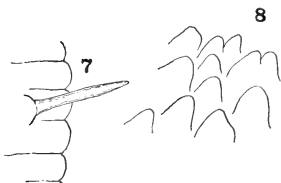
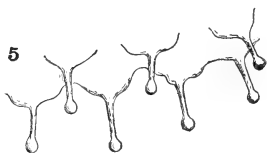
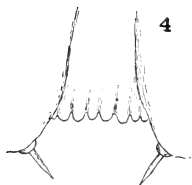
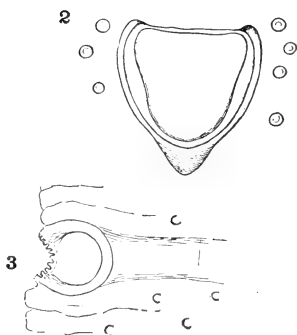
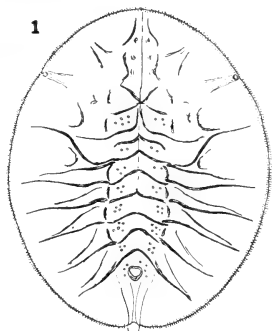


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WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

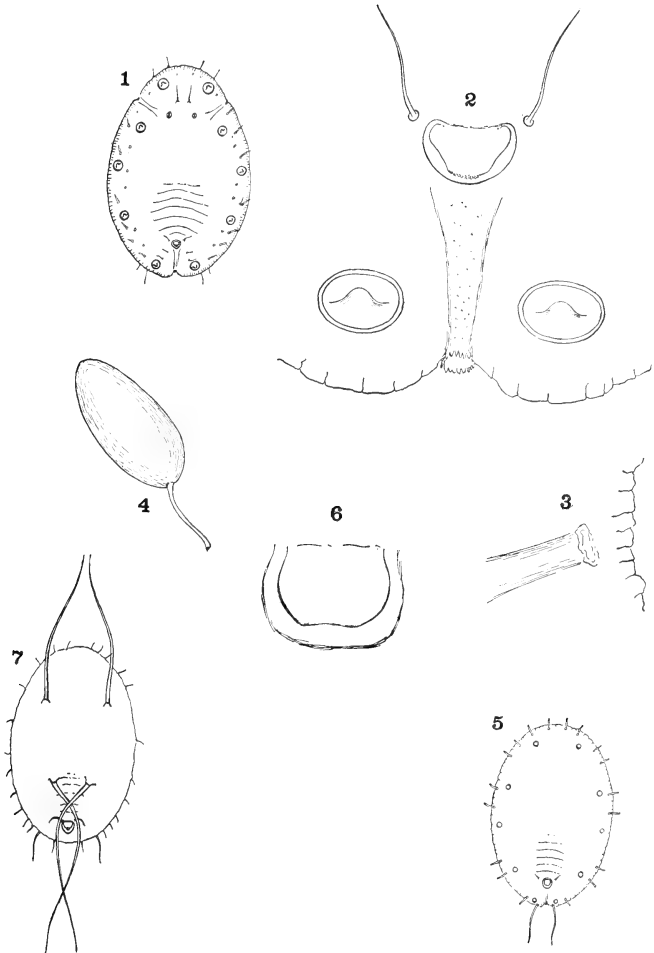
FOR EXPLANATION OF PLATE SEE PAGE 445.





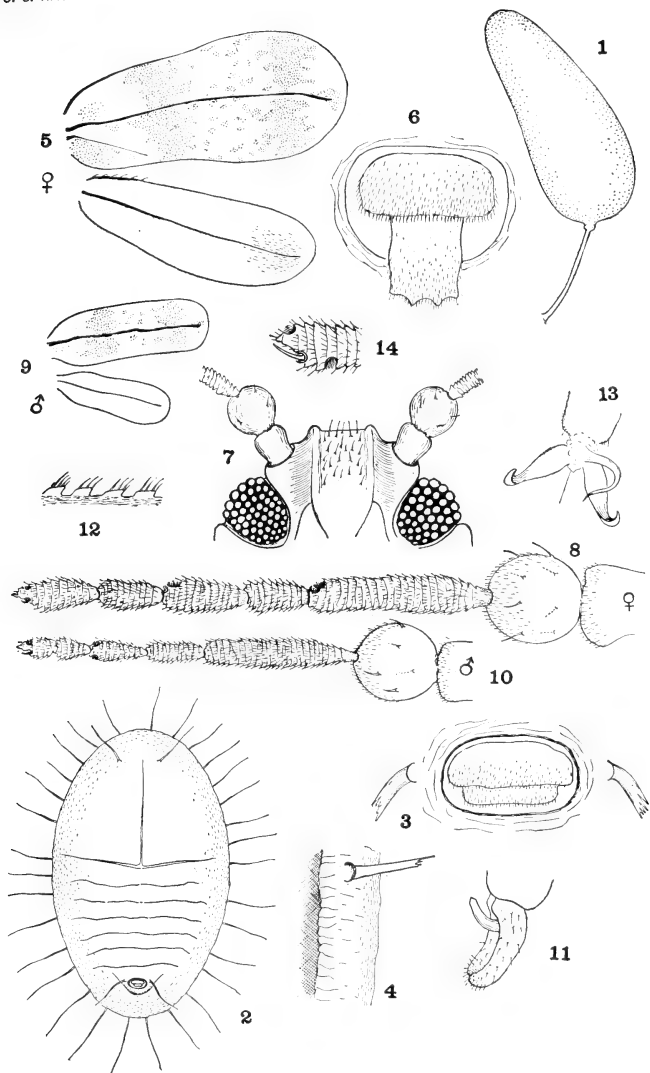
WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 445.



WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 445.



WHITE FLIES OF THE SUBFAMILY ALEYRODINAE.

FOR EXPLANATION OF PLATE SEE PAGE 445.

NOTES ON THE WHITFIELD COUNTY,
GEORGIA, METEORIC IRONS, WITH
NEW ANALYSES

BY

GEORGE P. MERRILL

Head Curator, Department of Geology, United States National Museum

No. 2157.—From the Proceedings of the United States National Museum,
Vol. 51, pages 447-449, with Plate 78

Published December 16, 1916



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Government Printing Office
1916

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NOTES ON THE WHITFIELD COUNTY, GEORGIA, METEORIC IRONS, WITH NEW ANALYSES.

By GEORGE P. MERRILL,

Head Curator, Department of Geology, United States National Museum.

It will be recalled that in 1881 in the *American Journal of Science* (vol. 21), W. E. Hidden described an iron meteorite from Whitfield County, Georgia, and gave a cut illustrating the etched surface, but no chemical analyses. In 1883, C. U. Shephard, in the same journal, published a description of a still larger mass, weighing some 117 pounds, from near Dalton in the same county, and in this description expressed a doubt as to whether this iron might not be identical with that previously described by Hidden. In 1887, again, George F. Kunz in writing on the East Tennessee (Cleveland) iron suggested that this too might be identical with the large mass of the Whitfield County iron. This refers, presumably, to the Dalton of Shepard. It was for the purpose of deciding these questions that the present investigation was undertaken, opportunity for which was offered by the final acquisition by the United States National Museum of the Shepard collection, which contained the 117-pound mass.

Referring to the two irons described by Hidden and Shepard, respectively—

These differ quite radically in structure, as shown in plate 78, figure 1 being an etched surface of the iron described by Shepard, and figure 2 of the mass described by Hidden. The Hidden iron, it will be observed, is marked by broad plessite areas and a peculiar swelling of the kamacite bands, while between the two alloys are the regularly disposed, parallel-lying taenite bands. In the Shepard iron the kamacite bands are not swollen, but show very straight borders, the taenite bands are thinner, so thin indeed, as to be scarcely recognizable, and the plessite areas much less conspicuous. More important yet is the presence in this iron of small, irregularly scattered, granular, and dendritic particles of schreibersite, shown somewhat indistinctly in white in figure 1 of the plate. These were noted by Shepard and described as being often interrupted at short intervals, so that they resemble the markings of telegraph ribbons, and the continuous lines

sometimes swelling into triangular or polygonal enlargements forming a string of nearly disconnected beads. Shepard, however, did not discriminate between the taenite and schreibersite, and the two are often so closely associated and intergrown as to make this a matter of difficulty. The most characteristic distinction is that the taenite lies in very thin films parallel to the kamacite, while the schreibersite is in knots, granules, and dendritic forms, sometimes by itself but often attached to or continuous with the taenite films. That these forms are of the phosphide has been determined by separation and microchemical tests. There is, further, a marked difference in the manner in which the two irons etch, the Hidden iron etching quickly and yielding a bright, lustrous surface, while that described by Shepard, under precisely the same conditions, is acted upon much more slowly and gives a dull surface, on which the figures show less distinctly.

An analysis of the Shepard iron as given in the paper referred to shows:

	Per cent.
Iron (Fe).....	94.66
Nickel (Ni).....	4.80
Cobalt (Co).....	.34
	99.80

There being reasons for doubting the accuracy of this analysis, it was repeated at my request by J. E. Whitfield, with the following results:

	Per cent.
Silicon (Si).....	0.001
Sulphur (S).....	.025
Phosphorus (P).....	.095
Manganese (Mn).....	None.
Carbon (C).....	.004
Nickel (Ni).....	7.575
Cobalt (Co).....	.550
Copper (Cu).....	.016
Platinum (Pt).....	Traces.
Iridium (Ir).....	.002
Iron oxide (Fe ₂ O ₃).....	.350
Iron (Fe).....	91.469
	100.087

A partial analysis of the iron described by Hidden shows a very close resemblance, so far as the two essential constituents are concerned, Nichols's results, as quoted by Farrington,¹ giving:

	Per cent.
Iron (Fe).....	91.02
Nickel (Ni) and cobalt (Co).....	7.38
	98.40

¹ Mem. Nat. Acad. Sci., vol. 13, 1915, p. 155.

Notwithstanding this close chemical resemblance, which is not at all unusual for irons of this class, I am, on the grounds of structure and etching peculiarities, convinced that the irons represent two distinct falls, and would suggest that the Hidden iron be known, as first described, under the name *Whitfield County*, and that described by Shepard as *Dalton*. They will be so listed in the future in the United States National Museum catalogue.

As to the suggested identity of the Shepard iron with that of Cleveland, as made by Kunz, while there is some resemblance between the two, I can not agree with his statement that the figures on the Cleveland and Shepard irons are identical. (See pl. 78.) Further than this, the Shepard (Dalton) iron shows nowhere on the five cut surfaces now available any of the Reichenbach figures, which are so pronounced on that of Cleveland, and which Cohen has further noted on that described by Hidden (the Whitfield County iron). A further difference is noted in the composition of the Cleveland iron, as determined by Genth, the results given in Kunz's paper being as follows:

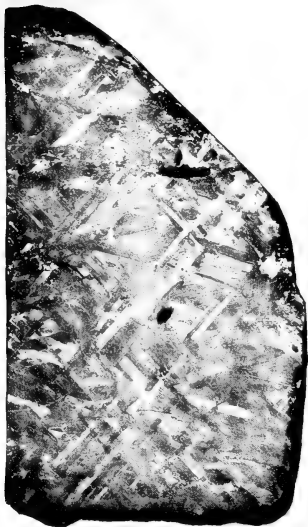
	Per cent.
Iron (Fe).....	89.93
Copper (Cu).....	.06
Nickel (Ni).....	8.06
Cobalt (Co).....	.56
Phosphorus (P).....	.66
Sulphur (S).....	Not determined
	99.27

It is my present opinion that the three irons represent three distinct falls.

EXPLANATION OF PLATE 78.

(All figures natural size.)

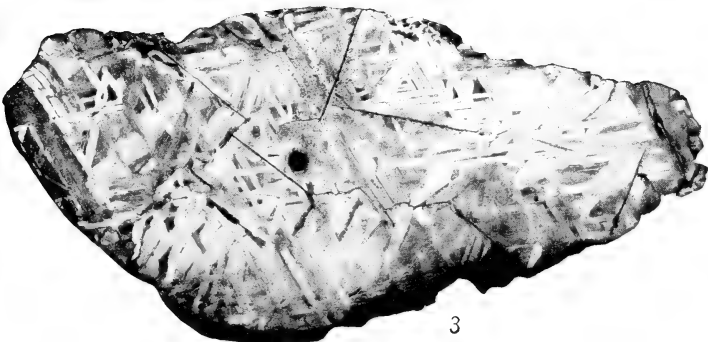
- FIG. 1. Etched surface of the Dalton iron described by Shepard. Cat. No. 90. (Shep. Coll.)
2. Etched surface of the Whitfield County iron described by Hidden. Cat. No. 520.
3. Etched surface of the Cleveland, East Tennessee, iron described by G. F. Kunz. Cat. No. 58.



1



2



3

THE WHITFIELD COUNTY, GEORGIA, METEORIC IRONS.

FOR EXPLANATION OF PLATE SEE PAGE 449.

ref

A LOWER JURASSIC FLORA FROM THE UPPER
MATANUSKA VALLEY, ALASKA

BY

F. H. KNOWLTON

Custodian of Mesozoic Plants, United States National Museum

No. 2158.—From the Proceedings of the United States National Museum,
Vol. 51, pages 451-460, with Plates 79-82

Published December 16, 1916



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A LOWER JURASSIC FLORA FROM THE UPPER MATANUSKA VALLEY, ALASKA.

BY F. H. KNOWLTON,

Custodian of Mesozoic Plants, United States National Museum.

The material upon which this paper is based was collected by Dr. George C. Martin, R. M. Overbeck, and J. B. Mertie, jr., of the United States Geological Survey, during the field season of 1913. The general location of the fossil collections, together with the available structural and stratigraphic data, is described in the following notes, which Doctor Martin has kindly prepared:

The fossil plants were obtained from four localities, all situated in a small area lying south of the east fork of Boulder Creek and north of Anthracite Ridge. These localities are in the eastern part of the Talkeetna Mountains, or in the upper Matanuska Valley, Boulder Creek flowing westward into Chickaloon River, which is the largest northern tributary of the Matanuska.

The Lower Jurassic rocks of the Matanuska Valley and adjacent areas have a wide geographic extent and constitute a very important stratigraphic and structural element in the geology of the eastern Talkeetna Mountains. These rocks were described by Paige and Knopf¹ as "lower Middle Jurassic rocks" (including only the volcanic members as described in the text, but the whole of the "Middle Jurassic andesitic greenstones, etc.," as represented on the map). They were tentatively correlated by Brooks with the Skwentna² group, which he referred to the lower Middle Jurassic on the basis of Paige and Knopf's assignment of their Matanuska Valley rocks. They include the "Lower Jurassic rocks" described by Martin and Katz,³ and by Martin and Mertie.⁴

These rocks include lavas, agglomerates, breccias, and tuffs, interbedded with lesser volumes of sandstone and shale. They are composed chiefly of water-laid volcanic detritus. Their thickness is probably several thousand feet, but can not be accurately estimated on account of the complex structure and the lack of recognizable horizons. The position of the plant-bearing beds within the formation has not been determined. These rocks carry also an abundant marine invertebrate fauna which Stanton regards⁵ as probably of Lower Jurassic age, and as probably equivalent to that

¹ Paige, Sidney, and Knopf, Adolph., Geologic reconnaissance in the Matanuska and Talkeetna basins, Alaska, U. S. Geol. Survey Bull. 327, 1907, pp. 16-19.

² Brooks, Alfred H., The Mount McKinley region, Alaska, U. S. Geol. Survey Prof. Paper 70, 1911, pp. 85-87.

³ Martin, G. C., and Katz, F. J., Geology and coal fields of the lower Matanuska Valley, U. S. Geol. Survey Bull. 500, 1912, pp. 29-32.

⁴ Martin, G. C., and Mertie, J. B., jr., Geology of the upper Matanuska district, U. S. Geol. Survey Bull. (in preparation).

⁵ U. S. Geol. Survey Bull. 500, p. 31.

of the Lower Jurassic tuffs¹ of Seldovia. They were largely, if not wholly, deposited in marine waters, although the plants herein described are possibly indicative of temporary terrestrial conditions. The plants have been found only in one small area, but the marine invertebrates are widely distributed. The plants and the marine shells have not been found in the same bed, nor have their precise relations been determined.

Neither the basal contact of these beds nor the rocks which underlie them have been observed, these being the oldest rocks known in this district. They are overlain by Middle Jurassic beds which have yielded numerous fossils (8567), including *Sagenopteris göppertiana* Zigno, together with a great variety of marine invertebrates. The fauna of these overlying Middle Jurassic rocks corresponds closely to that of the Tuxedni sandstone² of Cook Inlet, in which *Sagenopteris göppertiana* and other plants have also been found.

The plant material from the Matanuska Valley proves to be of exceptional interest and, as so frequently happens in reconnaissance work, it is perhaps of necessity unfortunately limited in amount. The matrix containing the plants had a tendency to break up into small pieces, with the result that there is hardly an entire leaf or frond in the whole collection. In some cases the nervation is much obscured, while in others, as for instance in the fragments of *Dictyophyllum* leaves, it is retained with remarkable fidelity.

The stratigraphy and invertebrate paleontology, as set forth in the preceding paragraphs by Doctor Martin, point to the reference of these rocks to the Lower Jurassic, and it naturally becomes of interest to ascertain the bearing of the plants on this point. Following is an enumeration of the species recognized from the combined localities, the local distribution of each species being indicated under the locality number below:

Name.	6698	6699	6700	6701
<i>Cladophlebis hirta</i> ? Möller.....			X	
<i>Dictyophyllum nilssonii</i> (Brongniart) Göppert.....			X	
<i>Sagenopteris</i> ?, species.....			X	
<i>Otozamites pterophylloides</i> Brongniart MSS.....		X		X
<i>Otozamites bornholmiensis</i> ? Möller.....			X	
<i>Pterophyllum rajmahalense</i> Morris.....	X			
<i>Pterophyllum aequale</i> (Brongniart) Nathorst.....	X			
<i>Ctenophyllum angustifolium</i> ? Fontaine.....	X			
<i>Nilssonia polymorpha</i> Schenk.....			X	
<i>Pagiophyllum falcatum</i> Bartolin.....			X	

As all these forms, with the exception of the unnamed *Sagenopteris*, are species previously known, they may furnish adequate information as to their age values. In the first place it may be pointed out that, although geographically related only one of the 10 forms enumerated above—namely, *Pterophyllum rajmahalense*, which has been

¹Stanton, T. W., and Martin, G. C., Mesozoic section on Cook Inlet and Alaska Peninsula, Geol. Soc. America Bull., vol. 16, 1905, pp. 396-397.

²Martin, G. C., and Katz, F. J., A geologic reconnaissance of the Iliamna region, Alaska, U. S. Geol. Survey Bull. 485, 1912, pp. 59-64.

reported¹ from the Middle Jurassic (Tuxedni sandstone) of Cook Inlet—has thus far been detected in any of the Jurassic areas known in Alaska, though several of the genera are present. To the south, however, three species are found to be common to the Jurassic of Douglas County, Oregon, as follows: *Pterophyllum rajmahalense*, *Pterophyllum aequale*, *Ctenophyllum angustifolium*?

As these three species occur together at a single locality in the Matanuska Valley, and were not found at any of the other localities, it is not impossible that they may represent a higher horizon, which would place them more in accord with the Oregon Jurassic.

The first of these species is reported by Fontaine to be one of the most abundant forms at the Oregon localities. It was first described from the Rajamahal series of India, in beds believed to be of Liassic age, while the Oregon localities are held to be of the same age as the Jurassic of Yorkshire, England—namely, Lower Oolite.

The second species (*Pterophyllum aequale*) is also one of the abundant forms in the Oregon Jurassic. It was first reported in the Rhaetic of Sweden by Brongniart, and later by Nathorst and others. Fontaine² has expressed the opinion that Nathorst has probably confused two species under this name from Sweden, one form of which is the abundant type at the Oregon localities.

There is some question about the identification of the third species (*Ctenophyllum angustifolium*), and its presence in the rocks of the Matanuska Valley has been queried. The only specimen in the collection is the fragmentary one shown in the figure (pl. 80, fig. 2), and while it is smaller than the usual Oregon form shown in Fontaine's figures, it is of the same type and may well have come from near the tip of an especially small leaf. In any event it has been thought better to refer it provisionally to this form rather than found a new species on inadequate material.

The Matanuska material undoubtedly finds its closest affinity with the material described by Nathorst, Bartolin, Möller, and others from the island of Bornholm, off the southern coast of Sweden, since all but two of the forms (*Pterophyllum rajmahalense* and *Ctenophyllum angustifolium*) are common to the two places. It should be noted that these two species have not been found at the same Alaskan localities as the other eight species. It is of course true that the identification of two or three of the Matanuska forms has been questioned, but the certainty with which certain of the other forms have been identified makes these doubtful ones the more reasonable. One of the most characteristic and unmistakable forms is the *Dictyophyllum* which genus has been reported but once before from America. Two of the varieties or forms of this species described by Nathorst are also present in the Alaskan material.

¹ U. S. Geol. Survey Bull. 484, p. 64, 1911.

² Fontaine, W. M., in Ward, U. S. Geol. Survey Mon. 50, p. 100, 1906.

To the best of present knowledge and belief, then, the Matanuska localities are thought to be of the same age as the Bornholm deposits, and the question only remains: What is that age? In the works of Möller, Nathorst, and others the Bornholm locality is referred to as Rhaetic or Liassic, there apparently being the same difficulty there, as in many other parts of Europe, in drawing the line between the Triassic and Jurassic. Taking everything into account in the present connection, such as the Jurassic affinity of certain of the forms, the absence of known plant-bearing Triassic rocks in Alaska, the apparently Lower Jurassic indication of the associated invertebrates, etc., all give weight to the reference of these rocks to the higher of the two alternatives. The material under consideration from the Matanuska Valley is, therefore, regarded as of Lower Jurassic (Liassic) age. This is the oldest, well-defined Jurassic flora known to the writer in North America.

It may be mentioned that the plant-bearing beds that are possibly of Lower Jurassic age have been found at Cold Bay on the Alaska Peninsula. The fossil plants obtained from these beds (lot 3109) are not well preserved and apparently include only two species which have been provisionally identified as *Glossozamites? schrenkii?* and *Pterophyllum?* species. These species probably are not identical with any of the forms here described.

ENUMERATION OF THE SPECIES.

CLADOPHLEBIS HIRTA? Möller.

Plate 81, fig. 3.

Cladophlebis hirta MÖLLER, Bidrag till Bornholm fossila flora, Pteridophyter: Kong. Fysiografiska Sällskapets, Handl., vol. 13, 1902, p. 30, pl. 2, figs. 23, 24; pl. 3, fig. 2.

Occurrence.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

DICTYOPHYLLUM NILSSONI (Brongniart) Göppert.

Plate 82, figs. 1-4.

Dictyophyllum nilssoni (Brongniart) GÖPPERT, Gattungen d. fossilen Pflanzen, pts. 5 and 6, 1846, p. 119 [153].—NATHORST, Bidrag till Sveriges fossila flora, Kongl. Svenska Vetenskaps-Ak. Handl., vol. 14, No. 3, 1876, p. 25, pl. 1, fig. 14; pl. 4, figs. 6-8; pl. 5, figs. 1-5; pl. 6, figs. 2-3; pl. 7, figs. 1, 2; Beitrag e fossilen flora Schwedens, 1878, p. 14, plates and figures the same as in the preceding paper; Über *Dictyophyllum* u. *Camptopteris spiralis*: Kongl. Svenska Vetenskaps-Ak. Handl., vol. 41, 1906, p. 5, pl. 2; pl. 3, figs. 2-8.

Phlebopteris nilsonii BRONGNIART, Hist. vég. foss., 1836, p. 376, pl. 132, fig. 2.

So far as known to the writer this is the second time the presence of *Dictyophyllum* has been noted in North America. The genus was

established by Lindley and Hutton¹ in 1834, with *D. rugosum* from the Lower Oolite of Yorkshire, England, as the type-species.²

Since that time about 40 species have been established, among them the splendid species with which the Matanuska specimens are believed to be identical. According to Nathorst, *Dictyophyllum nils-soni* is a fairly abundant species in the Rhaetic beds at Pålshö and Hör in southern Sweden, and he has figured some magnificent examples with as many as 18 pinnules or segments. The number of segments appears to range from 6 to 9 on a side, or from 12 to 18 in the whole frond.

The Matanuska specimens, although known only from pieces of small size, give evidence of having been as large as, or even larger, than the maximum size shown in Nathorst's figures. Thus, the fragments shown in plate 82, fig. 1, might well have come from the middle of a segment similar to that shown in Nathorst's plate 2.³ The nervation in the Alaskan specimens is preserved with great fidelity, as may be noted from the figures.

The Swedish specimens show such a range in size and outline that Nathorst has been induced to give them a number of form or varietal names, at least two of which are recognizable in the Alaskan material. Thus, figures 1-3 are referable to Nathorst's form *genuinum*, while figure 4 seems to be form *brevilobatum*.

Occurrence.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

SAGENOPTERIS?, species.

Plate 81, fig. 2.

The collections from the Matanuska region include the fragment here figured, which represents the apical portion of a small very obtuse leaf. The fragment is about 4 cm. long and a little less than 2 cm. wide, and gives little evidence of an increase in size toward the base. The substance of the leaf is extremely thick and the nervation, with the exception of the midrib, is made out with difficulty. The midrib is very slender, but appears to reach quite to the apex. The

¹ Lindley and Hutton, Foss. flora Great Britain, vol. 2, 1834, pl. 104.

² In this connection it may be worth while to point out an error into which Seward has fallen in considering the type-species. In his Jurassic flora of the Yorkshire Coast, 1900, p. 123, he says: "In 1828, Brongniart proposed the name *Phlebopteris phillipsi* for the plant figured by Lindley and Hutton in 1834 as *Dictyophyllum rugosum*; the latter name is quoted by the French author as a synonym, although the plant was not described in the *Fossil Flora* until 1834. We must assume, therefore, that Brongniart saw the description by the English authors some years before Lindley and Hutton published their work." As a matter of fact Brongniart's *Histoire*, although bearing the title-page date of 1828, was actually published in parts extending over the period from 1828 to 1838, and the parts 10 and 11, covering pages 337 to 416, and plates 131 to 134, within which falls the description of *Phlebopteris phillipsi*, was not issued until 1836, as worked out by Zeiller in his Valenciennes flora, 1888, p. 702. This shows that Brongniart must have had Lindley and Hutton's work before him, and his *Phlebopteris phillipsi* naturally and legitimately becomes a synonym of *Dictyophyllum rugosum*.

³ Kongl. Svenska Vetenskaps-Ak. Handl., vol. 41, 1906, pl. 2.

nerves emerge at an angle of about 45, curve slightly in passing outward, and are often forked. There is also some evidence that the nerves may anastomose, but the leaf is so thick and leathery that this point is obscured.

The generic reference is somewhat uncertain, but in all reasonable probability it belongs to *Sagenopteris*. It is quite unlike the species just described, but does resemble a number of well-known forms. It has been thought best, however, considering its fragmentary nature, not to give it a specific name.

Occurrence.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

OTOZAMITES PTEROPHYLLOIDES Brongniart.

Plate 79.

Otozamites pterophylloides Brongniart MSS., SCHIMPER, Pal. Vég., vol. 2, 1870, p. 173.—SAPORTA, Plants Jurassique, vol. 2, 1875, p. 152, pl. 104, figs. 1, 2; pl. 105; pl. 106, figs. 1, 2; pl. 107; pl. 108, fig. 1; pl. 110, fig. 3.—BARTOLIN, Nogle i den bornholmske Juraformation forekommende Planteforsteninger, Bot. Tidsskr., vol. 19, 1894, p. 94, pl. 2, fig. 7.—MÖLLER, Bidrag till Bornholms fossila flora, Gymnospermer, Kongl. Svenska Vetenskaps-Ak. Handl., vol. 36, 1903, p. 13, pl. 1, fig. 19; pl. 3, fig. 1; pl. 7, fig. 15.

This species is represented by several examples, the largest and best being the one figured. In size and shape of the leaflets it appears to agree most closely with several of the figures given by Saporta in his *Plants Jurassique*,¹ being if anything slightly larger than the French specimens. The examples referred to this species by Möller have the leaflets narrower and more acute than the Matanuska specimens, but the nervation is apparently the same in both.

Occurrence.—6699. Upper Matanuska Valley, Alaska. Talus from cliff about 1 mile up the next to the lowest creek entering the East Fork of Boulder Creek from the south.

6701. Float from about a third of a mile below locality 6700.

OTOTZAMITES BORNHOLMIENSIS Möller?

Plate 81, figs. 5, 6.

Otozamites bornholmiensis MÖLLER, Bidrag till Bornholms fossila flora, Gymnospermer, Kongl. Svenska Vetenskaps-Ak. Handl., vol. 36, 1902, p. 12, pl. 2, figs. 1-7.

The two fragments figured are all that were contained in the Matanuska collection, and while not very well preserved they appear to be the same as *Otozamites bornholmiensis* of Möller, from the island of Bornholm. They differ slightly in being a little larger and in having the pinnules more distinctly alternate, and for this reason the identification has been questioned. The nervation is very obscurely pre-

¹ Pls. 106, 107.

served, but so far as can be made out it is the same as in the Swedish specimens.

Occurrence.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

PTEROPHYLLUM RAJMAHALENSE Morris.

Plate 80, fig. 1.

Pterophyllum rajmahalense MORRIS in Oldham and Morris, Foss. Fl. Gondwana System, vol. 1, 1863, p. 25, pl. 13, figs. 3-5; pl. 14; pl. 18, fig. 2.—FONTAINE in Ward, Status Mesozoic floras of the United States, 2d paper, U. S. Geol. Survey Mon. 50, 1905, p. 102, pl. 21, figs. 1-7.

The specimen here figured, which appears to be from the basal portion of a small leaf, I am not able to distinguish from specimens figured by Fontaine under the name of *Pterophyllum rajmahalense* Morris. Fontaine's material came from Douglas County, Oregon, where it is said to be one of the most abundant species present. It is said to be somewhat less robust than the specimens described by Morris from the Rajamahal series of India. Fontaine states that the substance of the leaflets is thick and the veins are difficult to count, though by close study of a great many specimens he has made out the number as averaging about 15. In the present example the substance of the leaflets is very thick and the nerves are obscure, almost obsolete in fact, and in the figure they have been somewhat accentuated.

The Rajamahal series of India, whence this species was first described, is held to be of Liassic age, while the Oregon locality is thought to be of the same age as the well-known Jurassic beds at Yorkshire, England—namely, Lower Oolite. According to Fontaine this species is the same as that described by Heer,¹ under the name of *Pterophyllum sensinavianum*, from the Jurassic of Siberia. If the determination of the position of the Matanuska localities is correct, it is another step in showing that this species has been a persistent, long-lived type.

Occurrence.—6698. Upper Matanuska Valley, Alaska, about $\frac{3}{4}$ mile up the next to the lowest creek entering East Fork of Boulder Creek from the south.

PTEROPHYLLUM AEQUALE (Brongniart) Nathorst.

Plate 80, fig. 3.

Pterophyllum aequale (Brongniart) NATHORST, Floran vid Bjuf I, Sveriges geol. Medersökning, Ser. C, No. 27, 1878, p. 11; Floran vid Höganäs ock Helsingborg; Sveriges geol. Medersökning, Ser. C, No. 29, 1878, p. 18, pl. ii, fig. 13; Floran vid Bjuf II; Sveriges geol. Medersökning, Ser. C, No. 33, 1879, p. 67, pl. xv, figs. 6-10.—ZEILLER, Fl. Foss. Tonkin, 1902, pl. 49, figs. 4-7.

This species was originally described by Brongniart² in 1825 from Hör in Scania under the name *Nilssonia? æqualis*, and has subse-

¹ Heer, O., Fl. Foss. Arct., vol. 4, pt. 2 (Jura-Fl. Ostsiberiens u des Amurlandes), 1876, p. 105, pl. 24, fig. 8.

² Brongniart, Obs. sur. vég. foss. de Hore, Am. Sci. Nat. Paris, vol. 4, 1825, p. 219, pl. 12, fig. 6.

quently been found to be more or less abundant at other localities in southern Sweden (Bjuf, Högånäs, Bosharp, Bornholm) and has also been found in other widely separated parts of the world, including north Persia, Tonkin, China, Mongolia, Oregon, and now Alaska.

The specimen here figured is the basal portion of a leaf of some magnitude and is chiefly remarkable for the exceedingly thick petiole. This is stronger than is usually shown in this species, though occasionally it may reach nearly or quite this size, as may be seen in one of the specimens figured by Zeiller in his Tonkin flora (pl. 49, fig. 6). The size and angle of insertion of the leaflets is also the same as in the figure just referred to.

The specimen under consideration agrees very well with some of the figures given by Nathorst in his Bjuf flora (pl. 15, figs. 8, 10, etc.), except that the leaflets in the Swedish specimens are more nearly at right angles with the petiole than in ours, but the difference is of minor importance.

This form was noted by Möller¹ from Bornholm, but as it was a mere fragment its reference is questioned. The figure given of it shows it to have shorter and much more acute leaflets than is usual, and its reference may well be questioned.

Under this name Fontaine has figured a number of fine leaves from Douglas County, Oregon, but they have the leaflets broader, closer together, and at a less angle of insertion than the majority of specimens figured by Nathorst, Zeiller, and others from the Old World, but these variations are perhaps well within the limits of specific differentiation.

Occurrence.—6698. Upper Matanuska Valley, Alaska, about $\frac{3}{4}$ mile up the next to the lowest creek entering the East Fork of Boulder Creek from the south.

CTENOPHYLLUM ANGUSTIFOLIUM? Fontaine.

Plate 80, fig. 2.

Ctenophyllum angustifolium FONTAINE in Ward, Status Mesozoic floras of the United States, U. S. Geol. Survey Monog. 50, 1905, p. 105, pl. 22.

This specimen is referred with some hesitation to Fontaine's species, which has heretofore been known only from the Jurassic of Douglas County, Oregon. It is very much smaller than many of the examples figured by Fontaine and should perhaps be described as new, but it is so fragmentary that the full lengths of the leaflets can not be determined with certainty. So far as can be made out it might well enough be either a small leaf of this species or the upper portion of a leaf of medium size, yet considering the differences it has been thought best to question the reference.

¹ Möller, H., Bidrag till Bornholms foss. flora, Gymnospermer, Kongl. Svenska Vetenskaps-Ak. Handl., vol. 36, 1903, p. 19, pl. 3, fig. 11.

Occurrence.—6698. Upper Matanuska Valley, Alaska, about $\frac{3}{4}$ mile up the next to the lowest creek entering the East Fork of Boulder Creek from the south.

NILSSONIA POLYMORPHA Schenk.

Plate 81, fig. 4.

Nilssonia polymorpha SCHENK, Foss. flora Grenzsichtens d. Koupers u. Lias Frankens, 1867, p. 127, pl. 29; pl. 30, figs. 1-5.—NATHORST, Bidrag till Sveriges foss. flora, Kongl. Svenska Vetenskaps-Ak. Handl., vol. 14, 1876, p. 40, pl. 8, figs. 2-15; pl. 9; pl. 10; pl. 11.

This species, as may be seen in the two papers above quoted by Schenk and Nathorst, is an extremely variable one, showing a great range in size and outline of the leaf; in fact, the diversity is so great that it would seemingly do no harm to divide the species up at least into a number of well-marked forms, as, indeed, had been done before the species was defined by Schenk, especially if it could be shown that there were any stratigraphic relations established for the several forms. But, be this as it may, there are no data available in this country that would make such a course possible; in fact, the only specimen contained in the present collection is the one here figured which is a mere fragment from the middle of a medium-sized leaf with entire margins.

Occurrence.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

PAGIOPHYLLUM FALCATUM Bartolin.

Plate 81, fig. 1.

Pagiophyllum falcatum BARTOLIN, Nogle i den bornholmske Juraformation forekommende Planteforsteninger.—MÖLLER, Bildrag till Bornholms fossila flora, Gymnospermer, Kongl. Svenska Vetenskamps-Ah. Handl., vol. 36, 1902, p. 32, pl. 5, fig. 13.

The Alaskan material includes a number of small branches and branchlets that appear to be best referred to this species. They are slightly smaller than the original species given by Bartolin, but are indistinguishable from the fragments figured by Möller, who, however, has questioned their reference to Bartolin's species.

Occurrence.—6700. Upper Matanuska Valley, Alaska. Crest of spur between first and second tributaries entering East Fork of Boulder Creek above its mouth. Elevation, 4,780 feet.

EXPLANATION OF PLATES.

NOTE.—The figures in these plates were all made natural size, but by an unfortunate error they have been slightly reduced.

PLATE 79.

Otozamites pterophylloides Brongniart. Cat. No. 34,994, U.S.N.M.

PLATE 80.

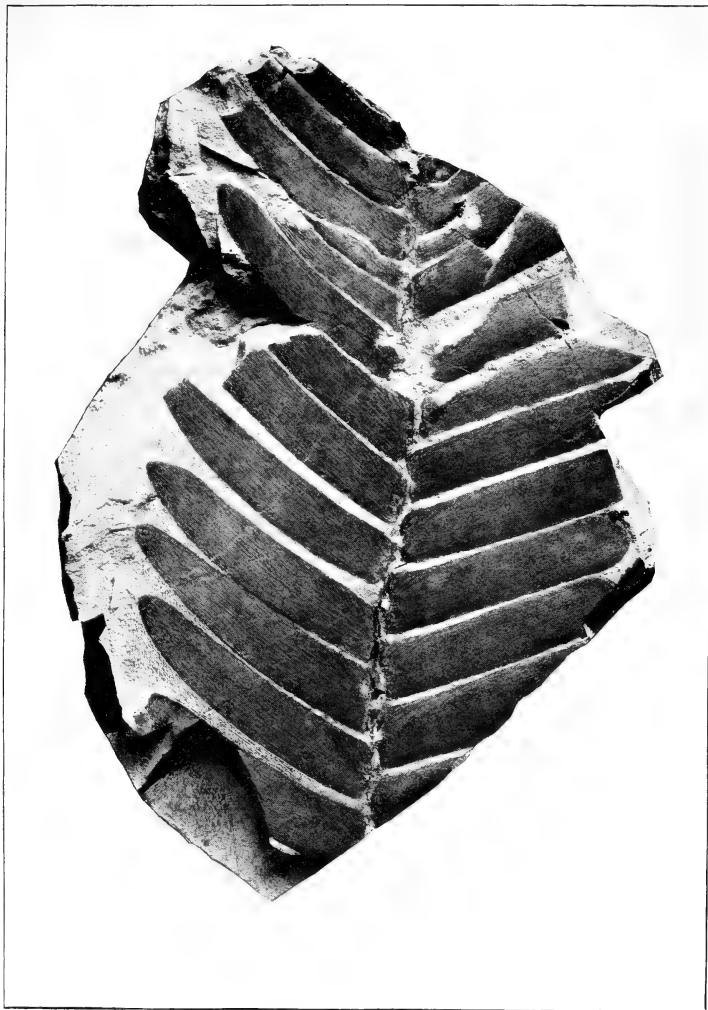
- FIG. 1.—*Pterophyllum rajmahalense* Morris. Cat. No. 34,995, U.S.N.M.
2.—*Ctenophyllum angustifolium*? Fontaine. Cat. No. 34,996, U.S.N.M.
3.—*Pterophyllum aequale* (Brongniart) Nathorst. Cat. No. 34,997, U.S.N.M.

PLATE 81.

- FIG. 1.—*Pagiophyllum falcatum* Bartolin. Cat. No. 34,998, U.S.N.M.
2.—*Sagenopteris*?, species. Cat. No. 34,999, U.S.N.M.
3.—*Cladophlebis hirta*? Möller. Cat. No. 35,000, U.S.N.M.
4.—*Nilssonia polymorpha* Schenk. Cat. No. 35,001, U.S.N.M.
5, 6.—*Otozamites bornholmiensis*? Möller. Cat. Nos. 35,002, 35,003, U.S.N.M.

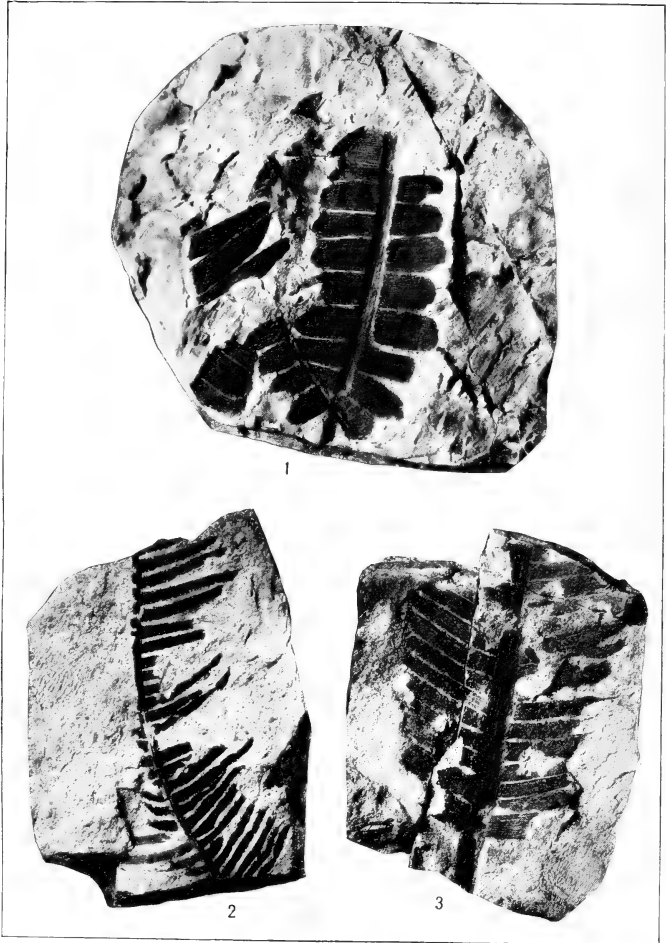
PLATE 82.

- FIGS. 1-4.—*Dictyophyllum nilssoni* (Brongniart) Göppert. Cat. Nos. 35,004, 35,005, 35,006, 35,007, U.S.N.M.
5.—*Otozamites*, species. Cat. No. 35,008, U.S.N.M.



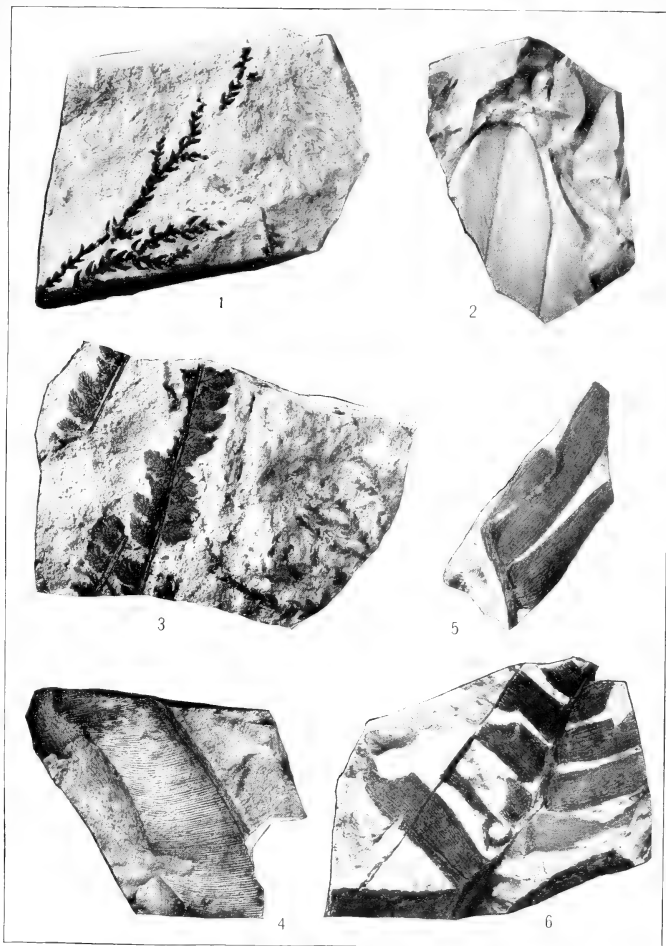
LOWER JURASSIC FLORA FROM ALASKA.

FOR EXPLANATION OF PLATE SEE PAGE 460.



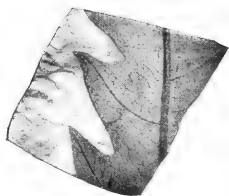
LOWER JURASSIC FLORA FROM ALASKA.

FOR EXPLANATION OF PLATE SEE PAGE 460.



LOWER JURASSIC FLORA FROM ALASKA.

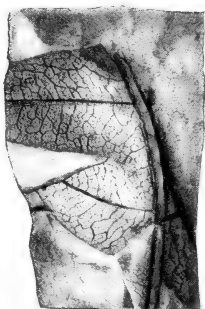
FOR EXPLANATION OF PLATE SEE PAGE 460.



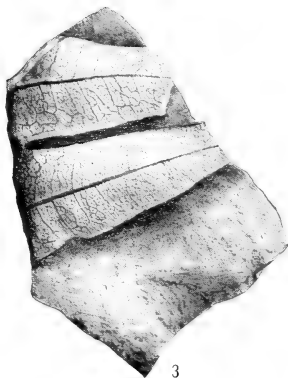
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LOWER JURASSIC FLORA FROM ALASKA.

FOR EXPLANATION OF PLATE SEE PAGE 460.



STUDIES OF WEEVILS (RHYNCHOPHORA)
WITH DESCRIPTIONS OF NEW
GENERA AND SPECIES

BY

W. DWIGHT PIERCE

Of the Bureau of Entomology, United States Department of Agriculture

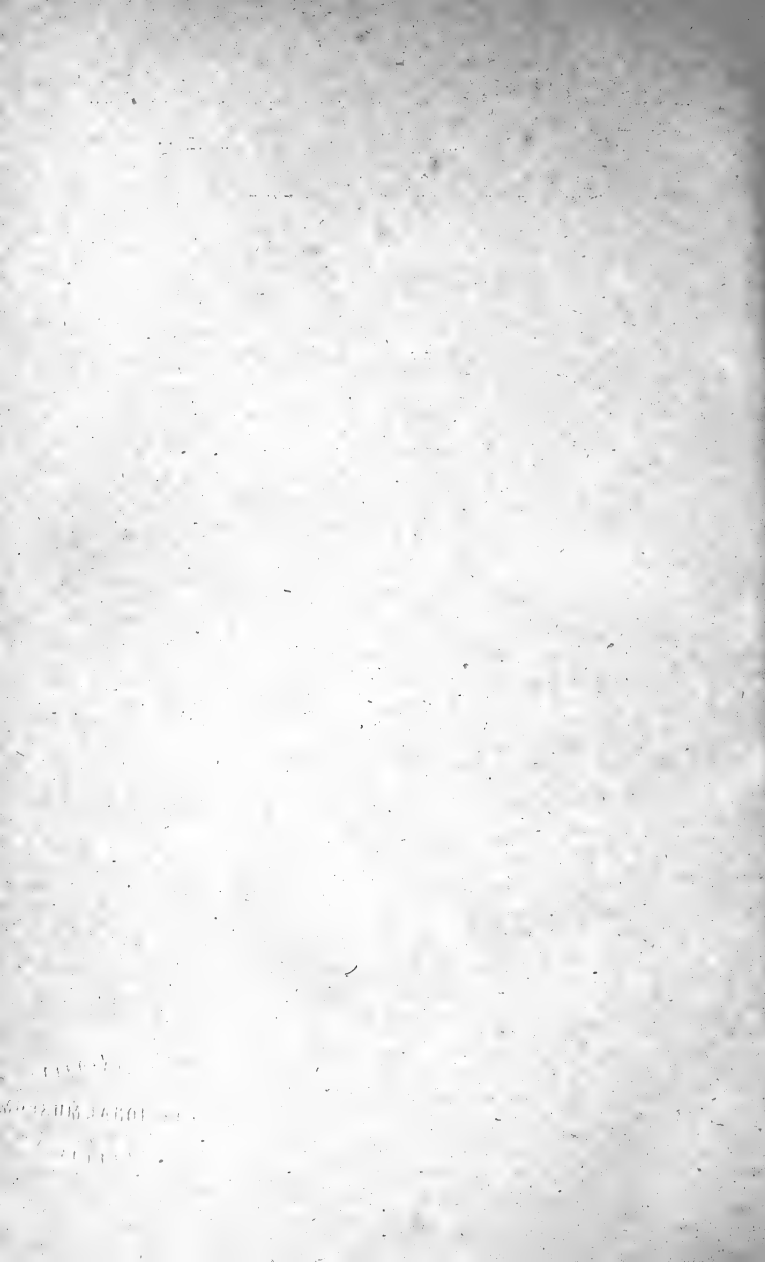
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STUDIES OF WEEVILS (RHYNCHOPHORA) WITH DESCRIPTIONS OF NEW GENERA AND SPECIES.

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The group Rhynchophora was originally defined for those Coleoptera with tetramerous tarsi which are provided with a beak, and has for a long time ranked as a suborder of Coleoptera. Recent studies, however, tend to subordinate the Rhynchophora as a part of a series, the other part being the group known as the Phytophaga. This arrangement is far more satisfactory because of the evident transitions from one group to the other.

It is impossible to make a linear arrangement of the superfamilies in this series because of several varying characters—namely, the tarsi, the maxillary palpi, the submentum, the antennae, the labrum, and the beak.

The tarsi are five-jointed, with the fourth joint minute and anchylose with the fifth, and with the third bilobed in Cerambycoidea, Chrysomeloidea, Mylabroidea, and Scolytoidea. They are four-jointed, with the third minute and anchylosed with the fourth and with the second bilobed in Aglycyderoidea. Finally, they are four-jointed with the third bilobed in Brentoidea, Platystomoidea, Doydirhynchoidea, Attelaboidea, Brachyceroidea, and Curculionoidea.

The maxillary palpi are normal and flexible in the Cerambycoidea, Chrysomeloidea, Mylabroidea, Brentoidea, Platystomoidea, and Doydirhynchoidea, and rigid, nonflexible in Scolytoidea, Aglycyderoidea, Attelaboidea, Brachyceroidea, and Curculionoidea.

The labrum is distinct in Cerambycoidea, Chrysomeloidea, Mylabroidea, Platypodidae of Scolytoidea, Platystomoidea, and Doydirhynchoidea; and absent or indistinct in Scolytidae, Aglycyderoidea, Brentoidea, Attelaboidea, Brachyceroidea, and Curculionoidea.

The submentum is not pedunculate in Cerambycoidea, Chrysomeloidea, Brentoidea, Platystomoidea, and Brachyceroidea, and is pedunculate in Mylabroidea and Attelaboidea.

The antennae are simple, nongeniculate, nonclavate in Cerambycoidea, Chrysomeloidea, Mylabroidea, Aglycyderoidea, and part of the

Brentoidea; nongeniculate but clavate in Platystomoidea, Doydirhynchoidea, Attelaboidea, and Brachyceroidea; geniculatè, nonclavate in part of the Brentoidea; geniculate and clavate in Scolytoidea and Curculionoidea.

In these characters it will be noted that the superfamily having the greatest number of specialized general characters is the Curculionoidea. On the other hand, it will be noted that the Scolytoidea are intermediate between the beakless Cerambycoidea, Chrysomeloidea, and Mylabroidea, and the beaked Rhynchophora.

Even in the larvae we find a progression of characters. The Cerambycoidea and Chrysomeloidea with a few exceptions have the larvae provided with legs. The Mylabroid larvae are provided with legs only in the first stage. Legs are also found in the larvae of the Platystomoidea. The other groups have legless larvae, although there are occasionally found tubercles or rings where the legs should be.

The writer has followed the prevailing tendency in considering the groups known to LeConte and Horn as families to be worthy of superfamily rank. The following table is proposed as a guide for the arrangement of superfamilies in the series Phytophaga. This series in the classification of Kolbe belongs in the Order Coleoptera, Suborder Heterophaga, Legion Symphyogastra, Phalanx Synactostemata, Superseries Anhistopoda.

TABLE OF SUPERFAMILIES IN THE PHYTOPHAGA.

1. Tarsi five-jointed, the fourth joint minute and anchylosed with the fifth, third usually bilobed, head not prolonged into a distinct beak. Subseries Phytophaga 2.
Tarsi four-jointed; head prolonged into a distinct beak. Subseries Rhynchophora 5.
2. Maxillary palpi flexible, labrum distinct.....3.
Maxillary palpi rigid, labrum sometimes lacking, submentum not pedunculate;
front very slightly prolonged into a broad beak; antennae geniculate, clavate.
SCOLYTOIDEA Hopkins.
3. Submentum not pedunculate; head not prolonged into a beak.....4.
Submentum pedunculate; front prolonged into a broad, quadrate beak; antennae
inserted in front of the eyes, variable in length, serrate or pectinate; tibial spurs
distinct or obsolete.....MYLABROIDEA, new superfamily.
4. Antennae usually long or greatly developed, frequently inserted upon frontal
prominences; front often vertical, large and quadrate; tibial spurs distinct.
CERAMBYCOIDEA, new superfamily.
Antennae moderate or short, not inserted upon frontal prominences; front small,
oblique, sometimes inflexed; tibial spurs usually wanting.
CHRYSOMELOIDEA, new superfamily.
5. Third tarsal joint minute, anchylosed with the fourth, second usually bilobed;
head prolonged into a beak in at least one sex; antennae nongeniculate, non-
clavate; maxillary palpi rigid; labrum absent.
AGLYCYDEROIDEA, new superfamily.
Third tarsal joint not minute, usually bilobed, head prolonged into beak in both
sexes.....6.
6. Antennae nonclavate, geniculate or nongeniculate; labrum absent; maxillary palpi
flexible; submentum nonpedunculate...BRENTOIDEA, new superfamily.
Antennae clavate.....7.

7. Antennae straight, or very feebly geniculate (Orthoceri).....8.
 Antennae geniculate; maxillary palpi abnormal rigid, conical, the joints diminishing successively; labrum absent; beak well developed, variable in form.
 CURCULIONOIDEA, Hopkins.
8. Maxillary palpi normal, flexible; labrum distinct.....9.
 Maxillary palpi rigid, conical, the joints diminishing successively; labrum never distinct.....10.
9. Anterior coxae globose; pygidium more or less exposed; submentum not pedunculate.....PLATYSTOMOIDEA, new superfamily.
 Anterior coxae conical; pygidium not exposed.
 DOYDIRHYNCHOIDEA, new superfamily.
10. Submentum pedunculate; mentum often very small; maxillae free.
 ATTELABOIDEA, new superfamily.
 Submentum without a peduncle, or any vestige of one; mentum covering the maxillae, except sometimes at their base; beak more or less robust, never slender and filiform; scrobes attaining, or almost so, the commissure of the mouth.
 BRACHYCEROIDEA, new superfamily.

The superfamily Mylabroidea is the old family Bruchidae. The genera in this group have become greatly confused. The name *Bruchus* was first used by Geoffroy in 1762 for two species, only one of which was definitely associated by the quotation given with a name. This was *Cerambyx fur* Linnaeus which becomes type of *Bruchus* and causes that genus to replace *Ptinus* Linnaeus. *Bruchus* Linnaeus was not described until 1767, being based on (*pisi* Linnaeus) *pisorum* Linnaeus. Besides being preoccupied it was an isogenotype of *Mylabris* Geoffroy 1762, which was based on three species, the first identified being No. 1, *pisorum* Linnaeus, and of *Laria* Scopoli 1763, of which Bedel in 1901 designated the type as (*salicis* Scopoli) *pisorum* Linnaeus.

The superfamily Aglycyderoidea includes the families Aglycyderidae and Proterhinidae.

The superfamily Brentoidea, based on the genus *Brentus* Fabricius, is the old family Brentidae.

The superfamily Platystomoidea is the old family Anthribidae. It is to be divided into the families Bruchelidae (Urodonidae), Platystomidae and Choragidae. The generic name *Anthribus* fares as badly as *Bruchus*. The name *Anthribus* was first used by Geoffroy in 1762 for four species, of which only one was at the time identifiable by the quotations given. This was *Dermestes pulicarius* Linnaeus now placed in the Nitidulidae. Müller in 1764 gave *Anthribus* the same meaning; De Geer in 1775 based his genus on a species *ruber*; Müller in 1776 based his genus on a species *glaber*; Clairville's 1798 conception was based on *ruficollis*, a Salpingid; Fabricius in 1790 gave the name the sense which has since been followed. As the name was many times excluded from the Rhynchophora the choice for the typical genus fell to the next oldest valid name in the superfamily, which was *Platystomos* Schneider (1791), of which Bedel (1881) designated the type as *albinus* Linnaeus.

The superfamily Doydirhynchoidea is the old family Rhinomaceridae. The genus name *Rhinomacer* was first used by Geoffroy in 1762 for 11 species, only one of which was definitely associated by quotations with a named species. This was *Attelabus coryli* Linnaeus, which has been designated by Bedel (1885) as type of *Attelabus* Linnaeus (1758). The Fabrician (1787) genus *Rhinomacer* is based on *attelaboidea* Fabricius and is a synonym of *Cimberis* Des Gozis. The oldest generic name available is therefore *Doydirhynchus* Dejean (1821) based on *austriacus* Olivier. This generic name has been frequently emended.

The superfamily Attelaboidea has as its type-genus *Attelabus* Linnaeus (1758) and contains the following families: Apionidae (Belidae), Attelabidae, Tachygonidae, Pterocolidae, and Oxyrhynchidae.

The superfamily Brachyceroidea has its type-genus *Brachycerus* Olivier and contains the families Brachyceridae and Microceridae.

The superfamily Curculionidea is the old family Curculionidae, based on *Curculio* Linnaeus (*Balaninus* Germar) of which the type was designated by Latreille (1810) as *nucum* Linnaeus. It contains the families Psallidiidae (Brachyrhinidae), Psaliduridae, Plinthidae, Hyperidae, Curculionidae, Orobitidae, Cryptorhynchidae, Rynchophoridae (Calandridae), and Cossonidae.

The superfamily Scolytoidea (Ipoidea Swaine) is the old family Scolytidae, and is based on *Scolytus* Geoffroy 1762.

More complete discussions of these various families will be presented from time to time.

PSALLIDIIDAE, new family (OTIORHYNCHIDAE, BRACHYRHINIDAE).

Subfamily PSALLIDIINAE (Brachyderini).

TRIBE THYLACITINI.

EXOPHTHALMODES, new genus.

Exophthalmus (Schönherr) CHAMPION (part), Biol. Centr. Amer. Coleopt., vol. 4, 1911, pt. 3, pp. 249-270 (not *Exophthalmus* Latreille).

Champion has included in his genus Schönherr's type *quadrivittatus* Olivier, *nicaraguensis* Bovie and *scalaris* Boheman, all of which undoubtedly belong to *Diaprepes* Schönherr, because of the presence of vibrissae on the lateral anterior margin of the prothorax.

Thirteen specimens of *quadrivittatus*, five of *nicaraguensis* determined by Champion, and 15 of *scalaris* have been personally examined.

Other than these and possibly a few other species, Champion had a distinct Thylacitine (Brachyderine) genus before him. Specimens determined by him are at hand in the following species: *verecundus* Chevrolat, *cupreipes* Champion, *carinirostris* Boheman, *vitticollis*

Champion, *opulentus* Boheman, *carneipes* Champion, *agrestis* Boheman, *distigma* Champion, *scalptus* Champion, *impositus* Pascoe, *triangulifer* Champion, *duplicatus* Champion, *coeruleovittatus* Champion, *lunaris* Champion, *Jekelianus* White, and *sulcicrus* Champion.

From these I have selected *opulentus* Boheman as type. Schönherr's (1826) generic name *Exophthalmus* is preoccupied by Latreille (1825).

Family CURCULIONIDAE.

RHININAE, new subfamily (Magdalini).

This subfamily is based on the genus *Rhina* Latreille,¹ 1802. *Rhina* was based on two species *barbicornis* Fabricius and *cerasi* Fabricius, the latter being questioned. Crotch is 1870 designated *barbicornis* as type. Latreille's 1807² use of *Rhina* is entirely different and is based on *barbirostris* Fabricius. In 1810 Latreille cited *barbirostris* as type of *Rhinus*. This species belongs to the Cossonidae. To differentiate the two subfamilies we will call the curculionid group, Rhininae, based on *Rhina*, and the Cossonid group Orthognathinae based on *Orthognathus* Schönherr, the next oldest genus.

The genus *Magdalis* Germar, 1817,³ has for its type (*aterrima* Linnaeus) *armigera* Geoffroy. The name *Rhinodes* Dejean (1821) is a synonym of *Magdalis*. The genus *Edo* Germar (1819) is based on (*pruni* Linnaeus) *ruficornis* Linnaeus. The preoccupied genus *Thamnophilus* Schönherr has for its type *violaceus* Fabricius, and *Panus* Schönherr is based on a synonym of *barbicornis* Latreille. Rafinesque (1815) proposed *Rhinostomus* as a substitute for *Rhina*.

All of these names are at present considered as belonging to one genus with four subgenera, which may ultimately be separated. As the genus now stands in the European check list the genus should be *Rhina* Latreille with subgenus 1, *Magdalis* Germar (*Thamnophilus* Schönherr, *Rhinodes* Dejean); subgenus 2, *Rhina* Latreille (*Rhinostomus* Rafinesque, *Panus* Schönherr); subgenus 3, *Edo* Germar; and subgenus 4, *Panopsis* Daniel.

The North American species have not been arranged in accordance with the subgeneric groupings.

CARCILINAE, new subfamily.

This subfamily differs from the Læmosaccinae by having the front coxæ partly contiguous and from the Rhininae (Magdalidinae) by having the first two abdominal segments partly concave and by having the pygidium covered, while the claws are single.

¹ Hist. Nat. Gén. et Part. des Crust. et Ins., vol. 3, 1802, pp. 198-199.

² Gen. Crust. et Insect., vol. 2, 1807, pp. 268, 269.

³ Mag. der Ent., vol. 2, 1817, p. 339.

Genus **CARCILIA** Roelofs, 1874.

Carcilia ROELOFS, Ann. Soc. Ent. Belg., vol. 17, 1874, pt. 2, pp. 152-155. Type *strigicollis* Roelofs, monotypic.

Trichomagdalis FALL, Trans. Amer. Ent. Soc., vol. 39, 1913, No. 1, pp. 37-38. Type, *fasciatus* Fall, by original designation.

The following is a translation of the original description, which was published in French:

Head large, suglobular, declivous in front. Beak drooping, as long as head, robust, a little enlarged toward the tip; scrobes anterior in the male, or behind the middle in the female, arcuate, strongly oblique and attaining the base. Antennae rather long, robuse, especially in the male, not strongly elbowed; scape short, capitata; funicle seven-jointed, first two joints elongate, subequal, obconical, the third, fourth, and fifth subturbinate, and the last joints shorter and transverse; club elongate, oval, apically acuminate, four-jointed, pubescent. Eyes very large, transverse, oval, shortly approximate above.

Prothorax as long as wide, convex, feebly bisinuate at base, with posterior angles rectangular, without ocular lobes, strongly and angularly emarginate beneath.

Scutellum moderate, triangularly rounded. Elytra elongate, hardly wider than the prothorax; covering the pygidium.

Legs short, very robust, compressed. Femora dentate. Tibiae strongly unguiculate at apex, unguis in form of a straightened claw. The three first joints of the tarsi very large; the claws of the fourth divaricate, dentate beneath. Mesosternal process narrow. Second segment of the abdomen as long as the two following together, separated from the first by a suture almost effaced at the middle and curved at this place. The abdomen is narrow, angular.

The typical species of the genus are Japanese.

TABLE OF SUBGENERA OF *CARCILIA*.

- | | |
|-------------------------------|-----------------------------|
| 1. Claws toothed beneath..... | <i>Carcilia</i> Roelofs. |
| 2. Claws single..... | <i>Trichomagdalis</i> Fall. |

TABLE OF THE NORTH AMERICAN SPECIES OF *TRICHOMAGDALIS*.

- | | |
|---|------------------------|
| 1. Vestiture quite uniform..... | 2 |
| Vestiture more condensed with semiglabrous areas unicolorous fawn-colored..... | <i>conspersa</i> Fall. |
| 2. Vestiture mottled reddish and grayish above almost uniform grayish beneath for anterior portions but reddish on abdomen..... | <i>fasciata</i> Fall. |
| Vestiture uniformly whitish..... | <i>atrata</i> Fall. |

CARCILIA (TRICHOMAGDALIS) FASCIATA Fall.

Trichomagdalis fasciatus FALL, Trans. Amer. Ent. Soc., vol. 39, 1913, pp. 37, 38.

A male specimen is at hand collected by H. S. Barber, on Redwood Creek, Blair's ranch, Humboldt County, California, June 13.

This specimen has tiny denticles beneath about the middle of the femora, thus answering Roelofs' diagnosis of the genus. It measures slightly over 5 mm. in length. The first abdominal suture is indistinct and curved forward at the middle. This character is also brought out by Roelofs.

CARCILIA (TRICHOMAGDALIS) CONSPERSA Fall.

Trichomagdalis conspersus FALL, Trans. Amer. Ent. Soc., vol. 39, 1913, p. 38.

The name is spelled *conspersus* at the bottom of the page, thus proving the original use to be a typographical error.

A specimen is at hand from Los Gatos, California, in the Hubbard and Schwarz collection. There is no indication of denticles on the femora. The first abdominal suture is as in the preceding species.

CARCILIA (TRICHOMAGDALIS) ATRATA Fall.

Trichomagdalis atratus FALL, Trans. Amer. Ent. Soc., vol. 39, 1913, p. 38.

No specimen of this species has come to hand.

ORCHESTINAE, new subfamily.

TABLE OF TRIBES.

1. Front legs normal, non saltatory.....	2
Front legs saltatory.....	<i>Orchestini</i>
2. Prothorax with more or less developed ocular lobes.....	<i>Loncophorini</i>
Prothorax without ocular lobes.....	<i>Anthonomini</i>

LONCOPHORINI, new tribe.

Ceratopides LACORDAIRE, Gen. Coleop., vol. 6, 1863, p. 589.

In Lacordaire's tables the specimens of *Loncophorus* before the writer would readily fall in the group *Ceratopides*, and as *Loncophorus* is the oldest genus the tribe will take its name from it.

The tribe is separated from *Anthonomini* by the presence of more or less well-defined ocular lobes on the prothorax. Champion has associated the genera *Chelotonyx*, *Ceratopus*, and *Acanthobrachium* with the *Erihriniinae* because of these lobes, but it seems better to arrange them in the *Orchestinae* with *Loncophorus*.

If the genus *Loncophorus* were admitted in the true *Anthonomini* it would be associated in the tables with *Chelonychus*, from which it is readily separated by its long beak, its long front legs, its slight ocular lobes, and the long slender antennae.

Genus LONCOPHORUS Chevrolat.

Loncophorus CHEVROLAT, Ann. Soc. Ent. France, vol. 1, 1832, pp. 215-217. (Not *Loncophorus* Germar 1824 in *Lamellicornes*)

Loncophorus GEMMINGER and HAROLD, Cat. Coleop., vol. 8, 1871, p. 2498.

This genus was founded on two species, *obliquus* Chevrolat and *parasita* Fabricius, of which *obliquus* is hereby designated as type. Schönherr in 1836,¹ designated as type, *chevrolati* Gyllenhal, which was not originally included and can not therefore serve as type.

The genus contains a number of species from the West Indies, Central and South America, of which the four following are char-

¹ Gen. et sp. Curc., vol. 3, 1836, p. 392.

acterized by a large spindle-shaped white marking on the elytra. It is quite possible that some synonymy may develop among the first three mentioned below.

LONCOPHORUS OBLIQUUS Chevrolat.

Loncophorus obliquus CHEVROLAT, Ann. Soc. Ent. France, vol. 1, 1832, p. 218, pl. 5, fig. 1.

Loncophorus obliquus CHAMPION, Biol. Centr.-Amer., Coleop., vol. 4, pt. 4, 1903, p. 152.

This species was originally described from Rio Janeiro, Brazil, and is recorded by Champion from Nicaragua.

Recently three handsome live female specimens were received by Representative Rufus Hardy, of Texas, from Panama on fruit of *Ceiba ceiba* and transmitted to the writer under date of June 19, 1913. These specimens agree quite well with Chevrolat's figure and description, but almost as well with Olivier's figure and description of the Cuban *stigma* and Germar's description of *petiminosus*.

LONCOPHORUS DAVIESII Swederus.

Curculio daviesii SWEDERUS, Acta Holmiae, vol. 3, 1787, p. 194, pl. 8, fig. 5.

Rhynchænus stigma OLIVIER (not *Curculio stigma* Linnaeus 1767), Entomologie, vol. 5, 1807, p. 194, pl. 8, fig. 87.

Loncophorus petiminosus GERMAR, Schönherr's Gen. et Sp. Curc., vol. 3, 1836, p. 395.

Loncophorus petiminosus GUNDLACH, Contr. Ent. Cubana, vol. 3, 1891, p. 290.

There still remains a little doubt concerning the synonym which is given by Germar. Gundlach records this species as breeding in the seeds of silk cotton (*Ceiba ceiba*) in Cuba. The description given by Swederus answers perfectly for a *Loncophorus*, but the locality is given as New York.

LONCOPHORUS HUMERALIS Chevrolat.

Loncophorus humeralis CHEVROLAT, Ann. Soc. Ent. France, vol. 1, 1832, p. 442.

This is also a Cuban species and probably identical with the preceding.

LONCOPHORUS NITIDUS Champion.

Several live adults were bred from fruit of *Bunchosia macrophylla* Rose? sent by C. Werkle from San Jose, Costa Rica, in quarantine at Washington, District of Columbia, October 22, 1914, by H. L. Sanford. This species occurs in Mexico, Guatemala, Panama, and Colombia.

LONCOPHORUS CHEVROLATI Gyllenhal.

A single crushed specimen of this species is at hand from San Bernardino, Paraguay, collected by K. Fiebrig from fruit of *Chorisia speciosa*, September 2. This species is distinguished especially by the multistriate beak, the castaneous color, and the relatively shorter beak, which is not as long as the body in the female.

LONCOPHORUS, species.

Other species in the genus are *parasita* Fabricius from Cayenne, *fortis* Champion of Panama, *fusiformis* Champion of Mexico, Guatemala, and Panama, *pustulatus* Champion of Panama, and *verruciger* Champion of Costa Rica.

OROBITIDAE, new family.

OROBITINAE, new subfamily (Cryptorhynchinae).

Tribe TYLODINI.

Genus LEIOMERUS (Chevrolat) Boheman.

Leiomerus (Chevrolat MS.) BOHEMAN, Schönherr's Gen. at Sp. Curc., vol. 8, 1844, pt. 1, p. 266. Based on *Coelosternus* (*Leiomerus*) *glabrirostris* (Chevrolat) Boheman.

Coelosternus SCHÖNHERR, Curc. Disp. Meth., 1826, p. 284 (not *Coelosternus* Sahlberg, 1823) type, *compennis* Germar.

The original usage of *Coelosternus* by Sahlberg makes *balteatus* Sahlberg the type of that genus, and it therefore replaces the erroneous use of *Cryptorhynchus* as found in Gemminger and Harold and other authors. The type of *Cryptorhynchus* Illiger was designated by Latreille in 1810 as *pericarpus* Linnaeus, which is also type of *Rhinoncus*. In view of the fact that Schönherr's *Coelosternus* is left without a name, it is necessary to search for some other available name. The only name thus found is the manuscript name *Leiomerus*, established in the synonymy of *Coelosternus glabrirostris* by Boheman, and henceforth quoted as a generic synonym of *Coelosternus* Schönherr. This name is therefore definitely chosen to represent the genus as redefined by Lacordaire (1866)¹ with *glabrirostris* Boheman as type. It is principally characterized by the single-jointed cylindrical club of the antennae.

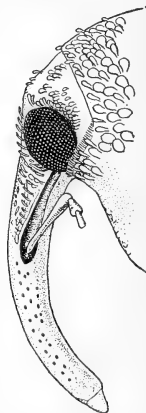


FIG. 1.—SIDE VIEW OF HEAD OF LEIOMERUS GRANICOLLIS.

LEIOMERUS GRANICOLLIS, new species.

Described from four specimens found alive in cassava (*Manihot*) stems from Brazil by H. L. Sanford at quarantine, Washington, District of Columbia, September 10, 1914.

Length, 5.5 to 7 mm.; width, 2.5 to 3.5 mm. Black, covered with tessellated pubescence, subovate. Head convex, very deeply, and closely rugoso-punctate, the rugosity forming a sort of arcuate ridge above the eyes; punctures squamigerous; front narrow, deeply

¹ Gen. Col., vol. 7, 1866, p. 123.

punctate, bristling squamigerous. Eyes, black, finely granulate; separated by less than half the breadth of the beak at base. Beak in male as long as head and prothorax, lightly arcuate, piceous black; rugoso-punctate, finely squamose and medianly carinate to middle; from middle to apex shining and finely punctulate; antennae inserted just behind the middle; scrobes diagonal, reaching to eyes. Female beak more slender, as long as head and thorax on median line, almost impunctate from insertion of antennae to apex; antennae inserted a

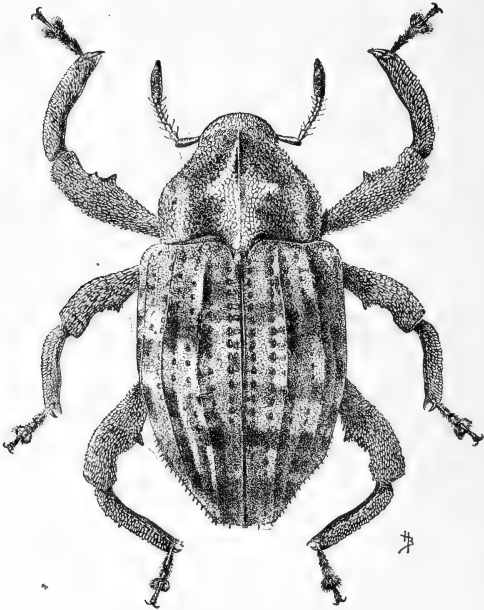


FIG. 2.—ADULT LEIOMERUS GRANICOLLIS.

little nearer the base than in the male. Antennae with scape slender clavate; funicle seven-jointed, sparsely pubescent, the first three joints longer than wide, the last four moniliform; club, one-jointed, elongate, cylindrical, a little longer than the last five funicular joints, very finely griseo-pubescent. Prothorax transverse, five-sevenths as long as wide, bisinuate at base, convexly produced at apex, roundly enlarged at sides to middle, thence strongly narrowed, and emarginate near apex, apex subtubulate, lateral margin rough, granulate at least in male; ocular lobes strong, with short vibrissae; surface coarsely granulato-punctate, medianly strongly carinate, closely clothed with broad, striate brownish scales, and more sparsely with

clavate squamiform setae. The scales and setae vary from pale fawn to dark brown and are arranged in longitudinal indistinct fasciae. The median fascia in the basal half is very light cream or fawn color and apically a light brown. On each side of this are very dark fasciae, which shade to lighter on the sides. Elytra wider than prothorax at base, with rounded humeri, sides somewhat sinuate, subparallel at base, gradually approximate behind, more suddenly so at apical declivity; base bisinuate, apex truncate; strial punctures deep, moderately distant, setigerous; interspaces 3, 5, 7, and 9 elevated, carinate, the carina of the third emarginate near base, other interspaces flat or slightly convex, somewhat granulate, especially the first; densely covered with oval, flattened, striate scales, which are smaller than those of the prothorax, varying in color from white to black and arranged in tessellations, the predominant color being fawn; on each interspace there is also a series of distant clavate, squamiform suberect setae. The strial setae are finer and hair like in the sutural and lateral striae and elongate squamiform in the intermediate striae. Scutellum black, oval, convex, coarsely punctate. Undersides black, coarsely punctate, densely squamose, with round and elongate clavate, pinkish striate scales. Rostral canal reaching to middle of mesocoxae. Mesosternum behind, almost even with the posterior margin of the coxae. Metasternum medianly grooved. Intercoxal process of abdomen broad. First abdominal segment behind coxae subequal to each of the following three segments; fifth segment transverse subtruncate in male and depressed semilunar in female. Legs densely punctate, squamose, sparsely setose; moderately stout; femora clavate, sinuate, bidentate, the outer tooth being minute; tibiae arcuate, carinate beneath, strongly unguiculate; tarsi densely pulvillate beneath, the third joint broadly bilobed; claws simple, divaricate.

The females at hand are all smaller than the males and all present different variations in the color pattern. On fresh specimens the scales present a distinct pinkish tint. Some have much more white than others. Two black spots at the basal third are especially marked in these specimens.

Type.—Cat. No. 19035, U.S.N.M.

This species belongs to the group with *scrobicollis*, *pullatus*, *atropos*, *sulcatulus*, *cinereus*, *tesselatus*, *carinatus*, and *guadelupensis*, all of which have bidentate femora, and alternately elevated intervals on the elytra, but it differs by the granulations of the thoracic and elytral surfaces, the color of the vestiture, and various other characters from all of them.

Leiomerus alternans Boheman (*Coelosternus*) is recorded on *Manihot manihot* (*Jatropha*) in Guadeloupe.

CRYPTORHYNCHIDAE, new family.

EURHININAE, new subfamily (Barini).

Genus EISONYX LeConte.

Eisonyx LeConte, Trans. Amer. Ent. Soc., vol. 8, 1880, p. 216. Type, *crassipes* LeConte.

Eumononycha Casey, Ann. N. Y. Acad. Sci., vol. 7, 1893, p. 601. Type, *opaca* Casey.

The species of this genus are exceedingly rare. The writer has before him ten specimens, representing three distinct species. Owing to the apparent transition furnished by one of these species between the typical *Eisonyx* and the typical *Eumononycha* it seems better to unite these as subgenera under *Eisonyx*, the genus being characterized by the single claw, and the connate first and second abdominal segments.

TABLE OF SUBGENERA OF EISONYX.

1. Elytral striae all but completely obsolete, indicated by foveae at base and very faint depressions.....*Eisonyx* LeConte.
2. Elytral striae complete.....*Eumononycha* Casey.

Subgenus EISONYX LeConte.

Only two specimens of *Eisonyx crassipes* LeConte from Texas have heretofore represented this species, and were to be found in the LeConte and Horn collections. Two other specimens were taken by the writer May 25, 1906, on *Physalis cornuta* at Dallas, Texas, on a railway embankment of the Santa Fe Railway in East Dallas at a point near where Mount Auburn car line crosses this railway. Every year since then repeated searches have been made in every conceivable place in this neighborhood without yielding another individual.

A character not mentioned in the previous descriptions of this species and which may possibly differentiate the Dallas specimens is a large broad median depression on the first and second abdominal segments, and the complete fusion of these segments in the middle.

Subgenus EUMONONYCHA Casey.

TABLE OF SPECIES OF EUMONONYCHA.

1. Body rhomboidal, shaped as in *Eisonyx*, but legs more slender; elytral striae strong at base, becoming very faint but distinct behind, elytral punctuation minute and sparse, body somewhat shining.....*picipes*, new species.
2. Body oval; legs moderately slender; elytral striae strong throughout; elytral punctuation dense, but very shallow, body opaque.....*opaca* Casey.

EISONYX (EUMONONYCHA) PICIPES, new species.

Described from one specimen collected at Nashville, Tennessee, in September in a strawberry field.

Size 3.75 mm. Rhomboidal, widest between basal third and fourth of the elytra, black, moderately shining and smooth throughout, convex. Vestiture consisting of a patch of about three linear squamules at the bases of the third and seventh elytral intervals, a few scattered squamules on the commissure between the prothorax and elytra, a very few on the sides of the prothorax, a few finer hair-like scales on the base of the beak, and at the sides of the fourth abdominal segments, and on the venter of the thorax and a very fine sparse pubescence on the legs; tarsi densely pubescent beneath. Head finely but sparsely punctate; the beak densely, and deeply, finely punctate, separated from the head by a transverse sharply defined groove, bead beneath with a deep groove from tip terminating between the grooves of the scrobes, which give the appearance of the beak being bent at the point they pass underneath. Antennal funicle seven-jointed, first joint somewhat elongate, others compact, moniliform; club ovate, compact. Prothorax deeply and strongly irregularly punctate, with median and discal smooth areas; as long as wide, convex; apex only one-half as wide as base, sides convex; base almost regularly convex, median lobe nearly obsolete. Elytra at base not wider than prothorax, but at widest point about one-half wider, and fully twice as long; sides convex, most strongly so at basal third, strongly convergent to apex, sutural notch obsolete; striae strong at base but gradually becoming very faint; punctuation extremely fine. Undersides finely and sparsely punctate, more strongly so at tip of last abdominal segment, first and second segments connate, the suture showing only at the sides. Legs reddish piceous, much more slender than in *crassipes*, but the tibiae slightly curved back near apex; tibiae unguiculate; tarsi with only a single claw.

One other specimen is at hand, collected also at Nashville, Tennessee, August 4-15, 1897, by Prof. H. F. Wickham. It measures just 2-5 mm. but it differs in no important structural characteristics from the type. Since the above was written Mr. G. G. Ainslie has collected several specimens at Nashville at roots of an aster.

Type.—Cat. No. 18823, U.S.N.M.

EISONYX (EUMONONYCHA) OPACA Casey.

There are at hand five specimens of this species collected in the stomach of a bird (*Oxyechus* ?sp.) at Mount Belview, Texas, December 2, 1898. (Biological Survey stomach 29859.)

One specimen, somewhat smaller than any of the above series, and with the legs lighter reddish, and the punctuation finer, was bred June 15, 1908 from roots of *Senecio lobatus* collected by E. S. Tucker, at Clarksville, Texas, March 30, 1908.



A NEW MOLLUSK OF THE GENUS PISIDIUM FROM
ALASKA, WITH FIELD NOTES BY
G. DALLAS HANNA

BY

VICTOR STERKI

Of New Philadelphia, Ohio

No. 2160.—From the Proceedings of the United States National Museum,
Vol. 51, pages 475-477

Published December 16, 1916



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A NEW MOLLUSK OF THE GENUS *PISIDIUM* FROM ALASKA,
WITH FIELD NOTES BY G. DALLAS HANNA.

By VICTOR STERKI,
Of New Philadelphia, Ohio.

NOTES ON HABITS AND LIFE HISTORY.

The Pribilof group of islands, noted for its fur-seal herds, is located in Bering Sea about 200 miles from land on the north, east, and south. St. Paul and St. George are the largest and most important of the group and are the only ones having bodies of fresh water.

St. George Island has several small, shallow ponds of typical arctic tundra character, the banks of which are composed of spongy moss and the bottoms are covered with a thick layer of decaying vegetable matter which colors the water brown. Crustacea abound in all of these, but fish and mollusks are absent from three and probably all of them.

On St. Paul Island there are a large number of lakes and ponds of a different character. The bottoms of these are sandy or rock, and the water of none has the brown tundra color. A few are brackish. One is over three miles and another is nearly a mile long. The deepest is a little over 8 feet. This *Pisidium* has been found abundant in four of these, which are known as Webster Lake, Ice House Lake, Big Lake, and the small pool above and adjacent to Ice House Lake. These are the only ones that have been carefully examined.

In some of the deeper sections of these ponds the bottoms are covered with a dense green aquatic vegetation, and in shallower parts grasses grow out and project above the water. The *Pisidium* do not seem to burrow in the sand, but crawl about over it, and may be found in abundance at the water's edge. Thus many are frozen solid for seven months of the year, while others, living in the deeper sections, remain active throughout the winter and creep over the stems of grasses and other submerged plants in arboreal, snail-like manner. Large numbers have been collected through the ice, and this method is recommended to malacologists throughout the north.

When creeping, the foot is fully extended from the anterior end of the shell. It is a narrow, white, ribbon-like organ, almost three times as long as the valves. The plantar surface of the foot is on the extreme tip. The movement of the foot is uniform, but the shell is brought up in a series of jerks, as in the *Pupillidae*, progression being as rapid as in any snail of their size. This movement is easily observed by placing the mollusks in a bottle of water, when they will quickly climb up the sides of the glass.

Specimens collected early in September had from one to five young in the umbonal region of the shell. Each of these had a pair of well-developed valves and appeared very large to have escaped from so small an animal. Before the end of September all the young seem to have escaped from the parent and lead a free existence during the first winter.

No definite data can be submitted to show how this and other fresh-water species of animals have come to these islands, which, geologically, are very young, and certainly never have been connected with main land. The young of *Pisidium* does not seem to be adapted for clinging to the feet or feathers of waterfowl, yet this seems to be the only way in which the animals could have been transported over the 200 miles of intervening salt water.

The new species is much more common than *P. scutellatum* Sterki which lives in the same ponds. Neither species seems to have been previously collected on the Pribilof group. Henry W. Elliott lists *Cyclas* as an abundant animal on all the islands. Along with it he gives *Planorbis*, *Melania*, and *Limnea*, which are not found there, so that it is questionable whether he really saw any of them.¹ Dr. W. H. Dall says: "* * * and probably *Pisidium* exists in the pools of St. Paul as it does on many of the Aleutians."² (G. Dallas Hanna.)

DESCRIPTION OF SPECIES.

PISIDIUM HANNAL, new species.

Mussel moderately inequipartite, slightly to barely oblique, medium inflated, the diameter greatest above the middle; outlines of the edges of the valves broadly elliptical, the anterior end almost as broadly rounded as the posterior; beaks slightly behind the middle, rather large, somewhat mammillar, projecting over the upper margin, slightly flattened on top, outward; surface dullish to slightly glossy, with slight, shallow, irregular concentric striae, and a few lines of growth; color yellowish to grayish corneous; shell thin, opaque to subpellucid; hinge rather stout, plate broad, broadest in the middle and with well-marked sinuses towards the anterior and posterior

¹ Seal and Salmon Fisheries and General Resources of Alaska, vol. 3, pp. 19, 227.

² Report of Fur Seal Investigations, 1896-97, part 3, p. 541.

laminae; cardinal teeth rather small, the right slightly curved to nearly straight, with its posterior end equally strong or slightly thicker; left anterior nearly straight, the posterior curved, oblique; laminae rather stout, their cusps ("lateral teeth") somewhat proximal, the left anterior short, abrupt, the others less abrupt, pointed; outer ones in the right valve small, especially so the posterior; ligament and resilium short, rather thick. Length, 3.4; height, 3; diameter, 2.2 mm. Soft parts not seen.

Type.—Cat. No. 273767, U.S.N.M.

Habitat.—St. Paul Island, of the Pribilof Islands, Behring Sea, collected by Mr. G. D. Hanna, in whose honor the species has been named. A good number of specimens was secured, from several places, partly associated with *P. scutellatum* Sterki.

P. hannai does not closely resemble any of the known North American species, and can not be mistaken for any of them. Its distinguishing features are: Its size, the elliptical outlines in lateral aspect, with the supero-anterior slope not marked, the broad beaks, and the hinge-plate being broadest in the middle.

The species is rather variable in several respects. Some specimens are more inflated above than shown in the figure, and from there the valves show nearly a straight line to the ventral margin, in frontal (or rear) aspect; an

upper line of growth is often rather deep and marks off the beaks like the "cap" in *Musculium*, probably due to the long winter season. In some instances the demarcation is so abrupt as to form a sharp ridge for rib; in some specimens the hinge is slighter, yet with the plates broader in the middle. It may be noted that in one specimen the posterior part of the hinge is reversed—that is, the posterior laminae.

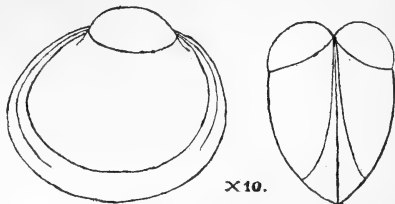


FIG. 1.—*PISIDIUM HANNAI*. LATERAL VIEW.

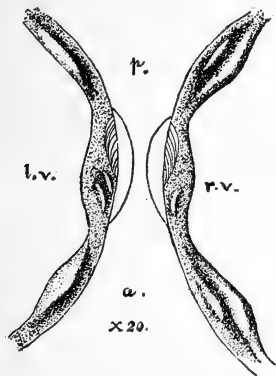


FIG. 2.—*PISIDIUM HANNAI*. END VIEW AND HINGES. A, ANTERIOR; P, POSTERIOR; L. V., LEFT VALVE; R. V., RIGHT VALVE.

Ref.

NEW JAVANESE CHALCIDOID HYMENOPTERA

BY

A. A. GIRAULT

Of the Bureau of Entomology, United States Department of Agriculture

No. 2161.—From the Proceedings of the United States National Museum,
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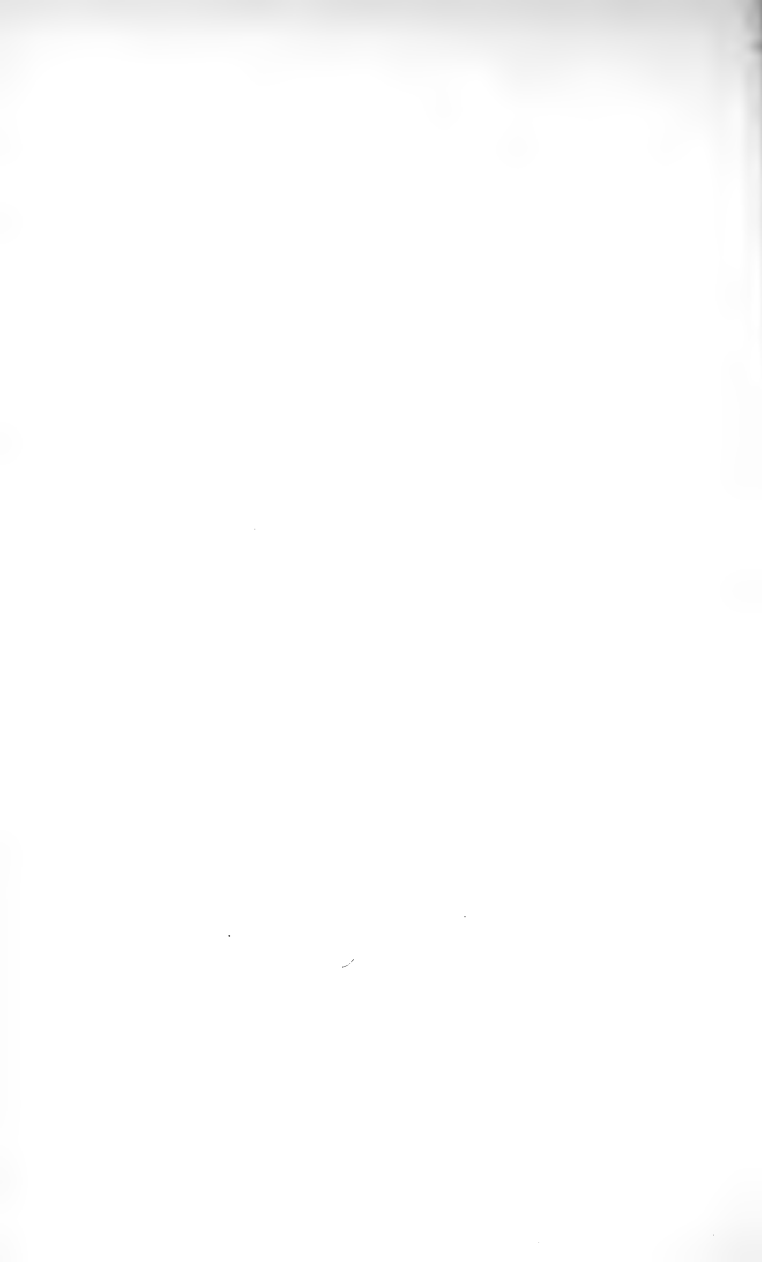
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NEW JAVANESE CHALCIDOID HYMENOPTERA.

By A. A. GIRAULT,

Of the Bureau of Entomology, United States Department of Agriculture.

All of the following species were reared by P. van der Goot, except the first and last:

Subfamily ENCYRTINAE.

LEPTOMASTIX TRILONGIFASCIATUS, new species.

Female.—Length, 1.60 mm.

Bright orange yellow, the head and abdomen and legs golden yellow, the middle coxae and the flagellum black, bullae of the scape dusky. Fore wing with the following pattern: As in *auraticorpus* in general, but the caudal wing margin is dusky incompletely (only to a point opposite the middle of the marginal vein from about a point opposite the apex of the proximal one-third of the submarginal vein); the cephalic margin is dusky very narrowly along the distal half of the venation and more thickly (with a convex caudal margin) to the apical turn from some little distance distad of the venation; and there is a distinct oblique stripe midlongitudinally, running to the caudo-distal apex from the middle of the blade opposite the apex of the stigmal vein; the cephalo-distal marginal stripe is thickest, the mid-longitudinal one next so. Axillae with a rather long carina between them. Scutum with short, black setae which are scattered; also on axillae and scutellum (four longer setae at apex of the latter). Abdomen a little dusky above. Marginal vein somewhat longer than the postmarginal, which is somewhat longer than the stigmal. Otherwise as in *auraticorpus*.

The male is the same but with hyaline wings, and the dorsum of the abdomen is black, the meson of propodeum dusky broadly. Venation of male not seen. The scape is shorter and stouter; the pedicel barely longer than wide; the funicle and club with long, scraggly hairs; the club solid with a few clavate sensory organs along one side, longest of the flagellum, funicle 1 next longest, over four and a half times longer than wide; 6 not much shorter and subequal to the others.

From one pair reared from *Pseudococcus* on *Leucaena glauca* and *Coffea* (Djember, Java).

Types.—One pair on a tag, the heads and female fore wing on a slide. Cat. No. 19886, U.S.N.M.

PARECHTHRODRYINUS, new genus.

Female.—In my table to the earth's ectromine genera of Encyrtidae runs to *Echthodryinus* Perkins, but differs in that the postmarginal vein is half the length of the stigmal, the latter slightly longer than the marginal, which is twice longer than wide. The narrow frons is about three and a half times the diameter of the cephalic ocellus. Ovipositor exerted slightly, white at apex.

Type of the genus.—*Parechthodryinus convexus*, new species.

PARECHTHRODRYINUS CONVEXUS, new species.

Female.—Length, 1.65 mm.

Dark metallic purple, the wings hyaline, the legs (except coxæ and base of all femora—basal half of cephalic femora) and antennae (except the black club) reddish yellow, the venation yellowish pallid. Pedicel one and a half times longer than wide, slightly longer than funicles 1 or 2, the latter subequal, longest, not quite twice longer than wide, 6 slightly wider than long; club somewhat over half the length of the funicle, conic-ovate, not greatly enlarged but wider than the funicle and distinct; funicle 6 somewhat wider than 1. Cheeks nearly as long as the eyes, the frons with scattered yet distinct punctures. Hairless line of fore wing with about five scattered lines of discal cilia proximad of it, not closed caudad. Axillae broadly joined, with a carina between them. Body finely scaly, densely so, the scutum and scutellum with numerous, short setae. Abdomen flat-triangular, about as long as the thorax, the latter from lateral aspect much convexed. Pronotum transverse-linear.

The male is about the same except secondary characters and smaller size; its antennal club is solid, the antennae filiform, yellow (scape and globose pedicel brown), the flagellum with scraggly hairs; funicle 1 subequal to the club, 3 longer than wide, 6 a half longer than wide. Scape shorter, distinctly compressed.

From four males, one female reared from a coccid on twigs of *Dequelia microphylla*, Assinan, February 2, 1915.

Types.—Cat. No. 19892, U.S.N.M., a pair on a tag and a slide with heads, fore wings, and a female hind tibia.

CHEILONEUROMYIA JAVENSIS, new species.

Female.—Mandibles as in *Cheiloneurella binotativentris* Girault, but the so-called second tooth is obtuse, yet a little larger than the first. Length, 1.10 mm.

Agrees with the description of the genotype except that of the antennae the entire club is black except apex of joint 3, the hyaline cross stripe of the fore wing is broadly divided longitudinally at middle, the wing thus with a large, nearly naked, hyaline oblique eye-spot, one on each margin (opposite each other), the cephalic one just at apex of the venation (stigmatal vein pale). The base of the abdomen more or less blackish; the pedicel is longer in relation to funicle 1, the funicle yellow. The postmarginal vein is present, yet less than half the length of the stigmatal, which is a little less than half the length of the black marginal. Center of face of pronotum black. Scutum with scattered white setae; the scutellum with longer black ones discally; otherwise the same.

From two females received from P. van der Goot and reared from *Lecanium viride* at Salitiga, Java, January, 1915.

Type.—Cat. No. 19893, U.S.N.M. The above specimens on a tag; the head, a hind tibia, and the fore wing on a slide.

CRISTATITHORAX LATISCAPUS, new species.

Female.—Length, 1.40 mm.

Dark metallic purple, the fore wing with the usual infuscation, the the following parts silvery white: Pedicel, funicle, dorsal edge of scape at distal half, and legs (except apex rather broadly of cephalic femur, base rather broadly of cephalic tibiae, both dusky; the same of middle femur, narrower ventrad, and tibia, but the color black and broader on the tibia, over proximal third; all of caudal femur except broadly at base and over proximal half of caudal tibia, proximal third or more dorsad). Tuft on scutellum rather long. Scutum with a short, dense, silvery pubescence, scattered on the scutellum. Body densely scaly. Frons narrow, at the occipital margin about three and a half times the diameter of an ocellus, narrowest far cephalad; the cephalic ocellus far in advance of the others. Axillae large, narrowly joined. Scape distinctly but not very greatly dilated foliaceously. Funicles 2-4 shortest, subequal, wider than long; 1 subquadrate; 6 largest, a little wider than long, somewhat smaller than the pedicel. Club enlarged, not quite so long as the funicle, obliquely truncate from near base of joint 3. Postmarginal vein very short, truncate, the stigmatal somewhat less than a third the length of the marginal. Distance between apex of wing and of infuscation somewhat over half the marginal vein's length. Marginal fringes not long.

Described from many females reared from *Lecanium viride*, January, 1915, Salatiga, Java.

Types.—Cat. No. 19895, U.S.N.M. Eight females on three tags and another on a slide (the former paratypes, the latter type).

Subfamily APHELININAE.

ANERISTUS CEROPLASTAE Howard.

The first two tibiae may be entirely white; the scape is white. Seven females received from P. van der Goot, labeled "VII, ♀ from *Lecanium viride*." Salatiga.

COCCOPHAGUS JAVAEE, new species.

Female.—Length, 1.10 mm.

Agrees with Howard's description of *flavoscutellum* Ashmead, but differs in the coloration of the legs, the latter white except sides of caudal coxae, the caudal femora and a little less or more than the proximal half of the caudal tibiae. Scape white, rest of antennae black. Mouth yellowish. Of the habitus of *mexicanus*. Base of scutellum narrowly black. Funicle 1 slightly longer than the others, somewhat longer than wide, much longer than the pedicel. Thorax densely, polygonally scaly, the lines delicately raised. Most of face and cheeks yellow.

Described from 10 females reared from *Lecanium viride*, Salatiga, Java, January, 1915 (P. van der Goot).

Types.—Cat. No. 19888, U.S.N.M. The above specimens on a slide.

According to van der Goot, this species has been described by Koningsberger as *Encyrtus bogoriensis*. I have been unable to see the description of this species.

COCCOPHAGUS JAVENSIS, new species.

Female.—Length, 1 mm.

Bright golden yellow, the wings hyaline, the venation yellow, the following conspicuous black markings: A broad band across the abdomen at middle and equal to over a third of the surface, center of occiput, meson of pronotum very broadly, postscutellum (dusky), and the cephalic margin of the propodeum very broadly across the meson. Funicle and club longitudinally striate; the club well defined but barely wider than the funicle; the joints of the latter subequal, each about a half longer than wide and distinctly longer than the pedicel; club joints about equal in length, each a little shorter than the funicle joints. Stigmal vein subglobular, sessile. Scutum with short, black bristles, less numerous on the scutellum and decidedly longer. Marginal vein slightly longer than the submarginal. Fore wings with short marginal cilia, uniformly ciliate discally; the caudal wing broad, with about 11 lines of discal cilia where broadest, the caudal marginal fringes not long, yet distinctly longer than those of the fore wing, about a fourth of the greatest wing width. Mandibles tridentate.

Described from five females reared from *Pseudococcus* on wild *Mangifera*, Salatiga, Java (P. van der Goot).

Types.—Cat. No. 19894, U.S.N.M. The above specimens on a slide.

Family ELASMIDAE.

EURYISCHIA SHAKESPEAREI Girault.

Several females; same source, "sp. VI^a, ♀ from *L. viride*." The cephalic tibiae are white. An Australian species. Salatiga.

Family MISCOGASTESIDAE.

Subfamily PIRENINAE.

ANYSIS AUSTRALIENSIS JAVENSIS, new variety.

Female.—Like *australiensis australiensis* Howard, but the femora and the dorsal edge of the tibiae are concolorous, also the distal club joint. Mandibles tridentate. Compared with types of *australiensis*.

Described from two females reared from *Lecanium viride*, Salatiga, Java, January (P. van der Goot).

Types.—Cat. No. 19887, U.S.N.M. Two females on a tag; a head, hind tibiae, and a forewing on a slide.

Family CALLIMOMIDAE.

ASEMANTOIDEUS, new genus.

Type of the genus.—*Asemantoideus dubius*, new species.

ASEMANTOIDEUS DUBIUS, new species.

Female.—Length, 1.30 mm. Resembles somewhat *Paracolystichus* Girault of the Idarninae except in venation and the hind tibiae bear two stout spurs.

Agrees with the description of the genotype of *Asemantus* Foerster, except that segments 3 and 4 of the compressed abdomen are deeply incised at meson caudad. Abdomen somewhat longer than the rest of the body. Dark metallic green with a coppery luster; the scape, knees, tibiae, and tarsi reddish brown. Head and thorax very densely punctulate; the abdomen scaly. Wings broad, hyaline, without marginal fringes; the discal ciliation minute, scattered. Marginal vein over twice the length of the stigmal, which is subequal to the postmarginal. A row of discal cilia around the margins of the fore wing a little within the edges, from apex of venation nearly all around the apex; from hence and along the caudal margin these are very short, minute marginal fringes. Mandibles tridentate. Funicle joints quadrate, but 5 a little wider than long; pedicel somewhat longer than funicle 1. Club with a terminal nipple. First ring

joint the smaller. Caudal femur compressed, somewhat enlarged, its tibia obclavate, the spurs very unequal. Caudal femur scaly, the tibiae above distad with rather stout tooth-like setae. Joint 1 of caudal tarsi longest, but not especially long. Propodeum short at the meson, long laterad; the spiracle *central*, the median carina obscure except at base; lateral carina represented by a sulcus which is straight. Parapsidal furrows complete, very delicate. Cephalic femora like the caudal ones; the caudal coxae large as in the Torymidae. Antennae inserted on the middle of the face. Scutellum large, convex. Antennae as in *Systasis*.

From one female reared from *Lecanium viride*, Salatiga, Java, January, 1915 (P. van der Goot).

Type.—Cat. No. 19889, U.S.N.M. The female on a tag; the head, hind tibia, and fore wing on a slide.

Subfamily TETRASTICHINAE.

EPITETRASTICHUS LECANII, new species.

Female.—Length, 0.75 mm.

Agreeing with the description of *Tetrastichus bicolor* Girault, but the head wholly black, the general color dark metallic purple; the yellow basal part of the abdomen is narrowly margined with purplish and the flagellum is dusky; also the legs are yellow except the cephalic coxae. The abdomen is purple except the proximal third. Funicle joints subequal to each other and to the pedicel. Club with a minute terminal spine. Club 1 shorter than the combined length of the other two. Propodeum with a carina *laterad* of the spiracle; no *true* lateral carina. Stigmal vein of moderate length.

The male has the coxae and femora dusky (cephalic femur only along proximal half), and the yellow of dorsal abdomen is a moderate round area near base. The funicle and club joints each bear one whorl of very slender hairs; three minute ring joints, four funicle, three club. Scape with a wart-like area or projection (large and round) ventrad near tip; pedicel somewhat longer than wide at apex; funicle 1 wider than long, 3 longest, over twice longer than wide, 2 and 4 subequal, each somewhat shorter than 3. Mandibles tridentate.

Described from a single pair reared from *Lecanium viride*, Salatiga, Java, January, 1915 (P. van der Goot).

Type.—Cat. No. 19890, U.S.N.M. The above specimens on a tag; the heads on a slide.

EPITETRASTICHUS IBSENI, new species.

Female.—Length, 1.25 mm.

Agrees with the description of the Australian *flaviscapus* Dodd, but differs in that the funicle joints are unequal, 1 twice longer than wide, 3 a half longer than wide; otherwise agreeing. Pedicel a little

longer than wide at apex. Club joints each shorter than funicle 3. Knees yellow.

Described from four females reared from *Lecanium viride*, Salatiga Java, January, 1915. (P. van der Goot).

Types.—Cat. No. 19891 U.S.N.M. Three females on two tags; two heads on a slide.

Subfamily ENTEDONINAE.

OMPHALOMOMYIA THYMUS, new species.

Female.—Length, 1.50 mm.

Agrees with the description of the genotype except that of the head only its dorsal half is dark metallic blue and there is no metallic color on the thorax. The scutellum bears a groove latero-dorsad (present in the genotype), but not the lateral groove as usually understood. Scutellum with four bristles, all well within the "lateral groove." Otherwise as in the genotype. Club somewhat shorter than the pedicel.

The male has the occiput concolorous and the distal fourth of the abdomen above dusky; the dorsal thorax also is darker. The legs and antennae are white; the scape compressed, rather much dilated; the funicle 4-jointed, of which 1 is somewhat longer than wide, 2 somewhat shorter than the pedicel, which is not so long; funicles 2-4 subequal, each somewhat longer than 1. Club longer than the pedicel, acuminate. Flagellum with very long, silky hairs. Club apparently 3-jointed. At least three ring-joints.

From 4 males, 25 females in United States National Museum, received from Dr. W. Roepke, Salatiga, Java. Secondary parasites of *Zaratha*.

Types.—Cat. No. 19896, U.S.N.M. One male, two females, on tags plus a slide with female head, wing and hind tibiae, and two male heads.



A CONTRIBUTION TO THE INVERTEBRATE FAUNA
OF THE OLIGOCENE BEDS OF FLINT
RIVER, GEORGIA

BY

WILLIAM HEALEY DALL

Honorary Curator of Mollusks, United States National Museum

No. 2162.—From the Proceedings of the United States National Museum,
Vol. 51, pages 487-524, with Plates 83-88

Published December 21, 1916



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INTRODUCTION.

The fossils described in this paper were collected on or near the Flint River, Georgia, above and below the town of Bainbridge, by Messrs. T. W. Vaughan, C. Wythe Cooke, and W. C. Mansfield, of the United States Geological Survey. While their state of preservation in many cases leaves much to be desired, the identification of the fauna has some importance for the geology of that part of the coastal plain of the southern United States. A feature of somewhat unusual interest paleontologically is the presence in the upper bed of a relatively large number of species of the Cerithiidae, several of them of unusual size, recalling the analogous group in the Parisian Eocene of France, and not paralleled in any of the other Tertiary horizons of the United States so far as known. Attention was called to the presence of these large Cerithia in our southern Tertiary by the writer in 1890,¹ but it was not until the present collection was made that material suitable for study was obtained.

These fossils are immediately separable into two groups characterizing two zones, the upper zone being represented chiefly south of Bainbridge, and the lower zone around and north of that town. The extensive solution which these beds have undergone has probably removed the upper bed in the vicinity of Bainbridge, leaving behind more or less scattered remains of silicified fossils over or near the present surface of the soil.

Sixty-one species have been identified from the upper zone, of which 29 are new to science. From the lower zone 39 species were obtained, of which 9 are new. Five of the new species and 14 of the others are common to both zones.

Of the forms from the upper zone, omitting the new species, 51 per cent are identical with species found in the *Orthaulax pugnax* zone at Tampa, Florida, including the two species of *Orthaulax*.

It is probable, allowing for the distance between the two localities, and for the shallower water indicated by the Flint River species,

¹ Bull. Soc. Zool. France, vol. 15, 1890, pp. 97-98.

that this upper zone should be regarded as the local equivalent of the *Orthaulax pugnax* zone of Tampa, Florida. In this conclusion Dr. T. W. Vaughan, in charge of the geological exploration of the coastal plain, concurs.

The lower zone has only 20 per cent of species common to the *Orthaulax pugnax* zone and *Orthaulax* is not among the fossils obtained from it. Omitting the new forms, about one-fourth of the species are common to the Vicksburgian Oligocene, and three-eighths are also represented in the Jacksonian or Ocala horizons. Only about 6 per cent of the species of the lower zone are common to the marls of the Chipola River or the lower bed at Alum Bluff, while from the upper zone about 10 per cent survive in the Chipola fauna.

The lower zone, therefore, while distinctly younger than the Ocala horizon, is believed by Doctor Vaughan and the writer to occupy a position between that and the *Orthaulax* zone, near the base of the upper Oligocene.

Acknowledgments are due to the authorities of the United States National Museum, in whose collection the types of this paper are deposited, for facilities granted during its preparation.

The plates have been prepared by the Division of Illustrations of the United States Geological Survey, and are used here by permission of the Director, who has authorized the publication of the present paper.

DISTRIBUTION OF THE SPECIES.

	Upper bed.	Lower bed.	Ocala.	Vicksburg.	Orthaulax.	Chipola.
<i>Arca subprotracta</i> Heilprin	X	X		X		
<i>cuculloides</i> Conrad.....	X			X		
<i>Glycymeris cookei</i> Dall.....	X	X				
<i>mississippiensis</i> Conrad.....	X	X		X		
<i>Ostrea mauricensis</i> Gabb.....	X			X		
<i>vicksburgensis</i> Conrad.....	X		X	X		
<i>cf. podagrina</i> Dall.....	X					
<i>Pecten alpha</i> Dall.....	X					
<i>suwanneensis</i> Dall.....	X	X	X			
<i>anatipes</i> Morton.....		X		X		
<i>Spondylus filiaris</i> Dall.....	X				X	
<i>Lima halensis</i> Dall.....	X					
<i>Modiolus grammatus</i> Dall.....		X			X	
<i>Gregariella</i> , species.....	X				?	
<i>Arcoperna inflata</i> Dall.....		X				
<i>Lithophaga nuda</i> Dall.....	X				X	
<i>Crassatellites paramesus</i> Dall.....	X	X				
<i>Venericardia praecisa</i> Dall.....		X	X			
<i>Cardita shepardii</i> Dall.....	X				X	
<i>Phacoides perovatus</i> Dall.....	X	X				
<i>wacissanus</i> Dall.....	X	X				
<i>species</i>		X				
<i>Miltha ocalana</i> Dall.....	X	X	X			
<i>hillsboroensis</i> Heilprin.....	X				X	
<i>Cardium glebosum</i> Conrad.....	X	X	X	X		
<i>eversum</i> Conrad.....	X			X		
<i>species</i>	X					

Distribution of the species—Continued.

	Upper bed.	Lower bed.	Ocala.	Vicks- burg.	Orth- aulax.	Chi- pola.
<i>Laevicardium</i> , species		X				
<i>Chione bainbridgensis</i> Dall	X	X				
<i>Macrocallista</i> cf. <i>ovata</i> Rogers		X	X			
<i>Antigona caesarina</i> Dall	X	X				X
<i>Pitaria silicifluvia</i> Dall		X				
<i>calcanea</i> Dall		X				
<i>Psammobia cerasia</i> Dall		X				
<i>Tellina segregata</i> Dall	X				X	
<i>Semele</i> , species		X				
<i>Maetra mississippiensis</i> Conrad		X		X		
<i>Conus vaughani</i> Dall	X					
<i>cookei</i> Dall	X					
<i>demiurgus</i> Dall		X				X
<i>tortilis</i> Conrad		X	X			
species	X					
<i>Turris</i> , species		X				
<i>Marginella silicifluvia</i> Dall	X					
<i>halensis</i> Dall	X					
<i>Lyria mansfieldi</i> Dall		X				
<i>silicata</i> ? Dall	X				X	
<i>Mitra syra</i> Dall	X				X	
<i>Xancus wilsoni</i> Conrad	X			X		
<i>Fusinus nexilis</i> Dall		X			X	
<i>Murex rufirupicolus</i> Dall		X				
<i>Epitonium</i> ? <i>dubiosum</i> Dall	X					
<i>Cymatium cecilianum</i> Dall	X					
<i>Bursa victrix</i> Dall	X					
<i>Cassis sulcifera</i> Sowerby	X	X				
<i>globosa</i> Dall	X	X	X			X
<i>Orthaulax inornatus</i> Gabb	X				X	
<i>pugnax</i> Heilprin	X				X	
<i>Strombus chipolanus</i> Dall	X				X	X
species indet.		X				
<i>Bittium silicium</i> Dall	X					
<i>Diatoma georgiana</i> Dall	X					
<i>Cerithium silicifluviunum</i> Dall	X	X				
<i>mascotianum</i> Dall	X					
<i>halense</i> Dall	X					
<i>vaughani</i> Dall	X					
<i>cookei</i> Dall	X					
<i>corallicolum</i> Dall	X					
<i>eutextile</i> Dall	X					
<i>vaginatum</i> Dall	X					
<i>insulatum</i> Dall	X					
<i>Cerithiopsis diagona</i> Dall	X					
<i>Turritella halensis</i> Dall	X					
<i>tampae</i> Heilprin	X				X	
species indet.		X				
<i>Calyptrea trochiformis</i> ? Conrad		X		X		
<i>Xenophora conchyliophora</i> Born	X	X	X	X	X	X
<i>Ampullina solidula</i> Dall	X	X			X	
<i>streptostoma</i> Heilprin	X	X			X	
<i>Amauropsis ocalana</i> Dall	X	X	X			
<i>Sinum imperforatum</i> Dall	X				X	
<i>Margarites corallica</i> Dall	X					
<i>Teinostoma sublimata</i> Dall	X					
<i>Liostrea halensis</i> Dall	X					
<i>persculpturata</i> Dall	X					
<i>Nerita tampaensis</i> Dall	X				X	
<i>Dentalium ladinum</i> Dall					X	

DESCRIPTIONS OF SPECIES.

ARCA SUBPROTRACTA Heilprin.

Arca subprotracta HEILPRIN, Proc. Acad. Nat. Sci., Phila. for 1881, p. 449.

Arca (Byssarca) protracta CONRAD, Journ. Acad. Nat. Sci., Phila., new ser., vol. 1, 1848, p. 126, pl. 13, fig. 36; not of Rogers, 1837.

Locality.—Station 6171, on the east bank of the Flint River at Bainbridge, Decatur County, Georgia, L. W. Stephenson, 1908. U. S. Nat. Mus. Cat. No. 166762. Also in the Oligocene of Vicksburg, Mississippi; Conrad.

BARBATIA (CALLOARCA) CUCULLOIDES Conrad.

Arca cuculloides CONRAD, Fos. Tert. Form., No. 3, p. 37 (not figured), 1833.

Byssarca lima CONRAD, Journ. Acad. Nat. Sci., Phila., new ser., vol. 1, 1848, p. 125, pl. 13, fig. 23; not of Reeve, 1844.

Barbatia (Calloarca) cuculloides DALL, Trans. Wagner Inst. Sci., Phila., vol. 3, 1898, p. 624.

Locality.—Station 3383, at the base of the bluff at Little Horseshoe Bend, just below the mouth of Blue or Russell Spring branch, on the east bank of the Flint River, 4 miles below Bainbridge, Decatur County, Georgia, in fossil coral reef; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166763. Also in the Oligocene of Vicksburg, Mississippi; Conrad.

GLYCYMERIS COOKEI, new species.

Plate 84, figs. 1, 2, 3, 4.

Shell small, slightly inequilateral, strongly sculptured; valves thick, suborbicular, with inner margins fluted in consonance with the external sculpture and the areas between the umbones very narrow and relatively long; sculpture of 12–15 stout flattened radial ribs, which distally become grooved on the summit and eventually duplex; the interspaces are channeled and about as wide as the ribs; in some specimens traces of intercalary threads, one to an interspace, begin to show themselves. There is no perceptible concentric sculpture, but all the specimens show a tendency to granulation of the surface, which, however, may be due to conditions of fossilization. The umbones are small and pointed; the hinge line is narrow, with seven or eight well-developed teeth on either side of the center. Height, 14; breadth, 15; diameter (double), 10 mm.

Locality.—Station 7095 on the east bank of Flint River, just above Lambert Island, about 10½ miles below Bainbridge, Decatur County, Georgia; also at station 7076, about half a mile below the island. Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166710.

The peculiar sculpture of this species is quite distinctive and does not closely resemble any other known Oligocene species. It is quite probable that it attains a larger size than that above noted.

GLYCYMERIS MISSISSIPPIENSIS Conrad.

Pectunculus mississippiensis CONRAD, Journ. Acad. Nat. Sci., Phila., new ser., vol. 1, 1848, p. 125, pl. 13, fig. 25.

Axinæa mississippiensis CONRAD, Amer. Journ. Conch., vol. 1, 1865, p. 12.

Glycymeris mississippiensis DALL, Trans. Wagner Inst. Sci., Phila., vol. 3, 1898, p. 608.

Localities.—Stations 3388, 3401, 6175, 7096, 7132, and 7150a, on the Flint River, within a range of 12 miles of Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166764. Also in the Oligocene of Vicksburg, Mississippi; Conrad.

OSTREA MAURICENSIS Gabb.

Ostrea mauricensis GABB (part) Journ. Acad. Nat. Sci., Phila., ser. 2, 1860, p. 376, pl. 67.—DALL, U.S. Nat. Mus. Bull. 90, 1915, p. 123.

Oligocene of southern New Jersey; of the layers above the Altamaha grit of Georgia; of the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida; of the beds at Vicksburg, Mississippi (Gabb); and at station 3400, at Mitchell Griffin's field, 8 miles southeast of Bainbridge, Decatur County, Georgia; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166747.

Poorly preserved specimens, apparently identical with those referred in the literature to Gabb's species.

OSTREA VICKSBURGENSIS Conrad.

Ostrea vicksburgensis CONRAD, Proc. Acad. Nat. Sci., Phila., for 1848, p. 296; Journ. Acad. Nat. Sci., Phila., new ser., vol. 1, 1848, p. 126, pl. 13, figs. 5, 37.

Ostrea mortoni GABB, Proc. Acad. Nat. Sci., Phila., for 1861, p. 329.

Locality.—Station 7074, on the west bank of Flint River at Hale Landing, 7 miles southeast of Bainbridge, Decatur County, Georgia, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166765. Also in the Oligocene of Vicksburg, Mississippi; Conrad, and the Jacksonian Eocene.

OSTREA cf. PODAGRINA Dall.

? *Ostrea podagrina* DALL, Proc. U. S. Nat. Mus., vol. 18, 1895, p. 122; Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 4, 1898, p. 682, pl. 30, figs. 5, 6.

Locality.—Station 2326, at Blue or Russell Spring, near the Flint River, 4 miles south of Bainbridge, Decatur County, Georgia; R. Pumpelly, 1891, U. S. Nat. Mus., Cat. No. 166748.

A species of oyster, apparently similar to *O. podagrina*, and differing from the others cited, but too imperfect to be positively identified with the form collected by Eldridge from the Sulphur Spring on the Suwannee River.

PECTEN (LYROPECTEN?) ALPHA Dall.

Plate 84, fig. 9.

Pecten (Lyropecten) alpha DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 4, 1898, p. 725 (not figured).

Shell small, thin, nearly equilateral, suborbicular, slightly convex, sculptured with 9 or 10 radial folds with subequal deep rounded interspaces, the disk and submargin also bearing fine radial threads; these appear to be smooth, but the condition of the specimens is such as to prevent a positive decision and they may have been slightly scaly; on the posterior ear of the left valve are five or six fine elevated radial threads with wider interspaces; the other ear is defective; height of valve 24; breadth 23 mm.

Locality.—Station 7075, on the east bank of Flint River, about 10½ miles below Bainbridge, Georgia, and just above Lambert Island; C. W. Cooke and W. C. Mansfield, 1914. Also at Sulphur Springs ferry, Suwannee River, Suwannee County, Florida; Burns. U. S. Nat. Mus. Cat. No. 166711.

PECTEN (AEQUIPECTEN) SUWANNEËNSIS Dall.

Plate 83, figs. 2, 3, 4.

Pecten (Aequipecten) suwanneënsis DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 4, 1898, p. 724.

Localities.—Jacksonian Eocene of the Suwannee River, Florida, Burns; and at station 7075, on the east bank of the Flint River, just above Lambert island, about 10½ miles below Bainbridge, Decatur County, Georgia; station 7076, at bend half a mile below Lambert island on the east bank of Flint River, about 12 miles below Bainbridge; and station 7079, at Mascot Point, below the mouth of Blue Spring branch, in chert blocks on the east bank of Flint River; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. Nos. 166749, 166750, and 166757.

PECTEN (CHLAMYS) ANATIPES Morton.

Pecten anatipes MORTON, Amer. Journ. Sci., vol. 23, 1833, p. 293, pl. 5, fig. 4; Synopsis Org. Rem., 1834, p. 58.

Vicksburgian Oligocene at Heidelberg and in Jasper County, Mississippi, Johnson; station 7096, at Red Bluff, on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia; and station 7132, on the west bank of Flint River, opposite Little Horseshoe Point, half a mile below Mascot Point, and 4½ miles below Bainbridge, in loose lumps of limestone; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166752.

SPONDYLUS FILIARIS, new species.

Plate 83, figs. 5, 6.

Shell large, thin, more or less irregular from its attachment to irregular surfaces which its growth follows, sculptured with small low radiating rounded threads without spiny processes, arranged in groups of five to eight, with the interspaces averaging subequal; these groups separated by larger but similar single threads; the inner margin of the valves slightly crenulated; concentric sculpture of inconspicuous incremental lines; beak of upper valve rather pointed, with a small and narrow inconspicuous auricle on each side, the lower valve not obtained; the hinge as usual in the genus, but narrow with a small resilifer. Height of large upper valve, approximately, 65; breadth, 57; depth, 18 mm. The small valve figured is about 20 mm. in height.

Locality.—Station 7078, on the east bank of Flint River, near the lower end of Smith's Reach, about one-quarter of a mile below Hale Landing, Decatur County, Georgia; collected by Dr. C. Wythe Cooke and W. C. Mansfield, 1914. Also with *Spondylus bostrychites* Guppy, in the Tampa siliceous beds at Ballast Point, Tampa Bay, Florida, by W. H. Dall in 1886. U. S. Nat. Mus. Cat. No. 166712.

This species is represented by a defective specimen in the Tampa collection which was supposed, when studied, to be a worn variant of *S. bostrychites*. But the more complete material obtained on the Flint River shows that its sculpture does not take on the spinose character of the latter species and the sculpture is finer and more regular. Between perfect shells the distinctiveness should be complete.

LIMA HALENSIS, new species.

Plate 83, figs. 1, 7, 8.

Shell ovate, moderately thin, with a short hingeline and inconspicuous auricles; sculpture of about 16 strong nearly smooth radial ribs with subequal channeled interspaces, the ribs near the submargins obsolescent and the submargins and auricles sculptured only with rather conspicuous incremental lines. The ribs are themselves sculptured with more or less obsolete minute radial striations most distinct toward the middle of the disk; concentric sculpture confined to more or less prominent incremental lines not rising into scales or imbrications; beaks narrow; anterior gape small with its bounding valve-margins thickened and slightly reflected; hinge area small, flat, with no crural callosities, the ligamentary pit large, equilaterally triangular, shallow; valves subequal, and moderately convex. Height, 52; breadth of shell, 37; of hingeline, 16; diameter, 14 mm.

Locality.—Station 7074, at Hale landing, on the west bank of Flint River, 7 miles southeast of Bainbridge, Decatur County,

Georgia, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914; station 7078, on the east bank of Flint River, below the mouth of Blue Spring branch, at Mascot Point, in chert blocks, by the same collectors, in 1914. U. S. Nat. Mus. Cat. No. 166713.

The chief peculiarity of this species and one by which it is easily distinguished is the presence of strong radial ribs with channeled interspaces, but without the strong almost spinose imbrications with which we are familiar in analogous recent species.

MODIOLUS (BRACHYDONTES) GRAMMATUS Dall.

Modiolus (Brachydontes) grammatus DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1898, pt. 4, p. 794, pl. 30, fig. 2; Bull. U. S. Nat. Mus. No. 90, 1915, p. 127, pl. 26, fig. 4.

Locality.—Station 7096, at Red Bluff, on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166753. Also in the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida. U. S. Nat. Mus. Cat. No. 165184.

MODIOLARIA (GREGARIELLA), species indeterminate.

Localities.—Station 7074, at Hale landing, on the west bank of the Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, in coralliferous chert; and station 7079, at Mascot Point on the east bank of Flint River below the mouth of Blue (or Russell) Spring branch, in chert blocks; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166754.

Casts of a species probably belonging to the section *Gregariella*, but too imperfect to be specifically determined, were obtained as above mentioned. Two species of this general type have been obtained from the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida.

Genus ARCOPERNA Conrad, 1865.

ARCOPERNA INFLATA, new species.

Plate 85, fig. 1.

Shell small, thin, inequilateral, the umbones nearly terminal, prosoelous, small; the anterior dorsal slope abruptly descending, the posterior nearly at a right angle to it, slightly convexly arcuate; both ends bluntly rounded, base almost straight; hinge edentulous, much as in *Musculus*; inner margins of the valve apparently smooth, interior disk concealed by matrix; the external sculpture of almost microscopic radial striae over the whole surface, and concentric emphatic resting stages, irregularly disposed on the lower part of the disk, to the number of two or three. Height, 12; length, 18.5; diameter (double), 9 mm.

Locality.—At station 7096, at Red Bluff, Flint River, on the west bank, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166714.

This shell seems to find a place halfway between *Crenella* and *Botula*. The type is *A. filosa* Conrad, from the Vicksburgian, from which the present shell differs by its much less prominent umbones and dorsally less and ventrally more arcuate profile.

LITHOPHAGA NUDA Dall.

Lithophaga nuda DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1898, pt. 4, p. 800, pl. 11, fig. 7; pl. 35, fig. 27; Bull. U. S. Nat. Mus. No. 90, 1915, p. 129, pl. 24, fig. 4; pl. 26, fig. 7.

Locality.—Station 3381, at the base of the bluff at Little Horseshoe Bend, just below the mouth of Blue (or Russell) Spring branch of the Flint River, 4 miles below Bainbridge, Decatur County, Georgia; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166755. Also from the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida. U. S. Nat. Mus. Cat. No. 165187.

The shell is seldom well preserved, but the casts of the burrows of this species are very common, and often in their silicified form retain a cavity more or less occupied by water.

CRASSATELLITES PARAMESUS, new species.

Plate 85, figs. 4, 5, 7, 8.

Shell solid, thick, inequilateral, the anterior end shorter; subovate, beaks small, pointed, flattened; anterior dorsal margin with an ovate-lanceolate, nearly smooth, deeply depressed lunule, the outer margin of which is abrupt and sharp-edged; the escutcheon is more than twice as long as the lunule, less depressed, concentrically striated, and with the bounding carina rounded off and less abrupt; the hinge is strongly developed, the anterior cardinal tooth very prominent, arcuately produced; the resiliary pit narrow and deep; there are no traces of lateral teeth, though the dorsal margins of the right valve are attenuated and produced; the inner margins of the valves are not crenulated; the adductor scars are conspicuous, the posterior larger, both rounded; the external sculpture on the flattened beaks comprises about ten concentric low rather sharp waves with much wider interspaces, angulated behind where they cross a low ridge which radiates from the vicinity of the umbo to the posterior basal margin, near which it becomes obsolete; in front of this ridge the concentric waves become closer, smaller, and more numerous, behind it every alternate rib, in general, ceases and the interspaces between the others are therefore about twice as wide as on the anterior part of the valve; the basal margin is obscurely angulated by the end of the ridge and the margin behind it subtruncated; the anterior end is evenly rounded and the base gently arcuated. Height 28; length of shell 35; of part behind the vertical from the umbones 21; diameter 16 mm.

Locality.—Station 7096, at Red Bluff on the west bank of Flint River, about 7 miles above Bainbridge. Also at station 7131, Cherry Chute on the Flint River, $2\frac{3}{4}$ miles below Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166715.

This species in a general way is intermediate between the Vicksburgian *Crassatellites mississippiensis* of Conrad, and the *C. deformis* Heilprin, of the Tampa *Orthaulax pugnax* zone. It is also found in the upper bed at station 7079, at Mascot Point, on the Flint River, in chert blocks. U. S. Nat. Mus. Cat. No. 166766.

VENERICARDIA PRAECISA Dall.

Venericardia praecisa DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1903, pt. 6, p. 427, pl. 56, figs. 7, 8.

Locality.—Station 7095, on the east bank of Flint River, at the bend near the "Old Factory," about three-quarters of a mile north-east of the railway station at Bainbridge, Decatur County, Georgia; Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166756. Also in the Jacksonian Eocene of Cleveland County, Arkansas; G. D. Harris.

CARDITA (CARDITAMERA) SHEPARDI Dall.

Cardita shepardi DALL, Bull. U. S. Nat. Mus. No. 90, 1915, p. 133, pl. 21, figs. 10, 11.

Locality.—Station 7075, on the east bank of Flint River, about $10\frac{1}{2}$ miles below Bainbridge, Decatur County, Georgia, and just above Lambert island; Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166757. Also in the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida. U. S. Nat. Mus. Cat. No. 165193.

This little species is closely related to the recent *C. domingensis* of the West Indies.

PHACOIDES PEROVATUS, new species.

Plate 84, figs. 7, 8.

Shell large, moderately thin, moderately inflated; inner margin of the valves entire, the pallial line rather near the margin, deeply impressed, posterior muscular impression narrow, prolonged downward inside the pallial line, beak rather pointed, and inclined forward, with, in the right valve, two narrow cardinal teeth below it; in the east there are no distinct traces of lateral teeth. Altitude of larger cast, 53; of smaller one, 48; breadth, 45 and 34; diameter (double), 30 and 18 mm., respectively.

Locality.—Station 7150a, from east bank of Flint River, just below wagon bridge at Bainbridge, Georgia, from loose blocks of chert; and station 7079, from chert blocks at Mascot Point, on the east bank of

Flint River, below the mouth of Blue Spring branch; Vaughan, Cooke, and Mansfield, October, 1914. U. S. Nat. Mus. Cat. No. 166716. Also on the left bank of Flint River at Bainbridge; A. H. Brooks, 1900.

Unfortunately no part of the exterior is represented by the specimens received. It is probable, however, that it was sculptured only by more or less conspicuous incremental lines, without radial sculpture.

From any other species of the group in the southern Tertiary this is readily distinguished by its markedly oval form.

The validity of the name *Phacoides* as a generic appellation has been called in question from the fact that it is doubtful whether Blainville used it in that sense or merely as a group name. However, as it was subsequently used by J. E. Gray in 1847 as a generic name, it seems that, failing any prior designation for the group in question, the question is hardly worth raising.

PHACOIDES (HERE) cf. WACISSANUS Dall.

?*Phacoides (Here) wacissanus* DALL, Bull. U. S. Nat. Mus. No. 90, 1915, p. 137, pl. 23, fig. 12.

Localities.—Station 7075, on the east bank of Flint River, about 10½ miles below Bainbridge, Decatur County, Georgia, and just above Lambert island; Cooke and Mansfield, 1914; station 7131, 2¾ miles below Bainbridge, at Cherry Chute on the Flint River, from hard residual blocks on a small island; and at station 7150a on the east bank of Flint River from loose blocks of chert just below the wagon bridge at Bainbridge; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166758.

P. wacissanus was collected from the limestone of Wacissa, Jefferson County, Florida (U. S. Nat. Mus. Cat. No. 165200) and is rather common in the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida.

PHACOIDES, species indeterminate.

Locality.—Station 7096, at Red Bluff on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166759.

A species represented by unidentifiable casts, but apparently different from the others here mentioned, was obtained at the above locality.

PHACOIDES (MILTHA) OCALANUS Dall.

Phacoides (Miltha) ocalanus DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1903, pt. 6, p. 1375, pl. 50, fig. 14.

Localities.—Station 7079, at Mascot Point, on the east bank of Flint River, below the mouth of Blue (or Russell) Spring branch, in chert blocks; and at station 7096, on the west bank of Flint River at

Red Bluff, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166760.

The species was originally described from the Jacksonian Eocene of the Ocala horizon, Ocala, Florida, where it was collected by Mr. Joseph Willcox.

PHACOIDES (MILTHA) HILLSBOROËNSIS Heilprin.

Plate 88, fig. 12.

Lucina hillsboroënsis HEILPRIN, Trans. Wagner Inst. Sci. Phila., vol. 1, 1887, pp. 117, 120, pl. 16, fig. 62.

Phacoides (Miltha) hillsboroënsis DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1903, pt. 6, p. 1376; Bull. U. S. Nat. Mus. No. 90, p. 139, fig. 5, 1915.

Localities.—Station 3381, at the base of the bluff at Little Horseshoe bend just below the mouth of Blue (or Russell) Spring branch, 4 miles below Bainbridge, Decatur County, Georgia, on the east bank of Flint River; T. W. Vaughan, 1900. Also at station 7095, just above Lambert Island, 10½ miles below Bainbridge, on the east bank of Flint River; and at station 7079, at Mascot Point, Flint River, in chert blocks; Vaughan, Cooke, and Mansfield, 1914, U. S. Nat. Mus. Cat. No. 166761.

This species is widely distributed, having been previously reported from the *Ortharulax pugnax* zone at Ballast Point, Tampa Bay, Florida; from the lower bed at Alum Bluff, Apalachicola River, Florida; and from the Chipola marl in Calhoun County, Florida, by Heilprin, Burns, and Dall. U. S. Nat. Mus. Cat. No. 114706, etc.

CARDIUM (TRACHYCARDIUM) GLEBOSUM Conrad.

Cardium glebosum CONRAD, Journ. Acad. Nat. Sci., Phila., new ser., vol. 1, 1848, p. 122.—DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1900, pt. 5, p. 1080.

Cardium globosum CONRAD, Amer. Journ. Conch., vol. 1, 1865, p. 7; not of Bean, 1839.

Locality.—Station 7075, on the east bank of Flint River, 10½ miles below Bainbridge, Decatur County, Georgia, just above Lambert Island; Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166767. Also from the Red Bluff beds of Mississippi.

CARDIUM EVERSUM Conrad.

Cardium eversum CONRAD, Journ. Acad. Nat. Sci., Phila., new ser., vol. 1, 1848, p. 122, pl. 12, fig. 18.

Locality.—Station 3381, at the base of the bluff at Little Horseshoe Bend, 4 miles below Bainbridge, Decatur County, Georgia, just below the mouth of Blue (or Russell) Spring branch, on the east bank of Flint River, Georgia; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166769. Also originally from the Oligocene of Vicksburg, Mississippi; Conrad.

CARDIUM (TRACHYCARDIUM), species indeterminate.

Locality.—Station 7079, at Mascot Point, on the east bank of the Flint River below the mouth of Blue (or Russell) Spring branch, in chert blocks; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166768.

This indeterminable species recalls *C. bowdenense* Dall, of the Oligocene of Bowden, Jamaica, and the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida, but is not sufficiently perfect to be positively identified. It is, at all events, one of the group exemplified by *C. muricatum* Linnaeus.

CARDIUM (LAEVICARDIUM), species.

Locality.—Station 7096, at Red Bluff, on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166770.

A small species of this type, not sufficiently well preserved to identify specifically.

CHIONE BAINBRIDGENSIS, new species.

Plate 84, figs. 5, 6.

Shell small, slightly inequilateral, moderately inflated, thin; beaks small, rather prominent, prosocœlous, with a short lanceolate impressed lunule below them; the escutcheon narrow and more elongated; sculpture of numerous sharp recurved lamellæ, somewhat sparser on the beaks but elsewhere uniformly distributed, and more elevated near the anterior end; radial sculpture of numerous fine threads evenly distributed, with narrower interspaces, strong on the front surface of the lamellæ and in the interspaces, but wanting on the back or concave side of the lamellæ; inner margin of the valves finely crenulated; anterior end of the valves rounded, the base prominently arcuate, the posterior end more pointed; hinge as usual in the genus. Height of somewhat defective valve, about 25; length, 35; diameter (double), 18 mm.

Localities.—Station 7095, on the east bank of Flint River, at the bend near the "Old Factory," about three-fourths of a mile northeast of the railway station at Bainbridge, Georgia. Also at station 7131, at Cherry Chute, 2¾ miles below Bainbridge, in hard residual blocks of limestone; and stations 3381, 7074, 7075, 7078, 7079, 7095, 7096, and 7131, at various points on Flint River above and below Bainbridge and within a dozen miles of that town; Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166717.

Each horizon from the Chattahoochee to the recent fauna contains a species of *Chione* of this general type, but distinguished by minor differences from the species in the zones above or below. *Chione woodwardi* Guppy, from the Oligocene of Bowden, Jamaica, is an example of the group.

MACROCALLISTA (CHIONELLA), species indeterminate.

cf. *Macrocallista ovata* ROGERS, Trans. Amer. Philos. Soc., new ser., 1837, vol. 5, p. 340, pl. 27, fig. 2, 1839.

Locality.—Station 7096, on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia, at Red Bluff; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166771.

Roger's species is from the Eocene of Maryland and Virginia, and is probably not identical with the imperfectly preserved form from Georgia, but the two have a certain similarity, and better specimens of the latter are needed before an exact comparison can be made.

ANTIGONA (aff.) CAESARINA Dall.

? *Cytherea caesarina* DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1903, pt. 6, p. 1275, pl. 53, fig. 5.

Localities.—Station 3381, at the base of the bluff at Little Horse-shoe Bend, on the east bank of the Flint River, 4 miles below Bainbridge, Decatur County, Georgia, just below the mouth of Blue (or Russell) Spring branch; T. W. Vaughan, 1900. Also at station 7074, on the west bank of Flint River, 7 miles southeast of Bainbridge at Hale landing; station 7078, near lower end of Smith's Reach, about a quarter of a mile below Hale landing; station 7079, at Mascot Point, near station 3381; and at station 7096 on the west bank of Flint River at Red Bluff, 7 miles above Bainbridge; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166772.

The *A. caesarina* was originally described from the sandstone of White Beach near Osprey, Florida, and the Oligocene marl of the Chipola River, Calhoun County, Florida. The present species is not sufficiently well preserved for a positive determination of its relations.

PITARIA (LAMELLICONCHA) SILICIFLUVIA, new species.

Plate 85, figs. 2, 3.

Shell small, inflated, arcuate, moderately thick; valves slightly inequilateral, rounded in front and behind with a prominently arcuate base, the inner margins smooth; beaks prominent, inflated, small, conspicuously incurved and prosocoelous, with an impressed and broadly heart-shaped lunule bordered by an impressed line; sculpture of small concentric waves with narrower interspaces; the crests of the waves, at first rounded, become more sharp-edged and crowded toward the basal margin; in the left valve there is no escutcheon; pallial line obscure, but the sinus is apparently small and triangular; the hinge is strongly developed, the middle cardinal largest, the anterior left lateral strong and subconic. Height of valve, 16; length, 19; length behind the vertical from the beaks, 14; double diameter of left valve, 16 mm.

Locality.—Station 7096, at Red Bluff, west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166718. Also from the Oligocene of Vicksburg, Mississippi.

PITARIA (LAMELLICONCHA) CALCANEA Dall.

Pitaria (Lamelliconcha) calcanea DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1903, pt. 6, p. 1270, pl. 55, fig. 19.

Locality.—Station 7096, at Red Bluff, on the west bank of the Flint River, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166773. Also in the Oligocene of Vicksburg, Mississippi; Johnson.

PSAMMOBIA CERASIA, new species.

Plate 84, fig. 10.

Shell thin, elongate, inequilateral, the anterior side shorter, the beaks inconspicuous; basal and dorsal margins roughly parallel, both ends evenly rounded, margins entire; pallial line and sinus indistinguishable; hinge in the left valve of three small diverging teeth; the exterior of the shell not preserved, but probably smooth. Length of valve (slightly defective in front), 45; length of posterior portion behind the vertical from the beaks, 28.5; height at the beaks, 25; estimated diameter, 10 mm.

Locality.—Station 3401, lower bed at Cherry Chute, west side of Flint River, 3 miles below Bainbridge, Georgia; T. Wayland Vaughan, collector, in 1900. U. S. Nat. Mus. Cat. No. 166719.

This form probably belongs to the subgenus *Gobraeus*, but whether the outer surface is smooth or sculptured with oblique lines, as in so many other species, can not be determined until more material is obtained.

TELLINA SEGREGATA Dall.

Tellina segregata DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1900, pt. 5, p. 1019, pl. 37, figs. 7, 8; Bull. U. S. Nat. Mus. No. 90, 1915, p. 151, figs. 3, 11.

Locality.—Station 7075, on the east bank of Flint River, about 10½ miles below Bainbridge, Decatur County, Georgia, just above Lambert island; Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166774. Originally collected in the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida. U. S. Nat. Mus. Cat. No. 157847.

?SEMELE, species indeterminate.

Locality.—Station 7094, on the west bank of Flint River, at the railway bridge at Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166775.

An impression, probably of a valve of *Semele*, too imperfect to identify specifically.

MACTRA MISSISSIPPIENSIS Conrad.

Mactra mississippiensis CONRAD, Journ. Acad. Nat. Sci. Phila., new ser., vol. 1, 1848, p. 121, pl. 12, fig. 14.

Locality.—Station 3401, on the west bank of Flint River, 3 miles below Bainbridge, Decatur County, Georgia, at Cherry Chute; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166776. Also from the Oligocene of Vicksburg, Mississippi; Conrad.

CONUS VAUGHANI, new species.

Plate 86, fig. 1.

Shell of moderate size, solid, conic, with about 11 whorls excluding the (defective) nucleus; the spire is moderately elevated, wavy-nodulous at the shoulder, with a very narrow but sharply cut suture; between the shoulder and the edge of the suture are three distinct spiral threads with somewhat wider interspaces; the sculpture of the sides of the shell, for at least half the length of it, is composed of spiral rows of low pustules apparently seated on obscure flattish spiral threads. The remainder of the sides, the aperture, and the canal are obscured by matrix. Height of shell, about 47; diameter at shoulder, 23; height of spire about 7 mm.

Locality.—Station 7074, at Hale landing on the west bank of Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166720.

This species recalls *Conus consobrinus* Sowerby, of the Santo Domingo Oligocene, but the granulation is not on elevated zones and the spire is lower and less conspicuous, judging from the insufficient description of this unfigured species, which is united by some authors with the *C. granozonatus* of Guppy.

CONUS COOKEI, new species.

Plate 86, fig. 2.

Shell of moderate size, regularly biconic, of eight or nine whorls, each on the spire rising slightly above the suture in front of it, the space between the sutures flattish, carrying three spiral threads with wider interspaces; the shoulder of the whorl simple; in front of the suture a very slight inflation of the upper half of the whorl, the rest being direct and flattened; near the shoulder the whorl is sculptured rather closely with obscure spiral threads; in front of these the sculpture becomes strap-like, separated by narrow sharp grooves; nearer the canal these flat spaces begin to be divided by a shallow medial groove, giving them a paired effect, these again become closer and feebler close to the canal. Length, 38; length of shell in front of the shoulder, 34; diameter at shoulder, 19 mm.

Locality.—Station 7079, on the east bank of the Flint River below the mouth of Blue Spring branch, at Mascot Point, in chert blocks; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166721.

This description is taken from a cast made from a mold in the chert rock. The shell seems nearest to the *Conus stenostomus* of Sowerby, from the Santo Domingo Oligocene, but is less attenuated anteriorly, has the spire less scalar and the extreme apex of the spire is much less prominent.

CONUS DEMIURGUS Dall.

Conus demiurgus DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1903, pt. 6, p. 1633, pl. 60, fig. 22.

Locality.—Station 7096, on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia, at Red Bluff; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166777. Also in the Oligocene marl of the Chipola River, Calhoun County, Florida; Dall.

CONUS TORTILIS Conrad.

Conus tortilis CONRAD, Proc. Acad. Nat. Sci., Phila., for 1855, p. 260.—WAILLES, Geol. Miss., 1858, pl. 15, fig. 5.—CONRAD, Amer. Journ. Conch., vol. 1, 1865, p. 30.

Locality.—Station 7096, on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia, at Red Bluff; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166778. Also in the Eocene of Jackson, Mississippi.

CONUS, species indeterminate.

Localities.—Station 3381, at the base of the bluff at Little Horse-shoe Bend, just below the mouth of Blue (or Russell) Spring branch, 4 miles below Bainbridge, Decatur County, Georgia, on the Flint River; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166779; and at station 7074, on the west bank of Flint River, 7 miles south-east of Bainbridge, at Hale landing, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166780.

Internal casts of undeterminable species of *Conus* were obtained at the above localities.

TURRIS, species indeterminate.

Locality.—Station 7094, on the west bank of Flint River, at the railway bridge at Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166781.

Casts of an undeterminable species of *Turris* were collected at the above locality.

MARGINELLA SILICIFLUVIA, new species.

Plate 88, fig. 1.

Shell small, smooth, slender, with about five moderately convex whorls, the suture obscured by a thin wash of enamel; apex blunt; last whorl much the largest, the suture behind it slightly constricted; outer lip slightly thickened, the aperture obscured by the presence of matrix. Actual length of specimen, 8.5 mm.; the total length probably about 8.8; diameter, 4 mm.

Locality.—Station 7074, on the west bank of Flint River, 7 miles southeast of Bainbridge, at Hale landing, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166722.

This species belongs to the group of *Marginella avena* Lamarck, a representative of which has hitherto been missing from this horizon.

MARGINELLA HALENSIS, new species.

Plate 88, fig. 2.

Shell small, smooth, a thin layer of callus covering the rather blunt spire, which appears to consist of three or four whorls; the aperture concealed by matrix; the outer lip noticeably thickened, the reflected callus carried around the outside of the canal; the body inflated, rapidly attenuated anteriorly, the periphery at the shoulder. Length, 2.75; diameter 1.78 mm.

Locality.—Station 7074, on the west bank of Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, at Hale landing, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166723.

LYRIA MANSFIELDI, new species.

Plate 86, fig. 3.

Shell fusiform, solid, with about seven whorls, excluding the (lost) nucleus; suture distinct but not impressed; whorls rapidly enlarging, moderately convex, with an acute apex; axial sculpture of about (on the penultimate whorl) nine low and ill-defined ribs, none distinct on the earlier whorls and on the last whorl becoming obsolete anteriorly; the lines of growth are also rather marked; spiral sculpture near the canal of four or five flattish threads with wider interspaces; the canal is bent to the right and has a distinct siphonal fasciole; outer lip defective; inner lip with eight or more columellar plaits more prominent anteriorly, with a rather heavy callus on the body near the junction of the outer lip. Length of shell, 47; of last whorl, 41; maximum diameter, 22 mm.

Locality.—Station 7096, at Red Bluff, on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166724.

This is not unlike *Lyria pulchella* Sowerby, of the Santo Domingo Oligocene, but has a higher spire and fewer and stronger ribs. *Lyria musicina* Heilprin, has a deeper suture and more emphatic sculpture.

LYRIA, sp. aff. SILICATA Dall.

Lyria silicata DALL, Bull. U. S. Nat. Mus. No. 90, 1915, p. 59, pl. 10, fig. 3 (*Orthaulax pugnax* zone, at Ballast Point, Tampa Bay, Florida).

Locality.—Station 7074, at Hale landing, on the west bank of Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166800.

Another specimen from the vicinity of the Blue Spring, near Flint River, resembles the type specimen of *L. silicata* in being smooth, but is even more inflated and shorter in proportion. Until more and better specimens of this form are obtained, the limits of its variation can not be safely determined.

MITRA SYRA Dall.

Mitra syra DALL, Bull. U. S. Nat. Mus. No. 90, 1915, p. 60, pl. 12, fig. 17.

Locality.—Station 3383, at the base of the bluff at Little Horseshoe bend, just below the mouth of Blue (or Russell) Spring branch, 4 miles below Bainbridge, Decatur County, Georgia, on the Flint River; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166782. Also in the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida, Post; U. S. Nat. Mus. Cat. No. 165067.

XANCUS WILSONI Conrad.

Turbinella wilsoni CONRAD, Journ. Acad. Nat. Sci., Phila., new ser., vol. 1, 1848, pt. 2, p. 120, pl. 12, fig. 12.

Locality.—Station 3381, at the base of the bluff at Little Horseshoe bend, 4 miles below Bainbridge, Decatur County, Georgia, and just below the mouth of Blue (or Russell) Spring branch, on the east bank of Flint River; T. W. Vaughan, 1900. U. S. Nat. Mus., Cat. No. 166783. Also at station 7075, on the east bank of Flint River, 10½ miles below Bainbridge and just above Lambert island; and at station 7079, on the east bank of Flint River, below the mouth of Blue Spring branch, at Mascot Point, in chert blocks; Vaughan, Cooke, and Mansfield, 1914. Also in the Oligocene of Mississippi at Vicksburg; Conrad.

FUSINUS NEXILIS Dall.

Plate 88, fig. 13.

Fusus (Chrysodomus) nexilis DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1890, pt. 1, p. 198, pl. 8, fig. 6 (not fig. 4), 1890.

Fusinus nexilis DALL, Bull. U. S. Nat. Mus. No. 90, 1915, p. 66, pl. 8, fig. 8.

Locality.—Station 7096, on the west bank of Flint River, at Red Bluff, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan,

Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166784. Also in the *Orthaulax pugnax* zone, at Ballast Point, Tampa Bay, Florida; Dall, 1885. U. S. Nat. Mus. Cat. No. 112054.

The figure does not show as clearly as might be wished the strength of the sculpture on the upper part of the spire, the curvature of the canal, or its constriction at the base of the whorl.

MUREX RUFIRUPICOLUS, new species.

Plate 86, fig. 8.

Specimen represented by an internal cast with a slightly defective apex; fusiform with over four whorls, a long straight canal, a rounded aperture, the outer lip expanded, thickened, crenulate, with a prominent guttered spine at the shoulder, a large dentiform callosity internally just in front of the suture, and six prominent internal lirations diminishing anteriorly, in front of the groove at the shoulder. There appear to have been two feeble varices or thickenings visible on the internal cast on each of the antecedent whorls, and an expansion of the outer lip continued some distance down on the right margin of the canal. Length of the cast as figured, 42; maximum diameter of the last whorl, 19 mm.

Locality.—Station 7096, on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia, at Red Bluff; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166725.

Ordinarily an internal cast is of little value in determining a species of gastropod, but in this case the imprint is so complete that distinctive characters separating this form from any other now known from the Gulf Coast Oligocene, are present.

EPITONIUM(?) DUBIOSUM, new species.

Plate 88, fig. 3.

Shell minute, only the last whorl accessible, the whorl with a circular cross section, smooth except for thin, sharp lamellae, of which there appear to be at least 30 on the (last) whorl; aperture slightly expanded with a sharp margin, apparently entire; umbilicus deep, circular, rather large for the shell. Maximum diameter of whorl, 1.5; minimum diameter, 1; height, 0.75 mm.

Locality.—Station 7074, on the west bank of the Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, at Hale landing, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166726.

This fragment may be the basal whorl of a minute *Epitonium*, or possibly a Trochoid allied to *Vetulonia*.

The impossibility of detaching the matrix renders a final decision impracticable; but, in any case, the characteristics are such that a complete specimen could not fail to be recognized. If we were per-

mitted to include a land shell in this marine deposit one might suspect it to be one of the lamellose Vallonias.

CYMATIUM CECILIANUM, new species.

Plate 85, fig. 10.

Shell small, thin, of about five whorls excluding the (decollate) apex, with a few thin, almost sharp varices irregularly disposed; suture distinct, not channeled; early whorls with two sharp revolving ridges, subequal, forming the periphery; within the excavated but not channeled interspace a single small spiral thread; in the space between the suture and the first ridge there are three or four threads, the first, well separated from the suture by an excavated but not channeled interval, is a little more prominent and sharper than the others; in the narrower space between the second ridge and the suture in front of it are one or two fine threads; the last whorl between the suture and the canal are seven or eight prominent rather sharp ridges, the two near the periphery most prominent; all are acutely nodulose, where they cross the varix and are separated by subequal interspaces which carry two or three fine spiral threads in each; the canal is almost straight and obliquely spirally closely threaded; there is no callus on the inner lip in the specimen, which is probably somewhat immature; the outer lip is wanting. Length of decollate five whorls, 25; of last whorl, 17; diameter of last whorl, about 14 mm.

Locality.—Station 7074, on the west bank of Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, at Hale landing, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166727.

BURSA VICTRIX, new species.

Plate 88, fig. 10.

Shell of moderate size, the apex wanting, the type-specimen cast from a mold comprising three whorls, with discontinuous lateral varices two to a whorl; the varices are rounded and nodulous, the sculpture harmonizing with the spiral sculpture of the roundly inflated whorls; the suture is distinct, not channeled. The sculpture comprises on the last whorl a smooth interval sloping from the suture; then a sparsely prominently beaded cord; then a wider interval carrying a less prominent and less distinctly beaded cord, followed by a simple spiral thread; then a broad band forming the shoulder of the whorl and carrying about a dozen semiglobular prominent nodulations, the whole sharply spirally striated; in front of this two subequal and equidistant narrower bands similarly but more closely and feebly nodulous and striated, in front of which on the preceding whorls the suture is laid. The base shows two minutely

beaded spirals, alternating with single plain spiral threads, followed by 8 or 10 smaller, mostly simple and closely adjacent threads, one or two of which show a tendency toward beading. The canal is short and twisted, and obscurely spirally threaded. Height of three visible whorls, 42; diameter at decollate earliest whorl, 11; maximum diameter of last whorl, 27 mm.

Locality.—Station 7079, on the east bank of Flint River, below the mouth of Blue (or Russell) Spring branch, at Mascot Point, in chert blocks; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 160728.

CASSIS SULCIFERA Sowerby.

Plate 86, fig. 4.

Cassis sulcifera SOWERBY, Quart. Journ. Geol. Soc. of London, vol. 6, pt. 1, May, 1849, p. 47, pl. 10, fig. 1. (Santo Domingo.)

Localities.—Station 3381, at the base of the bluff at Little Horseshoe bend, on the Flint River, 4 miles below Bainbridge, Decatur County, Georgia, just below the mouth of Blue (or Russell) Spring branch, in fossil coral reef; T. W. Vaughan, 1900; U. S. Nat. Mus. Cat. No. 166785. Also at station 3388 at Red Bluff, on Flint River, 7 miles above Bainbridge, in the upper fossiliferous stratum at that locality; at station 7074, at Hale landing, 7 miles southeast of Bainbridge, on the west bank of Flint River, in coralliferous chert; at station 7079, on the east bank of Flint River, at Mascot Point, in chert blocks; at station 7096, at Red Bluff, on the west bank of Flint River, 7 miles above Bainbridge; at station 7150a on the east bank of Flint River, just below the wagon bridge, from loose blocks of chert; Vaughan, Cooke, and Mansfield; and from the Oligocene of Santo Domingo; Sowerby.

Though no complete specimens were found, the identification of the species appears to be certain.

CASSIS GLOBOSA Dall.

Cassis (Phalium) globosum DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 1, 1890, p. 161; pt. 2, 1892, p. 262, pl. 20, figs. 6, 11.

Locality.—Station 3381, at the base of the bluff at Little Horseshoe bend, on the Flint River, 4 miles below Bainbridge, Decatur County, Georgia, just below the mouth of Blue (or Russell) Spring branch on the east bank of the river; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166786. Also in the Jacksonian Eocene of Ocala, Florida, and the Oligocene marl of the Chipola River, Calhoun County, Florida.

Unidentifiable remains of a species of *Cassis* from station 3401, on the west side of Flint River, at Cherry Chute, 3 miles below Bainbridge, probably belong to this species.

ORTHAULAX INORNATUS Gabb.

Plate 88, fig. 9.

Orthaulax inornatus GABB, Proc. Acad. Nat. Sci., Phila., vol. 24, 1872, p. 272, pl. 9, figs. 3, 4.—GUPPY, Quart. Journ. Geol. Soc. London, Nov. 1876, p. 520, pl. 28, fig. 8.—DALL, Bull. U. S. Nat. Mus. No. 90, 1915, p. 86, pl. 11, fig. 8, 1915.

Localities.—Station 3383, at the base of the bluff at Little Horse-shoe bend, on the east bank of the Flint River, just below the mouth of Blue (or Russell) Spring branch, four miles below Bainbridge, Decatur County, Georgia, in fossil coral reef; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166787. Also from the Oligocene limestone at White Beach, Florida, and the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida; Dall and Willcox. U. S. Nat. Mus. Cat. No. 165099.

Imperfect but perfectly identifiable fragments were obtained by Doctor Vaughan.

In response to a criticism by M. Cossmann that a perfect specimen was not figured in a recent publication, it may be noted that a perfect or nearly perfect adult specimen of this species is yet unknown. All that collectors have been able to secure so far are either immature specimens or fragments. Out of several hundred specimens of *O. gabbii* obtained at Alum Bluff only one retained the outer lip, and a complete specimen of *O. pugnax* is still a desideratum.

ORTHAULAX PUGNAX Heilprin.

Wagneria pugnax HEILPRIN, Trans. Wagner Inst. Sci. Phila., vol. 1, 1887, p. 106, pl. 15, figs. 36, 36a.

Orthaulax pugnax DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 1, 1890, p. 170, pl. 8, figs. 6, 8; Bull. U. S. Nat. Mus. No. 90, 1915, p. 87, pl. 15, figs. 5, 10.

Localities.—Station 7074, on the west bank of Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, at Hale landing, in coralliferous chert; and station 7079, on the east bank of Flint River below the mouth of Blue (or Russell) Spring branch, at Mascot Point, in chert blocks; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166788. Also from the Oligocene zone of which it is the type fossil, at Ballast Point, Tampa Bay, Florida; from Antigua, Cuba, and the Panama Canal Zone.

This can be distinguished at once from *O. inornatus* by its stouter and shorter form and blunt spire. Of neither species has an absolutely perfect specimen been collected, the thin expanded outer lip being invariably defective.

STROMBUS CHIPOLANUS Dall.

Strombus chipolanus DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 1, 1890, p. 176, pl. 4, fig. 1; pt. 2, 1892, p. 263, pl. 13, figs. 1, 3; Bull. U. S. Nat. Mus. No. 90, 1915, p. 87, pl. 9, figs. 9, 10.

Localities.—Station 7074, on the west bank of Flint River, 7 miles southeast of Bainbridge. Decatur County, Georgia, at Hale landing,

in coralliferous chert; and at station 7079, on the east bank of Flint River at Mascot Point, below the mouth of Blue (or Russell) Spring branch; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166789. Also from the Oligocene marl of the Chipola River, Calhoun County, Florida, and in the *Orthaulax pugnax* zone, at Bal-last Point, Tampa Bay, Florida.

STROMBUS, species indeterminate.

Locality.—Station 7096, at Red Bluff, on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166790.

An indeterminate cast of a species of *Strombus* was obtained at the above locality.

BITTIUM SILICIUM, new species.

Plate 86, fig. 11.

Shell small, slender, with a distinct, not channeled, suture and, in the decollate specimen, about eight nearly flat-sided strongly sculptured whorls; axial sculpture of about, on the penultimate whorl, 24 narrow low riblets, with about equal interspaces, overridden and obscured by the strong spiral sculpture. The latter consists of four spiral cords near the apex, rather more slender than the ribs, with about equal interspaces, but later they become broader and stronger, the interspaces relatively somewhat narrower, the cords where they cross the ribs are swollen rather than nodulous, and the interspace separating the anterior and posterior pairs is deeper and more channeled than the others; on the last whorl the ribs are feebler than previously and the periphery is formed by the fourth cord. On the base follow four more crowded simple spirals, the anterior a little more prominent than the others and separated by a wider space from a sort of keel and several finer threads which encircle the vicinity of the canal and the canal itself. The latter is short and shallow; the aperture is defective; the apex of the shell is wanting. Length of shell, 20; of last whorl, 7; diameter of decollation, 3; of the base, 7 mm.

Locality.—Station 7075, on the east bank of Flint River, about 10½ miles below Bainbridge, and just above Lambert Island; Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166729.

DIASTOMA GEORGIANA, new species.

Plate 86, fig. 6.

Shell small, slender, acute, the nucleus small, pointed, of about two whorls, obscured by adherent matrix, with about 10 subsequent gradually enlarging whorls; sculpture coarse, axially sculptured with about (on the penultimate whorl) a dozen rounded ribs with subequal interspaces, these ribs broader and more prominent anteriorly;

sutures deep, not channeled, and the whorls well rounded; spiral sculpture comprising two strong rounded cords with a narrower interspace at the periphery, with two finer threads behind and one in front of the more prominent pair; base convex with about five subequal spiral threads with about equal interspaces; the canal short and patulous, the aperture mostly concealed by matrix, but with the outer lip slightly flaring and a prominent rounded varix behind it. Length of shell, 6; maximum diameter, 2.6 mm.

Locality.—Station 7075, on the east bank of Flint River, about 10½ miles below Bainbridge, Decatur County, Georgia, and just above Lambert Island; Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166730.

CERITHIUM SILICIFLUVIUM, new species.

Plate 87, figs. 4, 5.

Shell large, solid, acute-conic, of 10 or more moderately convex whorls, earlier whorls sculptured with 11 or 12 retractively arcuate narrow simple axial ribs extending from suture to suture, with wider interspaces, the periphery of the whorls nearer the anterior suture; the cast of this part of the shell (fig. 4) shows no spiral sculpture; later whorls show an increasing number of more closely set ribs and a slight constriction appears a short distance in front of the suture, giving the effect of a narrow ill-defined presutural spiral band, which becomes more distinct on the later whorls; spiral sculpture also appears, at first as fine striae, later as narrow channels separating subequal flattish spiral cords, of which there are seven or eight on the last whorl of the cast (fig. 5). Length of seven whorls, 45; diameter of the posterior whorl of the seven, 5; of the anterior, 18 mm.

Locality.—Station 3383, at the base of the bluff at Little Horseshoe bend, just below the mouth of Blue (or Russell) Spring branch, Flint River, 4 miles below Bainbridge, Decatur County, Georgia; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166731.

This species has the same type of sculpture as *C. mascotianum*, but the reticulation is less coarse, the shell more slender, the whorls more convex, the presutural band narrower and less conspicuous than in that species. In both the casts do not show either the aperture or the base, but the sculpture and form are quite sufficient to discriminate the species when more perfect examples are obtained.

This species is also found in the lower bed at station 7150a, on the east bank of Flint River, near Bainbridge, just below the wagon bridge, in loose blocks of chert, and at station 7096 on the west bank, 7 miles above Bainbridge at Red Bluff, by Vaughan, Cooke, and Mansfield in 1914. It is the only species of Cerite known to be common to both horizons.

CERITHIUM MASCOTIANUM, new species.

Plate 87, fig. 12.

Shell large, robust, conical, the specimen a cast from an impression in a chert block, showing part of five flattish whorls; axial sculpture of about 30 narrow slightly flexuous ribs with narrower interspaces becoming less prominent on the later whorls; also irregularly distributed thickened varices, of which three are seen on the cast of three half whorls; suture distinct not channeled; in front of it the next whorl carries a thickened band separated from the rest of the whorl by a marked constriction and undulated by the posterior ends of the axial ribs; this band is also more or less spirally striated. Between the constriction and the periphery of the base are six or seven strap-like flattened bands, overriding the ribs without becoming nodulous, the interspaces very narrow. There is also more or less fine spiral striation, which is indistinct on the cast. Length of three whorls, 32; diameter of the posterior of the three, 16; of the anterior one, 22 mm.

Locality.—Station 7079, on the east bank of Flint River, below the mouth of Russell or Blue Spring branch at Mascot Point; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166732.

Fragmentary casts give a length of 70, a maximum width of 22 mm., and show more than 10 whorls. The base appears to have been convex and smooth with a very short stout twisted pillar.

CERITHIUM HALENSE, new species.

Plate 87, figs. 9, 10.

Shell large, conic, the apex defective, the remainder comprising $10\frac{1}{2}$ flat whorls rapidly widening; suture inconspicuous, not interrupting the lateral planes of the spire; sculpture on the ninth whorl comprising a spiral band just in front of the suture, ornamented with low rounded nodules separated from one another by distinct spaces, about four nodules to 10 millimeters length along the band; in front of this are two narrower more closely nodulous spirals with narrower spiral interspaces rather distinctly channeled; in front of the anterior one of these is a somewhat larger similarly nodulous band about half as wide as the first one; in the interspaces or just behind the suture there is occasionally a narrow not nodulate thread; no axial sculpture is perceptible; on the last whorl there is a small thread at the rounded periphery of the base, which in the preceding whorls is usually covered by the suture; the base is flat and smooth except for incremental lines which indicate that the basal part of the outer lip is produced and rounded; the siphon appears to have been very short and

strongly twisted; the specimens do not show the aperture. Height of 10 whorls as figured, 46; of the ninth whorl, 5.5; diameter of ninth whorl, 19; maximum diameter of specimen (fig. 9), 24; of (decollate) apex, 4 mm.

Locality.—Station 7074, at Hale landing on the west bank of Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166733.

A slight variation in the strength of the spiral bands in front of the broad presutural band is visible in some of the specimens when the first and fourth of the four anterior spirals may both be stronger than the included pair. A mold of 16 whorls measures—length, 77, and maximum diameter, 27 mm. The base is convex and smooth with a pillar like that of *C. mascotianum*. Another base measures 32 mm. in diameter.

CERITHIUM VAUGHANI, new species.

Plate 87, fig. 8.

Shell large, solid, flat sided, conic, the cast as figured showing part of five whorls; suture distinct, not channeled; whorls flat, spirally sculptured, the sculpture comprising in front of the suture a conspicuous row of beadlike nodules with about equal interspaces, on the last whorl about 26 in number; in front of this three slightly undulated fine spiral threads with wider subequal interspaces; beyond these a slightly more prominent and more distinctly undulated cord, with a spiral groove in front of it and between it and the sharp edge of the slightly convex nearly smooth base, on the edge of which the preceding sutures are laid; base sculptured only with faint lines of growth, the form of which indicates that the basal lip of the aperture was sharply and roundly produced with a narrow and deep acutely angular notch at the periphery of the base. There are no indications on the cast of axial sculpture unless the undulations of the spirals be so construed. Height of four whorls, 31; diameter of the earliest of these at the posterior suture, 14; diameter of base of last whorl, 25 mm. The aperture and canal are wanting in the mold.

Locality.—Station 7074, on the west bank of Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, at Hale landing, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166734.

CERITHIUM COOKEI, new species.

Plate 87, fig. 11.

Shell of moderate size, slender, acute, of about 10 regularly enlarging whorls; suture distinct, an elevated spiral cord in front of it giving a channeled effect; whorls moderately convex; sculpture

mostly spiral, consisting, first, of the above-mentioned rather prominent cord separated by a somewhat excavated interspace from (on the earlier whorls three) flattened spirals with equal wider interspaces, in two of which on the last whorl faint indications of a very small intercalary thread are visible; the last whorl rounds evenly to the convex base, on which five spiral bands occur, but with narrower groovelike interspaces; these basal bands are distinctly undulated or subnodulous. The canal was apparently short and strongly twisted, the aperture not represented on the mold. Height of 10 whorls (the nucleus not preserved), 41; maximum diameter of last whorl (the outer lip wanting), 17 mm.

Locality.—Station 3381, a fossil coral reef at the base of the bluff at Little Horseshoe bend, just below the mouth of the Blue (or Russell) Spring branch, 4 miles below Bainbridge, on the Flint River, Decatur County, Georgia; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166735.

CERITHIUM CORALLICOLUM, new species.

Plate 87, fig. 6.

Shell large, heavy, the decollate specimen with seven whorls, the four or five earlier whorls with an appressed suture; the subsequent turns in the type-specimen have a strongly marked shoulder just in front of the suture, giving the effect of a channel; the whorls moderately rounded, the earlier ones crossed by (about 14) slightly retractorily curved narrow rounded ribs extending from suture to suture, with somewhat wider interspaces; on the later whorls the ribs gradually become more sparse and prominent with wider interspaces, and are sigmoidly flexuous, subnodulous at the shoulder, and rather abruptly ceasing a short distance behind the succeeding suture; on the last whorl there is a slight constriction in front of the presutural nodules; spiral sculpture of fine at first subequal threads with narrower interspaces; later there is some irregularity in the width of the spirals which become flattish; on the last whorl between the shoulder and the periphery of the base there are about 15 of these spirals; the indications of the defective specimen are that the threads become more prominent at least near the periphery of the rounded base; the aperture is gone, but its posterior commissure is thickened and extended backward toward the periphery of the preceding whorl. Length of specimen as figured, 47; diameter of last whorl, about 20; of apex at fracture, 5 mm.

Locality.—Station 7074, on the west bank of Flint River at Hale landing, 7 miles southeast of Bainbridge, Decatur County, Georgia, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166736.

Though the type-specimen is so imperfect, the sculpture is quite sufficient to distinguish it from any of the other species described in this paper.

CERITHIUM EUTEXTILE, new species.

Plate 87, fig. 7.

Shell elongate, slender, thin, of about 10 flattened whorls; suture distinct but shallow, not channeled; earlier whorls with (about 24) narrow, low equidistant axial ribs extending straightly from suture to suture, and crossed by six or seven fine, equal and equidistant spiral cords, with occasional finer threads in the interspaces, forming an even and finely reticulate surface; the axial sculpture becomes obsolete about the middle of the spire, the spirals become more numerous until, on the last whorl, there are some 25 subequal, sometimes sharp, revolving threads; base slightly rounded, canal short; length of decollate shell as figured, 39; of last whorl, 14; diameter at decollation, 3; at base, 12 mm.

Locality.—Station 3381, at base of bluff at Little Horseshoe bend, 4 miles below Bainbridge and just below the mouth of Blue (or Russell) Spring branch, Flint River, Decatur County, Georgia; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166737.

This is a very characteristic species and can not fail to be recognized when better material is available.

CERITHIUM VAGINATUM, new species.

Plate 87, figs. 1, 2, 3.

Shell about 25 mm. long, acute, slender, with 9 or 10 evenly rounded whorls, suture distinct, not channeled; early whorls with three undulate spiral cords, with subequal interspaces, between the sutures; the undulations appear to be the result of the cords overriding faint axial ribs, but the ribs are indicated chiefly by the undulations and are absent from the later whorls; there are also fine spiral threads covering the entire surface, and occasional rounded varices irregularly distributed and more numerous on the earlier whorls. On the last whorl the posterior cord alone is undulated; the others are of a squarish form, with slightly narrower, deeply channeled interspaces; in addition to the three major cords there are two or three smaller ones, one at the edge of the base and the others in front of it, with a finer thread between and near the short twisted canal; aperture only slightly expanded, most of it defective in the specimens; length of specimen (fig. 1), 22; diameter at decollation, 4; diameter of last whorl, 11 mm.

Locality.—Station 7075, on the east bank of Flint River, about 10½ miles below Bainbridge, and just above Lambert Island; Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166738.

This species belongs to the group of *C. georgianum* Lyell and Sowerby, but differs from that species by its smaller size and less arcuate axial ribs.

CERITHIUM INSULATUM, new species.

Plate 86, fig. 12.

Shell small, acute, strongly sculptured with more than nine rounded whorls (the apex defective); suture distinct, not channeled; axial sculpture of 12 to 15 rounded ribs extending from suture to suture, but not over the base, with occasional much stronger but similar varices irregularly distributed; spiral sculpture of (on the penultimate whorl) five rounded threads, subequal and equidistant, which are swollen where they override the axial ribs; there is a strong simple spiral cord, at the periphery of the base, which is sometimes more or less visible behind the suture, and on the moderately rounded base are two or three rather strong spirals with equal or wider interspaces; the canal is short and twisted; the aperture concealed by matrix but with a thickened outer lip. Height (slightly decollate), 19; height of last whorl, 6.5; maximum diameter, 9 mm.

Locality.—Station 7075, on the east bank of Flint River, 10½ miles below Bainbridge, Decatur County, Georgia, just above Lambert Island; Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166739.

This species belongs to the group of *Cerithium muscarum* Say, and *C. georgianum* Sowerby, but is sufficiently distinct from either.

CERITHIOPSIS DIAGONA, new species.

Plate 86, fig. 7.

Shell small, slender (decollate), with 10 remaining flat-sided whorls; last whorl with a mesial constriction, on each side of which are two spiral cords, the anterior pair subequal, separated by a narrow sulcus, with the most anterior forming the periphery of the whorl; both cords are nodulously undulated, with about 22 nodulations separated by narrower intervals; of the posterior pair the first is laid upon the preceding inconspicuous suture and is broader than either of the anterior pair, is similarly but less distinctly undulated; the second cord is much smaller but also undulated. The base is flattened and nearly smooth, or faintly spirally striate, the condition of the specimen making the determination of the surface uncertain; the aperture is subquadrate, the canal short and twisted, the edge of the pillar with a thick not very sharply defined fold. Length of specimen as figured, 10; diameter of the base, 4; length axially of the last whorl, 2 mm.

Locality.—Station 7074, on the west bank of the Flint River at Hale landing, 7 miles southeast of Bainbridge, Decatur County, Georgia, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166740.

TURRITELLA HALENSIS, new species.

Plate 86, fig. 9.

Only a mold of about five whorls of this species is available, but the sculpture differs from that of any of the Tampa species and it therefore seems proper to describe it. The whorls increase in diameter very slowly and overhang somewhat at the suture. The spiral sculpture comprises on the best preserved whorl two or three minor threads in front of the suture; then one simple, more elevated major spiral; then a constriction carrying two minor threads with equal interspaces, in which are a few faint spiral striae; then a stronger and more prominent major spiral, simple and forming the periphery of the whorl; this spiral grows proportionately more prominent as the whorls succeed one another. In front of this and separated by a faintly spirally striated equal interspace is a third simple major spiral overhanging the next suture, and which in the earlier whorls is about equal in strength to the major spiral behind it, but in the later ones is somewhat weaker. Height of the three best preserved whorls, 21; diameter of the earlier of the three, 9.5; of the latest of the three, 14 mm. The base and apex of the shell are defective.

Locality.—Station 7074, on the west bank of the Flint River, 7 miles southeast of Bainbridge at Hale landing, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166741.

TURRITELLA TAMPAE Heilprin.

Turritella tampae HEILPRIN, Trans. Wagner Inst. Sci. Phila., vol. 1, 1887, p. 113, pl. 8, fig. 53.—DALL, Trans. Inst. Sci. Phila., vol. 3, pt. 2, 1892, p. 309, pl. 17, fig. 8; Bull. U. S. Nat. Museum No. 90, 1915, p. 97, pl. 14, fig. 1.

Localities.—Stations 3381 and 3383 at base of the bluff, on the east side of Flint River, 4 miles below Bainbridge, Decatur County, Georgia, at Little Horseshoe bend, just below the mouth of Blue (or Russell) Spring branch, in fossil coral reef; T. W. Vaughan, 1900. U. S. Nat. Mus. Cat. No. 166791. Also at station 7074 at Hale landing on the west bank of Flint River, 7 miles southeast of Bainbridge, in coralliferous chert; and station 7075, on the east bank of Flint River, 10½ miles below Bainbridge and just above Lambert island; Vaughan, Cooke, and Mansfield, 1914. The original provenance of the species, as its name implies, was in the *Orthaulax pug-nax* zone at Ballast Point, Tampa Bay, Florida, Heilprin, 1885. U. S. Nat. Mus. Cat. No. 165119.

TURRITELLA, species indeterminate.

Locality.—Station 7096, at Red Bluff on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia, and station 7079, at Mascot Point, on the east bank below the mouth of

Blue (or Russell) Spring branch, and about 4 miles below Bainbridge, in chert blocks; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166792.

Casts of an unidentifiable *Turritella* not identical with *T. tampae* were obtained at the localities mentioned.

CALYPTRAEA (TROCHITA) TROCHIFORMIS Lamarck.

?*Infundibulum trochiformis* CONRAD, Journ. Acad. Nat. Sci., Phila., new ser., vol. 1, 1848, pp. 113, 133, pl. 11, fig. 3.—Cf. DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, 1892, pt. 2, p. 352.

Locality.—Station 7096, at Red Bluff, on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166793.

Impressions of a *Calyptraea*, which is doubtless identical with that referred to by Conrad to Lamarck's species, were found as above mentioned.

XENOPHORA CONCHYLIOPHORA Born.

Plate 86, fig. 10.

Trochus conchyliphorus BORN, Mus. Caes. Vind. index, 1778, p. 333.

Xenophora laevigata FISCHER DE WALDHEIM, Tab. Syn. Zoogn., 1808, p. 113.

?*Trochus leprosus* MORTON, Syn. Org. Rem., 1834, p. 15, pl. 46, fig. 6.

Phorus reclusus CONRAD, Proc. Acad. Nat. Sci., Phila., vol. 7, 1855, p. 262.—WAILES, Geol. Miss., 1854, p. 289, pl. 17, figs. 6a, 6b.

Xenophora agglutinans GREGORIO, Mon. Eoc. Ala., 1890, p. 144; not of Lamarck.

Xenophora humilis DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 1, 1890, p. figs. 10, 10a; not of Conrad.

Xenophora conchyliphora DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 2, 182, 1892, p. 360; Bull. U. S. Nat. Mus. No. 90, 1915, p. 105, pl. 15, figs. 1, 3.

Localities.—Station 7078, on the east bank of Flint River, about a quarter of a mile below Hale's landing, Decatur County, Georgia, near the lower end of Smith's reach; Cooke and Mansfield, 1914. Also at station 7079, on the east bank of Flint River, at Mascot Point, below the mouth of Blue (or Russell) Spring branch, in chert blocks; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus., Cat. No. 166794.

A species of *Xenophora* which presents no distinguishable specific characters from the recent shell described by Born from the West Indies has been obtained from nearly every fossiliferous horizon from the Upper Cretaceous Ripley formation to the Pleistocene. If, as seems probable, these shells belong to one and the same species, it is one of the oldest, if not the very oldest, species of mollusk now living.

AMPULLINA SOLIDULA Dall.

Plate 85, fig. 9.

Ampullina solidula DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 2, 1892, p. 376, pl. 22, fig. 31; Bull. U. S. Nat. Mus. No. 90, 1915, p. 108, pl. 3, fig. 10.

Localities.—Station 3295, at Blue (or Russell) Springs, 4 miles south of Bainbridge, Decatur County, Georgia, on the east bank of

the Flint River; A. H. Brooks, 1900. Station 3388, at Red Bluff on Flint River, 7 miles above Bainbridge, from the upper fossiliferous horizon in the bluff; T. W. Vaughan, 1900. Station 7096, at the same locality; Vaughan, Cooke, and Mansfield, 1914. Station 7075, on the east bank of Flint River, 10½ miles below Bainbridge, and just above Lambert Island. Station 7079, at Mascot Point on the east bank of Flint River below the mouth of Blue Spring branch, in chert blocks; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166795. Also in the *Orthis pugnax* zone at Ballast Point, Tampa Bay, Florida; Dall. U. S. Nat. Mus. Cat. No. 112933.

AMPULLINA STREPTOSTOMA Heilprin.

Plate 85, fig. 11.

Natica streptostoma HEILPRIN, Trans. Wagner Inst. Sci. Phila., vol. 1, 1887, p. 112, pl. 16, fig. 51.

Ampullina streptostoma DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 2, 1902, p. 374; Bull. U. S. Nat. Mus. No. 90, 1915, p. 107, pl. 12, fig. 27.

Localities.—Station 3295, at Blue (or Russell) Springs, 4 miles south of Bainbridge, Decatur County, Georgia; station 3388, at Red Bluff, on Flint River, 7 miles above Bainbridge, from the upper fossiliferous horizon of the bluff; station 3381, at base of bluff at Little Horseshoe bend, just below the mouth of Blue Spring Branch on the east bank of Flint River, 4 miles below Bainbridge, in a fossil coral reef; station 3383 at the same locality; station 6171, at Bainbridge; station 7076, on the east bank of Flint River, at the bend half a mile below Lambert island, about 12 miles below Bainbridge; station 7079, at Mascot Point on the east bank of Flint River, below the mouth of Blue Spring branch, 4 miles south of Bainbridge, in chert blocks; station 7096, same locality as station 3388; and at Jacksonboro, Georgia, and the *Orthis pugnax* zone at Ballast Point, Tampa Bay, Florida. U. S. Nat. Mus. Cat. No. 166796.

As the above list indicates, this is one of the most common Oligocene species of the region, occurring in several horizons, but rarely in even tolerably perfect condition.

AMAUROPSIS OCALANA Dall.

Plate 88, fig. 11.

Amauropsis ocalana DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 1, 1890, p. 377.

Localities.—Station 7074, at Hale landing on the west bank of Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, in coralliferous chert; station 7079, at Mascot Point on the east bank of Flint River below the mouth of Blue (or Russell) Spring branch, 4 miles below Bainbridge, in chert blocks; and station 7095, on the east bank of Flint River, at the bend near the "Old Factory,"

about three-quarters of a mile northeast of the Atlantic Coast Line railway station at Bainbridge; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166797. Also in the Jacksonian limestone at Ocala, Florida; Willcox; U. S. Nat. Mus. Cat. No. 115744.

This species by inadvertance was not figured in the Wagner Transactions and the name was omitted from the index of part 1 of the volume. It has some resemblance to the "*Natica phasianelloides* Orbigny," figured on plate 1 (fig. 7) of the unpublished Paleontology of Cuba, proofs of the plates of which, possessed by the U. S. Geological Survey, were purchased from the Cotteau library. Orbigny's species, however, is larger, more ovate, with a shorter spire and much less elegant form.

SINUM IMPERFORATUM Dall.

Sinum imperforatum DALL, Bull. U. S. Nat. Mus. No. 90, 1915, p. 109, pl. 5, fig. 8.

Locality.—Station 7075, on the east bank of Flint River, about 10½ miles below Bainbridge, Decatur County, Georgia, and just above Lambert Island; Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166798. Also in the *Orthaulax pugnax* zone, at Ballast Point, Tampa Bay, Florida. U. S. Nat. Mus. Cat. No. 166107.

A specimen of this species was obtained at the locality on Flint River, above mentioned.

MARGARITES CORALLICUS, new species.

Plate 88, figs. 5, 6.

Shell small, turbiniform, of about four whorls; nucleus minute, flattened; earlier whorls slightly subangular, feebly spirally striated, with a conspicuous smooth cord behind the suture, which is closely appressed to it; last whorl evenly rounded, rather inflated, rapidly enlarging toward the aperture, which is concealed by matrix; with a strongly convex imperforate base. Maximum diameter 4; height 2.8 mm.

Locality.—Station 7074, on the west bank of Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, at Hale landing, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166744.

TEINOSTOMA SUBLIMATA, new species.

Plate 88, figs. 7, 8.

Shell small, depressed, smooth, with about four whorls; nucleus small, inflated; subsequent whorls nearly covered with enamel and inclosed by the last whorl; spire nearly flat, periphery subangular in the earlier whorls, becoming rounded on the final turn; outer lip slightly depressed above, simple, not sharp; aperture oblique, inter-

rupted by the body; pillar strong, slightly concave; lower lip meeting it at a slight angle and produced beyond it so as to cover the umbilical depression; base moderately convex, imperforate; surface slightly granulate, probably due to mineralization. Maximum diameter, 4; minimum diameter, 3; height, 2.5 mm.

Locality.—Station 7074, on the west bank of Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, at Hale landing, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166745.

LIOTIA (ARENE) HALENSIS, new species.

Plate 88, fig. 4.

Shell small, solid, turbiniform, of about three whorls, the suture appressed, indistinct, with a minute spiral beaded line in front of it; in front of this are two or three fine simple spiral threads with slightly wider interspaces; in front of these are three much stronger simple spirals, on the anterior of which the suture is laid, the interspaces wider and channeled. A fourth similar cord, forming the periphery of the base, enters the aperture just below the sutural commissure. The base is slightly flattened and sculptured with four or five simple cords, with slightly wider interspaces, both diminishing in size toward the pillar. The umbilical region is imperforate; the aperture is sub-circular, slightly crenulated on the outer lip in harmony with the sculpture; the pillar lip thickened and somewhat angular outside of the aperture, where it meets the lower lip. Height, 2; maximum diameter, 3 mm.

Locality.—Station 7074, on the east bank of Flint River, 7 miles southeast of Bainbridge, Decatur County, Georgia, at Hale landing, in coralliferous chert; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166742.

LIOTIA? PERSCULPTURATA, new species.

Plate 86, fig. 5.

Shell small, turbinate, with three or more rapidly increasing rounded whorls, separated by a deep but not channeled suture; apex concealed by matrix; last whorl sculptured by about 15 strong closely beaded subequal spiral cords, separated by subequal channeled interspaces, both evenly distributed over the whole whorl; the interspaces are axially sculptured by sharp, elevated, equal lamellae or imbrications about five to a millimeter, with equal interspaces and uniformly distributed; aperture circular, the inner margin thick and smoothly bevelled to the outer edge, the throat smooth, the base of the whorl imperforate. Height as figured, 65; diameter, 7 mm.

Locality.—Station 3383, from a fossil coral reef at Little Horse-shoe Bend, just below the mouth of Blue or Russell Spring on Flint

River, 4 miles below Bainbridge, Decatur County, Georgia; T. W. Vaughan coll. 1900. U. S. Nat. Mus. Cat. No. 166743.

This fossil, of which no perfect specimen was collected, has such characteristic sculpture that even a fragment of it can be identified. Some little doubt as to its genus existed, as some species of *Vanikoro* have an analogous sculpture. These, however, have a different aperture, and there can be little doubt that the present species should group with the imperforate *Liotias*.

NERITA TAMPAËNSIS Dall.

Nerita tampaënsis DALL, Trans. Wagner Inst. Sci. Phila., vol. 3, pt. 2, 1892, p. 421, pl. 17, fig. 3; Bull. U. S. Nat. Mus. No. 90, 1915, p. 114, pl. 16, fig. 2.

Locality.—Station 7075, on the east bank of Flint River, about $10\frac{1}{2}$ miles below Bainbridge, Decatur County, Georgia, and just above Lambert Island; Cooke and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166799. Also in the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida, and various other localities about Tampa Bay; Dall and Burns.

DENTALIUM LADINUM, new species.

Plate 85, fig. 6.

Shell slender, slightly curved, strongly sculptured, the posterior end more or less incrustated by matrix and the anterior end defective, but the section in front seems to be practically circular; near the posterior end there are 10 or 11 longitudinal ribs, subequal and separated by wider interspaces; at about one-third the distance from the posterior end finer intercalary threads begin to appear, sometimes two, usually one, and rarely none in the widening interspaces. These gradually enlarge until anteriorly they become equal to the original ribs, and all the ribs toward the aperture are more or less paired. The surface in the specimen is largely granulose, but this is probably an incident of silicification; a few indications of incremental lines are perceptible near the anterior end. Length of the specimen, 36; diameter anteriorly, 5; posteriorly, 2 mm.

Locality.—Station 6774, at Rock Island, in the Suwannee River, about half a mile above the wagon bridge at White Springs, Hamilton County, Florida; Vaughan and Cooke, 1913. U. S. Nat. Mus. Cat. No. 166746.

EXPLANATION OF PLATES.

PLATE 83.

- FIG. 1. *Lima halensis* Dall, exterior of right valve; height, 52 mm.; p. 493.
 2. *Pecten suwanneënsis* Dall, cast of left valve; height, 28 mm.; p. 492.
 3. The same, cast of interior of left valve; height, 20 mm.; p. 492.
 4. The same, exterior of right valve; height, 25 mm.; p. 492.
 5. *Spondylus filiaris* Dall, young valve; height, 20 mm.; p. 493.
 6. The same, showing outline and sculpture of adult upper valve; height, 65 mm.; p. 493.
 7. *Lima halensis* Dall, from cast taken from a mold of the hinge line; breadth 16 mm.; p. 493.
 8. The same, exterior of left valve; height, 52 mm.; p. 493.

PLATE 84.

- FIG. 1. *Glycymeris cookei* Dall, exterior of young valve with entire ribs; height, 14 mm.; p. 490.
 2. The same, interior of valve, showing hinge; height, 10 mm.; p. 490.
 3. The same, exterior of larger valve with bifurcated ribs; height, 13 mm.; p. 490.
 4. The same, exterior of another valve; height, 11 mm.; p. 490.
 5. *Chione bainbridgensis* Dall, defective adult right valve; length, 35 mm.; p. 499.
 6. The same, exterior of young left valve; length, 18 mm.; p. 499.
 7. *Phacoides perovatus* Dall, cast of interior of right valve; height, 48 mm.; p. 496.
 8. The same, cast of another valve; height, 53 mm.; p. 496.
 9. *Pecten alpha* Dall, mold of exterior of left valve; breadth, 23 mm.; p. 492.
 10. *Psammobia (Gobraeus) cerasia* Dall, right valve; height, 25 mm.; p. 501.

PLATE 85.

- FIG. 1. *Arcoperna inflata* Dall, right valve; length, 18.5 mm.; p. 494.
 2. *Pitaria (Lamelliconcha) silicifluvia* Dall, exterior of right valve, somewhat encrusted; length, 19 mm.; p. 500.
 3. Interior of the same valve, showing hinge; p. 500.
 4. *Crassatellites paramesus* Dall, exterior of young left valve, showing early sculpture; height, 28 mm.; p. 495.
 5. The same, cast of an adult left valve; height, 33 mm.; p. 495.
 6. *Dentalium ladinum* Dall; length, 36 mm.; p. 522.
 7. *Crassatellites paramesus* Dall, interior of right valve, showing hinge; height, 28 mm.; p. 495.
 8. Exterior of the same valve; p. 495.
 9. *Ampullina solidula* Dall; height, 40 mm.; p. 518.
 10. *Cymatium cecilianum* Dall; height, 25 mm.; p. 507.
 11. *Ampullina streptostoma* Heilprin; height, 40 mm.; p. 519.

PLATE 86.

- FIG. 1. *Conus vaughani* Dall, from a cast; length of entire figure, 51 mm.; p. 502.
 2. *Conus cookei* Dall, from cast; length of shell, 38 mm.; p. 502.
 3. *Lyria mansfieldi* Dall; length, 47 mm.; p. 504.
 4. *Cassis sulcifera* Sowerby, fragment showing the spire; width, 32 mm.; p. 508.
 5. *Liotia? persculpturata* Dall, back of specimen showing sculpture; height, 6.5 mm.; p. 521.
 6. *Diastoma georgiana* Dall; length, 6 mm.; p. 510.
 7. *Cerithiopsis diagona* Dall; length, 10 mm.; p. 516.
 8. *Murex rufirupicolus* Dall, internal cast; length, 42 mm.; p. 506.

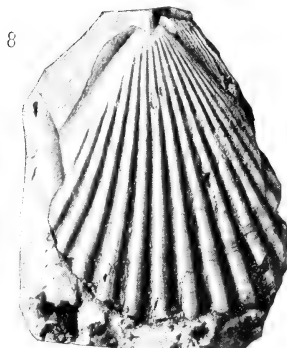
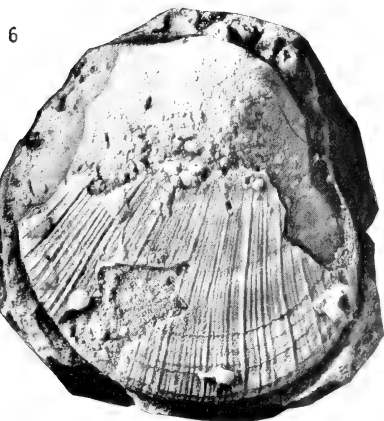
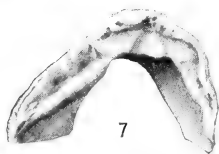
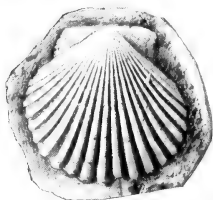
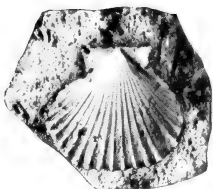
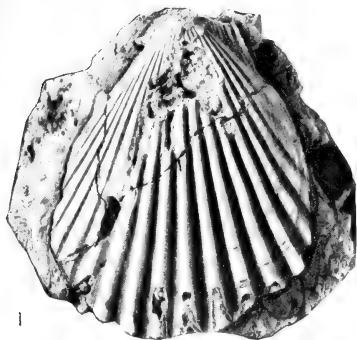
9. *Turritella halensis* Dall, from a cast; length of entire figure, 57 mm.; p. 517.
10. *Xenophora conchyliphora* Born, internal cast; maximum diameter, 42 mm.; p. 518.
11. *Bittium silicium* Dall; length, 20 mm.; p. 510.
12. *Cerithium insulatum* Dall, from a cast; length, 19 mm.; p. 516.

PLATE 87.

- FIG. 1. *Cerithium vaginatum* Dall, length of defective shell, 22 mm.; p. 515.
2. The same, fragment showing detail of spire; length, 17 mm.; p. 515.
 3. The same, cast of last whorl showing intensified sculpture; height of whorl, 11 mm.; p. 515.
 4. *Cerithium silicifluvium* Dall, cast of apex, length, 19 mm.; p. 511.
 5. The same, cast of decollate specimen; length, 45 mm.; p. 511.
 6. *Cerithium corallicolium* Dall, length of entire figure, 47 mm.; p. 514.
 7. *Cerithium eutextile* Dall, length of shell, 39 mm.; p. 515.
 8. *Cerithium vaughani* Dall, cast; height of shell, 32 mm.; p. 513.
 9. *Cerithium halense* Dall, length of entire figure, 60 mm.; p. 512.
 10. The same, cast showing sculpture of lower whorls; length of shell, 26 mm.; p. 512.
 11. *Cerithium cookei* Dall, height of shell, 41 mm.; upper part of apex obscured; p. 513.
 12. *Cerithium mascotianum* Dall, length of entire cast, 53 mm.; p. 512.

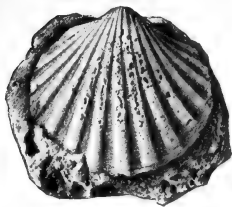
PLATE 88.

- FIG. 1. *Marginella silicifluvia* Dall, length, 8.5 mm.; p. 504.
2. *Marginella halensis* Dall, length, 2.75 mm.; p. 504.
 3. *Epitonium ? dubiosum* Dall, diameter, 1.5 mm.; p. 506.
 4. *Liotia (Arene) halensis* Dall, diameter, 3 mm.; p. 521.
 5. *Margarites corallicus* Dall, back view, diameter, 3 mm.; p. 520.
 6. The same, showing spire, diameter, 3 mm.; p. 520.
 7. *Teinostoma sublimata* Dall, base; diameter, 4 mm.; p. 520.
 8. The same, front view; diameter, 4 mm.; p. 520.
 9. *Orthaulax inornatus* Gabb, fragment showing spire; p. 509.
 10. *Bursa victrix* Dall, cast from mold, length of entire figure, 48 mm.; p. 507.
 11. *Amauropsis ocalana* Dall, internal cast; height, 40 mm.; p. 519.
 12. *Miltha hillsboroënsis* Heilprin, right valve; altitude, 48 mm.; p. 498.
 13. *Fusinus nexilis* Dall, cast; height, 17.5 mm.; p. 505.



MOLLUSKS FROM THE OLIGOCENE BEDS OF FLINT RIVER, GEORGIA.

FOR EXPLANATION OF PLATE SEE PAGE 523



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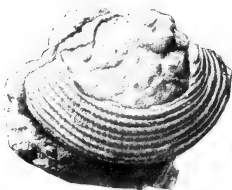
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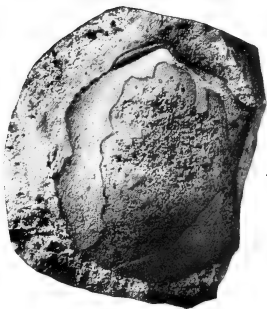
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MOLLUSKS FROM THE OLIGOCENE BEDS OF FLINT RIVER, GEORGIA.

FOR EXPLANATION OF PLATE SEE PAGE 523.



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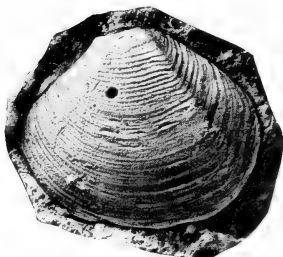
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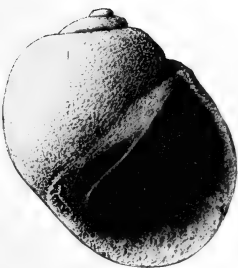
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MOLLUSKS FROM THE OLIGOCENE BEDS OF FLINT RIVER, GEORGIA.

FOR EXPLANATION OF PLATE SEE PAGE 523.



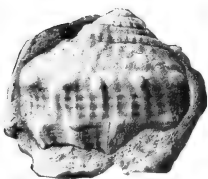
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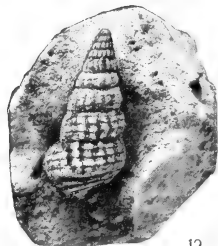
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MOLLUSKS FROM THE OLIGOCENE BEDS OF FLINT RIVER, GEORGIA.

FOR EXPLANATION OF PLATE SEE PAGES 523 AND 524.



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MOLLUSKS FROM THE OLIGOCENE BEDS OF FLINT RIVER, GEORGIA.

FOR EXPLANATION OF PLATE SEE PAGE 524





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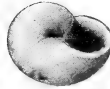
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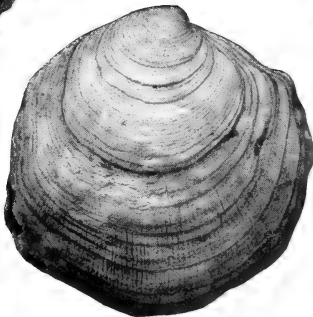
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MOLLUSKS FROM THE OLIGOCENE BEDS OF FLINT RIVER, GEORGIA.

FOR EXPLANATION OF PLATE SEE PAGE 524.

A NEWLY FOUND METEORIC STONE FROM LAKE OKECHOBEE, FLORIDA

BY

GEORGE P. MERRILL

Head Curator, Department of Geology, United States National Museum

No. 2163.—From the Proceedings of the United States National Museum,
Vol. 51, pages 525-526

Published December 21, 1916



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1916

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1867

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A NEWLY FOUND METEORIC STONE FROM LAKE OKE- CHOBEE, FLORIDA.¹

By GEORGE P. MERRILL,

Head Curator, Department of Geology, United States National Museum.

The stone described below was received from Mr. J. O'Neill of Ritta, Palm Beach County, Florida, who states that it was brought up in his net, while seine fishing, some three quarters of a mile from the shore, in the lake above mentioned.

The fragments secured weighed all together about 1,100 grams, the curved surfaces of which suggest that the stone from which they were broken had a diameter of 10 or 12 inches or more.

There is no definite record of a fall in this immediate vicinity, though Mr. O'Neill writes under date of April 11, 1916:

I clearly remember what was supposed to be a meteorite falling about 13 years ago, but it would be hard to ascertain just where it fell. All we know about it is that it fell west of us (i. e., west of Ritta), and people living 50 miles away said it fell east of them. The meteorite, or what was supposed to be one, fell at 10 o'clock one dark night. The sky was suddenly illuminated as if the whole world was on fire, and then there was a great noise like a very large explosion.

These are the well-known phenomena attending a meteoric fall, but whether or not they have any bearing upon the present find will probably never be known absolutely. Correlation is suggested but not proven.

Although from a locality so unfavorable for its preservation, the stone is still firm and shows the characteristic thin, rough, and lusterless black crust. Freshly broken surfaces show a dense, green-gray rock weathered to brown, with little to suggest its meteoric nature until examined under a pocket lens, when the outlines of broken chondrules or pits from which the chondrules have fallen become distinctly visible. Metallic points are few, and scarcely recognizable until the surface is ground smooth. In thin sections under the microscope the chondritic type of the stone is at once evident, the chondrules occurring in all conditions from mere fragments to very perfect spherical forms. They are composed in some cases of olivines, in others of enstatites, and still again of beautifully polysynthetically

¹ Catalogue No. 525, U. S. National Museum.

twinned monoclinic pyroxenes, the individual laminae of which give maximum extinctions of 28° . In but few cases were observed the grate or barred structures so common in olivine chondrules. The usual cryptocrystalline forms are common. The groundmass of the stone is plainly fragmental, consisting of a dense aggregate of minute particles of the three silicates mentioned, throughout which are scattered abundant larger fragments, and in addition numerous granules of metallic iron and iron sulphide. Rarely do these last occur surrounding the chondrules, wholly or in part, but rather as disseminated particles. The fragmental structure of the stone is its most pronounced feature, and relegates it to Brezina's class of chondritic tuffs (Cc) or spherical chondrites.

The staining of the stone through oxidation renders the detection of minor constituents difficult if not impossible. No phosphatic mineral could be recognized microscopically. The pulverized stone, however, digested in cold dilute nitric acid (1 part HNO_3 to 10 H_2O) for but 15 minutes reacted distinctly for calcium and phosphoric acid. It is well to remember in this connection, however, that the stone had been soaking for an undetermined period in the waters of Lake Okechobee, and that the lake itself must receive a portion of its waters from the phosphate fields to the north. Whether or not these facts have any bearing upon the chemical reactions noted, the writer is not prepared to even guess.

This is the first reported find of a meteorite within the state limits of Florida, and while in itself it presents nothing of unusual interest, the manner of its finding is decidedly unusual. So far as I am aware there is no other record of a meteorite having been found under similar conditions. It will be known as the Lake Okechobee stone.

A REVISION OF THE ROTATORIAN
GENERA LEPADILLA AND LOPHOCHARIS WITH
DESCRIPTIONS OF FIVE NEW SPECIES

BY

HARRY K. HARRING

Custodian of Rotatoria, United States National Museum

No. 2164.—From the Proceedings of the United States National Museum,
Vol. 51, pages 527-568, with Plates 89-97

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A REVISION OF THE ROTATORIAN GENERA LEPADELLA AND LOPHOCHARIS WITH DESCRIPTIONS OF FIVE NEW SPECIES.

By HARRY K. HARRING,
Custodian of Rotatoria, United States National Museum.

INTRODUCTION.

In the following pages an attempt has been made at a revision of the Rotatoria that have been gradually accumulating under the generic name *Metopidia*. Adequate descriptions exist only in the case of a few strikingly marked species, and the majority are decidedly unobtrusive in appearance, so that the group is now in a very confused condition. This is not entirely of recent origin, but dates back in part at least to Ehrenberg. He seems to have been temporarily under the ascendancy of Schelling's Naturphilosophie and the circular, quinary and other vagaries of Oken, who was trying by abstract speculation to discover the simple and perfectly logical system pervading all nature; the facts, when found, were bound to fit the theory. This influence is very evident in the highly artificial classification proposed by Ehrenberg in his paper read before the Berlin Academy in 1850.

While Ehrenberg gradually drifted away from this system, he never rescued the Lepadellids, the one group that, more than any other, had suffered from it. We find, therefore, in his Infusions-thierchen of 1838 a total of four species belonging to this genus under seven specific names, one animal being allotted no less than four specific and three generic names, founded on the supposed number of eyespots; none, two or four. That all the Lepadellids have two eyespots, and two only, was demonstrated long ago, and it is in no case accepted as a generic character. Dujardin, in 1841, united these supposed species in one genus, *Lepadella*, and attempted to reduce their number, but his first-hand knowledge of the animals appears to have been rather limited and his work is probably in this instance simply compilation. Gosse, in *The Rotifera*, followed his example and left the species in a single genus, applying to it the name *Metopidia*, the most recent one of those proposed up to that time. His treatment of the different species is a great improvement

over that of Ehrenberg, but his achievement was partly nullified by Hudson in the Supplement, where all the Ehrenbergian names are rehabilitated.

In dealing with the Rotatoria grouped under the name *Metopidia* by Hudson and Gosse it is necessary to separate them into two genera, *Lepadella* and *Lophocharis*, as proposed by Iroso in a recent paper. This division was suggested by Ehrenberg in 1838,¹ but for convenience he left the only then known species of *Lophocharis* in the genus *Lepadella*. The anatomy of the two genera differs in so many important points that no serious objection can be urged against their separation. *Lepadella* is without doubt descended from forms that until comparatively recent times did not have the integument stiffened into a lorica except on the dorsal surface. If additional evidence were needed on this point, it is furnished by the closely related genus *Colurella* (= *Colurus*), which even today is without a ventral plate; it is true that the edges of the dorsal plate have in this case curved toward each other, so as to leave only a narrow ventral slit unprotected by the lorica, thus accomplishing the same object in a different way, but the history of the development of the lorica is obvious. *Lophocharis*, on the contrary, has a box-like lorica, which shows no evidence of having passed through the *Colurella*-stage, and it is highly probable that the lorica was developed gradually and simultaneously over the entire surface of the body. The peculiar structure of the posterior end of the body in the Lepadellids, with the foot projecting through the ventral plate at the anterior end of a "foot groove," occupying about one-third of the length of the ventral plate, is totally absent in *Lophocharis*, and so is the protective dorsal hood over the corona. The Lepadellids have two frontal eyespots, while *Lophocharis* has, according to Iroso, a single eyespot on the ganglion.

While both genera belong to the group centering about the genus *Euchlanis*, they must be assigned to different branches of it. *Lepadella* (with *Colurella*) appears to be more nearly related to the genus *Euchlanis* than to any other, while *Lophocharis* belongs to a small group typified by the genus *Trichotria* (= *Dinocharis*). This group also includes *Macrochaetus* (= *Polychaetus*) and *Wolga* Skorikov, the last-named genus with the single species *W. spinifera* (= *Distyla spinifera* Western), which is in no way related to the genus *Lecane* (including the genera *Cathypna* Gosse and *Distyla* Eckstein, not of Eichwald), as it is without any of the generic characters of typical Lecanids.

As a rule no localities have been given for the species considered in this paper. Two reasons may be advanced for this omission. The more easily recognized species, which may with a fair degree

¹ Infusionsthierchen, p. 438.

of certainty be accepted as correctly determined, appear to be found the world over, wherever collections are made in suitable localities, and the relatively small number of existing records are consequently of little significance. As for the more critical species, on account of the lack of precision in the original descriptions, from which the determinations were made, it is usually quite uncertain what the investigator who recorded them may have been dealing with, and a repetition of such references would be of no assistance in attempts to ascertain the geographic range of the species. It is the hope of the writer that this paper may simplify the task of identifying these small forms and thus contribute to a solution of the problems of distribution. Of the species here described there are at least 8, and possibly 10, that have not as yet been reported from Europe; whether they will eventually be found there also, or whether an equal number of non-American forms will be discovered, remains to be seen. However, the latter contingency appears rather remote, as the genus has all the earmarks of being a very ancient one, which long ago became so highly specialized as to preclude any further evolution or local species-formation and therefore devoted its energies to dispersion.

All the species described have been studied from fully contracted specimens, as the anterior margin offers some of the most important characteristics. In order to avoid needless multiplication of plates and to indicate the limits of variation the dorsal and ventral views have been drawn from different specimens. For some highly variable species this was insufficient and enough figures have been added to show at least the principal forms likely to be met with.

For the illustrations the sliding scale used by the writer in two earlier papers has been employed. An animal measuring 100 μ is represented by a figure 50 mm. long and for each succeeding 100 μ an addition of 10 mm. is made. This method is a compromise and as such is of course open to objections, but it gives at least a system. The uniform magnification used by some writers is objectionable in that either the small species must be figured so very small as to make it impossible to give the necessary detail, or else the large forms reach impracticable dimensions. A uniform magnification seems, moreover, comparatively meaningless; when natural size is once discarded, the extent of the departure is of minor importance. In the study of the animals a magnification suited to the object is employed and actual measurements obtained by means of the micrometer. The sliding scale has the advantage of not reducing the smallest species below the point where details may be satisfactorily shown, while the largest known rotifer may be figured on an octavo page and at the same time some indication of the comparative size is given.

Among the important causes of the present confusion in the Lepadellids, allowance must be made for the variability of some of the species, notably of *Lepadella patella* (Müller) and *L. ovalis* (Müller); intimately connected with this is the fact that material from a sufficiently large territory to ascertain the limits of these variations has not been at the command of any one investigator. The writer has been very fortunate in having access to an abundance of collections, without which this work would have been impossible.

Through the kind intervention of Dr. Chancey Juday, of the University of Wisconsin, to whom I am specially indebted, as well as to Dr. E. A. Birge, director of the Wisconsin Geological and Natural History Survey, I have had the use of the following material from the all but inexhaustible storehouse of the Survey:

Collections by Doctor Birge during the Great Lakes Investigations by the United States Fish Commission in 1899.

Collections from Texas, Louisiana, Arkansas, and Missouri, by Doctor Birge and Doctor Juday in 1903.

Collections from the Finger Lakes in New York, by Doctor Birge and Doctor Juday in 1910.

Collections from Washington, Oregon, Idaho, and California by Mr. W. Boormann, of the University of Wisconsin, in 1910.

Collections from Mexico, Guatemala, Salvador, and Nicaragua by Doctor Juday in 1910.

Collections from various points in Alaska by Mr. G. Dallas Hanna in 1905.

Collections by Mr. J. M. Jessup in 1911 and 1912 along the boundary line between Alaska and Canada from the Porcupine River to the Arctic Ocean.

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It is a great pleasure to express my gratitude to these gentlemen, as any value which this work may have is principally due to their kind assistance; with only local material for study, the writer would have been no better off than earlier investigators working also on collections from a limited territory and would no doubt have encountered the same pitfalls.

The species listed below have been omitted from the specific descriptions, as they are unknown to the writer. Some appear to be insufficiently described for identification and others were probably incorrectly referred to the genera which form the subject of this paper.

Lepadella mucronata SCHMARDA, Neue wirbell. Thiere, vol. 1, pt. 1, 1859, p. 57, pl. 13, fig. 120.

Lepadella setifera SCHMARDA, Neue wirbell. Thiere, vol. 1, pt. 1, 1859, p. 58, pl. 13, fig. 121.

Lepadella vitrea (SHEPHARD).

Metopidia ovalis ANDERSON and SHEPHARD, Proc. Royal Soc. Victoria, n. ser., vol. 4, 1892, p. 78, pl. 12, fig. 6.

Metopidia vitrea SHEPHARD, Proc. Royal Soc. Victoria, n. ser., vol. 24, 1911, p. 55.

Lepadella vitrea HARRING, Bull. 81 U. S. Nat. Mus., 1913, p. 65.

Lophocharis rostrata EICHWALD, Bull. Soc. Imp. Nat. Moscou, vol. 22, 1849, pt. 1, p. 536, pl. 4, fig. 27.

Lophocharis triangulum EICHWALD, Bull. Soc. Imp. Nat. Moscou, vol. 17, 1844, pt. 2, p. 680.

Metopidia pygmaea GOSSE, Journ. Royal Micr. Soc., 1887, p. 867, pl. 15, fig. 17.—HUDSON and GOSSE, Rotifera, Suppl., 1889, p. 46, pl. 31, fig. 47.

Metopidia scutumipes MOLA, Zool. Anz., vol. 42, 1913, p. 124, text fig.; Ann. Biol. Lacustre, vol. 6, 1913, p. 271.

Genus LEPADELLA Bory de St. Vincent.

Lepadella BORY DE ST. VINCENT, Class. Anim. Micr., 1826, p. 44. Type (by designation of Haring, Bull. 81 U. S. Nat. Mus., 1913, p. 63), *Lepadella patella* (Müller)=*Brachionus patella* Müller.

Metopidia EHRENBERG, Abh. Akad. Wiss., Berlin, 1830, p. 72. Type (monotype): *Metopidia triptera* Ehrenberg.

The genus *Lepadella* was proposed by Bory de St. Vincent in his Essai d'une classification des animaux microscopiques, 1826, for *Brachionus patella* Müller, to which were doubtfully added *Trichoda cornuta* Müller and *Brachionus lamellaris* Müller. When the question of type designation was before the writer, it seemed that *Brachionus patella* was the logical choice, this being the only species definitely designated as a member of the genus *Lepadella*, which was accepted by Ehrenberg and Dujardin in substantially the same sense; moreover, Müller's figure is as good as many of the much more recent picto-

rial representations of this animal. Depending as usual for generic distinction upon the number of eyespots, in this case incorrectly observed, Ehrenberg added a new generic name, *Metopidia*, and made use also of Bory de St. Vincent's *Squamella*, which was originally proposed for *Brachionus bractea* Müller, a *Euchlanis* species, probably *E. dilatata*. Dujardin reduced these three genera to one, retaining the name *Lepadella*; as this is the oldest available name, it has been used here in preference to *Metopidia*, the generic designation employed by Hudson and Gosse. It should be borne in mind that the types are different, and *Metopidia* may at some future date be revived, when a subdivision of the present genus becomes necessary. With the comparatively small number of species now known, there is no occasion for a division among such closely related forms.

The Lepadellids are a group of uniformly small ploidate Rotatoria related to the Euchlanids and characterized by the peculiar structure of the lorica. While without any actual division, it is convenient to describe the lorica as composed of a dorsal and a ventral plate, rigidly united at the edges. This also serves as a reminder of the probable development of the lorica, as noted in the introduction; it seems evident that the Lepadellids are descended from ancestors protected only by a firm dorsal plate, the ventral integument being flexible, with the suture where we now find the edge of the lorica. On this assumption only is the structure of the Lepadellid lorica in its present form intelligible.

The lorica has at the anterior end an opening for the protrusion of the head and on the ventral surface, some distance from the posterior end, there is a perforation through which the foot projects. The outline of the lorica is usually ovate; in some species it is provided with lateral spurs or wing-like extensions, giving it a rhomboid or trianguloid appearance. The cross section of the body in the typical group is a segment of a circle, of varying height; in the *Metopidia*-group it is triradiate, in various degrees of development. The dorsal plate has near its posterior end two openings for the lateral antennae; these are indicated in the figures, but, as their position is so nearly uniform in the genus, no mention has been made of them in the descriptions.

The anterior opening of the lorica is usually supplemented by a dorsal sinus of moderate depth and a relatively large ventral sinus is always present. To give additional room for the free movement of the head the ventral plate curves downward around the anterior opening. In reading the descriptions of the dorsal and ventral sinus the fact that the animals are not flat must be kept in mind; what is actually seen is a projection on a plane of a structure with appreciable depth, as will be realized from the lateral views, and the anterior points shown in the dorsal and ventral views are in

some instances really broad, rounded lobes. Nearly all the species have a collar of some sort around the anterior opening; this may be only a beadlike thickening of the edge of the lorica, or it may take the form of a coarsely stippled area limited posteriorly by a faint line. This stippled collar is usually narrowest on the median line and increases in width toward the edges of the lorica; the stippling is coarsest near the middle of the collar and disappears gradually as the width becomes greater.

The foot projects through an opening in the ventral plate, about two-thirds the length of the lorica from the anterior end, and at the bottom of a nearly parallel-sided groove, semicircular in section, which is here called the foot groove. The body projects slightly through the foot opening, forming the base of the three-jointed foot, which bears two slender toes, about one third the length of the lorica. While no doubt good reasons could be advanced for considering the foot four-jointed, it seems natural to apply the term "joint" only to the three posterior segments of the foot, as the basal segment is not mobile. Moreover, the "foot," as this term is applied to Rotatoria, is in no case anything but a mere convention for the posterior reduced portion of the body and the starting point is consequently also conventional and not founded upon any morphological distinction.

On the dorsal side of the terminal foot joint there is a circular depression with a small rounded papilla in the center. This is here called a sensory pit. Whether this is really the true significance of this structure can not be definitely established, but it is at least not improbable, reasoning from analogous organs in other genera. The rounded papilla appears to have a central marking, but no sensory setae have been found on it, in spite of careful search. This sensory pit has not been demonstrated in all the species, but has been found in all cases where it was possible to obtain a properly oriented view under a sufficiently high magnification.

No detailed study has been made of the corona and the trophi in the different species of the genus, but *Lepadella benjamini* may serve as an example, especially as these organs apparently vary but little in this genus. The corona, plate 93, figures 5 and 6, is a typical *Euchlanis*-corona with the dorsal arc of cilia suppressed on account of the protective dorsal hood. In *Euchlanis* the head is protected by three plates—one dorsal and two lateral—none of which projects far enough to interfere with the free movement of the coronal cilia. In *Lecane* and *Monostyla* various stages of the progressive development of the dorsal segment of this head covering are to be found; in *Monostyla galeata* Bryce it reaches almost the extreme specialization of the Lepadellids. The buccal plate is covered with very short cilia and the mouth is at its lower extremity; the lateral arcs are

moderately developed and probably serve to direct the food to the mouth rather than as organs of locomotion. As such the lateral portions of the circumapical band have become specialized, recalling the auricles of the Notommatids. The trophi, plate 93, figures 7 and 8, are typically malleate, only differing in the large transverse crutch at the end of the fulcrum. The basal apophyse or, probably more correctly, the first transverse ridge, of the rami is very large and evidently specialized for the attachment of the abductor muscles. The unci are five-toothed, the slightly clavate teeth resting in the depressions between the ridges of the rami.

The males of the Lepadellids are very rarely found; Wesché has described¹ the male of *Lepadella ovalis* (Müller) (= *Metopidia solidus* Gosse). It is of the usual degenerate type and in appearance almost identical with the male of *L. patella* (Müller), plate 91, figures 1 and 2.

The majority of the species belonging to this genus vary between rather wide extremes; the variations are, however, heritable, in contradistinction to the cyclic, seasonal or ecologic variations exhibited by many Rotatoria. Consequently we find each species broken up into a number of local races, varying but little individually, so that, in order to establish the limits, it is not sufficient to examine the form which happens to exist in a circumscribed territory, but it is important to have material from the greatest possible number of stations. It will readily be understood from this, that when some rare species, of which the description given here is based on material from one or two collections, is found elsewhere, it is quite likely to possess a number of peculiarities. The most reliable characteristics are the relative longitudinal dimensions, such as the depth of the dorsal and ventral sinus, the length of the foot groove, foot and its terminal joint, and, finally, the length of the toes. Proportional measurements given in the text have therefore been referred to the length of the lorica. Transverse measurements, such as the width of the lorica, anterior opening and the width of the foot groove are all subject to considerable variation and therefore rather unreliable.

The genus seems naturally divisible into two groups, a *Lepadella*-group, having a convex dorsal plate without any median keel, and a *Metopidia*-group with a dorsal keel, making the cross section of the body triradiate or trialate. The *Lepadella*-group would under this arrangement be composed of the following species: *Lepadella apsidea*, new species, *L. ovalis* (Müller), *L. patella* (Müller), *L. latusinus* (Hilgendorf), *L. amphitropis*, new species, *L. quinquecostata* (Lucks), *L. cryphaea*, new species, *L. acuminata* (Ehrenberg), *L. dactyliseta* (Stenroos), *Lepadella benjamini*, new species, *L. cyrtopus* Harring,

¹ Journ. Quekett Micr. Club, ser. 2, vol. 8, p. 123.

L. bidentata Voronkov, *L. borealis*, new species, *L. heterostyla* (Murray), *L. ehrenbergii* (Perty), and *L. pterygoida* (Dunlop). To the Metopidia-group must be referred: *Lepadella imbricata* Harring, *L. rhomboides* (Gosse), *L. cristata* (Rousselet), *L. rhomboidula* (Bryce), *L. triptera* Ehrenberg. The lateral projections of *L. ehrenbergii* and *pterygoida* are probably of specific value only, as may be inferred from the variations of *L. latusinus*. In extreme cases this has lateral spurs rivalling in size those of *L. ehrenbergii*, and yet furnishes a complete series of forms limited at the other extreme by a variety with a posterior emargination differing but little from that of *L. ovalis*. The same is apparently true of the longitudinal ridges developed in a number of species, conspicuously so in *L. quinquecostata* and *pterygoida*. If this peculiarity really possessed any generic or subgeneric value, these two species would be expected to possess other characteristics in common; as a matter of fact they agree only in the generic characters.

KEY TO THE GENUS LEPADILLA.

1. Dorsal plate convex, without prominent median ridge2.
Dorsal plate with prominent median ridge, body triradiate in cross section ...17.
2. With distinct anterior dorsal sinus3.
Without distinct anterior dorsal sinus13.
3. Depth of anterior dorsal sinus less than 1/2 width4.
Depth of anterior dorsal sinus more than 1/2 width9.
4. Toes equal5.
Toes unequal8.
5. Toes fused at base13. *borealis*, new species.
Toes not fused at base6.
6. Lorica with two prominent dorsal ribs and two curved lateral projections.
16. *pterygoida* (Dunlop).
Lorica without prominent dorsal ribs7.
7. Foot groove very wide4. *latusinus* (Hilgendorf).
Foot groove not very wide, a median ridge on dorsal and ventral plate.
5. *amphitropis*, new species.
8. Lorica rhomboid, edges upturned anteriorly14. *heterostyla* (Murray).
Lorica with two curved lateral projections, edges not upturned.
15. *ehrenbergii* (Perty).
9. Lorica rounded posteriorly10.
Lorica with a posterior point12.
10. Dorsal plate with longitudinal ridges6. *quinquecostata* (Lucks).
Dorsal plate without longitudinal ridges12.
11. Lorica strongly depressed2. *ovalis* (Müller).
Lorica not strongly depressed3. *patella* (Müller).
12. Posterior point with basal inangulation7. *cryphaea*, new species.
Posterior point without basal inangulation8. *acuminata* (Ehrenberg).
13. Toes equal14.
Toes unequal11. *cyrtopus* Harring.
14. Posterior margin with a median lobe between two small spines.
12. *bidentata* Voronkov.
Posterior margin rounded, without spines15.
15. Anterior dorsal margin slightly concave10. *benjamini*, new species.
Anterior dorsal margin slightly convex16.

- | | |
|---|-----------------------------------|
| 16. Foot groove very wide..... | 1. <i>apsida</i> , new species. |
| Foot groove very narrow..... | 9. <i>dactyliseta</i> (Stenroos). |
| 17. With a dorsal spine..... | 19. <i>cristata</i> (Rousselet). |
| Without dorsal spine..... | 18. |
| 18. With dorsal sinus..... | 18. <i>rhomboides</i> (Gosse). |
| Without dorsal sinus..... | 19. |
| 19. Lorica ovate..... | 17. <i>imbricata</i> Harring. |
| Lorica rhomboid or subcircular..... | 20. |
| 20. Keel of moderate height, anterior dorsal margin slightly concave. | 20. <i>rhomboidula</i> (Bryce). |
| Keel very high, anterior dorsal margin with a shallow notch between two convex lobes..... | 21. <i>triptera</i> Ehrenberg. |

1. LEPADELLA APSIDA, new species.

Plate 89, figs. 1-3.

The body of this small species is nearly circular in outline; the dorsal plate is moderately convex and its edges project slightly below the general level of the nearly flat ventral plate. The depth of the body is less than half the width of the lorica at its widest point.

The opening for the head is circular; there is consequently no dorsal sinus, but, on the contrary, the anterior dorsal margin is convex. In order to permit the free movement of the head the ventral plate projects downwards around the anterior sinus. No stippled collar is present, but there is a beadlike line around the posterior half of the ventral sinus and slightly removed from the edge; it does not follow a course parallel to the edge of the ventral sinus, but, as shown in the ventral view, forms roughly five sides of a regular octagon.

The foot groove is U-shaped and rounded anteriorly; its length is about one-third that of the lorica and the width slightly greater. There are no posterior spines or other projections at the junction of the lateral edges of the foot groove and the posterior margin of the lorica.

The foot is fairly stout and short, the joints increasing slightly in length from the basal to the posterior. The toes are very short, less than one-sixth the length of the lorica, and taper regularly to acute points. A sensory pit on the terminal joint has not been found; this may be partly or entirely accounted for by the difficulties of observation.

Total length, 84 μ ; length of lorica, 70 μ , width 60 μ ; length of head opening 20 μ , width 24 μ ; length of foot groove 22 μ , width 24 μ ; length of toes, 12 μ ; depth of body, 24 μ .

Type.—Cat. No. 16826, U.S.N.M., is from East Swamp, South Bass Island, Lake Erie; this species has also been found in collections from ponds in Audubon Park, New Orleans, Louisiana. The material was in both cases collected by Dr. E. A. Birge, of the University of Wisconsin.

Lepadella apsidea appears to be rare; only a few specimens were found in each collection. It does not bear any close resemblance to other members of the genus and is easy enough to identify when found, but this is a matter of some difficulty, as it shares with *L. triptera* the distinction of being the smallest Lepadellid, and it is, in addition, excessively transparent.

2. LEPADELLA OVALIS (Müller).

Plate 89, figs. 4-10.

Brachionus ovalis MÜLLER, Anim. Infus., 1786, p. 345, pl. 49, figs. 1-3.

Mytilina lepidura BORY de St. VINCENT, Class. Anim. Micr., 1826, p. 87= *Brachionus ovalis* renamed.

Lepadella ovalis EHRENBERG, Abh. Akad. Wiss., Berlin, 1830, p. 85, pl. 7, fig. 4; Infusionsth., 1838, p. 457, pl. 57, fig. 1.

Metopidia lepadella EHRENBERG, Abh. Akad. Wiss., Berlin (for 1831), 1832, p. 136; Infusionsth., 1838, p. 477, pl. 59, fig. 10.—V. HOFSTEN, Ark. Zool., Stockholm, vol. 6, No. 1, 1909, p. 63, text figs., part.—DIEFFENBACH, Süßwasserfauna Deutschlands, pt. 14, 1912, p. 192, text fig., part.

Squamella oblonga EHRENBERG, Abh. Akad. Wiss., Berlin (for 1833), 1834, p. 220; Infusionsth., 1838, p. 480, pl. 59, fig. 17.

Squamella bractea EHRENBERG, Infusionsth., 1838, p. 480, pl. 59, fig. 16; not *Brachionus bractea* MÜLLER, 1786.

Lepadella oblonga DUJARDIN, Hist. Nat. Zooph., 1841, p. 633.

Lepadella rotundata DUJARDIN, Hist. Nat. Zooph., 1841, p. 633.

Metopidia solidus GOSSE, Ann. Mag. Nat. Hist., ser. 2, vol. 8, 1851, p. 201.—HUDSON and GOSSE, Rotifera, 1886, vol. 2, p. 106, pl. 25, fig. 11.—SKORIKOV, Trav. Soc. Nat. Kharkow, vol. 30, 1896, p. 326, pl. 7, fig. 22.—WEBER, Rev. Suisse Zool., vol. 5, 1898, p. 632, pl. 22, figs. 25-27.—WESCHÉ, Journ. Quekett Micr. Club, ser. 2, vol. 8, 1901, p. 124, text fig.; Journ. Quekett Micr. Club, ser. 2, vol. 8, 1902, p. 324, footnote, pl. 18, fig. 5d.—LIE-PETTERSEN, Tromsø Mus. Aarsh., vol. 33, 1911, p. 67, text figs.—LUCKS, Rotatorienfauna Westpreussens, 1912, p. 120, text fig.

?*Stephanops ovalis* SCHMARDA, Neue wirbell. Thiere, vol. 1, pt. 1, 1859, p. 60, pl. 14, fig. 127.

Hexastemma melanoglena SCHMARDA, Neue wirbell. Thiere, vol. 1, pt. 1, 1859, p. 60, pl. 14, fig. 129.

Metopidia ovalis HUDSON and GOSSE, Rotifera, Suppl., 1889, p. 46, pl. 34, fig. 2.

Metopidia torquata ANDERSON, Journ. Asiatic Soc. Bengal, vol. 58, 1889, pt. 2, p. 356, pl. 21, fig. 9.

?*Metopidia bractea* IROSO, Atti R. Ist. Incorr. Napoli, vol. 64 (for 1912), 1913, p. 475; not *Brachionus bractea* Müller, 1786.

Lepadella solidus HARRING, Proc. U. S. Nat. Mus., vol. 47, 1914, p. 549.

The outline of the lorica varies from the broadly ovate form shown in figure 6 to subcircular, as figure 10; its width is but little less than the length. The dorsal plate is only slightly convex and, as the ventral plate is nearly flat, the actual volume of the body is quite small; the dorso-ventral depth is about one-fifth of the length of the lorica. The two plates are joined for some distance from the edge and the internal termination of this border is slightly irregular and minutely crenulate, the "milled edge" of Gosse.

The width of the anterior margin is one-fifth the length of the lorica. The dorsal sinus is U-shaped with slightly convergent sides; its depth is two-thirds of the width. The ventral sinus is very large and subrhomboid in outline, its widest point being some distance from the front; the depth is equal to the width of the anterior margin. The ventral plate curves strongly downward around the anterior sinus in order to give greater freedom to the movements of the head. A stippled collar is present on both dorsal and ventral plate.

The foot groove varies from the wide, nearly parallel-sided outline of figure 5 to the narrower, ovate form shown in figures 4 and 9; its length is equal to one-fifth of the length of the body. The edges of the groove project below the surface of the main portion of the ventral plate, at least posteriorly, as low ridges, occasionally forming obtuse points on each side of the posterior emargination.

The foot is stout and projects beyond the lorica; it is one-fifth the length of the body; the terminal joint is half the length of the entire foot. The toes are unusually short, about one-sixth the length of the lorica, tapering and slightly decurved. There is a sensory pit on the dorsal side of the last foot joint.

Total length, 190 μ ; length of lorica 155 μ , width 120–130 μ ; width of anterior margin, 25–32 μ ; depth of dorsal sinus, 20 μ ; depth of ventral sinus 30–35 μ , width 30–32 μ ; length of foot groove 42–45 μ , greatest width 30 μ , posterior width, minimum, 18 μ ; length of foot 38 μ , of terminal joint 18 μ ; length of toes, 32 μ ; depth of body, 30 μ . Figure 4 represents a small variety found near Atlantic City, New Jersey. Its dimensions are: Total length, 148 μ ; length of lorica 120 μ , width 96 μ ; width of anterior margin, 24 μ ; depth of dorsal sinus, 14 μ ; depth of ventral sinus 27 μ , width 27 μ ; length of foot groove 36 μ , greatest width 24 μ , posterior width 12 μ ; length of foot, 30 μ , terminal joint, 15 μ ; length of toes, 22 μ ; depth of body, 25 μ .

Lepadella ovalis is easily recognizable by its large size and the strongly depressed lorica, as well as by the relatively small opening for the head and the very short toes. While this species is quite variable, the variations are between the races found in different localities rather than between the individuals found in any one locality, so that in order to obtain the entire range of intermediate forms it is necessary to examine specimens from as many stations as possible. The narrow form illustrated by figures 5 to 8 is the one occurring at Washington; the nearly circular variant of figures 9 and 10 is from Yellowstone Park, Wyoming; the small form, figure 4, is, as noted above, from Atlantic City, New Jersey. The species is common in weedy ponds the world over.

In the study of the Ehrenbergian species greater dependence has been placed upon his figures than on the measurements given in the

text, as these are frequently unreliable and at times impossible, the length of *Lepadella emarginata*, for instance, being given as $\frac{1}{48}$ line, or 46 μ . His figures of the species here concerned are all stated to be drawn to a uniform magnification of 300 diameters, and with this as a guide, as well as the work of subsequent investigators, there can be little doubt of their identity. Müller's figure of *Brachionus ovalis* is not especially good, but the same criticism applies to a great many of the more recent illustrations and, as the name was accepted by Ehrenberg, there appears to be no reason for rejecting it now.

3. LEPADELLA PATELLA (Müller).

Plate 90, figs. 1-12.

Brachionus patella MÜLLER, Verm. Terr. Fluv., vol. 1, pt. 1, 1773, p. 130; Anim. Infus., 1786, p. 341, pl. 48, figs. 15-19.—SCHRANK, Fauna Boica, vol. 3, pt. 2, 1803, p. 132.

Lepadella patella BORY de St. VINCENT, Class. Anim. Micr., 1826, p. 86.

Lepadella emarginata EHRENBERG, Hemprich and Ehrenberg, Symb. Phys. Anim. Evert., 1831 (?1832), Phytozoa, fol. d (third page), pl. 2, Sinaitica, fig. 19; Infusionsth., 1838, p. 458, pl. 57, fig. 2.

?*Squamella quadridentata* SCHMARDA, Neue wirbell. Thiere, vol. 1, pt. 1, 1859, p. 60, pl. 14, fig. 128.

Squamella bractea ECKSTEIN, Zeitschr. wiss. Zool., vol. 39, 1883, p. 388.—FRANCÉ, Term. Füz., vol. 17, 1894, pp. 121, 176, pl. 6; not *Brachionus bractea* Müller, 1786.

Squamella oblonga ECKSTEIN, Zeitschr. wiss. Zool., vol. 39, 1883, p. 391; not of Ehrenberg, 1834.

Metopidia lepadella HUDSON and GOSSE, Rotifera, 1886, vol. 2, p. 106, pl. 25, fig. 6.—PLATE, Jenaische Zeitschr. Naturw., vol. 19, 1886, p. 59.—TESSIN, Arch. Naturg. Mecklenburg, vol. 43, 1890, p. 160, pl. 2, fig. 18.—LEVANDER, Acta Soc. Fauna et Flora Fennica, vol. 12, No. 3, 1894, p. 54, pl. 3, fig. 38.—SKORIKOV, Trav. Soc. Nat. Kharkow, vol. 30, 1896, p. 325.—STENROOS, Acta Soc. Fauna et Flora Fennica, vol. 17, No. 1, 1898, p. 167, pl. 3, fig. 3.—VORONKOV, Trudy Hidrobiol. Stantsii Glubokom Oz., vol. 2, 1907, p. 289.—V. HOFSTEN, Ark. Zool., Stockholm, vol. 6, No. 1, 1909, p. 63, text figs., part.—DIEFFENBACH, Süßwasserfauna Deutschlands, pt. 14, 1912, p. 192, text fig., part; not *Metopidia lepadella* of Ehrenberg, 1832.

Metopidia bractea HUDSON and GOSSE, Rotifera, 1886, vol. 2, p. 109.—SKORIKOV, Trav. Soc. Nat. Kharkow, vol. 30, 1896, p. 329; not *Brachionus bractea* Müller, 1786.

Metopidia elliptica TURNER, Bull. Denison Univ., vol. 6, 1892, p. 62, pl. 1, fig. 8.

Metopidia dentata TURNER, Bull. Denison Univ., vol. 6, 1892, p. 63, pl. 1, fig. 9.

?*Monostyla tentaculata* COSMOVICI, Naturaliste (Paris), vol. 14, 1892, p. 70; Anal. Acad. Rom., ser. 2, vol. 28, 1906, p. 44, text fig.

Metopidia parvula BRYCE, Journ. Quekett Micr. Club, ser. 2, vol. 5, 1893, p. 284.

Metopidia lepadella collaris LEVANDER, Acta Soc. Fauna et Flora Fennica, vol. 12, No. 3, 1894, p. 54, pl. 3, fig. 39.

Metopidia ovalis SKORIKOV, Trav. Soc. Nat. Kharkow, vol. 30, 1896, p. 328, pl. 7, fig. 21.

Metopidia collaris STOKES, Ann. Mag. Nat. Hist., ser. 6, vol. 18, 1896, p. 19, pl. 7, figs. 3, 4.

Metopidia collaris similis STOKES, Ann. Mag. Nat. Hist., ser. 6, vol. 18, 1896, p. 20, pl. 7, fig. 5.—RUNNSTRÖM, Zool. Anz., vol. 34, 1909, p. 273, text fig.

- Metopidia quadricarinata* STENROOS, Acta Soc. Fauna et Flora Fennica, vol. 17, No. 1, 1898, p. 165, pl. 3, fig. 2.
- Metopidia oblonga* v. HOFSTEN, Ark. Zool., Stockholm, vol. 6, No. 1, 1909, p. 63, text figs.—LIE-PETTERSEN, Tromsø Mus. Aarsh., vol. 33 (for 1910), 1911, p. 67.—DIEFFENBACH, Süswasserfauna Deutschlands, pt. 14, 1912, p. 191, text fig.—LUCKS, Rotatorienfauna Westpreussens, 1912, p. 119, text figs.; not *Squamella oblonga* Ehrenberg, 1834.
- ? *Metopidia similis* LUCKS, Süswasserfauna Deutschlands, pt. 14, 1912, p. 191, text fig.; Rotatorienfauna Westpreussens, 1912, p. 119, text fig.
- Lepadella parvula* HARRING, Bull. 81 U. S. Nat. Mus., 1913, p. 64.
- Lepadella quadricarinata* HARRING, Bull. 81 U. S. Nat. Mus., 1913, p. 64.
- Metopidia patella* IROSO, Atti R. Ist. Incorr. Napoli, vol. 64 (for 1912), 1913, p. 474.

The outline of the lorica varies from nearly circular to moderately elongate oval and ovate, the most common forms being those of figures 1, 8 and 9; the width varies from two-thirds to four-fifths of the length. The dorsal plate is strongly convex and its edges overhang the nearly flat ventral plate; over the foot groove it is occasionally marked with two or four indistinct longitudinal folds or ridges, seldom found in the narrower specimens, but apparently constant in the widest specimens. On this peculiarity Stenroos's *Metopidia quadricarinata* was founded; it appears to be an individual rather than a specific character. The dorso-ventral depth of the body is about one-third the length of the lorica and nearly constant for all varieties, whether narrow or wide.

The width of the anterior opening is about one-fourth the length of the lorica. The dorsal sinus is broadly U-shaped and its depth is about one-half the width. The ventral sinus is approximately V-shaped, its sides slightly outcurved and the posterior angle rounded; the depth is a little less than the distance between the anterior points. Both dorsal and ventral plates have a stippled collar, strongly marked on the median line and disappearing gradually toward the sides.

The foot groove is approximately one-third the length of the lorica; its outline varies from nearly parallel-sided to slightly ovate. The posterior emargination is usually very shallow, with rounded corners, but varies to the lunate forms of figures 2 and 12, plate 90, with obtuse-angled points. The edges of the foot groove project slightly below the surface of the ventral plate as low ridges.

The foot is fairly stout; the first and second joints are very short and of equal length; the third joint is somewhat longer and has a sensory pit on its dorsal side. The toes are about one-third the length of the lorica; they are slightly decurved, with a certain amount of individual variation, and taper to fine points, the anterior half a little more rapidly than the posterior portion.

Total length, 135–145 μ ; length of lorica, 100–108 μ , width, 65–90 μ ; anterior points, 25–27 μ ; depth of dorsal sinus, 12–14 μ , of ventral sinus, 18–20 μ ; length of foot groove, 30–34 μ , width, 18–20 μ ;

length of foot, 32–35 μ , of last joint, 11–12 μ , of toes, 25–30 μ ; depth of body in median plane, 30–35 μ ; from highest point of dorsal plate to edges of lorica, 40–45 μ .

Lepadella patella occurs everywhere in weedy pools and ponds, as well as in wet mosses, and is in such places probably the most abundant of all rotifers. On account of its variability it has during its history received a considerable number of names. What the value of these variations may be is difficult to say; in a circumscribed locality they are usually slight, and it is only when material from widely separated regions is brought together and compared that the different forms are seen to overlap. Only some of the principal varieties have been illustrated. Intermediate forms joining all of these are to be found; but, as stated above, not in the same locality.

The nearest relative of this species appears to be *Lepadella ovalis*; the relative thickness of the body is sufficient to differentiate the two species. In *L. patella* this is one-third the length of the lorica, while in *L. ovalis* it is only one-fifth. The anterior opening is also relatively larger in *L. patella*, and the form of the ventral sinus is quite different in the two species. In *L. patella* it is roughly V-shaped and widest in front, while in *L. ovalis* the sinus is rhomboid, with the widest point some distance from the front.

Metopidia collaris Stokes appears, judging from the figure, to be a synonym of *L. patella*. In any case the name is not available, as it was previously used by Levander for a variety that is undoubtedly synonymous. Under the name *M. collaris* Stokes, Murray lists¹ from Sydney, Australia, the animal figured on plate 91, figures 3–5. This is drawn from a single mounted specimen given to me by Mr. Murray. Only the lorica is preserved, the foot and toes having disappeared. It is very evidently different from any known Lepadellid, but on account of the defective specimen it seems undesirable to give it any name. It is figured here to complete Murray's record and also in the hope that better material may eventually be discovered somewhere. The anterior opening is very peculiar and so is the broken lateral edge. It is barely possible that this may be due to the preservative. No details of the foot opening are available. The figure represents only the condition of the specimen and evidently not the normal structure. On the ventral plate there are two short longitudinal ridges quite close together. The dorsal plate has a median ridge, beginning a short distance from the anterior margin and continuing to the posterior point of the lorica. Two subdorsal ridges originate on the anterior points and reach very nearly to the end of the lorica. Length of lorica, 72 μ , width, 45 μ ; width of anterior margin, 15 μ ; depth of dorsal sinus, 5 μ , of ventral sinus, 18 μ ; dorso-ventral depth of lorica, 30 μ .

¹ Journ. Royal Micr. Soc., 1913, p. 460.

Specimens identified for me by Mr. Bryce as *Metopidia parvula* represent a Sphagnum-form which falls within the variation limits of *L. patella*. This is probably not true of the form described by Montet¹ as *M. parvula* Bryce. The shallow ventral sinus, absence of any dorsal sinus and the very large foot groove all indicate a very distinct species.

4. LEPADELLA LATUSINUS (Hilgendorf).

Plate 91, figs. 7-12.

Metopidia solidus latusinus HILGENDORF, Trans. and Proc. New Zealand Inst., vol. 31, 1899, p. 131, pl. 11, fig. 15d.

Metopidia latusinus MURRAY, Journ. Roy. Micr. Soc., 1911, p. 581, pl. 17, fig. 11.

Lepadella latusinus HARRING, Bull. 81 U. S. Nat. Mus., 1913, p. 63.

The body of this species is broadly oval or subovate in outline. The dorsal plate of the lorica is strongly convex and evenly rounded, with its edges slightly overhanging the nearly flat ventral plate. The width of the lorica is about three-fourths of the length of the dorsal plate and is subject to only slight variations. The cross section of the body is nearly semicircular, as the dorso-ventral depth is but little less than half the width.

The distance apart of the lateral points of the head opening is about one-fourth the length of the lorica. The dorsal sinus is broadly U-shaped and quite shallow, its depth not exceeding one-third of the width. The ventral sinus is deeply lunate, its depth being nearly two-thirds of the width. There is a certain amount of variation in the form of both the dorsal and the ventral sinus, as shown in figures 8-11. A stippled collar is present both dorsally and ventrally.

The length of the foot groove is one-third to one-fourth the length of the lorica; its form varies greatly. Anteriorly it is always evenly rounded; the sides may be moderately divergent, as in figure 8, or widely flaring, with the extremities recurved, as in figures 9 and 11; the posterior width may be from one-third to two-thirds of the length of the lorica. The lateral points always project beyond the lorica; in the narrower forms they are nearly square, while in the extreme varieties they show a strong outward curvature; in rare cases they are even slightly recurved. The posterior margin has in the narrower forms a shallow median emargination; in the widest forms a very slightly convex median lobe is interposed between two lateral emarginations. In other words, from the lateral angles the posterior margin always curves forward, the curvature being nearly constant in all varieties, while the widest forms have a slightly convex median lobe, which gradually disappears as the total width decreases.

The foot is stout and projects but little beyond the lorica; no sensory pit has been observed on the terminal joint. The toes are

¹ Rev. Suisse Zool., vol. 23, 1915, p. 339, pl. 13, fig. 37.

long, slender, and slightly decurved; they are about one-third the length of the lorica. They are nearly parallel-sided for one-third of their length and end in very slender points.

Total length, 138–142 μ ; length of lorica 98–105 μ , width 70–75 μ ; anterior points, 28 μ ; depth of dorsal sinus, 8–10 μ , of ventral sinus, 20–22 μ ; length of foot groove, 26–33 μ , width 32–65 μ ; length of foot, 22 μ , of terminal joint, 12 μ ; length of toes, 32 μ ; depth of body in median plane, 30 μ ; from highest point of dorsal plate to edges of lorica, 36 μ .

This species has not been found outside of New Zealand; I am indebted to Mr. Rousset for the material on which this description is based; it was collected by Mr. Murray on the return trip of the Shackleton Antarctic Expedition.

5. LEPADELLA AMPHITROPIS, new species.

Plate 93, figs. 9–12.

The outline of the lorica is ovate, bluntly pointed posteriorly; its width is more than two-thirds of the length. The right and left halves of the dorsal and ventral plates are nearly flat and meet in the median plane at obtuse angles, so that the cross section of the body is rhomboid. On the dorsal plate there is a ridge, beginning a short distance behind the stippled collar and gradually becoming more prominent toward the posterior end of the lorica, where it is raised above the surface as a distinct keel, extending about one-third the length of the lorica. The depth of the body is one-third the length of the dorsal plate.

The opening for the head is about half the width of the lorica. The dorsal sinus is shallow and semielliptic; its depth is two-thirds of the width. The ventral sinus is roughly V-shaped, rounded posteriorly, and with slightly concave sides; the depth is equal to the width. Both the dorsal and the ventral plate have a stippled collar.

The foot groove is less than one-third the length of the lorica; it is slightly truncate anteriorly and the sides diverge somewhat toward the posterior end of the lorica, where they curve rapidly inward. In some specimens the foot groove is nearly parallel-sided, but this is rather unusual. The foot is of moderate length and projects slightly beyond the lorica; the terminal joint is a little longer than the first and second joints, which are nearly equal. A sensory pit is present on the dorsal side of the posterior foot joint. The toes are one-third the length of the lorica, very slender, and slightly decurved in the posterior half of their length.

Total length, 104 μ ; length of lorica, 76 μ , width, 54 μ ; width of anterior points, 22 μ ; depth of dorsal sinus, 8 μ , of ventral sinus, 22 μ ; length of foot groove, 21 μ , anterior width, 15 μ , posterior

width, 18 μ ; length of foot, 20 μ , of terminal joint, 8 μ ; length of toes, 24 μ ; depth of body, 28 μ .

Type.—Cat. No. 16827, U.S.N.M., was collected in sphagnum growing in the old gravel pit at Hyattsville, Maryland. It has also been found in a collection from the United States Bureau of Fisheries station at San Marcos, Texas.

6. *LEPADELLA QUINQUECOSTATA* (Lucks).

Plate 95, figs. 5-8.

Metopidia quinquecostata LUCKS, Süswasserfauna Deutschlands, pt. 14, 1912, p. 189, text fig.; Rotatorienfauna Westpreussens, 1912, p. 126, text fig.—

MURRAY, Journ. Royal Micr. Soc., 1913, pp. 450, 460, pl. 19, fig. 9.

Lepadella quinquecostata HARRING, Bull. 81 U. S. Nat. Mus., 1913, p. 64.

The lorica is distinctly pyriform in outline, narrowing perceptibly toward the head. The dorsal plate is, disregarding for the moment the lateral ridges, composed of two flat plates, meeting at an obtuse angle in the median line. The ventral plate is slightly concave and the cross section of the body approximately triangular. The dorsal plate has a median ridge, beginning a short distance behind the stippled collar as two indistinct, convergent lines, uniting about halfway down the dorsal plate and continued as a single, inconspicuous ridge to the extreme end of the lorica. Two ridges begin near the anterior points of the lorica and, converging very slightly throughout their length, continue a short distance past the lateral antennae, where the points turn sharply in toward the median ridge and then disappear. A second pair of strongly curved ridges, starting back of the collar and outside those already described, follow a course roughly parallel to the edges of the lorica and terminate just in front of the lateral antennae. These lateral ridges are all most prominent at their middle and decrease toward the ends. Their form will be understood from figure 8. The width of the lorica is two-thirds and the depth of the body a little less than one-third the length of the lorica.

The distance apart of the prominent anterior points is one-fourth the length of the lorica; the anterior sinus is broadly U-shaped, and its depth equals one-half its width. The ventral sinus is approximately V-shaped, its posterior angle slightly blunted, and the sides decidedly concave; its depth is a little less than its anterior width. The stippled collar, which is present on both the dorsal and the ventral plate, is very narrow on the median line and increases gradually in width as it disappears toward the sides of the lorica.

The foot groove is one-third the length of the lorica; it is rounded anteriorly and very nearly parallel-sided; the sides are occasionally slightly pinched in at the base of the foot, as shown in the ventral view; but as a rule this narrowing does not exist and the sides curve

gradually and very gently throughout their length. The posterior end of the lorica is slightly emarginate.

The foot is very robust and about one-fourth the length of the lorica. No sensory pit has been observed on the third foot joint. The stout toes are as long as the foot; they are nearly parallel sided for half their length and from there taper gently toward the point. They are not, strictly speaking, decurved; the lower or ventral edge is almost straight, while the dorsal edge curves downward to the point.

Total length, 135 μ ; length of lorica 105 μ , width 66 μ ; anterior points, 28 μ ; depth of dorsal sinus, 12 μ , of ventral sinus, 24 μ ; length of foot groove, 33 μ , anterior width, 16 μ , posterior width, 18 μ ; length of foot, 24 μ , of terminal joint, 9 μ ; length of toes, 27 μ ; depth of body, 30 μ .

Lepadella quinquecostata was found by Lucks in various localities near Danzig, Germany; Murray collected it at Sydney, Australia, and Rio de Janeiro, Brazil; by the writer it has been found in the Panama collections, made by Dr. C. Dwight Marsh from Rio Grande Reservoir, as well as in local collections from Kenilworth, District of Columbia. It usually occurs in small numbers only.

7. LEPADELLA CRYPHAEA, new species.

Plate 92, figs. 9-12.

The lorica is distinctly pyriform in outline; it is prolonged posteriorly as a bluntly pointed or slightly angulate projection with distinct basal inangulations. The cross section of this projection is triangular, and there is a fairly well marked median ridge; from the lateral angles an inconspicuous line continues forward to a point even with, and a little inside of, the lateral antennae. The dorsal plate is evenly rounded, its edges slightly overhanging the nearly flat ventral plate. The cross section of the body is approximately semicircular. The width of the lorica is three-fifths and the depth of the body one-third of the length of the dorsal plate.

The anterior margin is very narrow, about one-fifth of the length of the lorica. The dorsal sinus is broadly U-shaped; its depth is about half the width of the anterior margin. The ventral sinus is slightly elliptic and bluntly pointed posteriorly; the depth is three-fourths of the width. There is a stippled collar on both the dorsal and the ventral plate.

The foot groove is a little more than one-third the length of the lorica; its sides converge somewhat toward the posterior projection. The foot is rather slender and projects very little beyond the lorica; its three joints are of nearly equal length. The toes are slender and taper gradually to fine points; their length, one-fourth that of the

lorica, is somewhat less than the average. No sensory pit has been found on the posterior foot joint.

Total length, 130 μ ; length of lorica 97 μ , width 58 μ ; width of anterior points, 21 μ ; depth of dorsal sinus, 10 μ , of ventral sinus, 15 μ ; length of foot groove, 28–30 μ , anterior width, 19 μ , posterior width, 15 μ ; length of foot, 26 μ , of terminal joint, 9 μ ; length of toes, 24 μ ; depth of body, 34 μ .

Type.—Cat. No. 16828, U.S.N.M., was collected from a species of moss, *Amblystegium irriguum*, growing submerged on the rocks in a small stream near the United States Bureau of Standards, District of Columbia.

Lepadella cryphaea is undoubtedly closely related to *L. acuminata*, but differs consistently in the following characters: The lorica is always distinctly pyriform and the anterior margin very narrow, one-fifth the length of the lorica; the foot projects slightly beyond the lorica and the toes are only one-fourth the length of the lorica. In *L. acuminata* the lorica is nearly always oval and may be ovate, but is never pyriform; the width of the anterior margin is one-fourth the length of the lorica. The posterior point of the lorica projects beyond the foot and the toes are fully one-third the length of the lorica, and much more slender than in *L. cryphaea*. These characters selected for comparison are among the most constant in the genus, and the two forms may therefore with reasonable certainty be considered distinct species.

8. LEPADELLA ACUMINATA (Ehrenberg).

Plate 92, figs. 4–8.

Metopidia acuminata EHRENBURG, Abh. Akad. Wiss., Berlin (for 1833), 1834, p. 210; Infusionsth., 1838, p. 477, pl. 59, fig. 10.—ECKSTEIN, Zeitschr. wiss. Zool., vol. 39, 1883, p. 387, pl. 27, fig. 52.—HUDSON and GOSSE, Rotifera, 1886, vol. 2, p. 107, pl. 25, fig. 9.—LEVANDER, Acta Soc. Fauna et Flora Fennica, vol. 12, No. 3, 1894, p. 55.—WEBER, Rev. Suisse Zool., vol. 5, 1898, p. 635, pl. 22, figs. 28–30.—DIEFFENBACH, Süßwasserfauna Deutschlands, pt. 14, 1912, p. 188, text fig.—LUCKS, Rotatorienfauna Westpreussens, 1912, p. 118.—MONTET, Rev. Suisse Zool., vol. 23, 1915, p. 338.

Lepadella acuminata DUJARDIN, Hist. Nat. Zooph., 1841, p. 633.

The body is usually oval in outline, in rare instances somewhat ovate, as shown in figure 8; the width is about three-fourths of the length. Posteriorly the lorica is prolonged into a pointed projection, usually merging gradually with the edges of the lorica, but occasionally with a slight constriction at the base. (See fig. 8.) The dorsal plate is strongly convex and evenly rounded; it is usually marked with faint ridges, some or all of which may be absent. A median ridge on the posterior third of the dorsal plate and continuing to the terminal point of the lorica is nearly always present; it may be approximately paralleled at its base by two short, slightly con-

vergent ridges, which do not reach the end of the lorica. Two curved ridges, nearly parallel to the edges of the dorsal plate, begin at about mid-length and terminate just above the lateral antennae. This pair of ridges is frequently absent. The ventral plate is nearly flat. The cross section of the body is approximately semicircular; the dorso-ventral depth is a little more than one-third the length of the lorica.

The width of the anterior margin is one-fourth the length of the lorica. The dorsal sinus is broadly U-shaped; its depth is a little more than half the anterior width. The ventral sinus is semi-elliptic, slightly pointed posteriorly; its depth is two-thirds of the width. A stippled collar is present on the dorsal plate; the ventral plate may have a very faint collar, but is usually without any.

The foot groove is one-third the length of the lorica and of elongate ovate form; its width is a little less than one-half the length. The foot is moderately stout and about one-fourth the length of the body. No sensory pit has been found on the terminal joint. The toes are one-third the length of the lorica, very slender, and nearly straight.

Total length, 144 μ ; length of lorica 109 μ , width 72 μ ; width of anterior margin, 27 μ ; depth of dorsal sinus, 15 μ , of ventral sinus, 18 μ ; length of foot groove, 38 μ , width, 16 μ ; length of foot, 26 μ ; length of toes, 35 μ ; depth of body, 42 μ .

Lepadella acuminata is of world-wide distribution and usually fairly common.

9. LEPADELLA DACTYLISETA (Stenroos).

Plate 92, figs. 1-3.

Metopidia dactyliseta STENROOS, Acta Soc. Fauna et Flora Fennica, vol. 17, 1898, p. 165, pl. 3, fig. 1.

Metopidia rottenburgi LUCKS, Rotatorienfauna Westpreussens, 1912, p. 127, text fig.

Lepadella rottenburgi HARRING, Bull. 81 U. S. Nat. Mus., 1913, p. 65.

The body is subrhomboid in outline and unusually narrow posteriorly; its width is two-thirds of the length of the dorsal plate. The dorsal plate is strongly convex and the ventral plate slightly concave; the cross section of the body is nearly semicircular.

The anterior margin of the dorsal plate is without any sinus and usually slightly convex; the ventral sinus is V-shaped, with slightly convex sides, which meet posteriorly in a fairly sharp point. The width of the anterior margin is one-third the length of the lorica; the depth of the ventral sinus is a little more than half the width of the anterior margin. There is no stippled collar, but an inconspicuous line parallels the sides of the ventral sinus.

The foot groove is rather short, about one-fourth the length of the lorica, and unusually narrow, its width being little more than half the length. The sides of the foot groove converge slightly toward

the posterior end of the lorica, which is squarely truncate or very slightly emarginate.

The foot is one-fourth the length of the lorica and quite stout; its three joints are of approximately equal length. The toes are one-third the length of the lorica and taper rather rapidly for one-half their length, ending in long, slender points.

Total length, 127 μ ; length of lorica, 90 μ , width, 60 μ ; width of head opening, 30 μ ; depth of ventral sinus, 17 μ ; length of foot groove, 24 μ , anterior width, 15 μ , posterior width, 12 μ ; length of toes, 32 μ ; depth of body, 38 μ .

A few specimens of this species have been found by the writer in Lake Smith, the source of the water supply of the city of Norfolk, Virginia. It does not appear to have been recorded by anybody but Stenroos and Lucks, so that it is probably rare; while without any striking peculiarities, it is yet a fairly well marked species and it is not likely to have been overlooked.

10. LEPADILLA BENJAMINI, new species.

Plate 93, figs. 1-8.

The form of the lorica varies from subcircular to broadly ovate; the extremes are shown in figures 1 and 2. The dorsal plate is evenly and very strongly arched; its edges project considerably below the general level of the nearly flat ventral plate; posteriorly it is slightly emarginate over the foot groove. The width of the body varies from three-fourths to seven-eighths of the length of the lorica. The cross section of the body is approximately semicircular; its dorso-ventral depth is more than half the width of the lorica.

The width of the anterior margin is a little less than one-third the length of the body. There is no dorsal sinus; the frontal edge of the dorsal plate is almost straight or very slightly concave. The ventral sinus is U-shaped and somewhat angulate; its depth is two-thirds the width of the anterior margin. The stippled collar present on both the dorsal and the ventral plate is unusually narrow. The lateral edges of the lorica are slightly constricted immediately behind the anterior margin, giving this a necklike appearance.

The foot groove is shorter than in any other species of the genus, its length being only one-fifth of the length of the lorica; the outline is roughly trapezoid, truncate anteriorly, and with diverging sides. The posterior width is nearly one-fourth the length of the lorica.

The foot is approximately one-fourth the length of the body; it is fairly stout and its three joints are of nearly equal length. A sensory pit on the terminal foot joint has not been observed. The toes are extremely long, two-fifths the length of the lorica, and slightly decurved; they taper rather rapidly to the nearly cylindrical or very slightly conical posterior portion.

Total length, 180 μ ; length of lorica, 114 μ , width, 85–100 μ ; width of anterior margin, 35 μ ; depth of ventral sinus, 24 μ ; length of foot groove, 24 μ , posterior width, 30 μ ; length of foot, 30 μ , of last joint, 12 μ ; length of toes, 45 μ ; depth of body in median plane, 43 μ ; from highest point of dorsal plate to edges of lorica, 52 μ .

Type.—Cat. No. 16829, U.S.N.M., was collected in weedy ponds at Kenilworth, District of Columbia. It is fairly common. Mr. Murray brought me a specimen which he collected at Sydney, Australia.

The corona, figures 5 and 6, and the trophi, figures 7 and 8, have been described in the introduction, so that a repetition is unnecessary.

Lepadella benjamini is easily recognized by the great dorso-ventral depth of the body and the overhanging edges of the lorica, recalling *Euchlanis pyriformis*, as well as by the very short foot groove and the unusually long toes. It is surpassed in size only by *L. ovalis* (Müller), while the actual bulk is probably greater.

This species has been named for Dr. Marcus Benjamin, editor of the publications of the United States National Museum.

11. LEPADILLA CYRTOPIUS Harring.

Plate 93, figs. 13–16.

Lepadella cyrtopus HARRING, Proc. U. S. Nat. Mus., vol. 47, 1914, p. 550, pl. 16, figs. 6–8.

The body is broadly oval and usually somewhat truncate posteriorly. The dorsal plate is evenly rounded, and its edges do not project below the level of the ventral plate. The latter is nearly flat, with a very shallow longitudinal depression near each lateral edge. The width of the body is equal to four-fifths of the length of the lorica; its cross-section is semicircular.

There is no distinct dorsal sinus, but the anterior margin of the dorsal plate is slightly concave. Its width is one-third the length of the lorica. The ventral sinus is very deep, about four-fifths of its anterior width, and subcircular in outline. A bead-like thickening of the dorsal and ventral edges of the opening for the head is present, but no stippled collar.

The foot groove is short, broadly U-shaped, and its sides slightly divergent posteriorly. Its length is one-fourth the length of the lorica, and the width is very nearly the same. The posterior margin of the lorica varies from the broadly truncate form of figure 13 to that of figure 14, where the truncation is very slight.

The length of the foot is two-fifths the length of the body, the second joint being nearly half the entire length. The toes are short, less than one-fourth the length of the lorica, and strongly

asymmetric. The right toe tapers rapidly for half its length and ends in a slender, nearly cylindrical point. The left toe tapers gradually to the point and is strongly decurved. The last joint of the foot is twisted, so that the curved left toe is almost directly under the right toe.

Total length, 98 μ ; length of lorica, 70 μ , width, 56 μ ; width of anterior margin, 24 μ ; depth of ventral sinus, 19 μ ; length of foot groove, 17 μ , posterior width, 15 μ ; length of foot, 26 μ , of second foot joint, 11 μ ; length of right toe, 16 μ ; depth of body, 29 μ .

Type.—Cat. No. 16585, U.S.N.M., was collected in Camacho Reservoir, on the Isthmus of Panama. This species occurs rather widely distributed on the Isthmus, but usually in small numbers. It has been found by the writer in Lake Smith, near Norfolk, Virginia, and in collections made by Dr. E. A. Birge, of the University of Wisconsin, in Rondeau Harbor, Ontario, on the Canadian shore of Lake Erie, and in ponds in Audubon Park, New Orleans, Louisiana.

12. *LEPADELLA BIDENTATA* Voronkov.

Plate 91, fig. 6.

Lepadella dactyliseta bidentata VORONKOV, Trudy Hidrobiol. Stants. Glubokom Oz., vol. 5, pt. 1, 1913, pp. 99, 107, text fig.

Metopidia dactyliseta bidentata VORONKOV, Trudy Dnieprovsk. Biol. Stants., pt. 2, No. 5, 1915, p. 71, text fig.

This species has not been studied by the writer. The figure is redrawn from the original by Voronkov, which shows an animal with marked differences from *Lepadella dactyliseta* (Stenroos) and evidently entitled to specific rank.

The original description is not very detailed, but the figure shows the lorica to be broadly oval and without any dorsal sinus. The ventral sinus is very deep, rounded posteriorly, and fairly wide anteriorly. The posterior end of the lorica has a small, rounded median lobe and, separated from this by shallow emarginations, two small spines. The toes are straight and parallel-sided for one-half their length and taper somewhat abruptly to slender points. No measurements are given in the text.

Voronkov found three specimens in the Desenska, a tributary to the Dniepr, near Kiev, Russia.

13. *LEPADELLA BOREALIS*, new species.

Plate 92, figs. 13-16.

The lorica is usually pyriform in outline and obtusely pointed posteriorly, but may be slightly constricted in the region of the lateral antennae, as shown in figure 14. The dorsal plate is evenly rounded and moderately convex; the ventral plate is slightly con-

cave. The width of the body is four-fifths the length of the dorsal plate. The cross-section of the body is a shallow segment of a circle. Its depth is one-third the length of the lorica.

The anterior margin is very wide, more than one-third the length of the dorsal plate. The dorsal sinus is very shallow and broadly U-shaped. Its depth is one-fourth of the width. The ventral sinus is V-shaped, with nearly straight sides diverging approximately at a right angle, and slightly rounded posteriorly. Its depth is a little more than half the width. Both the dorsal and the ventral plate have a stippled collar.

The foot groove is short, measuring but one-fourth the length of the lorica from the base to the points where the sides of the groove meet the posterior edge of the lorica. Its outline is trapezoid, truncate anteriorly, and with widely divergent sides. Posteriorly its width is one-third the length of the body.

The foot is one-third the length of the body. Its three joints are of nearly equal length. The toes are one-third the length of the lorica, parallel-sided for about one-third of their length and then taper abruptly to slender, nearly cylindrical points about half the entire length of the toe. At the base the toes are coalescent for about one-fourth of their length, and consequently inseparable, so that their movements are those of a single toe, as in the genus *Monostyla*.

Total length, 145 μ ; length of lorica, 102 μ ; width, 80 μ , width of anterior margin, 36 μ ; depth of dorsal sinus, 9 μ , of ventral sinus, 20 μ ; length of foot groove to junction of sides and edges of ventral plate, 24 μ , to posterior angle of lorica, 30 μ , posterior width, 30–33 μ ; length of foot, 30 μ , of last foot joint, 12 μ ; length of toes, 35 μ , of basal ankylosis, 8 μ ; depth of body, 32 μ .

Type.—Cat. No. 16830, U.S.N.M., from Ice House Pond, St. Paul Island, Alaska. This collection was made by Dr. G. H. Parker, of Harvard University, while acting as a member of the commission for the investigation of the Alaskan fur seals, appointed by the Secretary of Commerce in 1914. St. Paul Island is the largest and northernmost island of the Pribilof group in Bering Sea; the distance from the mainland of Alaska is about 300 miles, from the Aleutian chain of islands about 200 miles.

This species is interesting on account of the sidelight it affords on the generic significance of the single toe in *Monostyla*, as opposed to the two toes of *Lecane* (= *Cathypna*). We have here what is in every other respect a typical *Lepadella*, possessing all the structural peculiarities of its congeners, and yet having developed what is to all intents and purposes a single toe, as in *Monostyla*. It is a fair inference that the generic value of the single toe of *Monostyla* is but slight; this is also corroborated by the otherwise identical, or rather parallel, structure of *Lecane* and *Monostyla*, even in minute details.

14. LEPADELLA HETEROSTYLA (Murray).

Plate 94, figs. 9-13.

?*Metopidia rhomboides* v. HOFSTEN, Ark. Zool., Stockholm, vol. 6, No. 1, 1909, p. 70, text fig.—DIEFFENBACH, Süßwasserfauna Deutschlands, pt. 14, 1912, p. 190, text fig., not *Metopidia rhomboides* Gosse, 1886.

Metopidia heterostyla MURRAY, Journ. Royal Micr. Soc., 1913, p. 459, pl. 19, fig. 6.

The lorica is broadly rhomboid and has a well-marked posterior emargination. The edge of the lorica curves upwards from the blunt lateral angles toward the anterior margin, the curvature increasing from the angles toward the opening for the head, where it is rolled back upon the dorsal plate, so that the actual outer edge does not represent the morphological outer edge. The nature of this peculiar structural modification is illustrated in figures 12 and 13, figure 12 being a cross section through the angles of the lorica, and figure 13 at the point of greatest curvature, about halfway between the lateral angles and the anterior margin. The width of the lorica is equal to the length. The dorsal plate is strongly convex in its median section and becomes gradually recurved toward the lateral angles; posteriorly it curves slightly upwards in the region of the lateral antennae and again over the foot groove, where the upward curvature is greater. The ventral plate is moderately convex and follows in general the sinuations of the dorsal plate. The cross section of the body consists of a roughly cylindrical median portion, produced laterally as two thin wings, merging gradually with the cylindrical median section; the general proportions of figure 12 are maintained, with reduced dimensions, from the lateral angles to the posterior end of the lorica.

The width of the anterior margin is one-third the length of the lorica. The dorsal sinus is broadly U-shaped and very shallow, its depth being only one-third of the width; the ventral sinus is semi-elliptic in outline and its depth equal to half the width. A stippled collar is present on both the dorsal and the ventral plate.

The foot groove is U-shaped and one-third the length of the lorica; its sides gradually merge into the curved ventral plate and disappear entirely at the posterior end of the body; its width is two-thirds of the length. There is a semicircular emargination between two rounded lobes at the posterior angle of the lorica.

The foot is long and slender, about one-third the length of the body; the terminal joint is a little more than half the length of the entire foot and has posteriorly a sensory pit. The toes are as long as the foot and are somewhat asymmetric; they both taper gradually toward the point, but the right toe is nearly straight, while the left toe curves away from it, increasing in curvature toward the point. The last foot joint is twisted, so that, instead of both toes being in

the same transverse plane, the left toe is almost directly under the right toe.

Total length, 134 μ ; length of lorica, 88 μ , width at lateral angles, 90 μ ; width of anterior margin, 27 μ ; depth of dorsal sinus, 10 μ , of ventral sinus, 14 μ ; length of foot groove, 28 μ , width, 18 μ ; length of foot, 32 μ , of posterior joint, 18 μ ; length of right toe, 32 μ , of left toe, 26 μ ; depth of body, 36 μ .

The material upon which this description is based was given to the writer by Mr. Murray; it was collected in a pond at Sydney, Australia. As stated by Murray, the animal figured by v. Hofsten and copied by Dieffenbach under the name of *Metopidia rhomboides* appears to be the same species; v. Hofsten found a single specimen in the "Mästermyr," a swampy area on the island of Gotland.

15. LEPADELLA EHRENBERGII (Perty).

Plate 94, figs. 1-4.

Notogonia ehrenbergii PERTY, Mitth. Nat. Ges. Bern., 1850, p. 20; Zur Kenntn. kleinst. Lebensf., 1852, p. 42, pl. 1, fig. 5.—HUDSON and GOSSE, Rotifera, Suppl., 1889, p. 60, pl. 33, fig. 38.

Metopidia angulata ANDERSON, Journ. Asiatic Soc. Bengal, vol. 58, 1889, pt. 2, p. 356, pl. 21, fig. 10.

Metopidia notogonia TERNETZ, Rot. Umg. Basels, 1892, pp. 19, 34.

Metopidia ehrenbergii JENNINGS, Bull. Michigan Fish Comm., No. 3, 1894, p. 26.—WEBER, Zool. Jahrb., Syst., vol. 24, 1906, p. 216.—v. HOFSTEN, Ark. Zool., Stockholm, vol. 6, No. 1, 1909, p. 72, text fig.—LIE-PETERSEN, Bergens Mus. Aarb. (for 1909), 1910, No. 15, p. 70, pl. 2, fig. 15.—DIEFFENBACH, Süßwasserfauna Deutschlands, pt. 14, 1912, p. 186, text fig.—MURRAY, Journ. Royal Micr. Soc., 1913, p. 459, pl. 19, fig. 8.—PENARD, Rev. Suisse Zool., vol. 22, 1914, p. 8.

Lepadella ehrenbergii HARRING, Bull. 81 U. S. Nat. Mus., 1913, p. 63.

The normal form of this species, to which the following description refers unless specially noted, is shown in the dorsal view, figure 2: Figure 1 represents a local, slightly aberrant race. The lorica is broadly ovate in outline and produced postero-laterally into two broad triangular spurs, curving upward and forward; at the sides of the foot groove there are two similar but smaller and less curved spurs. The lateral spurs have on the dorsal side a central ridge and are triangular in cross section. The width of the body over the lateral spurs equals the length of the lorica; immediately in front of the spurs the width is approximately two-thirds of the length. The depth of the body, which is greatest near mid-length, is more than one-third of the length. The dorsal plate is strongly convex and evenly rounded; the ventral plate is nearly flat. The cross section of the body in front of the spurs is nearly semicircular; figure 4 represents a section through the spurs, where the dorso-ventral depth is much smaller.

The anterior margin is very wide, nearly one-third the length of the lorica. The dorsal sinus is very shallow and evenly rounded; its depth is about one-fourth of its width. The ventral sinus is

semielliptic in outline and its depth two-thirds of the width of the anterior margin. There is a broad stippled collar on both the dorsal and the ventral plate.

The foot groove is rounded anteriorly, its sides slightly divergent and somewhat curved, the curvature increasing toward the posterior end of the lorica. The length and width of the foot groove are nearly equal and a little more than one-fourth the length of the body. The posterior emargination may be evenly rounded, as in figure 1, or V-shaped and slightly truncate anteriorly, as in figure 2; its depth varies from two-fifths to one-half of its width.

The foot is moderately stout and about one-third the length of the lorica; the third joint is one-half the entire length; it has posteriorly a sensory pit. The toes are very long, about one-third the length of the body, and strongly asymmetric; both are slender and taper gradually to very fine points. The right toe is straight and the left toe slightly curved and bent downwards, away from the right toe. The last foot joint is twisted, so that the left toe is directly under the right.

Figure 1 represents a variety from Lake Smith, near Norfolk, Virginia. It differs in several respects from the normal form; the anterior margin is considerably narrower and the lorica much wider. The lateral spurs are broader at the base and less curved; the posterior spurs are more slender and somewhat longer than in the common form.

Total length, 132 μ ; length of lorica 94 μ , width over lateral spurs 75-90 μ ; width of anterior margin, 24-30 μ ; depth of dorsal sinus, 8 μ , of ventral sinus, 16 μ ; length of foot groove, 27 μ ; width of posterior spurs, 26-30 μ ; depth of posterior emargination, 10-12 μ ; length of foot, 28 μ , of last joint, 15 μ ; length of right, straight toe, 32 μ , of left, curved toe, 27 μ ; depth of body, 35 μ .

The distribution of this species appears to be somewhat erratic; it has been recorded from Switzerland, Germany, Sweden, Norway, India, Australia, and a few localities in the United States, but as a rule only from restricted areas. It is of interest to note its occurrence in a collection made by Mr. J. M. Jessup from lakes on Old Crow River flats, on the boundary line between Alaska and Canada, 40 miles north of the Porcupine River, lat. 68° N., long. 141° W., or well within the Arctic Circle. Where it does occur, it is, according to the experience of the writer, fairly common.

16. *LEPADELLA PTERYGONIA* (Dunlop).

Plate 94, figs. 5-8.

Metopidia pterygonia DUNLOP, Journ. Quekett Micr. Club, ser. 2, vol. 6, 1897, p. 325, pl. 17, figs. 1-3.

Lepadella pterygonia HARRING, Bull 81 U. S. Nat. Mus., 1913, p. 64.

The outline of the lorica is broadly oval and produced posterolaterally into two roughly triangular spurs, which give the entire

body a trianguloid appearance; posteriorly the lorica is constricted in the region of the foot groove and the extreme end is quite narrow. The width of the body over the spurs is equal to the length of the lorica. The spurs are slightly outcurved and very slightly decurved; the principal part of the spur is rather narrow, while the base is somewhat abruptly widened and merges gradually with the lorica. The dorsal plate is tectiform and has three pairs of longitudinal ribs or ridges. The medial or innermost pair of ridges are inconspicuous and quite close together, separated by a shallow groove; no definite length can be assigned to these ridges, as they gradually disappear, but they are approximately one-third the length of the lorica. The intermediate pair of ridges are lamellar and project from the dorsal plate as distinct keels, highest in the middle; anteriorly they are nearly parallel and do not quite reach to the collar, while posteriorly they gradually converge and disappear without attaining the posterior end of the lorica. The external pair of ridges are not very prominent; they are somewhat wavy and nearly parallel; anteriorly they seem to reach the edge of the lorica, some distance behind the collar, but posteriorly they terminate in front of the spurs. The ventral plate is very nearly flat. The cross section of the body is roughly a low, obtuse-angled triangle; the relative prominence of the longitudinal ridges is shown in figure 8. The dorso-ventral depth of the body is less than one-third the length of the lorica.

The anterior margin is extremely broad, nearly one-half the length of the lorica; there is really no dorsal sinus present, as the anterior points are wholly on the ventral plate, but the frontal margin of the dorsal plate is slightly concave. The ventral sinus is broadly V-shaped and slightly rounded posteriorly; its depth is less than half the width of the anterior margin. There is a very narrow stippled collar, of nearly the same width everywhere; it is continuous around the anterior opening and does not disappear at the edges of the lorica, as usual.

The foot groove is ovate, widest anteriorly, its edges slightly convergent and gradually disappearing before reaching the posterior end of the lorica. The length of the foot groove is somewhat less than one-third the length of the lorica, its width about one-half the length. The posterior end of the lorica is distinctly tectiform and has a shallow, V-shaped emargination, slightly rounded anteriorly.

The foot is moderately stout and a little less than one-third the length of the body; the first and second joint are of nearly the same length, while the third is somewhat longer. There is a sensory pit on the last foot joint. The toes are as long as the foot, straight and slender, and taper gradually to acute points.

Total length, 95 μ ; length of lorica, 70 μ , width over spurs, 74 μ ; width of anterior margin, 30 μ ; depth of dorsal emargination, measured from anterior points, 9 μ ; depth of ventral sinus, 12 μ ; length of

foot groove, 22 μ , width, 12 μ ; width of posterior margin of lorica, 12 μ ; length of foot, 21 μ , of last joint, 9 μ ; length of toes, 20 μ ; depth of body, 23 μ .

This description is from a single specimen, found in moss from the gravel pit at Hyattsville, Maryland. It differs in a number of points from Dunlop's original description and Dixon-Nuttall's figure; Dunlop's animal is considerably narrower anteriorly, but this may possibly be due to his having studied an extended specimen; the figure shows a median ridge on the dorsal plate, which is certainly not present in the Hyattsville specimen; the intermediate pair of ridges are shown as similar in form to the other two pairs, while in my specimen there are two distinct keels projecting above the general level of the dorsal plate. However, the similarity is so great that the existence of two species seems improbable, and we may perhaps ascribe some of the differences to difficulties of observation, others to the known variability of the members of this genus.

Lepadella pterygoida is evidently extremely rare; Dunlop found only two specimens. With the single specimen here described the records of its appearances seem to be exhausted.

17. LEPADELLA IMBRICATA Harring.

Plate 95, figs. 9-11.

Lepadella imbricata HARRING, Proc. U. S. Nat. Mus., vol. 47, 1914, p. 549, pl. 16, figs. 3-5.

The lorica is ovate in outline and very slightly constricted at the anterior margin. The dorsal plate is tectiform with a shallow groove on each side, equidistant from the edge of the lorica and an inconspicuous median ridge; its edges project very slightly below the nearly flat ventral plate. The cross section of the body is obscurely tri-radiate; in this respect *L. imbricata* is the least specialized member of the *Metopidia* group. The dorso-ventral depth of the body is nearly one-half the length of the lorica.

The width of the anterior margin is a little less than one-third the length of the lorica. No dorsal sinus is present, the frontal edge of the dorsal plate being nearly straight. The ventral sinus is broadly V-shaped and pointed posteriorly; its depth is two-thirds of the width of the anterior margin. Neither a stippled collar nor the bead-like thickening of the anterior margin occasionally taking its place is present in this species.

The foot groove is U-shaped and very narrow, rounded anteriorly and with parallel sides; its length is a little less than one-third the length of the lorica and the width somewhat more than half the length. The lorica is rounded posteriorly, without any emargination.

The foot is nearly two-fifths of the length of the body and quite slender; the terminal joint is more than half the entire length. No

sensory pit on the foot has been observed. The toes are nearly one-third the length of the lorica, slender, and almost straight; they taper gradually to very fine points.

Total length, 128 μ ; length of lorica, 86 μ , width, 54 μ ; width of anterior margin, 29 μ ; depth of ventral sinus, 18 μ ; length of foot groove, 25 μ , width, 15 μ ; length of foot, 32 μ , of last joint, 18 μ ; length of toes, 27 μ ; depth of body, 39 μ .

Type.—Cat. No. 16586, U.S.N.M., was collected at Kenilworth, District of Columbia; on the Isthmus of Panama it was collected by Dr. C. Dwight Marsh at Empire and in Rio Trinidad, at Escoval. Dr. Chancey Juday, of the University of Wisconsin, collected this species at Puerto Barrios, Guatemala. It appears to be a rare animal, only a few specimens occurring in each of the collections mentioned.

18. LEPADELLA RHOMBOIDES (Gosse).

Plate 95, figs. 12-15.

Metopidia rhomboides GOSSE, Hudson and Gosse, Rotifera, 1886, vol. 2, p. 108, pl. 25, fig. 10.—WIERZEJSKI, Rozpr. Akad. Umiejetn., Wydz. Mat.-Przyr., ser. 2, vol. 4, 1893, p. 246, pl. 6, fig. 46.—? SKORIKOV, Trav. Soc. Nat. Kharkov, vol. 30, 1896, p. 328.—LIE-PETTERSEN, Bergens Mus. Aarb. (for 1909), 1910, No. 15, p. 70.—LUCKS, Rotatorienfauna Westpreussens, 1912, p. 123, text fig.—MURRAY, Journ. Roy. Micr. Soc., 1913, p. 459.

Lepadella rhomboides HARRING, Bull. 81 U. S. Nat. Mus., 1913, p. 65.

The lorica is rhomboid-ovate in outline; its width is about two-thirds of the length. The dorsal plate is moderately convex, with a very wide and moderately high keel, beginning at the anterior margin and continuing to the end of the lorica. The sides of the keel are strongly convex and meet at an obtuse angle, thus forming a faint median ridge. The ventral plate is slightly concave. The entire surface of the lorica is covered with a "moiré" pattern of short, nearly straight and parallel lines or minute wrinkles. The cross section of the body is moderately triradiate, as shown in figure 15; the width of the keel is a little less than one-third the width of the dorsal plate; the dorso-ventral depth of the body is nearly one-third the length of the lorica.

The anterior margin is rather narrow, its width being only one-fourth the length of the lorica. The dorsal sinus is broadly U-shaped with a small median notch; its depth is one-third of the width. The ventral sinus is V-shaped and pointed posteriorly; the depth is two-thirds of the width of the anterior margin. No collar is present on either the dorsal or the ventral plate.

The foot groove is U-shaped and quite narrow, rounded anteriorly and with parallel sides; its length is a little less than one-third the length of the body, and the width is equal to one-half its length. The lorica is rounded posteriorly, without any emargination.

The foot is approximately one-third the length of the lorica and fairly stout; the third joint is a little longer than both anterior joints and has a dorsal sensory pit. The toes are short, less than one-fourth the length of the body; they are slightly decurved and taper rather rapidly to slender points.

Total length, 156 μ ; length of lorica, 120 μ , width, 80 μ ; width of anterior margin, 29 μ ; depth of dorsal sinus, 11 μ , of ventral sinus, 20 μ ; length of foot groove, 37 μ , width, 19 μ ; length of foot, 35 μ , of last joint, 19 μ ; length of toes, 26 μ ; depth of body in median plane, 36 μ , to edges of lorica, 44 μ .

This species is widely, but apparently rather irregularly distributed; it usually occurs in small numbers.

19. LEPADELLA CRISTATA (Rousselet).

Plate 96, figs. 5-12.

Colurus cristatus ROUSSELET, Journ. Royal Micr. Soc., 1893, p. 446, pl. 7, fig. 2.

Metopidia cristata VORONKOV, Trudy Hidrobiol. Stants. Glubokom Oz., vol. 2, 1907, p. 112, pl. 7, figs. 39-42.

Metopidia mucronata DADAY, Math. Term. Ért., vol. 26, 1908, p. 30; not *Lepadella mucronata* Schmarida, 1859.

Metopidia semicarinata LUCKS, Ber. Westpreuss. Bot.-Zool. Ver., vol. 31, 1909, p. 141.—DIEFFENBACH, Süßwasserfauna Deutschlands, pt. 14, 1912, p. 189, text fig.—LUCKS, Rotatorienfauna Westpreussens, 1912, p. 124, text fig.

Metopidia semicarinata tripteris LUCKS, Ber. Westpreuss. Bot.-Zool. Ver., vol. 31, 1909, p. 141.—DIEFFENBACH, Süßwasserfauna Deutschlands, pt. 14, 1912, p. 189.—LUCKS, Rotatorienfauna Westpreussens, 1912, p. 125; not *Lepadella triptera* Ehrenberg, 1832.

Lepadella cristata, HARRING, Bull. 81 U. S. Nat. Mus., 1913, p. 63.

The lorica is broadly oval in outline, slightly constricted near the anterior margin, and truncate posteriorly; its width is three-fourths of the length. The dorsal plate is convex and has a high median keel, prominent at the anterior margin and increasing in height until reaching the middle of the dorsal plate; from this point the height decreases gradually toward the posterior end of the lorica. A large spine is nearly always present on the anterior half of the keel; it is extremely variable in size and form, as shown by figures 8 to 11, and may be completely absent, as in figure 7; perhaps the commonest form is that represented by figure 10. The spine is strongly compressed laterally; the base is quite narrow and the dorsal edge linear. Longitudinally the base of the spine usually extends about half the length of the lorica; its length, measured from the anterior margin to the tip, may in extreme individuals be almost equal to the length of the lorica, but is more commonly about half the length. The ventral plate is nearly flat, slightly decurved at the edges. The cross section of the body is triradiate; at its highest point the keel is comparatively thin with moderately concave sides. The dorso-ventral depth of the body is one-half the length.

The width of the anterior margin is a little more than one-third the length of the lorica. No dorsal sinus is present; the frontal edge of the dorsal plate has a shallow median emargination between two slightly convex lobes. The ventral sinus is V-shaped and pointed posteriorly; its depth is one-fourth the length of the lorica. The dorsal plate has a narrow stippled collar, interrupted by a small median triangular space; the ventral sinus has a comparatively wide, thickened border of semielliptic outline and with two rounded lateral lobes. (See fig. 5.)

The foot groove is rather short and wide, semielliptic in outline; its length is but little more than one-fourth the length of the lorica and its width four-fifths of the length. The posterior end of the lorica is very slightly emarginate over the foot groove.

The foot is fairly stout and somewhat more than one-third the length of the body; the posterior joint is half the length of the entire foot. The toes are one-fourth the length of the lorica and rather slender, with slightly recurved points. There is a sensory pit on the dorsal side of the last foot joint.

Total length, 180 μ ; length of lorica 118 μ , width 90 μ ; width of anterior margin, 34 μ ; depth of ventral sinus, 30 μ ; length of foot groove, 34 μ , width, 27 μ ; length of foot, 45 μ , of last joint, 22 μ ; length of toes, 32 μ ; depth of body, 60 μ .

This species was originally described by Rousselet from notes and sketches by Mrs. Pell, of Highland Falls, New York. It seems to be widely distributed in the eastern half of the United States, and is occasionally found in considerable numbers. Daday figures it from African collections under the name *Metopidia mucronata* (Schmarda), giving *Lepadella mucronata* Schmarda as synonym. As far as may be judged from Schmarda's minute figure, his was an entirely different form, with a high keel extending the entire length of the lorica and continued beyond the posterior end of the body as a long spine. If Schmarda's figure correctly represents the animal he found, it is obviously very different from *L. cristata*.

20. LEPADELLA RHOMBOIDULA (Bryce).

Plate 96, figs. 1-4.

Metopidia rhomboidula BRYCE, Science Gossip, vol. 26, 1890, p. 76, text figs.—MURRAY, Journ. Royal Micr. Soc., 1913, p. 459, pl. 19, fig. 7.—MONTET, Rev. Suisse Zool., vol. 23, 1915, p. 339.

Lepadella rhomboidula HARRING, Bull. 81 U. S. Nat. Mus., 1913, p. 65.

The body is very broadly rhomboid in outline; its width is equal to the length. The dorsal plate is slightly convex and has a high median keel, extending the entire length of the lorica. The sides

of the keel are somewhat concave and meet in the median plane at a rather acute angle, thus forming a pronounced dorsal ridge; there is no distinct lateral groove, as the sides of the keel merge very gradually with the dorsal plate. The cross section of the body is triradiate; the lateral, wing-like portion of the body is very thin. The dorso-ventral depth of the lorica is somewhat less than half the length of the body.

The width of the anterior margin is a little less than one-third the length of the lorica. No dorsal sinus is present, but the frontal edge of the dorsal plate is slightly concave. The ventral sinus is semicircular; its depth is slightly more than half the width. There is no stippled collar, but the anterior margin is slightly thickened, thus forming a faint, bead-like line around the opening for the head.

The foot groove is U-shaped, parallel-sided, and rounded anteriorly; its length is about one-third the length of the lorica. The posterior end of the lorica is bluntly pointed, and projects beyond the point where the sides of the foot groove meet the edge of the ventral plate.

The foot is less than one-fourth the length of the lorica and rather slender; its three joints are of nearly equal length. The toes are a little more than one-fourth the length of the body; they are very slender and taper gradually to acute points. No dorsal sensory pit has been observed on the last foot joint.

Total length, 112 μ ; length of lorica 86 μ , width 88 μ ; width of anterior margin, 26 μ ; depth of ventral sinus, 15 μ ; length of foot groove, 30 μ , width, 14 μ ; length of foot, 19 μ , of last joint, 7 μ ; length of toes, 24 μ ; depth of body, 36 μ .

This description is from a single specimen collected by Mr. Murray in New Zealand and sent to me by Mr. Rousselet. It seems to be rare, the records by Bryce, Murray, and Montet being all that I have been able to find. It is possible that it may have been confused with *L. triptera*, with which it has a certain general similarity; it is, however, considerably larger and more markedly rhomboid.

21. LEPADELLA TRIPTERA Ehrenberg.

Plate 95, figs. 1-4.

Lepadella triptera EHRENBERG, Abh. Akad. Wiss., Berlin, 1830, p. 71.

Metopidia triptera EHRENBERG, Abh. Akad. Wiss., Berlin, 1830, p. 72; Infusionsth., 1838, p. 478, pl. 59, fig. 12.—HUDSON and GOSSE, Rotifera, 1886, vol. 2, p. 108, pl. 25, fig. 7.—WIERZEJSKI, Rozpr. Akad. Umiej. etn., Wydz. Mat.-Przyr., ser. 2, vol. 4, 1893, p. 246.—WEBER, Rev. Suisse Zool., vol. 5, 1898, p. 640, pl. 23, figs. 6-9.—LUCKS, Rotatorienfauna Westpreussens, 1912, p. 124.—MONTET, Rev. Suisse Zool., vol. 23, 1915, p. 339.

The outline of the lorica varies from nearly circular to broadly pyriform; its width is about seven-eighths of the length. The dorsal

plate is slightly convex and has an extremely high and very thin median keel, extending the entire length of the lorica. The ventral plate is almost plane. The cross section of the body is triradiate; the lateral portions of the body and the keel are very thin, about one-sixth the width of the lorica. The dorso-ventral depth of the body from the highest point of the keel to the ventral plate is a little more than one-half the length of the lorica.

The width of the anterior margin is about two-fifths of the length of the body. No dorsal sinus is present; the frontal edge of the dorsal plate has a shallow notch between two slightly convex lobes. The ventral sinus is broadly V-shaped and rounded posteriorly. There is no stippled collar or any beadlike reenforcement of the anterior edge.

The foot groove is slightly ovate and about one-third of the length of the lorica; its width is a little more than half the length. The posterior end of the lorica projects as an inconspicuous, obtusely pointed lobe, as wide as the dorsal keel.

The foot is a little less than one-third the length of the lorica and moderately stout; its three joints are of nearly equal length. The toes are slender and slightly decurved; their length is about one-fourth of the length of the body.

Total length, 100 μ (small specimens, 83 μ); length of lorica 75 μ , width 64 μ ; anterior margin, 30 μ ; depth of median dorsal notch, 3 μ , of ventral sinus, 14 μ ; length of foot groove, 25 μ , width, 15 μ ; length of foot, 23 μ ; length of toes, 20 μ ; depth of body, 40 μ .

Lepadella triptera is widely distributed; as it is so small and difficult to find, it is probably more abundant than the published records indicate.

Genus LOPHOCHARIS Ehrenberg.

Lophocharis EHRENBURG, Infusionsth., 1838, p. 458. Type (Monotype), *Lophocharis salpina* (Ehrenberg) = *Lepadella salpina* Ehrenberg.

Oxysterna IROSO, Mon. Zool. Italiano, vol. 21, 1910, p. 303. Type (by original designation), *Oxysterna oxysternum* (Gosse) = *Metopidia oxysternon* Gosse.

As noted in the introduction, the two species included in this genus have usually been referred to *Lepadella* (= *Metopidia*). There is no justification for this, as the genus is a well-marked one and differs in many important characters from the Lepadellids.

The lorica is a very rigid, boxlike structure protecting the body on all sides. It is somewhat rhomboid in cross section and has a prominent dorsal keel, of a height equal to about one-third the dorso-ventral depth of the body, extending the entire length of the lorica. A prominent lateral ridge bifurcates anteriorly and continues to the posterior end of the lorica, curving slightly upward in the region of

the foot opening. Near the middle of the body two inclined transverse ridges on each side originate from the lateral longitudinal ridges and disappear before reaching the dorsal keel. On the ventral surface of the lorica a median ridge, beginning near the anterior sinus, reaches as far as the middle of the body and joins a curved transverse ridge, passing entirely across the ventral plate and joining the lateral ridges.

The anterior opening of the lorica is elongate oval, continued dorsally and ventrally as a fairly deep sinus. The opening for the foot is large and ovate, its edges apparently curving inward, so that the border is rather ill-defined.

The lateral antennae are situated some distance above the lateral longitudinal ridges and immediately behind the posterior pair of transverse dorsal ridges; the sensory setae project through small conical prominences on the lorica.

No material suitable for a detailed study of the corona was available, but as far as may be judged from preserved specimens, it does not differ materially from the type of *Trichotria* (= *Dinocharis*).

The foot is about one-fourth the length of the lorica and decreases considerably in size toward the toes. The posterior segment is well marked, but anterior segments are rather ill-defined; apparently two are present. The toes are stout at the base, and the posterior half is very slender and slightly decurved.

The trophi are malleate, resembling closely the *Euchlanis*-type and differ only in minute details in the two species. Figures 11-13, plate 97, are drawn from *L. oxysternon*. The rami are elongate and triangular; on the upper surface of the right ramus there are three prominent transverse ridges continuing over the inner edge as blunt, knob-like teeth, which interlock with two similar structures on the left ramus. The unci are six-toothed; the right uncus has three strong clavate and three linear teeth, while the left uncus has two clavate and four linear teeth. The clavate teeth on each side rest in the grooves between the transverse ridges on the rami, and all six teeth of one uncus are opposite the interspaces of the other. The fulcrum and manubria offer nothing of special interest.

The genus includes but two species, and while the original descriptions are perfectly clear the two forms have for many years been considered varieties of a single species; the records are consequently so inextricably confused that it is rarely possible to decide positively which animal they refer to. Only such citations as appear with reasonable certainty to be assignable to one or the other species are given in the synonymy.

1. *LOPHOCHARIS SALPINA* (Ehrenberg).

Plate 97, figs. 1-5.

Lepadella salpina EHRENBERG, Abh. Akad. Wiss., Berlin (for 1833), 1834, p. 209; Infusionsth., 1838, p. 458, pl. 57, fig. 3.—? TESSIN, Arch. Naturg. Mecklenburg, vol. 43, 1890, p. 162.

Metopidia salpina HUDSON and GOSSE, Rotifera, Suppl., 1889, p. 46, pl. 34, fig. 4.—? JENNINGS, Bull. U. S. Fish Comm., vol. 19 (for 1899), 1900, p. 95.—DIEFFENBACH, Süßwasserfauna Deutschlands, pt. 14, 1912, p. 189, text fig.

Metopidia oxysternum ? GLASSCOTT, Sci. Proc. Royal Dublin Soc., n. ser., vol. 8, 1893, p. 75.—BILFINGER, Jahresh. Ver. Naturk. Württemberg, vol. 50, 1894, p. 59.—WEBER, Rev. Suisse Zool., vol. 5, 1898, p. 637; pl. 23, figs. 1-5.

Oxysterna major IROSO, Mon. Zool. Italiano, vol. 21, 1910, p. 304.

Metopidia oxysterna DIEFFENBACH, Süßwasserfauna Deutschlands, pt. 14, 1912, p. 187, text fig.

Lophocharis oxysternum IROSO, Atti R. Ist. Incorr. Napoli, vol. 64 (for 1912), 1913, p. 477, fig. 8.

The lorica of this species is rigid, of very irregularly prismatic form and rhomboid in cross section. It has a prominent dorsal keel which begins at the anterior sinus and continues to the posterior end of the lorica; its height is nearly uniform in the anterior half, about one-third of the dorso-ventral depth of the body, and from there decreases gradually. The cross section is variable; it may be as wide as in figure 5, but is usually narrow and similar to *L. oxysternon*, shown in figure 10. Immediately behind the middle the keel has four transverse folds, those on the right side alternating with identical plications on the left side; they are most prominent at their dorsal extremity and cause the upper edge of the keel to assume a zigzag course, as shown in the dorsal view, figure 3. A lateral rib or ridge begins immediately behind the anterior margin of the lorica and continues to the posterior end; it is bifurcate anteriorly and its course is somewhat irregular, but follows approximately the lateral mid-line of the body, curving upward at the foot opening. Near the middle of the body two transverse ridges, with a slight posterior inclination, start from the lateral ridge and disappear before they reach the dorsal keel. On the ventral surface of the body a median ridge begins near the anterior sinus and reaches as far as the middle of the body, where it joins a curved transverse ridge, which passes entirely across the ventral plate and joins the lateral ridges. From the transverse ridge the ventral plate is rather sharply inclined toward the foot opening, but no groove is present. The dorso-ventral depth of the body is approximately equal to its width, about three-fifths of the length of the lorica.

The anterior margin of the lorica is truncate and provided with a series of denticulations, about 20 in number, decreasing gradually in size from the ventral to the dorsal edge. Neither the general

course nor the spacing is quite constant; frequently the two ventral denticles project slightly beyond the rest, as in figure 1. The dorsal sinus is V-shaped, rounded at the bottom; its depth is one-fifth the length of the lorica. The ventral sinus is semielliptic, and to give additional room for the movements of the head the edges are slightly outcurved; its depth is one-fourth the length of the body.

The foot opening is ovate in outline and pointed posteriorly; its length is one-fourth the length of the lorica and the width about two-thirds of the length. The foot is of moderate length and decreases in size toward the toes; it is apparently three-jointed, but only the posterior segment is well defined. The toes are stout at the base and the posterior half is very slender and slightly decurved; they are one-fifth of the length of the body.

Total length, 175 μ ; length of lorica 135 μ , width 85–90 μ ; dorso-ventral depth, 80–88 μ ; transverse width of anterior margin, 37–42 μ ; depth of dorsal sinus, 17 μ , of ventral sinus, 24 μ ; length of foot opening 38–40 μ , width 25 μ ; length of foot, 32 μ , of last joint, 14 μ ; length of toes, 26 μ .

2. LOPHOCHARIS OXYSTERNON (Gosse).

Plate 97, figs. 6–13.

Metopidia oxysternon GOSSE, Ann. Mag. Nat. Hist., ser. 2, vol. 8, 1851, p. 201.

Metopidia oxysternum HUDSON and GOSSE, Rotifera, 1886, vol. 2, p. 107, pl. 25, fig. 8.—SKORIKOV, Trav. Soc. Nat. Kharkow, vol. 30, 1896, p. 327.—VORONKOV, Trudy Hidrobiol Stants. Glubokom Oz., vol. 2, 1907, p. 289.

Oxysterna oxysternum IROSO, Mon. Zool. Italiano, vol. 21, 1910, p. 303.

Lophocharis salpina IROSO, Atti R. Ist. Incorr. Napoli, vol. 64 (for 1912), 1913, p. 477, fig. 7.

The body is inclosed in a firm lorica of irregularly prismatic form and rhomboid cross section. The dorsal keel is very prominent and strongly curved; the height is nearly uniform in the anterior half of its length and from there decreases gradually to the posterior end of the lorica. The sides of the keel are closely approximated, so that it is very narrow in cross section, as shown in figure 10; its height is one-third the dorso-ventral depth of the body; in individual cases a little more. The transverse plications of *L. salpina* are not present in this species. A lateral rib runs the entire length of the lorica; it is bifurcate anteriorly and follows a somewhat irregular course along the lateral mid-line, the posterior end curving slightly upward. From a point near the middle of the body two transverse ridges with a slight posterior inclination branch off from the lateral ridge; they disappear before reaching the dorsal keel. The ventral median ridge begins immediately behind the anterior sinus and joins a transverse ridge crossing the ventral plate near the middle of the body. In front of the foot opening there is a curved ridge, which merges with the lateral ridges at the sides of the foot opening; be-

tween these two ridges there is a deep groove of semicircular cross section passing from side to side of the ventral plate. This groove is narrowest and deepest on the median line, and becomes wider and shallower as it approaches the sides of the body. The dorso-ventral depth of the body varies from one-half to two-thirds of the length.

The anterior margin of the lorica is curved very slightly in its upper portion and quite strongly in the region of the ventral sinus. While it has the appearance of being smooth, it is in reality very minutely denticulate; as this denticulation is quite beyond the possibilities of the halftone process without excessive magnification, it has not been indicated in the illustrations. The dorsal sinus is narrowly V-shaped, slightly rounded posteriorly, and its depth is one-fourth the length of the lorica. The ventral sinus is broadly semielliptic and its edges slightly outcurved, to give the necessary freedom for the head and coronal cilia.

The foot opening is ovate and pointed posteriorly; the length is one-fourth the length of the lorica and the width about two-thirds of its length. The foot is moderately long and the basal portion quite stout; the posterior segment bearing the toes is slender and well defined; anterior segments are indistinct, but probably two are present. The toes are stout at the base and taper fairly rapidly for one-half their length, ending in slender, acute points; their length is one-fifth the length of the body.

Total length, 160 μ ; length of lorica 120 μ , width 75–80 μ , dorso-ventral depth, 55–70 μ ; transverse width of anterior opening, 32–35 μ ; depth of dorsal sinus, 20 μ , of ventral sinus, 21 μ ; length of foot opening, 34–36 μ , width, 24 μ ; length of foot, 30 μ , of last joint, 12 μ ; length of toes, 24 μ .

The differences between *Lophocharis salpina* and *L. oxysternon* are so slight that one description is almost a repetition of the other. Both are variable to a considerable extent, especially in dorso-ventral dimensions; perhaps *L. oxysternon* is the more variable, at least such are the indications of the material examined. On the other hand, this seems to be by far the more common species and there was consequently a better opportunity to ascertain the limits for this form than for the comparatively rare *L. salpina*, known to the writer from local collections only. The following characteristics only may be depended on as distinctive: For *L. salpina*—(1) The angulate anterior margin with distinct dorsal and ventral sinus, the truncate portion being coarsely denticulate; (2) the transverse plication of the dorsal keel; and (3) the absence of a transverse groove on the ventral plate. For *L. oxysternon*—(1) The rounded anterior margin, merging gradually with the dorsal and ventral sinus, denticulation excessively minute; (2) the absence of transverse plications on the dorsal keel; and (3) the deep transverse groove in front of the foot opening. In all other respects they appear to be identical.

EXPLANATION OF PLATES.

All figures are highly magnified. For actual measurements see text.

PLATE 89.

- FIG. 1. *Lepadella apsidea*, ventral view; page 536.
2. *Lepadella apsidea*, lateral view.
3. *Lepadella apsidea*, cross section of body.
4. *Lepadella ovalis*, ventral view; page 537.
5. *Lepadella ovalis*, ventral view.
6. *Lepadella ovalis*, dorsal view.
7. *Lepadella ovalis*, lateral view.
8. *Lepadella ovalis*, cross section of body.
9. *Lepadella ovalis*, ventral view.
10. *Lepadella ovalis*, dorsal view.

PLATE 90.

- FIG. 1. *Lepadella patella*, ventral view; page 539.
2. *Lepadella patella*, ventral view.
3. *Lepadella patella*, dorsal view.
4. *Lepadella patella*, ventral view.
5. *Lepadella patella*, dorsal view.
6. *Lepadella patella*, dorsal view.
7. *Lepadella patella*, cross section of body.
8. *Lepadella patella*, dorsal view.
9. *Lepadella patella*, ventral view.
10. *Lepadella patella*, lateral view.
11. *Lepadella patella*, cross section of body.
12. *Lepadella patella*, ventral view.

PLATE 91.

- FIG. 1. *Lepadella patella*, male, lateral view; page 534.
2. *Lepadella patella*, male, ventral view.
3. *Metopidia collaris*?, lateral view; page 541.
4. *Metopidia collaris*?, ventral view.
5. *Metopidia collaris*?, cross section of body.
6. *Lepadella bidentata*, ventral view; page 550.
7. *Lepadella latusinus*, lateral view; page 542.
8. *Lepadella latusinus*, ventral view.
9. *Lepadella latusinus*, ventral view.
10. *Lepadella latusinus*, dorsal view.
11. *Lepadella latusinus*, ventral view.
12. *Lepadella latusinus*, cross section of body.

PLATE 92.

- FIG. 1. *Lepadella dactyliseta*, ventral view; page 547.
2. *Lepadella dactyliseta*, lateral view.
3. *Lepadella dactyliseta*, cross section of body.
4. *Lepadella acuminata*, ventral view; page 546.
5. *Lepadella acuminata*, dorsal view.
6. *Lepadella acuminata*, lateral view.
7. *Lepadella acuminata*, cross section of body.

- FIG. 8. *Lepadella acuminata*, ventral view.
 9. *Lepadella cryphaea*, ventral view; page 545.
 10. *Lepadella cryphaea*, dorsal view.
 11. *Lepadella cryphaea*, lateral view.
 12. *Lepadella cryphaea*, cross section of body.
 13. *Lepadella borealis*, ventral view; page 550.
 14. *Lepadella borealis*, dorsal view.
 15. *Lepadella borealis*, lateral view.
 16. *Lepadella borealis*, cross section of body.

PLATE 93.

- FIG. 1. *Lepadella benjamini*, ventral view; page 548.
 2. *Lepadella benjamini*, dorsal view.
 3. *Lepadella benjamini*, lateral view.
 4. *Lepadella benjamini*, cross section of body.
 5. *Lepadella benjamini*, corona, lateral view.
 6. *Lepadella benjamini*, corona, ventral view.
 7. *Lepadella benjamini*, trophi, lateral view.
 8. *Lepadella benjamini*, trophi, ventral view.
 9. *Lepadella amphitropis*, ventral view; page 543.
 10. *Lepadella amphitropis*, dorsal view.
 11. *Lepadella amphitropis*, lateral view.
 12. *Lepadella amphitropis*, cross section of body.
 13. *Lepadella cyrtopus*, ventral view; page 549.
 14. *Lepadella cyrtopus*, dorsal view.
 15. *Lepadella cyrtopus*, lateral view.
 16. *Lepadella cyrtopus*, cross section of body.

PLATE 94.

- FIG. 1. *Lepadella ehrenbergii*, ventral view; page 553.
 2. *Lepadella ehrenbergii*, dorsal view.
 3. *Lepadella ehrenbergii*, lateral view.
 4. *Lepadella ehrenbergii*, cross section of body.
 5. *Lepadella pterygoida*, ventral view; page 554.
 6. *Lepadella pterygoida*, dorsal view.
 7. *Lepadella pterygoida*, lateral view.
 8. *Lepadella pterygoida*, cross section of body.
 9. *Lepadella heterostyla*, ventral view; page 552.
 10. *Lepadella heterostyla*, dorsal view.
 11. *Lepadella heterostyla*, lateral view.
 12. *Lepadella heterostyla*, cross section of body.
 13. *Lepadella heterostyla*, cross section through curved wings.

PLATE 95.

- FIG. 1. *Lepadella triptera*, ventral view; page 560.
 2. *Lepadella triptera*, dorsal view.
 3. *Lepadella triptera*, lateral view.
 4. *Lepadella triptera*, cross section of body.
 5. *Lepadella quinquecostata*, ventral view; page 544.
 6. *Lepadella quinquecostata*, dorsal view.
 7. *Lepadella quinquecostata*, lateral view.
 8. *Lepadella quinquecostata*, cross section of body.
 9. *Lepadella imbricata*, ventral view; page 556.

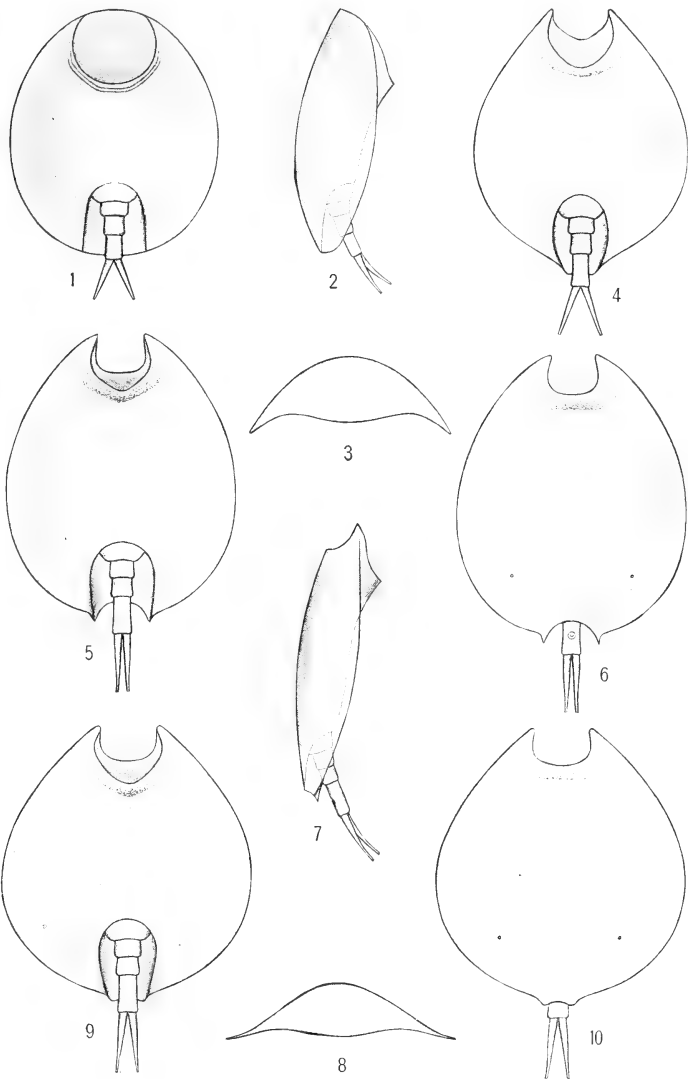
- FIG. 10. *Lepadella imbricata*, lateral view.
11. *Lepadella imbricata*, cross section of body.
12. *Lepadella rhomboides*, ventral view; page 557.
13. *Lepadella rhomboides*, dorsal view.
14. *Lepadella rhomboides*, lateral view.
15. *Lepadella rhomboides*, cross section of body.

PLATE 96.

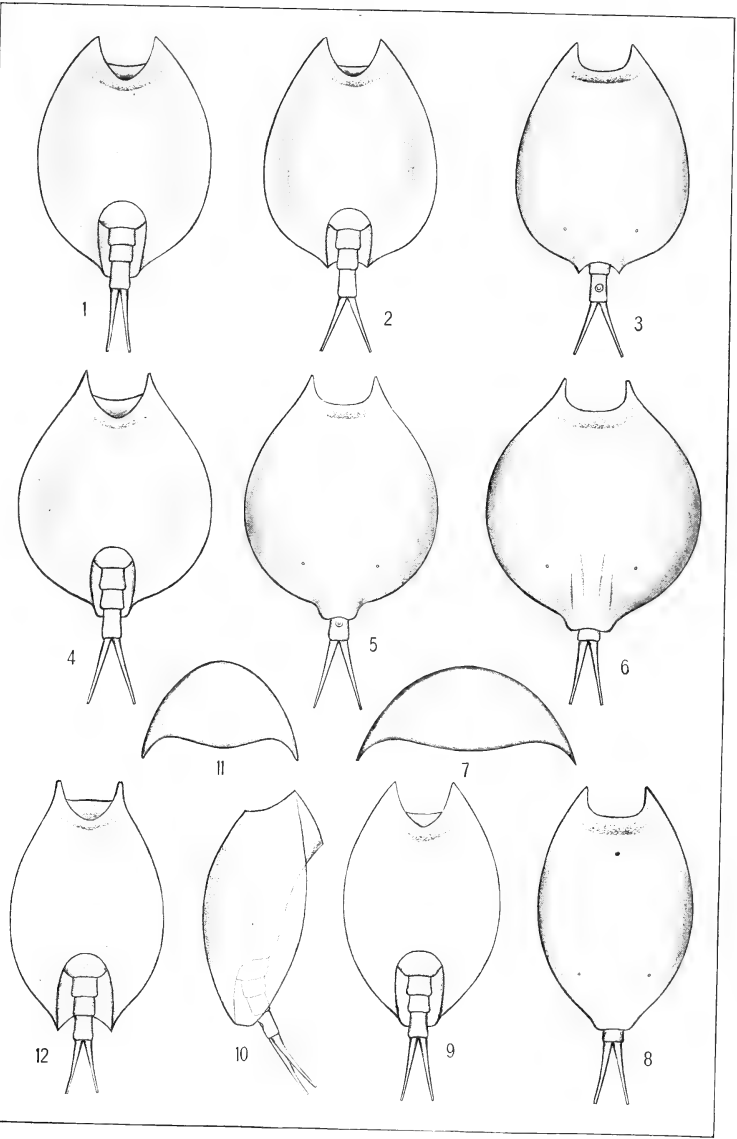
- FIG. 1. *Lepadella rhomboidula*, ventral view; page 559.
2. *Lepadella rhomboidula*, dorsal view.
3. *Lepadella rhomboidula*, lateral view.
4. *Lepadella rhomboidula*, cross section of body.
5. *Lepadella cristata*, ventral view; page 558.
6. *Lepadella cristata*, dorsal view.
7. *Lepadella cristata*, lateral view.
8. *Lepadella cristata*, lateral view.
9. *Lepadella cristata*, lateral view.
10. *Lepadella cristata*, lateral view.
11. *Lepadella cristata*, lateral view.
12. *Lepadella cristata*, cross section of body.

PLATE 97.

- FIG. 1. *Lophocharis salpina*, lateral view; page 563.
2. *Lophocharis salpina*, lateral view.
3. *Lophocharis salpina*, dorsal view.
4. *Lophocharis salpina*, ventral view.
5. *Lophocharis salpina*, cross section of body.
6. *Lophocharis oxysternon*, lateral view; page 564.
7. *Lophocharis oxysternon*, lateral view.
8. *Lophocharis oxysternon*, dorsal view.
9. *Lophocharis oxysternon*, ventral view.
10. *Lophocharis oxysternon*, cross section of body.
11. *Lophocharis oxysternon*, trophi, lateral view.
12. *Lophocharis oxysternon*, trophi, ventral view.
13. *Lophocharis oxysternon*, trophi, frontal view.

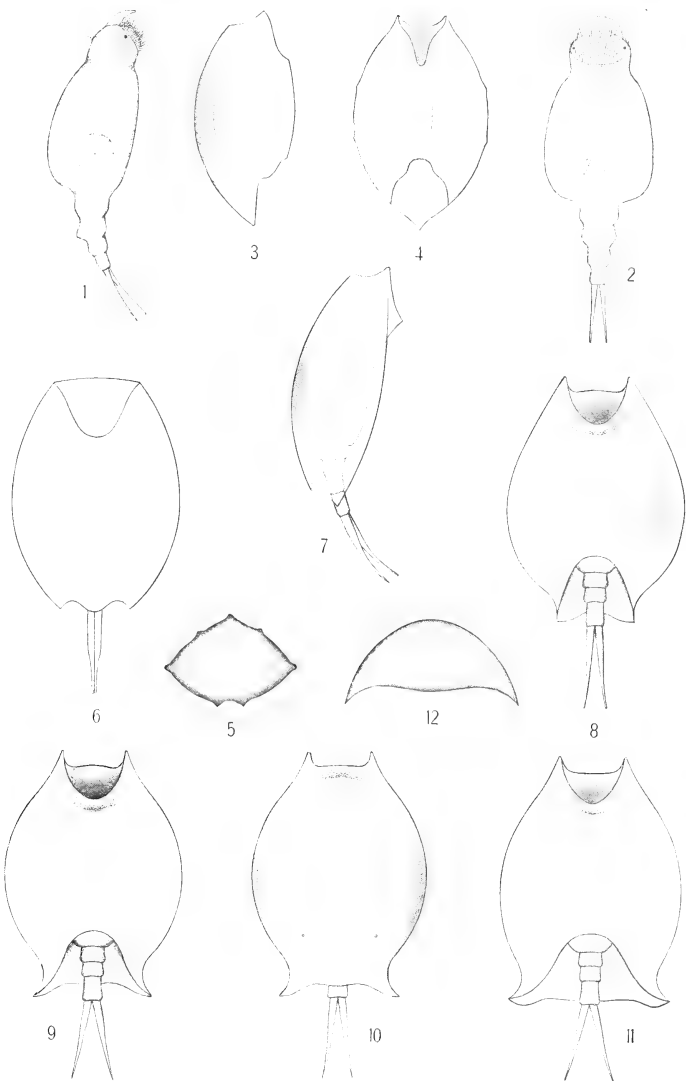
ROTATORIA OF THE GENUS *LEPADELLA*.

FOR EXPLANATION OF PLATE SEE PAGE 566.



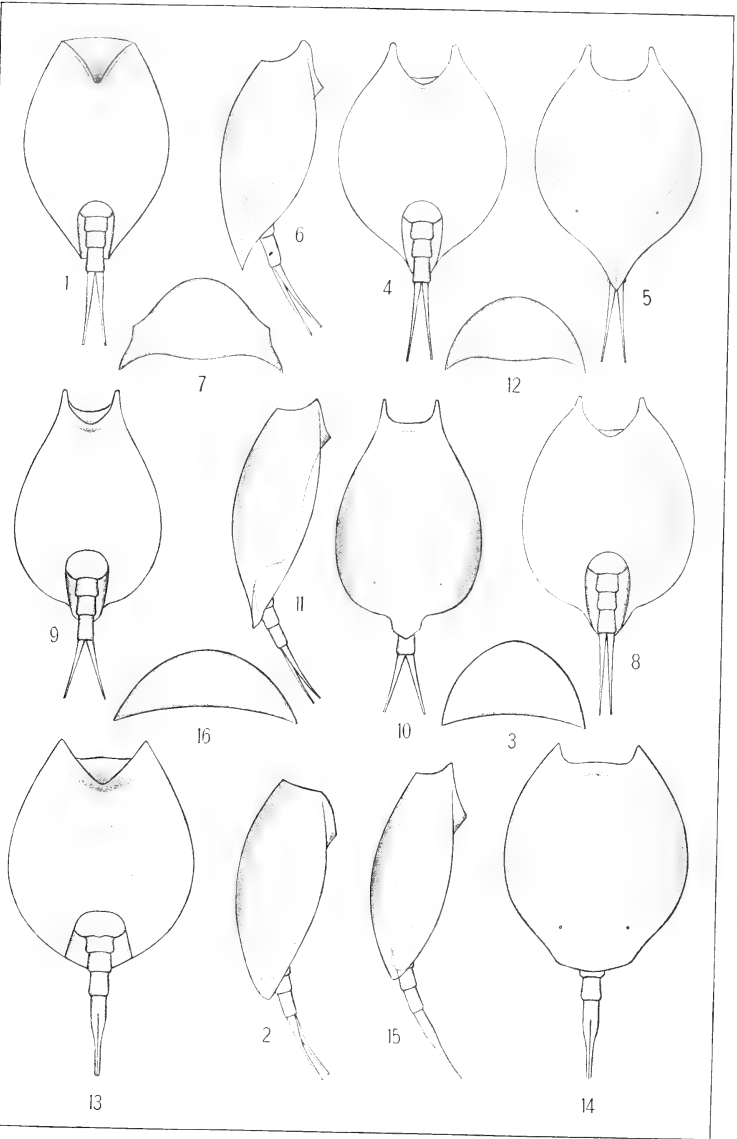
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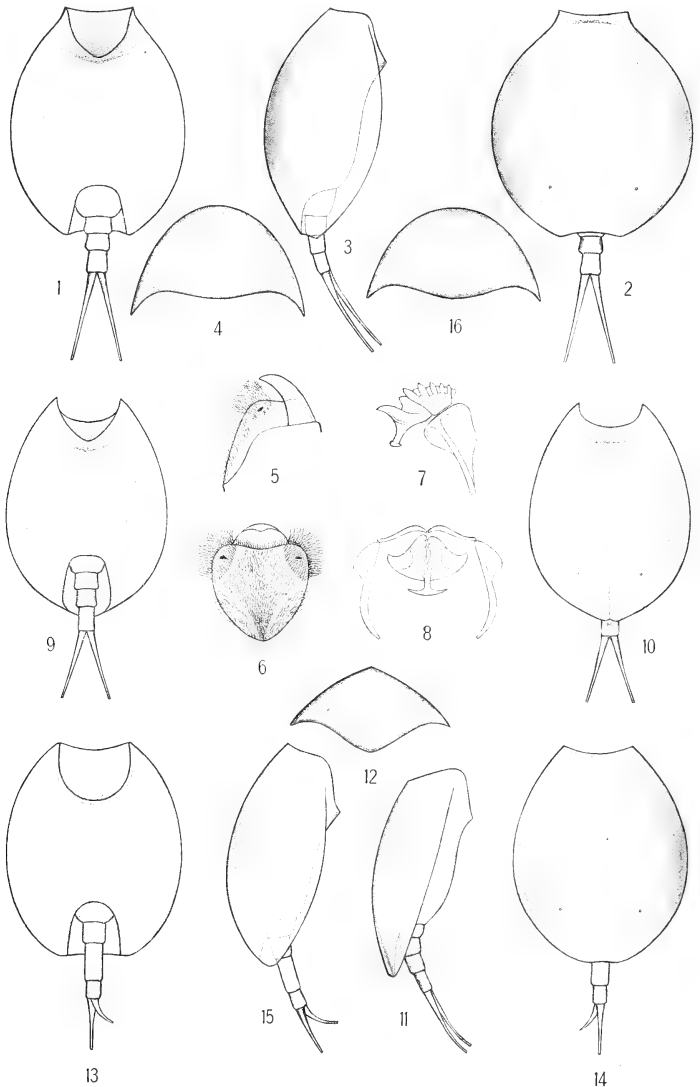
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FOR EXPLANATION OF PLATE SEE PAGE 566.



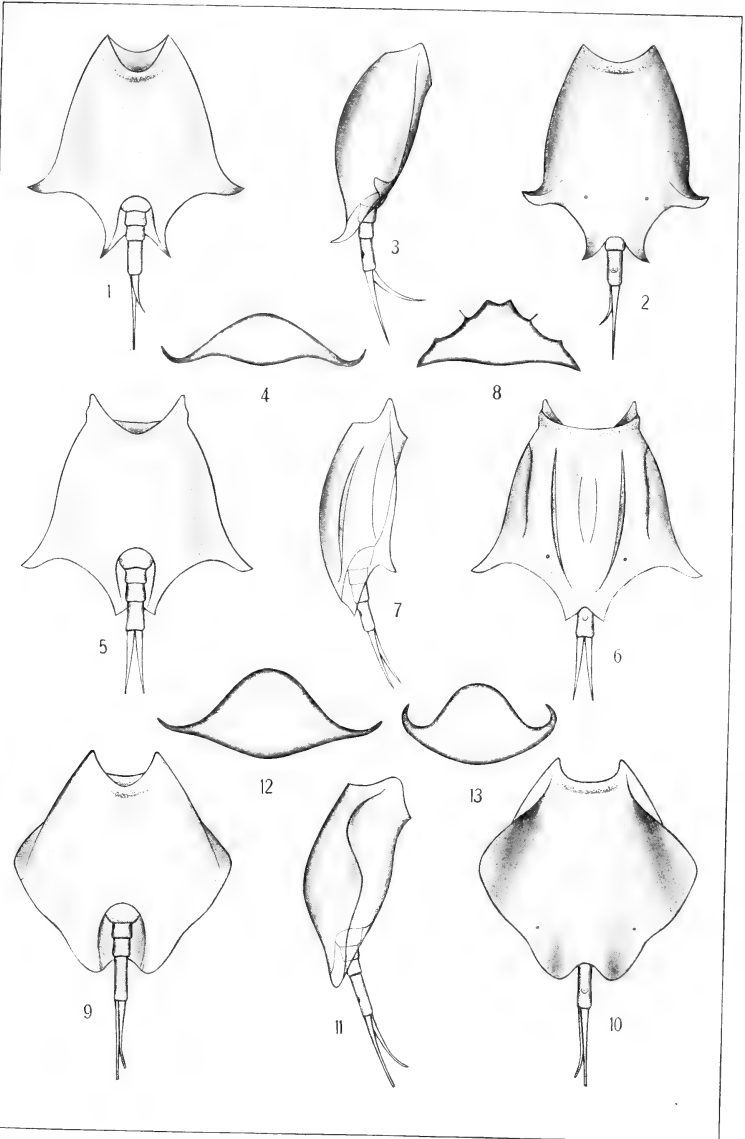
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FOR EXPLANATION OF PLATE SEE PAGES 566 AND 567.



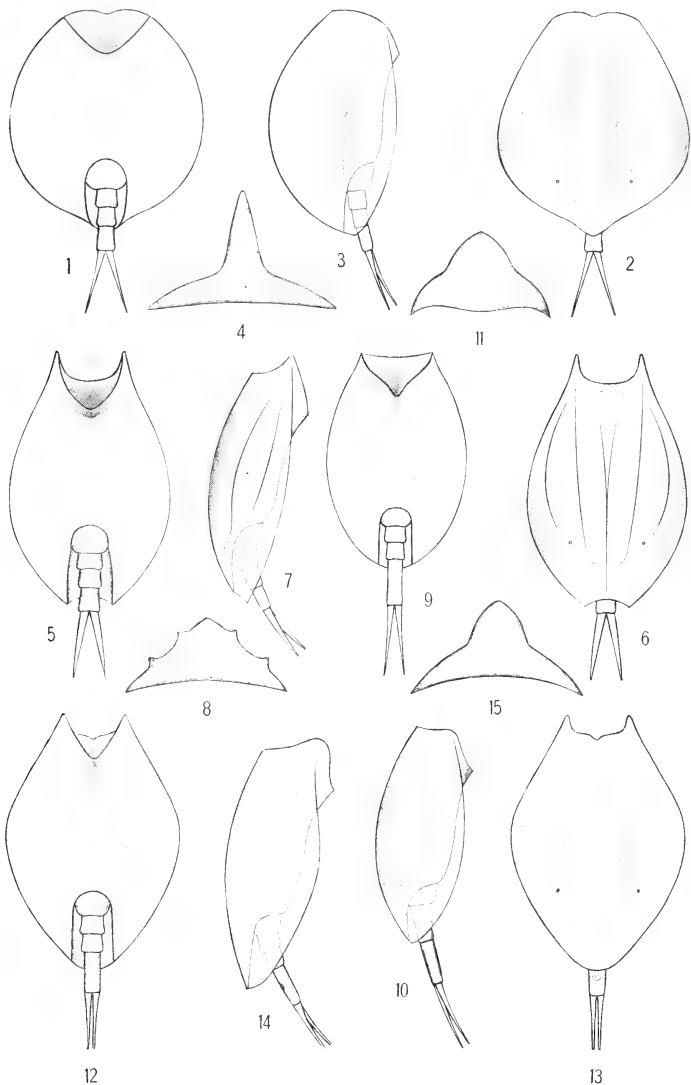
ROTATORIA OF THE GENUS *LEPADELLA*.

FOR EXPLANATION OF PLATE SEE PAGE 567.



ROTATORIA OF THE GENUS LEPADELLA.

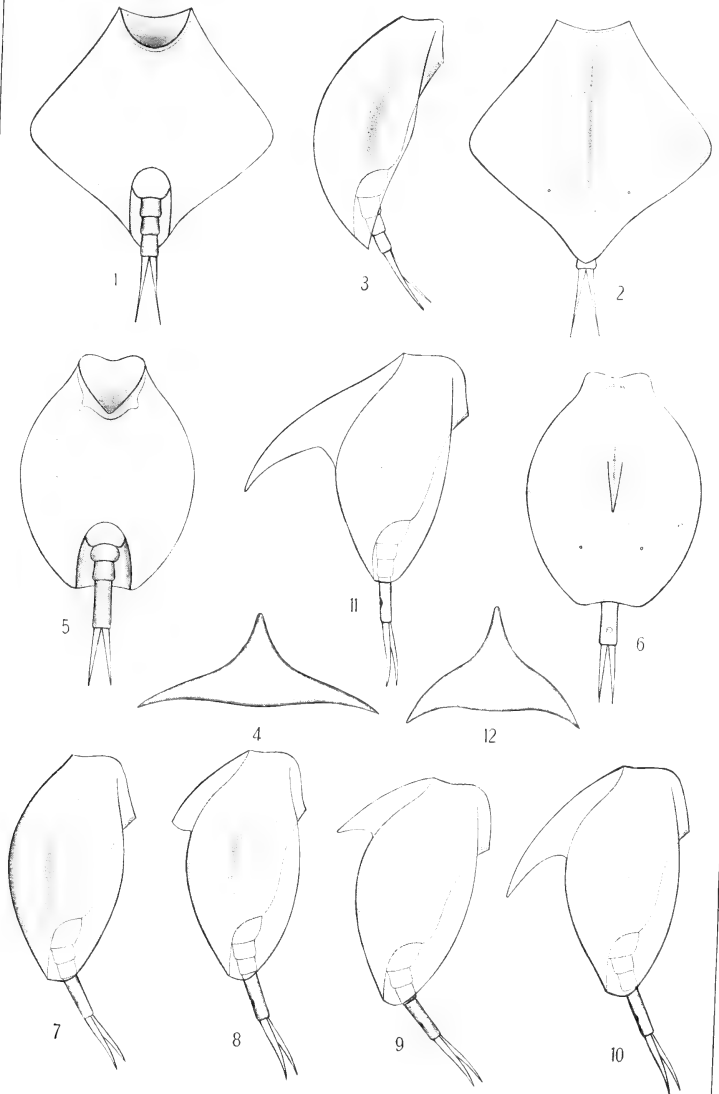
FOR EXPLANATION OF PLATE SEE PAGE 567.



ROTATORIA OF THE GENUS LEPADELLA.

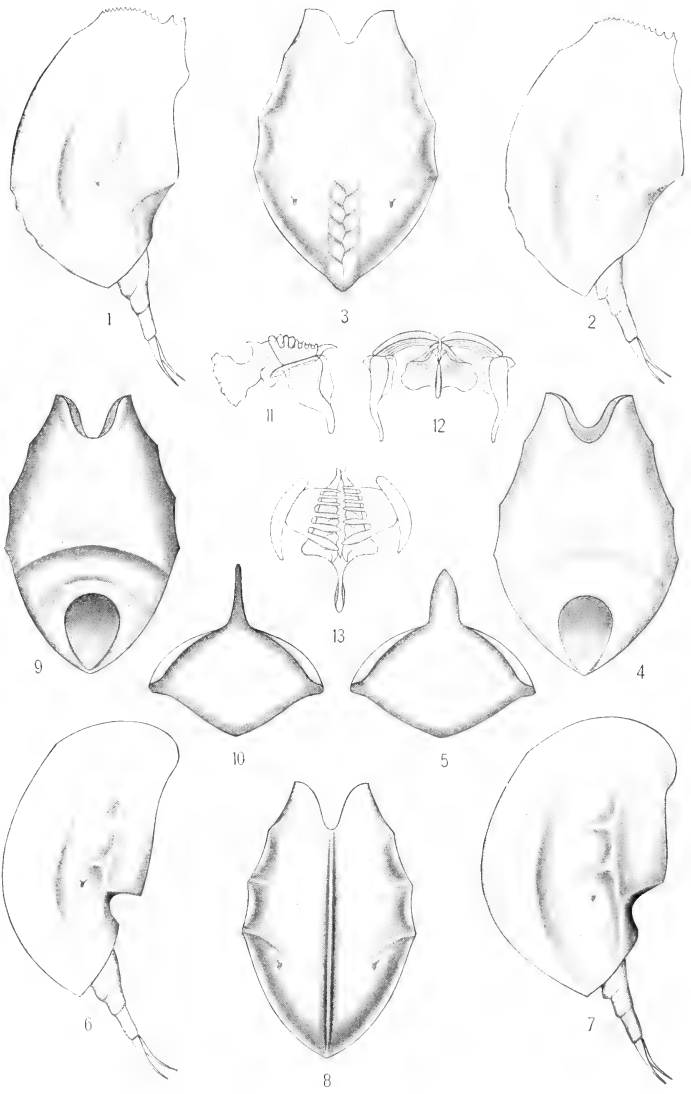
FOR EXPLANATION OF PLATE SEE PAGES 567 AND 568.





ROTATORIA OF THE GENUS *LEPADELLA*.

FOR EXPLANATION OF PLATE SEE PAGE 568.



ROTATORIA OF THE GENUS LOPHOCHARIS.

FOR EXPLANATION OF PLATE SEE PAGE 568.



A NEW GENUS AND THREE NEW SPECIES OF
PARASITIC ISOPOD CRUSTACEANS

BY

W. P. HAY

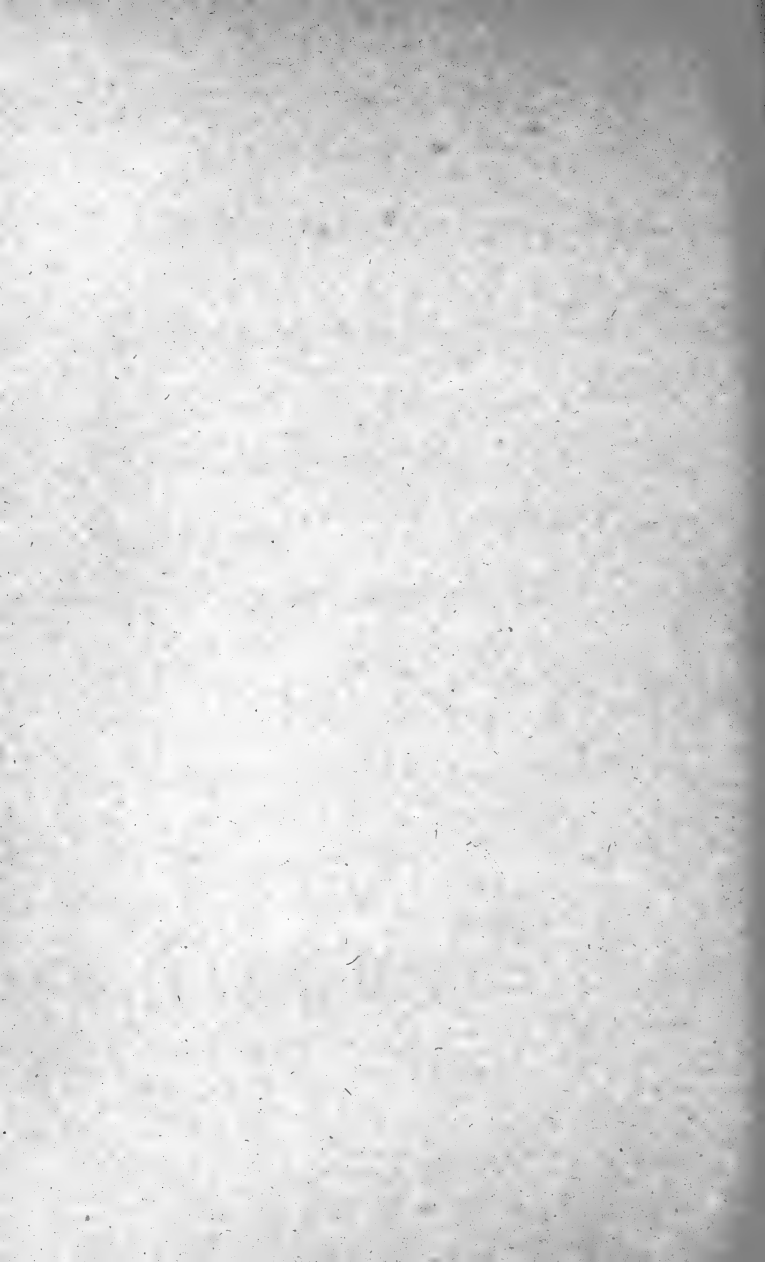
Of the Washington (District of Columbia) High Schools

No. 2165.—From the Proceedings of the United States National Museum,
Vol. 51, pages 569–574, with Plates 98–100

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A NEW GENUS AND THREE NEW SPECIES OF PARASITIC ISOPOD CRUSTACEANS

BY W. P. HAY,

Of the Washington (District of Columbia) High Schools.

The three species of bopyridian crustaceans herein described were collected by the author during the summer of 1915 while making a study of the decapod crustaceans of the region about Beaufort, North Carolina, for the United States Bureau of Fisheries. For the facilities for obtaining, preserving, and studying the animals I have to thank the Director of the Beaufort Fisheries Biological Station, Mr. S. F. Hildebrand, and the Commissioner of Fisheries, Dr. Hugh M. Smith. It is with the permission of the latter that the paper is published.

PHRYXUS SUBCAUDALIS, new species.

Plate 98, figs. 1 to 6.

Holotypes.—Cat. No. 48367, U.S.N.M., paratypes female and male, Cat. No. 48368, U.S.N.M., from Onslow Bay, North Carolina, about 20 miles off Beaufort Inlet, on *Synalpheus longicarpus* (Herrick); depth, 10 fathoms; station 8293, United States Fisheries Steamer *Fish Hawk*; August, 1915.

Female (Holotype).—Similar in general appearance and structure to *Phryxus abdominalis* Krøyer, but differing markedly in having five well-developed legs on the long side of the body, the second and third legs only being absent. The expanded epimera of the abdominal segments are usually shorter and broader than those of *P. abdominalis* and are inclined to be orbicular or even broader than long. The posterior lobe of the broad plate borne by the first leg is longest in its transverse diameter. The terminal segment of the abdomen tapers to a point and is not notched at the end.

Male (Paratype).—Compared with *P. abdominalis* the thoracic and abdominal segments taper more toward their sides, thus giving the body the appearance of being more loosely articulated, the legs appear

to be longer and more slender, and the abdomen is distinctly notched at the tip and usually shows no indication of its component parts.

A series of over 20 of these crustaceans was obtained from specimens of *Synalpheus longicarpus* (Herrick) picked out of a large sponge dredged by the Bureau of Fisheries Steamer *Fish Hawk* from a depth of about 10 fathoms. About 5 per cent of the shrimps bore this parasite and another 5 per cent had a branchial parasite (*Synsynella deformans*, new species). No case was found in which both kinds were present in the same individual. The parasites attach themselves to the under surface of the abdomen of their host, to whose swimmerets they cling with their prehensile feet. So strong is the hold of the females that unless great care is exercised in removing them their legs are invariably broken off and left behind. The ventral surface of the parasite is uppermost and its head is turned toward the tail of its host. In addition to the attachment by the feet, there appears to be a sort of pedicel extending from the soft interarticular membrane of the shrimp to the mouth of the parasite, but it is so completely hidden that I have not been able to satisfy myself as to its nature. All the females are apparently mature and are swollen with eggs. About half of the specimens are accompanied by males, but the latter are not found on the females as is usual in the parasitic isopods, but are to be found clinging to bases of the swimmerets or the last pair of walking legs of the host, immediately above the position occupied by their mate. In one case a small male was found within the egg pouch of a female; it is much smaller than the free males, its antennae and legs are much reduced in size, its abdomen is longer, turned to one side at its extremity and undulate along the margins, and the eyes and antennules are not discernible. Whether this is merely an immature male or a complementary male somewhat similar to those described by Bonnier in *Grapsicepon edwardsii* I am unable to determine.

The striking difference between this species and *P. abdominalis* is the presence in the adult female of *P. subcaudalis* of five well-developed legs on the long side of the body. It is stated by Sars that the immature female of *P. abdominalis* has four such legs, the last three of which are reduced at maturity to mere vestiges. It may be that the small size of the host of *P. subcaudalis* has made the parasite so stunted that it has retained some of its immature characteristics, but it appears more probable that we are dealing with a more primitive species, which retains its ancestral characteristics.

With the exception of Spence Bates's record for the Philippine Islands, *P. abdominalis* has been reported only from localities much farther north than Beaufort, and it appears to be most common in Arctic waters. The range of *P. subcaudalis* is probably a much more southern one, for its host belongs to a subfamily the members of which are practically all tropical and subtropical in their distribution.

SYNSYNELLA, new genus.

Branchial parasites. Head and first thoracic segment completely fused in both sexes. Eyes present. Uropods wanting.

Female.—Body somewhat asymmetrical. First and second thoracic segments and first four abdominal segments fused in the middle region, but free at the sides; last two abdominal segments completely fused; other segments distinct. Pleopods usually rudimentary but with indications of being biramous.

Males.—Body symmetrical. Abdominal segments five, all distinct. Pleopods wanting.

This genus, which probably stands closest to *Bopyriscus* Richardson, differs from all other genera of the family Bopyridae in the complete fusion in both sexes of the first thoracic segment with the head. This condition, according to Dr. H. Richardson,¹ is paralleled in only a few isopods, namely in the family Tanaidae, the family Dajidae (males only), the family Serolidae, and in the species *Crabyzos longicaudatus* Spence Bate and *Arcturides cornutus* Studer and the genus *Stenasellus* Dollfus. The union of the second thoracic segment with the head mass, as shown in the female of the present species, is a still rarer condition, being known only in the genus *Sphyrapus* Norman and Stebbing.

Type of the genus.—*Synsynella deformans*, new species.

SYNSYNELLA DEFORMANS, new species.

Plate 99, figs. 13 to 18.

Holotype and paratypes.—Female, Cat. No. 48371, U.S.N.M., Cat. No. 48372, U.S.N.M., from Onslow Bay, North Carolina, about 20 miles off Beaufort Inlet, parasitic on *Synalpheus longicarpus* (Herrick); depth, 10 fathoms, station 8293, United States Fisheries Steamer *Fish Hawk*; August, 1915.

Female.—Body nearly symmetrical, slightly longer on one side than on the other, about two-thirds as wide as long. Color entirely white or white with a brown area on the dorsal surface. Eyes red. Head broad, completely consolidated with the first thoracic segment, but a deep notch on each side continued into a shallow groove indicates its margins. Second segment fused with the first in the middle, but free at the sides. The other thoracic segments distinct. Epimeral plates present on the second, third, and fourth segments on both sides of the body, but smaller on the short side. Ovarian bosses entirely lacking. Abdomen composed of six segments fused together along the middle line; the first four have their outer half or two-thirds free, the last two are completely fused; the outer ends of all turn backward and from front to back are increasingly acute. First lamella of the marsupium bilobed, those of the two sides approximately alike in

¹ Proc. U. S. Nat. Mus., vol. 27, 1903, p. 9.

size and shape. Maxillipeds consisting of two broad basal articles obliquely articulated and a minute distal article. Antennae minute, composed of two short articles and completely concealed beneath the margin of the head. Pleopods, four pairs of small, rather broad, bilobed plates, growing smaller posteriorly, the last two or three always rudimentary. Uropods wanting.

Male.—About one-fourth as long as the female, symmetrical, about four times as long as wide. Head consolidated with the first thoracic segment, emarginate in front and with a deep notch on each side in a line with the small, black eyes. Thoracic segments rather loosely articulated, their outer ends rounded. Abdomen consisting of five distinct segments, the first three large, but diminishing in size backward, the fourth very small and completely immersed in the third, the fifth a small rounded lobe. Antennae composed of two articles. Pleopods and uropods wanting. Color white or yellowish, usually with a minute pigment fleck on each side of some of the thoracic segments.

A series of over 20 specimens of this species was secured from the same lot of shrimps as supplied the specimens of *Phryxus subcaudalis*. This parasite lives in the gill chamber, either the right or the left, with its dorsal surface resting against the gills of its host. A male is invariably found attached to the pleopods of the female close behind the marsupial chamber.

Among the specimens examined only one female was found with two pairs of well-developed pleopods. The usual condition was to have the first pair obscurely biramous, the next pair rather deeply notched, and the last two pairs much smaller and subquadrate. One male was found which was considerably broader in proportion to its length than the others, owing to the reduction of its abdomen to only three segments. It was clinging to a perfectly normal female.

PSEUDIONE UPOGEBIAE, new species.

Plate 100, figs. 7 to 12.

Holotype.—Cat. No. 48369, U.S.N.M. (female), and paratype from Beaufort, North Carolina, on *Upogebia affinis* (Say). Collector, W. P. Hay, August 17, 1915.

Female (holotype).—Body somewhat asymmetrical, longer than broad, irregularly ovate. Head small, deeply immersed in the thorax, with a frontal border the anterior margin of which is sinuately curved and indistinctly cleft in the center. Antennules of three and antennae of four articles the last two of which, in each case, project beyond the frontal border. Thorax with all the segments distinct. Ovarian bosses present on the first four segments. Epimera of first four segments reduced to narrow ridges external to the ovarian

bosses, those of the last three segments occupying the entire lateral margins. Abdominal segments distinct and with the epimera produced into broad plates which are expanded at the outer end and, with the exception of the first, have their anterior angle drawn out into a more or less prominent tooth. The pleopods are five pairs of elongate, tapering, leaf-shaped, biramous appendages having the margins produced into a number of thick, finger-like processes, which stand at right angles to the plane of the appendage both above and below, giving it the appearance, when viewed from the edge, of being pinnately branched; there may be eight or nine of these processes on each margin of both endopodite and exopodite, but those of the latter branch are reduced in size. The uropods are uniramous and resemble the endopodite of the pleopods. The incubatory pouch is formed by five broad, foliaceous plates overlapping in the middle line; the last four of these plates are approximately alike but the first is divided into two lobes, an anterior and a posterior, by a broad fold; the posterior lobe helps to cover the eggs, the anterior lobe covers the mouthparts and the fold, the margin of which bears processes similar to those on the pleopods, forms the front boundary of the egg chamber. Maxillipeds broad, roughly quadrangular and divided obliquely into two parts; the anterior inner angle produced into an unsegmented tip; posterior outer angle curved and pointed.

Male (paratype).—Much smaller than the female, symmetrical, about three times as long as broad, with all the segments of the body developed and distinct. There is a pair of very small eyes. The antennules, of three articles, are hidden beneath the margin of the head. The antennae, of four articles, are partly visible from above. The legs are all alike and prehensile. The lateral portions of all the segments of the body are narrowed, the lateral angles tending to be acuminate in the thoracic and rounded in the abdominal regions. The terminal segment of the abdomen is reduced to a knoblike structure, narrow anteriorly and notched horizontally and vertically behind.

Six specimens of this isopod, three males and three females, were obtained from the gill chambers of *Upogebia affinis*. It resembles most closely, perhaps, *P. furcata* Richardson, but differs from it and all other American species of the genus in the structure of the pleopods of the female.

EXPLANATION OF PLATES.

PLATE 98.

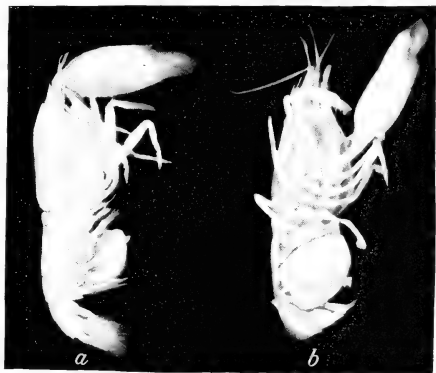
- FIG. 1, *a, b*, two specimens of *Synalpheus longicarpus* with the parasite *Phryxus subcaudalis*, $\times 4$.
2. *Phryxus subcaudalis*, female, view showing the short side of the body, $\times 10$.
 3. *Phryxus subcaudalis*, female, ventral view, $\times 8$.
 4. *Phryxus subcaudalis*, female, dorsal view, $\times 8$.
 5. *Phryxus subcaudalis*, female, view showing the legs of the long side of the body, $\times 10$.
 6. *a, b, c, Phryxus subcaudalis*, males, $\times 20$; *a, c*, ventral; *b*, dorsal view.

PLATE 99.

13. *a, b, c*, Three specimens of *Synalpheus longicarpus* with the parasite *Synsynnella deformans*, $\times 4$.
14. *Synsynnella deformans*, male, $\times 25$, ventral view.
15. *Synsynnella deformans*, male, $\times 25$, the one showing the dorsal surface has the abdomen abnormal.
16. *Synsynnella deformans*, female, ventral view, $\times 10$.
17. *Synsynnella deformans*, female, dorsal view, $\times 10$.
18. *Synsynnella deformans*, male and female, $\times 10$.

PLATE 100.

7. *Pseudione upogebiae*, female, dorsal view, $\times 4$.
8. *Pseudione upogebiae*, female, ventral view, $\times 4$.
9. *Upogebia affinis* with the parasite *Pseudione upogebiae*, natural size.
10. *Pseudione upogebiae*, male, dorsal view, $\times 10$.
11. *Pseudione upogebiae*, male, ventral view, $\times 10$.
12. *Pseudione upogebiae*, male and female, $\times 4$.



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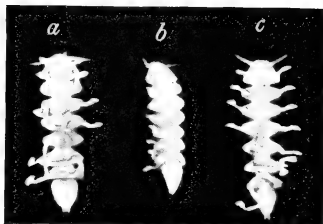
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NEW SPECIES OF PARASITIC ISOPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 574.





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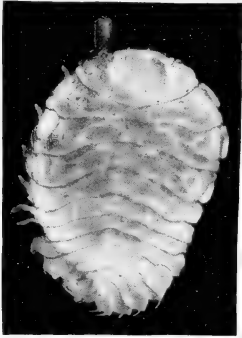
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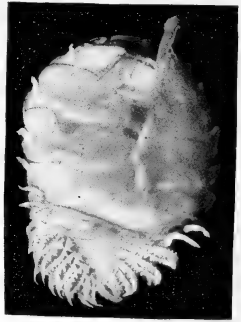
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NEW SPECIES OF PARASITIC ISOPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 574.



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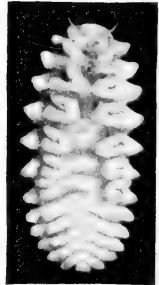
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NEW SPECIES OF PARASITIC ISOPOD CRUSTACEANS.

FOR EXPLANATION OF PLATE SEE PAGE 574.



SUMMARY OF THE MOLLUSKS OF THE FAMILY
ALECTRIONIDAE OF THE WEST COAST
OF AMERICA

BY

WILLIAM HEALEY DALL

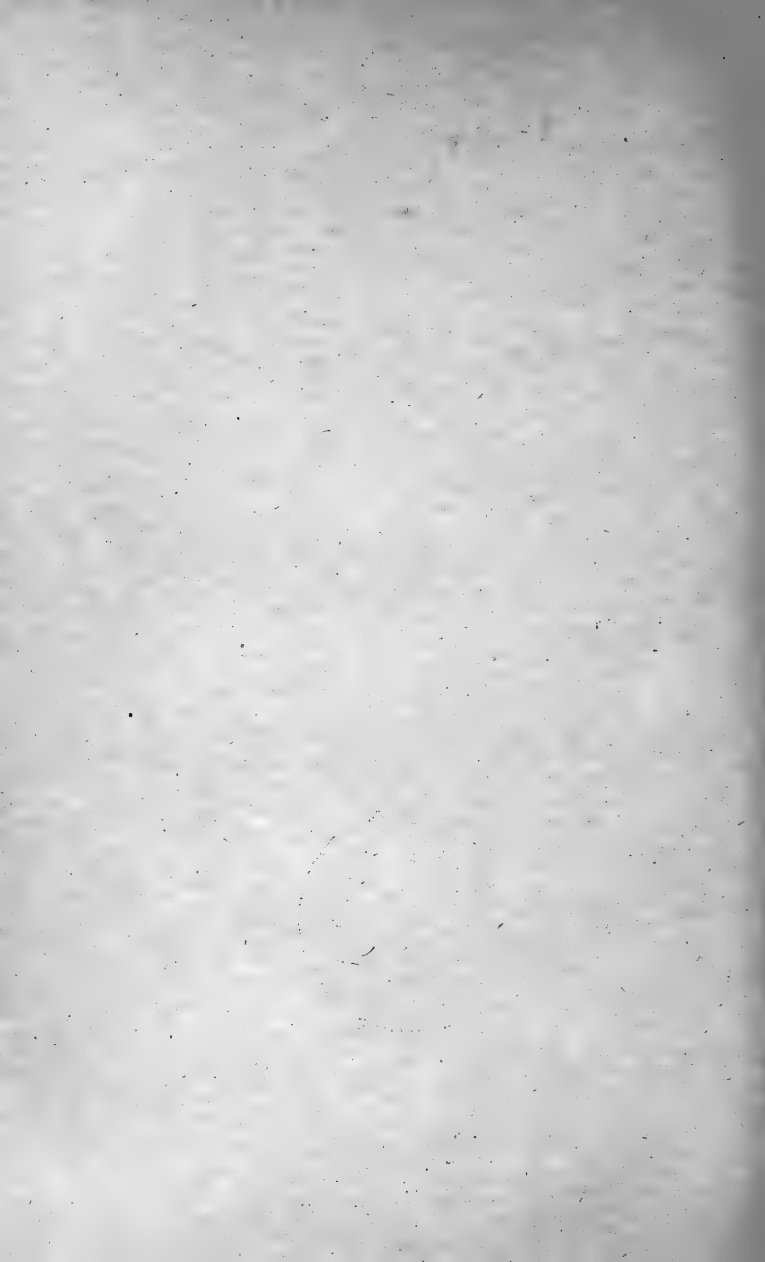
Honorary Curator of Mollusks, United States National Museum

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SUMMARY OF THE MOLLUSKS OF THE FAMILY ALECTRIONIDAE OF THE WEST COAST OF AMERICA.

By WILLIAM HEALEY DALL,

Honorary Curator of Mollusks, United States National Museum.

In reviewing the West American Nassas in the United States National Museum the following notes were made which may be useful to students of the West Coast fauna.

It has long since been pointed out that the name *Nassa*, applied first by Bolten in 1798 to the shell later named by the brothers Adams *Iopas* (*sertum* Lamarck), could not be used for the different group to which Lamarck gave the name a year later.

Bolten included the Lamarckian Nassas, typified by *Buccinum arcularia* Gmelin, in the second section of his genus *Distorsio*. If we regard only the aspect of the shells this arrangement was not unjustified by the current ideas of the time.

The different groups of the Lamarckian Nassas grade into one another so insensibly that it is difficult to award generic rank to any portion of the genus. However, a practical solution of the difficulty from a conchological standpoint, pending anatomical researches, is to use Link's name *Arcularia* (1807) for the group carrying a heavy callus about the aperture and a hump on the back of the last whorl, typified by *Buccinum arcularia* Gmelin; and for the reticulate species with little or no callus, no hump, and simple or nearly simple outer lip, Montfort's name *Alectrion* (1810), typified by *Buccinum papillosum* Linnaeus. The numerous sections into which these groups have been divided, may for the present purpose be ignored. The name which is masculine may be supposed to have been suggested by a distant resemblance of the sculpture to the caruncles of a cock's comb.

Alectrion fossatus Gould, 1850. This is *Buccinum elegans* of Reeve, 1842, but not of J. Sowerby, 1814. Its known range is from Vancouver Island south to the vicinity of Cerros Island, Lower California, and possibly to the Gulf.

Alectrion grammatus Dall, new species. Pleistocene of Santa Barbara, California. About the same size as *fossatus*, but more regular and compact, with a uniform sculpture of flat spiral cords separated by narrow channels without intercalary minor spirals. (Cat. No. 101721, U.S.N.M.) There are several older fossils of this family not included in this list.

Alectrion (Schizopyga) californianus Conrad, 1856. This is *fossata* part Gabb, not of Gould. It has been collected from Drakes Bay, north of San Francisco to the San Ignacio lagoon, Lower California.

Alectrion perpinguis Hinds, 1844. This is probably the same as *Nassa interstriata* Conrad, 1856, from the Santa Barbara Pleistocene, and has even been reported from the Miocene. Its known range is from Puget Sound to Cerros Island.

Alectrion dentiferus Powys, 1835. Peru and Chile.

Alectrion rubricatus Gould, 1849. Peru and Chile.

Alectrion gayii Kiener, 1834. This is probably *exilis* Powys, 1835, and *obscurus* Hupé 1854. Peru and Chile.

Alectrion planicostatus A. Adams, 1851. Payta, Peru.

Alectrion mendicus Gould, 1850. *Nassa woodwardi* Forbes, 1850, and *gibbsi* W. Cooper, 1857, are synonymous.

The species ranges from Kodiak Island, Alaska, to San Diego, California. It is reported from the Pliocene and Pleistocene.

Alectrion cooperi Forbes, 1850. Puget Sound and south to San Diego; also Pliocene and Pleistocene. I am inclined to think it distinct from *mendicus*, though the latter sometimes has a few strong ribs.

Alectrion cerritensis Arnold, 1903. Originally described from the Pleistocene of Los Cerritos, California. We also have it living from San Pedro to the Gulf of California. The living specimens are not quite as large as some of the fossils, and resemble young specimens of *fossatus*, but are narrower.

Alectrion pagoda Reeve, 1844. This is *Buccinum decussatum* Kiener, 1834, but not of Linnaeus, 1758. *Nassa acuta* Carpenter, 1857, and *corpulenta* C. B. Adams, 1852, are synonymous. It is known to range from the Gulf of California to Panama.

Alectrion miser Dall, 1908. A rather deep water species, like a coarse, stumpy *perpinguis*, dredged from Acapulco to Panama, and usually eroded.

Alectrion exsarcus Dall, 1908. In deep water off the Galapagos Islands.

Alectrion goniopleura Dall, 1908. With the last.

Alectrion townsendi Dall, 1908. With the two preceding species.

Alectrion tschudii Troschel, 1852. From Cerros Island, Lower California, to Peru.

Alectrion moestus Hinds, 1844. This was named *brunneostoma* by Stearns in 1893, and ranges from the Gulf of California to Chile.

Alectrion versicolor C. B. Adams, 1852. It ranges from Magdalena Bay, Lower California, to Payta, Peru.

Alectrion nodicinctus A. Adams, 1851. This species ranges from San Diego, California, to Panama and the Galapagos.

Alectrion escalae Philippi, 1860. This extremely pretty little species has been collected at Antofagasta and Mejillones, Chile.

Alectrion catallus Dall, 1908. Dredged from off San Miguel Island, California, to the Gulf of Panama.

Alectrion insculptus Carpenter, 1863, not of Cooper, 1888. This elegant species has been collected from Point Arena, California, to Cerros Island, and also from the Pleistocene.

Alectrion insculptus, new variety *eupleura* Dall. In this form the axial ribs, which in the type are only indicated at the suture, are prolonged over the periphery of the whorl to the base. It has been collected from San Simeon, California, to Cerros Island. (Cat. No. 209046, U.S.N.M.)

Alectrion taeniolatus Philippi, 1845. Collected from Acapulco, Mexico, to Guayaquil and Chile. A small reticulate species, white with two or three brown spirals, one at the suture.

- Alectrion limacina** Dall, new species. Shell very small, glistening, yellowish white with flecks of brown, especially one on the anterior angle of the outer lip; nuclear whorls smooth, three, followed by three and a half sculptured whorls; axial sculpture of 8 or 10 ribs coronated at the suture and the shoulder, crossed by two sharp narrow sulci between the sutures and by about six on the last whorl with three stronger on the base; the ribs are obsolete anteriorly on the last whorl; outer lip white, strongly varicose, with six or seven internal lirae. Length, 5.3; diameter, 3 mm. Gulf of California in shallow water. (Cat. No. 274095, U.S.N.M.)
- Alectrion onchodes** Dall, new species. A small, short, acute, swollen, evenly reticulate, whitish shell with a channeled suture, three smooth nuclear and three reticulate whorls, a heavily thickened outer lip with seven or eight denticles inside; a smooth labium, subsutural nodule, and short canal. Length, 6 mm.; width, 5; spire, 2.5 mm. (Cat. No. 96827, U.S.N.M.) Collected from off Cerros Island, Lower California, to Panama.
- Alectrion polistes** Dall, new species. Shell rather large, acute, with nine rounded whorls of which about three are nuclear and smooth, the rest reticulate; the axial sculpture stronger, of (on the last whorl about 23) arcuate, similar, narrow ribs with wider interspaces, crossed between the sutures by six or seven flattish spirals with narrower channeled interspaces in which as a rule there are no intercalary threads. The siphonal fasciole is in front of a deep sulcus, the labial callus is thin and obscurely lirate; the outer lip varicose and internally lirate, the canal very short. The color is yellowish white. Length, 24; width, 15; length of aperture, 12 mm. (Cat. No. 96642, U.S.N.M.) This species has been dredged from Panama Bay to Sechura Bay, Peru, in moderate depths of water.
- Arcularia luteostoma** Broderip and Sowerby, 1829. *A. xanthostoma* Gray, 1839, is synonymous. This very distinct species ranges from the Gulf of California to Chile.
- Arcularia tiarula** Kiener, 1834. Cape St. Lucas to Panama. This is the whitish, polished, smooth-backed form with coronated last whorl and brown spots in front of the suture, which with the two following forms has generally been regarded, following Carpenter, as a variety of *tegula*. It is certain they are intimately allied but are geographically of different distribution. This is the southern form ranging from Cape St. Lucas to Panama.
- Arcularia nodulifera** Philippi in Carpenter, 1857. This form is strongly spirally sulcate and ranges from San Diego, California, to the Gulf of California. It is usually dark gray with a rude surface.
- Arcularia tegula** Reeve, 1853. This is the large, dark-colored form which ranges from San Francisco to San Diego, California.
- Arcularia crebristriata** Carpenter, 1857. This form ranges from Mazatlan to Salina Cruz, Mexico.
- Arcularia complanata** Powys, 1835. This is the dark form of which the two following may be geographical races. It ranges from Panama to Valparaiso.
- Arcularia major** Stearns, 1894. Larger, yellow brown, apparently quite distinct from the preceding. Ranges from Panama to the Gulf of California.
- Arcularia iodes** Dall, new species? Pale violet with darker violet spiral bands and conspicuous white callus about the mouth. Smaller than *major* or *complanata*. (Cat. No. 53946, U.S.N.M.) Gulf of California.
- Arcularia scabriuscula** Powys, 1835. *Nassa stimpsoniana* C. B. Adams, 1852, is synonymous. Ranges from Montijo Bay, Central America, to Panama.

Arcularia exilis Powys, 1835. This is *Nassa fontainei* Orbigny, 1841, and *panamensis* Philippi, 1851, not of C. B. Adams, 1852. It ranges from Panama to Peru and Chile.

Ilyanassa obsoleta Say, 1822. This species has been introduced with "seed" oysters from the Atlantic coast, and at last accounts was flourishing on the oyster beds in San Francisco Bay.

The only recorded recent species from this region of which I have not seen specimens and which are not contained in the collection of the United States National Museum are *Arcularia paposana* Philippi, 1860, from Paposo, Chile; *festiva* Powys, 1835, Panama to Guayaquil; and *sparta* Marrat, 1897, from the "west coast of South America."

The following forms near to or usually associated with the Nassas, may not improperly be included here:

Genus PHOS Montfort, 1810.

Phos cocosensis Dall, 1896. Gulf of Panama, Cocos Island. (Gulf of California?)

Phos crassus Hinds, 1844. Lower California and the Gulf of California.

Phos chelonia Dall, new species. Shell very similar in general appearance and size to *P. varicosus* Gould, having similar whitish varices, about three or four to a whorl, but differing by having the whorls appressed to the suture, not deeply impressed, and in having a nuclear shell of five or six whorls, deeply spirally sulcate instead of a nearly smooth one of three and a half whorls. The color of the present species is pale yellowish with a tinge of brown, as in *varicosus*, which also has narrower and more numerous ribs between the varices. (Cat. No. 194961, U.S.N.M.) Dredged at the Galapagos Islands in 40 fathoms.

Phos alternatus Dall, new species. Shell resembling *P. cancellatus* in a general way, but without the nodose-prickly sculpture. Whorls six with two or three nuclear turns in addition. Suture distinct, not deep, spire about as long as the aperture; sculpture of narrow, nearly straight, axial ribs with wider interspaces, about 22 on the last whorl, extending to the base; these are overridden by (between the sutures five) flattened, straplike spirals, with narrower channelled interspaces, in which are two or three very fine distinct spiral threads. The intersections are not nodulous, though the spirals are undulated where they cross the ribs. The outer lip is hardly thickened, not varicose but lirate within, the pillar simple with a sharp basal fold. Length, 26; width, 12 mm. (Cat. No. 212110, U.S.N.M.) This species like most of the others is occasionally banded with brown. The specimens examined are from the Gulf of California.

Phos mexicanus Dall, new species. Shell small, slender, not unlike *P. articulatus* Hinds, but without the articulations; with only 10 ribs on the last whorl instead of 14; with eight or nine whorls; the suture appressed, the spiral sculpture of flattish threads, larger and flatter on the base; between sutures two or three spirals more prominent than the rest and swollen where they pass over the axial ribs; aperture simple, lips not callous, pillar without a keel anteriorly; the canal short, the siphonal notch deep. Length, 23; diameter, 8.5; length of last whorl, 13 mm. (Cat. No. 212111, U.S.N.M.) Ranges from Cape St. Lucas to Panama.

Phos minusculus Dall, new species. Shell very small and thin, with about six whorls without the nucleus; whorls rounded, suture distinct, with two undulated spiral threads in front of it, and in front of them six flattened threads with wider channelled interspaces between the sutures on the penultimate whorl; these are not swollen when they cross the ribs, of which on the last whorl there are 14, with wider interspaces; there are no intercalary spirals; outer lip slightly

varicose, with about 10 short internal lirae; labium smooth with no subsutural callus and no anterior keel on the pillar. Length, 12; diameter, 5; length of last whorl, 8 mm. (Cat. No. 122775, U.S.N.M.) Dredged in Panama Bay in 26 to 47 fathoms. This is the smallest species so far on record.

Genus NASSARINA Dall, 1889.

Nassarina solida Dall, new species. Shell small, solid, strongly sculptured, short-fusiform, dark brown, with white spots on the ribs in front of the periphery on the last whorl; there are about six rapidly increasing sculptured and three smooth nuclear whorls; sculpture of seven strong rounded axial ribs, obsolete on the base, overrun by, between the sutures, three very strong spiral cords, the most prominent pair being peripheral; the other, just in front of the appressed suture becomes obsolete on the last whorl; the whorl slightly in front of the latter cord is constricted, the constriction corresponding to a prominent callosity, or nodule on the inside of the outer lip; the entire surface is also covered by very fine uniform sharp spiral threads; the canal is short and slightly directed to the right; the aperture is small, the labium with a thin coarsely lirate callus and a large subsutural callosity; the outer lip beside the nodosity above referred to has five well-developed denticles and is internally thickened but not varicose. Length, 12; diameter, 6; length of aperture including the canal, 5 mm. Near La Paz, Gulf of California, in 8 fathoms. (Cat. No. 274095, U.S.N.M.)

Genus HINDSIA Adams, 1853.

Hindsia perideris Dall, 1910. Gulf of California, near La Paz.

Genus NORTHIA Gray, 1847.

Northia northiae Gray, 1833.

This is *Buccinum serratum* Dufresne, in Kiener, 1834, not of Brocchi, 1814; and *B. pristis* Deshayes, 1844. It ranges from the Gulf of California to Guayaquil.

In the proceedings of the United States National Museum, volume 26, page 350, I called attention to the fact that no species of *Gouldia* was yet known from the Pacific coast. Since then the supposed deficiency has been supplied by the discovery among some unworked small shells from the Gulf of California of a new species of that genus.

Genus GOULDIA C. B. Adams, 1847.

Gouldia californica Dall, new species. Shell small, thin, white, with touches of brown along the dorsal border, ovate-triangular, the anterior lateral tooth large and prominent, the pallial line hardly sinuated; sculpture reticulate, the concentric sculpture more prominent in the middle of the disk, the radial toward the ends of the valves; the inner valve margins smooth. Length, 6; height, 5.5; diameter, 3 mm.

Gulf of California near La Paz, in 21 fathoms. (Cat. No. 211736, U.S.N.M.)

This is a smaller and frailer species than either of those of the Atlantic coast.

DESCRIPTIONS OF SEVEN NEW SPECIES OF RED SPIDERS

BY

E. A. MCGREGOR

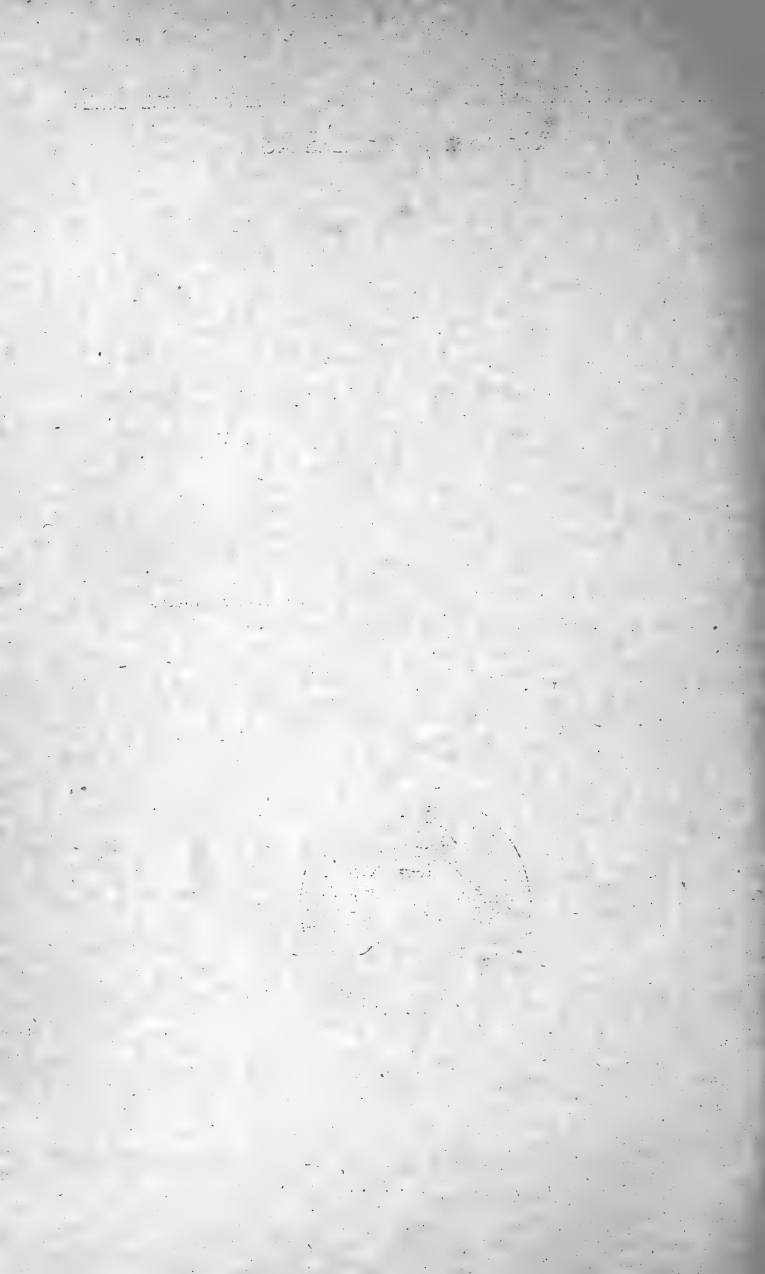
Of the Bureau of Entomology, United States Department of Agriculture

No. 2167.—From the Proceedings of the United States National Museum,
Vol. 51, pages 581-590, with Plates 101-107

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By E. A. MCGREGOR,

Of the Bureau of Entomology, United States Department of Agriculture.

Six species of *Tetranychus* and one of *Tetranychina* are herein described for the first time. Two of these from South America and five from North America are of some economic importance. One discolors the leaves of American holly, one injures at times the appearance of the beautiful western white oak, and one saps the vitality of the large huckleberry of the Cascade region.

TETRANYCHUS PERUIANUS, new species.

Color, translucent yellowish green. Eyes (in mounted material) clear, directly over front margin of coxæ II. Dorsal bristles, 24 in number, not arising from tubercles, for the most part very short and weak, distributed on dorsal aspect of body in about the usual arrangement. Body of female rhombic-ovate, widest across hind margin of cephalothorax, which is slightly emarginate in front; male cuneate-pentagonal, widest across hind margin of cephalothorax, which is truncate in front, abdomen tapering to acute point posteriorly. Mandibular plate considerably more than twice as long as broad, margins subparallel, with a very distinct anterior emargination. "Thumb" of palpus very short in proportion to its width, bearing at its tip a relatively large, subconical "finger," whose base is half as wide as tip of "thumb," length of "thumb" and terminal "finger" together equaling width of "thumb." On its rather truncate tip, on opposite sides of the "finger," are two stout spines or pseudo-fingers (not much thicker than hairs); on upper side, about one-third to base, is a small "finger," and between this and base are two short hairs, the distal-most one of which appears to arise adjacent to the small "finger." The claw on the penultimate joint reaches far beyond the middle of the "thumb;" a hair arises laterally from the center of the "thumb," and another from a similar position on the penultimate joint. The legs are unusually short, in the female distinctly less than the width of the body, in the male barely exceeding the width of body. Femur I considerably less than twice as long as wide, about half again as long as tarsus I. Tibia I just equaling patella I, which

barely equals trochanter I. Tip of tarsus bears a stout, sickle-shaped claw, which is uncleft to its tip; arising from the under face of this claw, near its base, are six weak spines, which are less than one-fourth the length of the main claw. The usual series of four capitate hairs arise by the sides of the base of the claw from the tip of the short onychium. The egg is unknown to the writer.

Type.—Cat. No. 20164, U.S.N.M.

The type material was collected by Mr. E. W. Rust "along the line of the Ferrocarril Central del Peru near La Legua (between Lima and Callao), Peru, South America, January, 1913, from the under-side of willow (*Salix*, species) leaves." The species is somewhat intermediate between *T. bicolor* Banks and *T. yothersi* McGregor, but is in no wise closely allied to either species.

Notes.—An ample series of measurements of mounted material in fair condition have yielded the following averages for adults of both sexes.

Sex.	Length (not including palp).	Width.	Foreleg.
	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
Female.....	0.299	0.205	0.173
Male.....	0.237	0.168	0.177

The relative lengths of the leg joints are as follows: Coxa 9, trochanter 10, femur 16, patella 9.5, tibia 9.5, tarsus 10.

Mr. Rust states that the presence of this species causes the willow leaves to turn yellow and drop, but did not appear to greatly injure the trees. He says that the individuals live in restricted colonies under small, compact webs which almost completely conceal them. These webs, according to Mr. Rust, resemble very much the webs under which many true spiders deposit their eggs. No predaceous species were observed in the mite colonies.

TETRANYCHUS RUSTI, new species.

Color ranging from yellowish or greenish to red. Eyes (in mounted material) translucent, directly over coxae II and between subfrontal and posterior cephalothoracic bristles. The dorsal epidermal appendages are not distributed to conform with the usual arrangement for this genus, but a series of 26 shortish, nontapering, sparsely serrate, rod-like appendages are distributed on the dorsal aspect of the body as follows: One at either side of mandibular plate anteriorly, one just anterior to each eye, one just posterior to each eye, six forming a fringe at hind margin of body, three along each side of abdomen, a series of four along the anterior margin of abdomen, one on either side of median axis in line with coxae III, and one on either side of

median line near hind margin of abdomen. Body of female ovate, widest across front region of abdomen, slightly obese for the size of legs; cephalothorax rather evenly rounded anteriorly with a slight truncate border overlying the palpi; male elongate-sagitate in outline, legs conspicuously long for size of body. Mandibular plate slightly over half as wide as long, tapering gradually forward, with almost no emargination anteriorly. "Thumb" of palpus subcylindrical, beelling considerably at base, upper surface indented near central point; tip of "thumb" bearing three "fingers," one at inferior angle conical and three times as long as thick, one at superior angle slender and eight times as long as thick; a slender "finger" between these at inner angle which in size is intermediate between them. A reduced "finger" and a slender spine arise side by side from the indentation of the upper side of "thumb"; a hair arises latero-ventrally from near base of "thumb." The claw of the penultimate joint reaches to the subbasal "finger." Legs of female are of average length, barely less than that of body; those of male are slightly more than half again as long as body. Femur nearly five times as long as thick, from three-quarters again to twice as long as tarsus. Tibia about a quarter again as long as patella, which is two and a half times as long as trochanter. Relative length of joints are as follows: Coxa, 6; trochanter, 4; femur, 15; patella, 10.3; tibia, 12.7; tarsus, 8.5. Tip of tarsus not provided with a claw. The usual series of four capitate hairs arise from the end of the onychium.

Type.—Cat. No. 20170, U.S.N.M.

The type material from Mira Flores Station, Departamento of Piura, Hacienda "San Jacinto," Peru, South America, October 15, 1912, on papaya (*Carica papaya*). Collected by Mr. E. W. Rust. Allied to *T. latus* of Europe, but closest to *T. banksi* McGregor, from which it may be distinguished as follows:

T. banksi: Body widest across middle of cephalothorax; length of body of male barely exceeding width; 18 spatulate-serrate hairs comprise the dorsal series of epidermal appendages; palpal "thumb" with a single terminal "finger;" mandibular plate distinctly emarginate.

T. rusti: Body widest across anterior region of abdomen; length of body of male two-thirds again as long as wide; 26 slightly serrate rod-like hairs comprise the dorsal series of epidermal appendages; palpal "thumb" with three terminal "fingers;" mandibular plate not clearly emarginate.

Notes.—Mr. Rust writes that—

A bad infestation injures the large, tender leaves of the papaya in much the same way that cotton is injured by *T. bimaculatus*. Very abundant, feeding on the upper sides of medium-aged leaves, but very little web was seen. In short the species in life behaves and appears so much like *T. bimaculatus* that I supposed from a superficial examination that they were one and the same. In color, like *T. bimaculatus*, ranging from yellowish and greenish to red. No predaceous species were noted.

An ample series of measurements of individuals of this species have yielded the following averages:

Sex.	Length (exclusive of palpi).	Width.	Foreleg.
	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
Female.....	0.325	0.245	0.302
Male.....	.282	.175	.405

TETRANYCHUS MONTICOLUS, new species.

Body of a rather uniform pale amber color. Eyes pale; one cornea on each side close behind the subfrontal bristle, behind which are the carrot-colored eye spots. Legs and palpi rather paler than body. Dorsal bristles colorless, distinctly plumose, 26 in four rows, the longest about five-ninths the width of body. Body pyriform-elliptic, usually widest between legs II and III. Mandibular plate nearly three times as long as broad, narrowed considerably anteriorly to a well-rounded, unemarginated tip. "Thumb" of palpus two-thirds as long as broad, bearing on its truncate tip a subconical "finger," whose base is only two-fifths as wide as the tip of the "thumb." On its upper distal corner are two pin-shaped pseudo-fingers, in length somewhat exceeding the terminal "finger," on upper side, about a third the distance to base, is a very small "finger;" and immediately proximad to this is a short hair. Another similar hair occurs on the upper side just at base; a hair arises on the ventral aspect of the "thumb." The claw of the penultimate joint does not reach quite to the dorsal "finger." The legs are short, not much over two-thirds the length of body (exclusive of palpi). Femur a little more than twice as long as wide, not quite as long as tarsus; tibia a little longer than patella, which is five-sevenths again as long as the trochanter. Relative length of joints is as follows: Coxa, 8; trochanter, 7; femur, 20; patella, 12; tibia, 14; tarsus, 22. Tip of tarsus bears a claw which is bent near its middle and cleft into six slightly curved spurs. The customary four capitate hairs arise, two on either side by base of claw, tarsal claw of male differing from that of female in that its six divisions are much shorter and more abruptly acuminate. The collar trachea is rather novel; it runs downward and backward from the pore, then turns suddenly upward and backward to form an angle of about 130°, and then the superior arm bends abruptly forward and upward, paralleling the inferior arm. The superior arm is much shorter and of somewhat smaller caliber than the inferior arm. The penis is of unusual type. The short inner lobe is rod-like for most of its length and then expands suddenly to form the prominent basilar lobe; the outer shaft arises as a rod-like structure not materially stouter than the inner lobe, and for one-third its length is directed

about continuous with the inner lobe, but bends slightly downward, then extending backward as a straight, slender spur, terminating in a very sharp point.

Type.—Cat. No. 20165, U.S.N.M.

The type material is from the south slope of Mount Hood, Oregon, above Government Camp, at an altitude of 6,000 feet, August 23, 1915, from underside of leaves of large-berried huckleberry (*Vaccinium*, species). Considerable discoloration and dropping of leaves accompanies the mite's activities. The species is rather close to *T. oregonensis*, described herein, but is readily distinguished from the latter through the marked differences in the form of the penis and collar trachea. As far as we know this establishes a record for altitude for a red spider species.

TETRANYCHUS OREGONENSIS, new species.

Color, straw-color or pale yellowish amber; lateral spots lacking or very inconspicuous. Eyes pale, a single one on either side near base of subfrontal bristles. Legs and palpi paler than body. Dorsal bristles, 26, in four rows, plumose, pale, longest bristle (subfrontal) equal to half the breadth of body. Body elliptic-ovate, 0.304 mm. long by 0.142 mm. wide; vertical thickness of body greatly reduced. "Thumb" of palpus very short, nearly half again as wide as long, bearing at its tip a fairly ample "finger," whose base, however, is slightly more than one-third the width of "thumb" at tip. On its upper distal corner are two pseudo-fingers; on upper side hardly midway to base is a very small "finger" or sensilla, and between this and base are two short hairs; a hair arises latero-ventrally from the center of the "thumb." The claw on the penultimate joint reaches to the dorsal "finger." The spur on the second joint of the male palpus is rather long and tack-like. The legs are rather short, about three-fourths the length of body. Femur hardly twice as long as wide, equaling the tarsus; tibia one-fourth longer than patella, which barely surpasses the trochanter in length. Relative length of joints as follows: Trochanter, 10; femur, 21; patella, 11; tibia, 14; tarsus, 21. Tip of tarsus bears a claw, which is strongly bent below its middle; the portion beyond this point is cleft into six nearly straight claw divisions, the two inner of which are somewhat stronger than the others. The usual series of four capitate hairs arise by the sides of the claw base. Collar trachea of novel type; runs backward and downward as a straight even-calibred tube, and then bends sharply upward into a short wide chamber, the two arms making an angle with one another of less than 90°. In the one rather poor male specimen the penis shaft appears to taper gradually to a strong, unbarbed hook.

Type.—Cat. No. 20166, U.S.N.M.

The type material is from Portland, Oregon, September 2, 1915, from wild cherry (*Prunus*, species), collected by the author. The species is nearest *T. monticolus*, herein described, from which it is readily separable through the collar trachea and penis characters.

TETRANYCHUS WILLAMETTEI, new species.

Color, pale lemon-yellow. Eyes single on each side. Legs and palpi, pale color. Dorsal bristles not arising from tubercles. Body of female elliptical, four-fifths again as long as broad, widest between legs III; length, 0.25 mm.; breadth, 0.14 mm. Bristles, about 22, in four dorsal rows, the longest about half the width of the body. Mandibular plate with parallel sides, $2\frac{3}{4}$ as long as broad, rounded at tip with no emargination visible. "Thumb" of palpus of very unusual form—semispherical or subconical, bearing at its tip a very slender, long "finger"; on its upper side near apex are two pin-shaped pseudo-fingers, and on same side about midway to base is a "finger" shorter and even thinner than terminal "finger;" between this and base are two slender hairs a trifle longer than subbasal "finger"; a slender hair arises latero-ventrally one-third the distance from tip to base of "thumb." The claw on the penultimate joint does not reach to subbasal "finger." The legs are rather short; forelegs about four-fifths the length of body. Femur about two and one-half times as long as thick, barely longer than the tarsus; tibia, and patella equal. Tip of tarsus bears a claw which is rather strongly bent near base and only slightly arched for the rest of its length; it appears to be uncleft for over half its length, and then divided into six closely appressed spines. The usual series of four capitate (tenent) hairs arise in pairs by the sides of the claw base. The collar trachea, opening medially in a pore, runs first downward and backward, then upward and backward, and then upward and slightly forward. It is of nearly even caliber throughout, but gradually enlarges a trifle toward the hind end. Viewed as a whole it is very nearly sickle-shaped. The penis is simple in structure, the shaft being very gradually attenuated to an extremely sharp point; it is very slightly bent just distad to the middle, but is generally straight.

Type.—Cat. No. 20169, U.S.N.M.

The type material is from Oregon City, Oregon, August 22, 1915, from the leaves of the white oak (*Quercus lobata*), collected by the author. The presence of this species on oaks is revealed from a distance through the rusty appearance. The species appears to be quite aberrant, but finds its nearest ally, perhaps, in *Neotetranychus rubi* of Trägårdh.

TETRANYCHUS ILICIS, new species.

Color, from ferruginous to reddish-brown, with a pale pink area embracing central portion of the cephalothorax; darker than most red spider species. Eyes conspicuous, carmine. Dorsal bristles

colorless, arising from rather prominent tubercles, densely clothed with distally pointing barbules; subfrontal bristle one-fourth again as long as frontal one. Body rotund-elliptical; male much less rotund, narrowed backward. Bristles about 22 in four rows, in length averaging about five-sevenths the width of body. Mandibular plate three-fourths again as long as wide, narrowed somewhat anteriorly to a rounded tip, which is distinctly emarginate in the female. Palpi pale pink, like cephalothorax. "Thumb" of palpus not greatly shortened axially, the thickness at middle being about nine-tenths of its length, bearing at its tip a slightly clavate "finger," whose base is less than half as wide as the tip of the "thumb;" on its upper distal corner are two spine-like pseudo-fingers; on upper side almost midway to base is a greatly reduced "finger," about one-fourth as thick as the terminal "finger," and between this and base are two short stout hairs rather similar to the pseudo-fingers. A hair, similar to the upper basal one, arises laterally from the center of the "thumb." The claw of the penultimate joint reaches just beyond the dorsal "finger." The legs are pale amber-color, not quite as long as width of body. Femur three and one-half times as long as wide, somewhat exceeding tarsus. Tibia nearly a third longer than patella, which is nearly twice the length of the trochanter. Tip of tarsus bears a stout claw, which is sickle-shaped; six weak spines arise perpendicularly from the claw a short distance from its base. The usual series of four capitate hairs are present, two on each side fusing to form a swollen pedicel which are set on the onychium on either side of the main claw base. Relative lengths of leg joints as follows: Coxa, 15; trochanter, 7; femur, 26; patella, 12; tibia, 15; tarsus, 23. The collar trachea, opening medially in a pore, runs downward in an almost straight line and just above the ventral end bends sharply backward and expands into an elliptical chamber, which is twice the caliber of the linear portion.

Penis appears to be about intermediate between the *T. telarius* type (as figured by Ewing) and that of *T. monticolus* (herein figured); the inner lobe appears to be longer than the shaft proper, rodlike, and somewhat slender; a well-developed basilar lobe occurs dorsally; the shaft is comparatively short and thick and bends abruptly downward and slightly forward to form the stout hook, which terminates in a rather straight, unbarbed, very sharp spur. The egg is slightly depressed globose and bears a stalk which about equals the height of the egg.

Type.—Cat. No. 20167, U.S.N.M.

The type material is from Batesburg, South Carolina, January 6, 1916, from the upper and under sides of American holly leaves (*Ilex opaca*), collected by Mr. F. L. McDonough and the author. The species is in the group comprising *T. pilosus* Canestrini and Fanzago,

T. ununguis Jacobs, both of Europe, and *T. yothersi* McGregor, of America. The present species also bears some likeness to Trägårdh's genus *Schizotetranychus* in the presence of two main divisions of the tarsal claw.

TETRANYCHINA MACDONOUGHII, new species.

Color, bright ferruginous to orange red. Dorsal cuticular appendages, 26, arising from very prominent tubercles, arranged as follows: Two frontals, 2 subfrontals, 5 on each side along the lateral margins of the abdomen, 8 grouped on the hind region of abdomen, and 4 near the center of abdomen. Each appendage is rather filiform, appressed plumose, slightly thicker at tip than at base, tinged with red. Body elliptical, widest equatorially; cephalothorax truncate in front; abdomen rounded behind. Mandibular plate with sides arching to a narrow, unemarginated tip. Palpi stout, bearing in all eight spines; "Thumb" of palpus three times as long as thick, bearing two spines at tip, two dorsally and one ventrally; claw of penultimate joint reaching two-thirds distance to tip of "thumb." Legs I of female almost two and a half times the length of body; tibia I a trifle over one-third the length of entire leg; tarsi I slightly swollen immediately behind tip; tarsus on its tip bears a single claw, which is nearly straight for two-thirds its length and is then bent to form a short hook; the claw is plumose, bearing 11 pairs of capitate spines. Arising from the onychium by the sides of the claw base (much as in the case of *Tetranychus*) are the four tenent hairs, the two on each side united at base into a swollen pedicel. Comparative length of segments of leg I of female as follows: trochanter, 4; femur, 35; patella, 5; tibia, 36; tarsus, 16. Leg I of male three times the length of body.

Type.—Cat. No. 20168, U.S.N.M.

The type material was collected by Mr. F. L. McDonough at Quincy, Florida, June 5, 1915, on the underside of leaves of *Oxalis stricta*. The species is probably closest to *Tetranychina* (*Neophillobius*) *harti* of Ewing, but is easily separable from the latter as follows:

T. macdonoughi: Body, 0.43 mm. by 0.35 mm.; dorsal bristles enlarged toward end; differently distributed (from that of *T. harti*): tarsi I somewhat swollen at end; palpus bears eight bristles.

T. harti: Body, 0.64 mm. by 0.44 mm.; dorsal bristles acuminate to tip; none of leg joints swollen; palpus bears six bristles.

Mr. McDonough says that the species is gregarious, living in small colonies, just as is the case with red spiders, and that the effect on the leaves is exactly similar to the work of red spiders.

EXPLANATION OF PLATES.

[Drawings by the author.]

PLATE 101.

Tetranychus peruvianus.

- FIG. 1. Female, dorsal view.
 2. Male, dorsal view (bristles not shown).
 3. Left eye, seen from above.
 4. Mandibular plate, showing normal extrusion from cephalothorax.
 5. Left foreleg, seen from above.
 6. Extremity of left palpus (viewed from outside), showing "thumb," "fingers," claw, and other appendages.
 7. Tarsal appendages (lateral view), showing onychium, claw, and tenent hairs.

Figures 3, 4, 6, and 7 were drawn with oil-immersion lens and camera lucida. In figures 1 and 2 the legs are shown foreshortened through lack of uncontracted specimens.

PLATE 102.

Tetranychus rusti.

- FIG. 1. Male, dorsal view, bristles not drawn.
 2. Mandibular plate, showing also stylets and spina.
 3. Profile view of typical dorsal appendage.
 4. Tarsal appendages (lateral view), showing onychium, terminal protruberances, and tenent hairs.
 5. Extremity of left palpus (viewed from inside), showing "thumb," "fingers," claw, and other appendages.
 6. Female, dorsal view.

Figures 2, 3, 4, and 5 were drawn with oil-immersion lens and camera lucida.

PLATE 103.

Tetranychus monticolus.

- FIG. 1. Penis, lateral view.
 2. Collar trachea, from right side.
 3. Tarsal appendages of leg II of female (lateral view), showing onychium, claw, and tenent hairs.
 4. Tarsal appendages of male (lateral view).
 5. End of right palpus (viewed from outside), showing "thumb," "fingers," claw, and other appendages.
 6. Frontal and subfrontal bristles and eye of right side (viewed dorsally).

Figures 1, 2, 3, 4, and 5 were drawn with oil-immersion lens and camera lucida.

PLATE 104.

Tetranychus oregonensis.

- FIG. 1. Collar trachea, from right side.
 2. Right leg I, from outside.
 3. Profile view of adult female.
 4. Extremity of right palpus (viewed from outside), showing "thumb," "fingers," claw, and hairs.
 5. Tarsal appendages (lateral view) showing onychium, claw, and tenent hairs.

Figures 1, 4, and 5 were drawn with oil-immersion lens and camera lucida.

PLATE 105.

Tretranychus willamettei.

- FIG. 1. Penis, lateral view (owing to the opaqueness of body the innermost portion of penis was not clearly revealed).
2. Right eye and basal portion of subfrontal bristle, from above.
 3. Tarsal extremity, dorsal view.
 4. Collar trachea (viewed from right side).
 5. Tarsal appendages (lateral view), showing onychium, claw, and tenent hairs.
 6. Extremity of right palpus (viewed from outside) showing "thumb," "fingers," claw, and hairs.

Figures 1, 2, 3, 4, 5, and 6 drawn with oil-immersion lens and camera lucida.

PLATE 106.

Tetranychus ilicis.

- FIG. 1. Right leg I, ventral view.
2. Tarsal appendages (lateral view), showing onychium, claw, and tenent hairs (on Chinaberry from Florida).
 3. Frontal and subfrontal bristles (frontal bristle shown only in part).
 4. Tarsal appendages (lateral view), showing onychium, claw, and tenent hairs (on holly—*Ilex opaca*).
 5. Three of dorsal bristles, showing attachment in tubercles.
 6. Extremity of right palpus (viewed from outside), showing "thumb," "fingers," claw, and hairs.
 7. Collar trachea, from right side.

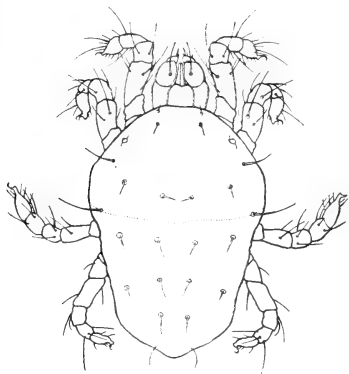
Figures 2, 4, 6, and 7 drawn with oil-immersion lens and camera lucida.

PLATE 107.

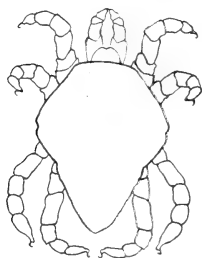
Tetranychina macdonoughi.

- FIG. 1. Right palpus from outside, showing "thumb," "thumb" spines, claw, and other appendages (lateral view).
2. Extremity of tarsus, showing claw and its plumose arrangement, onychium, and tenent hairs.
 3. Female (dorsal view), showing leg stumps and dorsal appendages.
 4. Extremity of tarsus (ventral view), showing onychium, plumose claw, and tenent hairs.
 5. Female (lateral view), showing left foreleg, dorsal and ventral appendages.

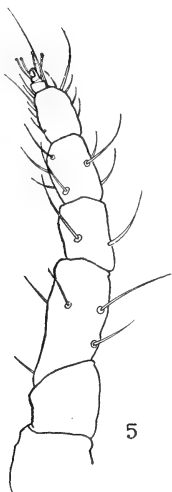
Figures 1, 2, and 4 drawn with oil-immersion lens and camera lucida.



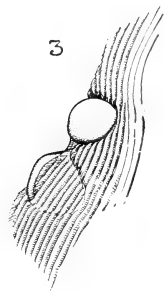
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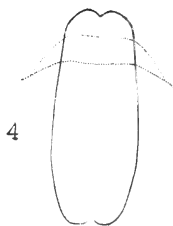
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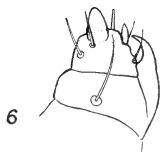
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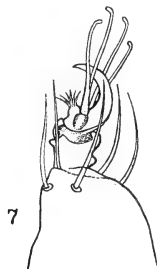
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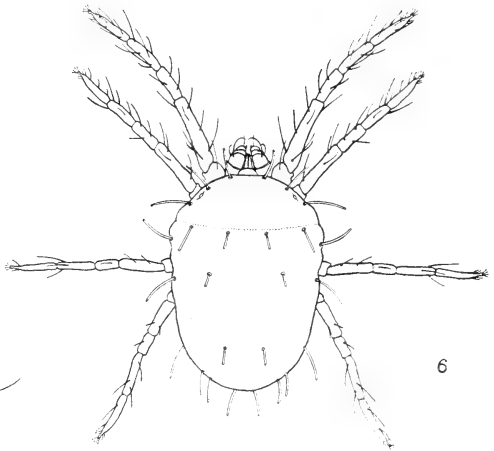
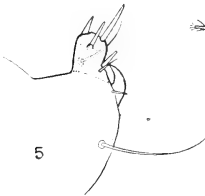
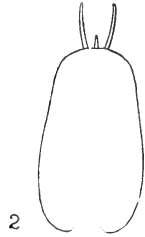
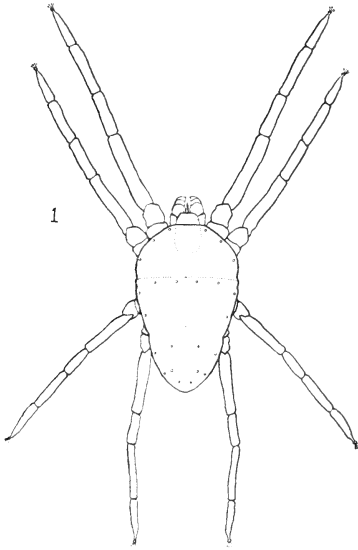


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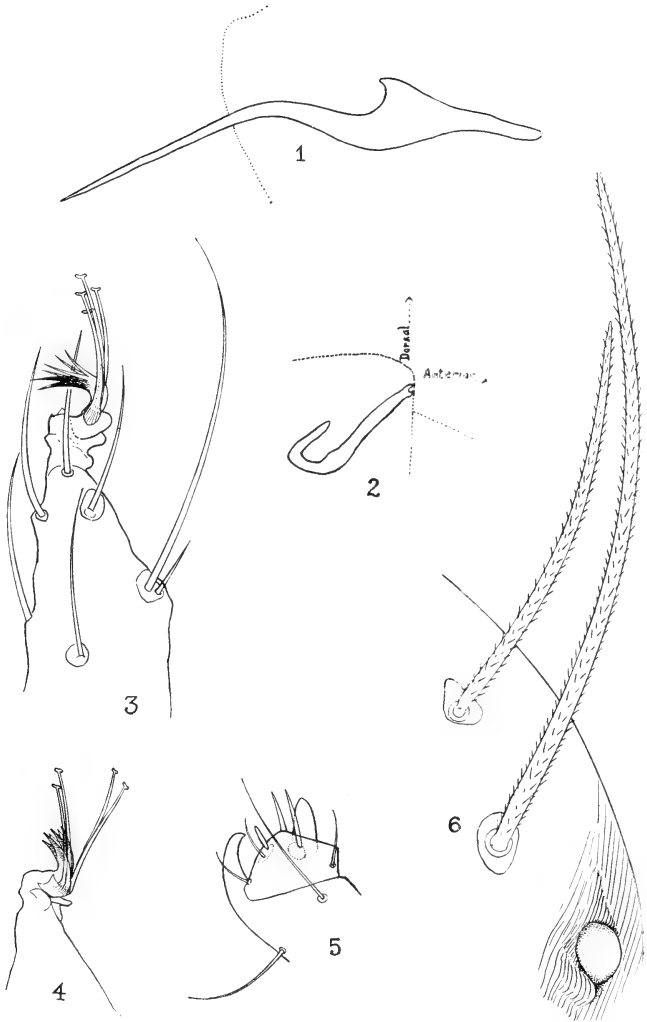
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NEW SPECIES OF RED SPIDERS.
FOR DESCRIPTION OF PLATE SEE PAGE 589.



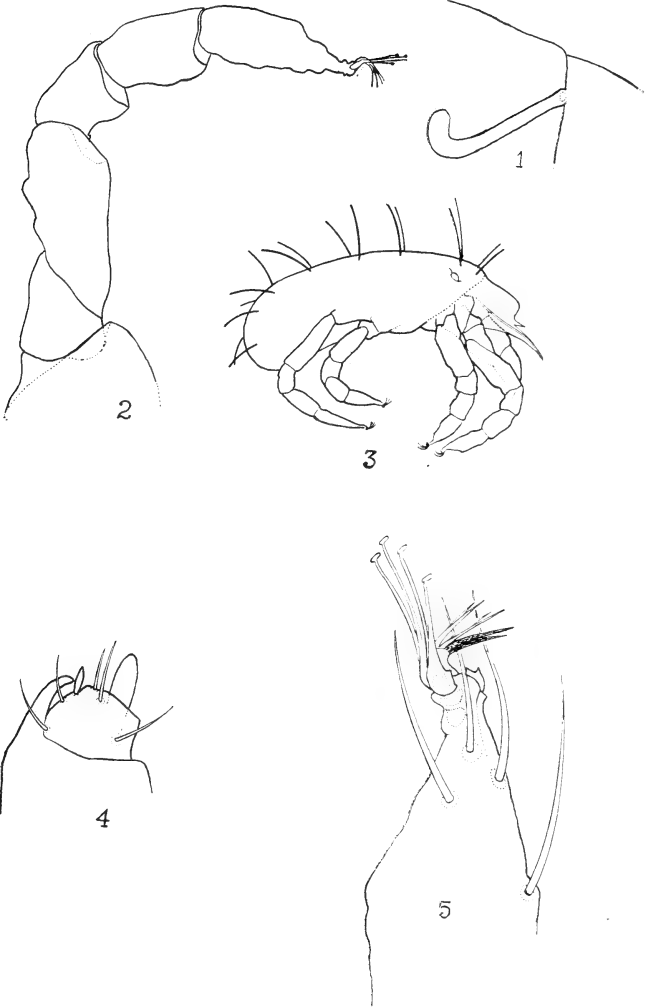
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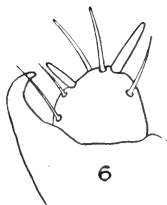
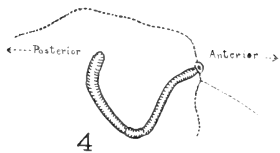
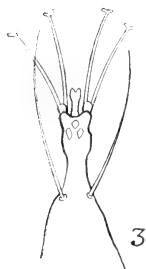
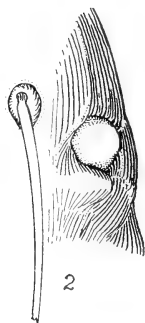
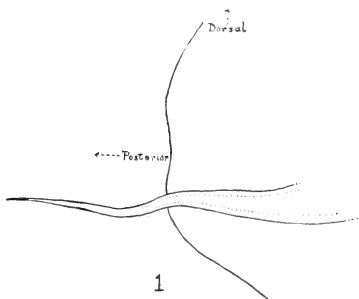


NEW SPECIES OF RED SPIDERS.

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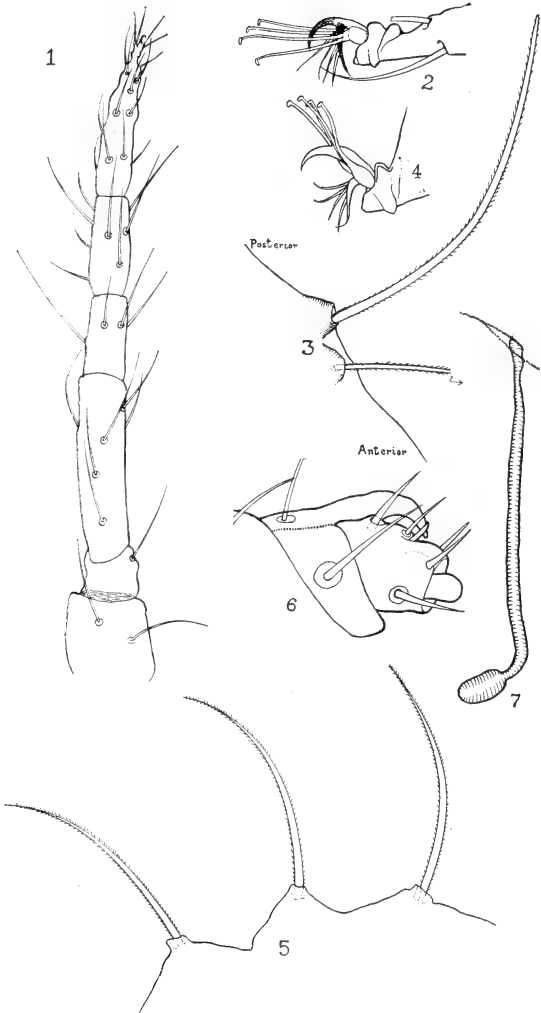


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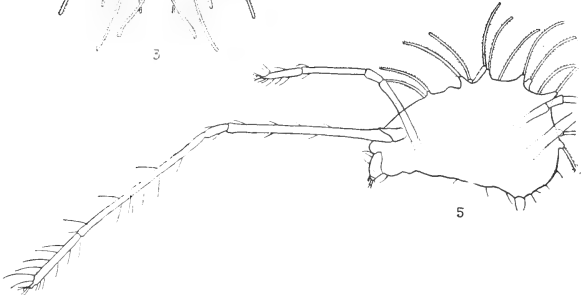
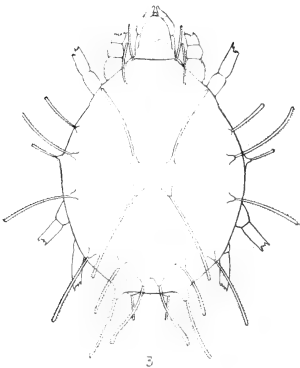
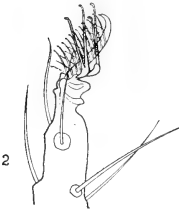
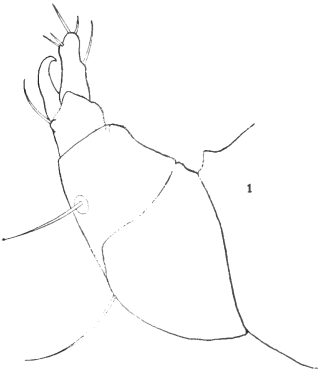
NEW SPECIES OF RED SPIDERS.

FOR DESCRIPTION OF PLATE SEE PAGE 590.



NEW SPECIES OF RED SPIDERS.

FOR DESCRIPTION OF PLATE SEE PAGE 590.



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PARAPHERNALIA OF A KOREAN SORCERESS IN
UNITED STATES NATIONAL MUSEUM

BY

I. M. CASANOWICZ

Assistant Curator, Division of Old World Archeology, United States National Museum

No. 2168.—From the Proceedings of the United States National Museum,
Vol. 51, pages 591-597, with Plates 108-112

Published December 21, 1916



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INTRODUCTION.

The collection described in this paper consists of paraphernalia of a Korean sorceress or exorcist employed in the exercise of her calling. The various articles were acquired by the United States National Museum in 1896 through the agency of the late Hon. W. W. Rockhill, formerly envoy extraordinary and minister plenipotentiary of the United States to China. It is at present installed in the Section of Historic Religions in the old building of the Museum.

THE RELIGION OF KOREA.¹

The earliest religion of the Koreans was very probably like that of most primitive peoples, some species of animism, consisting in the worship of the powers and elements of nature conceived as spirits. In 372 A. D. Buddhism was introduced into Korea from China, which by the middle of the sixth century was fully established, and for three centuries, from the tenth to the fourteenth, was the dominant religion of Korea, exercising also great political influence. With the accession of the last reigning dynasty of Korea (the Ni Taijo) Buddhism fell into disgrace and Confucianism was established as the official cult. Confucian ethics are still the basis of morality and the social order. Ancestor worship is also universal. It is however, shamanism, which is the belief in a host of inferior deities or spirits, for the greater part malevolent, who determine the fortunes of life, and are to be appeased or coerced by means of spells or incantations and offerings—a survival of the primitive animism, that dominates the broad masses of Korea. To the Korean the world is populous

¹ It is to be remembered, with regard to the statements made in the following pages, that what was true in Korea yesterday may not be true to-day or will not be true to-morrow. Things and conditions are now changing in the "immovable east," and it may be assumed that the present political and social status of Korea, as part of the empire of Japan, is also exercising a modifying influence on the religious views and practices of the people.

with active and malevolent beings who are ready at any moment to fall upon him in wrath. "If he goes among the mountains, they are there; if he goes into his inner room, they are there; if he travels to the remotest corner of the earth, they will follow him."¹ They haunt every tree, mountain, watercourse; they are on every roof, ceiling, fireplace, and beam; they fill the chimney, the living room, and the kitchen; they waylay the traveler on the road; in short, they are everywhere. To their influence the Korean attributes every ill by which he may be afflicted, bad luck in any transaction, official malevolence, loss of power or position, and especially sickness, whether sudden or prolonged.

The countless legions of spirits which populate the earth, the clouds, and the air, and are lurking everywhere, may be divided according to their attitude to man, into two main classes: (1) Demons in the proper sense—that is, self-existent spirits whose designs are always malicious, and spirits of departed persons, who died in poverty and distress and are now naked, hungry, and shivering vagrants, and therefore inflict calamities on the living who neglect to supply their wants; and (2) spirits whose natures are partly kindly, and ghosts of prosperous and good people. But even these are easily offended and act with extraordinary capriciousness.²

EXORCISTS AND SORCERERS.

There are two classes of shamans³ or sorcerers in Korea: The Pansu and the Mutang. They do not constitute an order, nor are they linked by a common organization, but are nevertheless practically recognized as a sort of priesthood, inasmuch as they are the mediators and intercessors between the spirits and the people. The word Pansu is composed of *pan*, "to decide," and *su*, "destiny," which designate the bearer of the name as a "fortune-teller." But this describes the office of the Pansu only in part. Mutang is also made up of two parts, *mu*, "to deceive," and *tang*, "company." The individual is sometimes called *mu-nyu* "deceiving woman." So that Mutang may be

¹ H. B. Hulbert, *The Passing of Korea*, New York, 1906, p. 408.

² The belief in the possibility of the reappearance of the ghost or specter of the dead, either by being raised from the nether-world by a sorcerer or sorceress (comp. i Samuel xxviii, 11 ff.), or returning on its own accord, with the power of inflicting harm on the living, was also general among the ancient Semites and Egyptians, and is still in vogue in the East. Especially were and are still dreaded the spirits of such as died a premature or violent death or who had not received the requisite funerary rites and offerings. Compare Morris Jastrow, *Die Religion Babylonien und Assyrien*, Giessen, 1905, vol. 1, pp. 358, 372; R. Campbell Thompson, *Semitic Magic, Its Origin and Development*, London, 1905, pp. 2, 7, 18, 93; A. E. W. Budge, *Egyptian Magic*, London, 1901, p. 219; Georg Steindorff, *The Religion of the Ancient Egyptians*, New York, 1905, p. 119; James Henry Breasted, *Development of Religion and Thought in Ancient Egypt*, New York, 1912, p. 192; T. Canaan, *Aberglaube und Volksmedizin im Lande der Bibel* (*Abhandlungen des Hamburgischen Kolonialinstituts*, vol. 20, Hamburg, 1914, p. 11). In like manner was it believed that the sorcerers by their exorcisms could "lay" such perturbed spirits.

³ "Shaman may be applied to all persons, male or female, whose profession is to have direct dealings with demons and to possess the power of securing their good will and averting their malignant influences by various magical rites, charms, and incantations, to cure diseases by exorcisms, to predict future events, and to interpret dreams."—I. B. Bishop, *Korea and Her Neighbors*, p. 401.

rendered, "deceiving crowd," or "bad lot." The office of the Pansu is restricted to blind men, perhaps owing to the common belief among primitive peoples that those who have been deprived of physical sight have been given an inner spiritual vision. The Mutang is always a woman, generally from the lower classes and of bad repute, and her calling is considered the very lowest in the social scale.

While the Pansu is, as it were, born or made by dint of his loss of eyesight, the Mutang enters upon her office in consequence of a "supernatural call," consisting in the assurance of demoniacal possession, the demon being supposed to have become her double and to have superimposed his personality upon hers. The "possession" is often accompanied by hysterical and pathological symptoms. The spirit may seize any woman, maid or wife, rich or poor, plebeian or patrician, and compel her to serve him, and on receiving the "call of the spirit" a woman will break every tie of custom and relationship, leave home and family to become henceforth a social outcast, so that she is not even allowed to live within the city walls. But notwithstanding her low social status, her services are in constant demand. "In traveling through the country, the *mutang* or sorceress is constantly to be seen going through the various musical and dancing performances in the midst of a crowd in front of a house where there is sickness."¹ And at the close of the nineteenth century the fees annually paid in Korea to the sorcerers were estimated at \$750,000.²

RELATION OF THE PANSU AND MUTANG TO THE SPIRITS.

The Pansu acts as master of the spirits, having gained by his potent formulæ and ritual an ascendancy over them. By his spells he can direct them, drive them out, and even bury them. The Mutang is supposed to be able to influence them through her friendship with them. She has to pray to them and to coax them to go. By her performances she puts herself *en rapport* with the spirits and is able to ascertain their will and to name the ransom for which they will release the victim who is under torment.

FUNCTIONS OF THE PANSU.

While in practice the functions of the Pansu and the Mutang largely overlap, so that at times the one may be called to perform the services of the other, theoretically they hold two distinct fields in the domain of the spirits, corresponding to their different attitudes to the spirits.

The services of the Pansu may be comprised under two general heads: (1) Divination (*chum*), and (2) exorcism (*kyung*). The former occupies by far the larger part of his energies. In his capacity as

¹ I. B. Bishop, *Korea and Her Neighbors*, p. 400.

² *Encyclopædia Britannica*, ed. 11, vol. 15, p. 911.

fortune teller and clairvoyant he is consulted for all imaginable relations of life—whether, for instance, an offender will escape punishment, or a deserving man will be rewarded, what will happen during the day, the week, the month, and up to the point of death; what was one's condition in a former state of existence; how to recover a lost article; what is the condition of a distant friend or relation; whether a tree may be cut down or not (because of the spirit's inhabiting it); whether a dream that one has had augurs good or evil; when one is to marry in order to secure happiness; when a son will be born; whether a woman should give birth to a child in her own house or go to some other place until the child is born, and the like.

For obtaining his answers the Pansu employs three systems of divination: (1) Dice boxes (*san-tong*, "number box"); (2) coins (*ton-jun*, "money divination"), and (3) Chinese characters (*chalk-chum*, "book divination")

For the dice-box divination, also called tortoise divination, because the box was formerly in shape of a tortoise,¹ a box containing eight small metal rods or bamboo splinters, having in order from one to eight notches. The Pansu makes three throws of one rod or splinter each, and from the combination of the notches on them he works out the answer to the question. In the money divination three coins out of four which he holds in his hand are thrown in the same manner as in the preceding method, and the combination of the characters on them yield the supposed answer; while for the book divination (the highest form), he learns the hour, day, month, and year of the birth of the inquirer, and from the Chinese characters which depict these four dates he determines the answer. The responses are given in an enigmatic poetical formula which is capable of a double meaning, like the Delphic oracles of yore.

The performance of exorcism by a Pansu is described in The Korea Review² as follows:

The Pansu comes into the presence of the afflicted and food is laid out as for a feast. The Pansu invites the various spirits to come and feast, such as the house spirit, the kitchen spirit, the door spirit. He orders them to go and invite to the feast the evil spirit that has caused the disease, and if he will not come, to call upon the master spirit to compel him to come. When he arrives the Pansu bids him eat and then leave the place and cease to torment the patient. If he consents, the fight is over, but he probably will not submit so easily, in which case the Pansu gets out the book, "Thoughts on the works of the Jade Emperor in Heaven," and chants a stave or two. The mystic power of the book paralyzes the imp, and he is seized and imprisoned in a stone bottle and securely corked down. In some cases he is able to burst the bottle, and then he will be invited again to a feast and subdued by the book. He is then put into a bottle, but this time the cork is made of peach wood which has a peculiar power over

¹"The tortoise is the center of a great circle of pleasing superstitions, and hence is one of a set of symbols oftenest employed in Korean art. The practice of divination is mostly associated with tortoise shell, the figuring of a tortoise's back having a mystic signification."—W. E. Griffis, *Corea, the Hermit Nation*, p. 303.

²Pp. 387-388; also see I. B. Bishop, *Korea and Her Neighbors*, p. 405.

imps, and the bottle is beaten with peach twigs to reduce the imp to complete helplessness. The bottle is then delivered to a Mutang, and she is told to go in a certain direction, which will prevent the return of the imp, and bury the bottle in the ground. The cure is now supposed to be complete.

The instruments of exorcism used by the Pansu are a drum, cymbals, a divination box, a wand or wands.

FUNCTIONS OF THE MUTANG.

More varied than the functions of the Pansu are the pacifications and propitiations, called *kauts* or *kuts*, performed by the Mutang. The kaut may be carried out either at the house of the patient or at the home of the Mutang, or at some shrine or temple, called *tang*, dedicated to some spirits, which are seen on the hillsides in Korea. If, as is occasionally the case, the Mutang belongs to a noble family, she is allowed by her family to ply her trade only in her own house. Those who require her services send the required fee and necessary offerings, and the ceremony is performed by the Mutang in her own house or at the tang.

Her equipment consists of a number of dresses, some of them very costly; a drum, shaped like an hourglass, about 4 feet high; copper cymbals; a copper gong; a copper rod with small bells or tinklers suspended from it by copper chains;¹ a pair of telescoping baskets;² strips of silk and paper banners which float around her as she dances; fans; umbrellas; wands and images of men and animals. (See Plates 108-111.)

The service of the Mutang most in demand is the healing of the sick. If a sick man believes that his distemper has been caused by a spirit, he sends to the Mutang to describe the symptoms and learn what spirit is doing the mischief. The Mutang may declare the name of the spirit without going to the patient's house, or may say that she must see the patient first. On retaining her fee she names a "fortunate" day for the ceremony, which will be performed either at her house or shrine or at the patient's house, according to the seriousness of the ailment and the fee he can pay.

A performance of such a kaut at the house of the patient is described by Mrs. Bishop as follows:³

In a hovel with an open door a man lay very ill. The space in front was matted and inclosed by low screens, within which were Korean tables loaded with rice cakes,

¹ Some Biblical commentators explain the small golden bells which fringed the high priest's robe of office (Exodus xxviii, 33; xxxix, 25) as a survival of the primitive practice of the employment of bells as amulets to frighten away demons and evil spirits. The custom referred to in Zechariah xiv, 20, of hanging bells on the foreheads and round the necks of horses, may also belong to the same circle of ideas. Numerous small bells, apparently amulets, have been found in the excavations of Gezer, Palestine; see Palestine Exploration Fund Quarterly Statement, 1904, p. 353, pl. 4, figs. 4 and 5.

² The baskets are used chiefly in the case of cholera, which is supposed to result from rats climbing about in the human interior. The scratching sound made by rubbing the baskets against one another, which resembles the noise made by cats, is expected to drive out those rodents. On other occasions they are used to summon the spirits.

³ Korea and Her Neighbors, p. 350.

boiled rice, stewed chicken, sprouted beans, and other delicacies. In this open space squatted three old women, two of whom beat large drums, shaped like hourglasses, while the third clashed large cymbals. Facing them was the Mutang or sorceress, dressed in rose-pink silk, with a buff gauze robe, with its sleeves trailing much on the ground, over it pieces of paper resembling a shinto *gohei*,¹ decorated her hair, and a curious cap of buff gauze with red patches upon it, completed the not inelegant costume. She carried a fan, but it was only used in one of the dances. She carried over her left shoulder a stick, painted with bands of bright colors from which hung a gong which she beat with a similar stick, executing at the same time a slow rhythmic movement accompanied by a chant. From time to time one of the ancient drummers gathered on one plate pieces from the others and scattered them to the four winds for the spirits to eat, invoking them saying, "Do not trouble this house any more, and we will again appease you by offerings."² The exorcism lasted 14 hours, until 4 in the next morning, when the patient began to recover. . . . Mrs. Tayler adds:³

I have witnessed several of these dances, and it appeared to me that the sorceress produced in herself a sort of ecstasy which increased in force until at length she sank on the ground utterly exhausted. I could not but feel that the banging of drums, and the clashing of cymbals wielded by her attendants together with the whirling motions and violent gestures of the Mutang herself, must at times, themselves, give the *coup de grace* to the poor patient.

In case of smallpox (*kwe-yuk tasin*), the universal scourge of Korean childhood, the spirit who is supposed to have caused it, is treated with the utmost respect. The parents do obeisance to the suffering child, which for the time being is inhabited by the spirit, and address it in honorific terms. On the appearance of the disease the Mutang is called to honor the arrival of the spirit with a feast and fitting ceremonial. Little or no work is done in the house in order not to disturb the "honorable guest." No member of the household may cut the hair, wear new clothes, sweep the house, or bring any goods into the house. No animal must be killed in the house, because if blood flows, it will make the patient scratch and cause his blood to flow.⁴ No washing or wall papering must be undertaken, for this will cause the nose of the patient to be stopped up; and if there are neighbors whose children have not had the malady, they rest likewise, lest, displeased with their want of respect, the spirit should deal harshly with them. On the thirteenth day from the appearance of

¹ The *gohei* consists of strips of white paper, cut out of one piece, suspended from a wand. It is one of the important objects which are placed in the Shinto temples, supposed to be the resting place of the *kami* or spirit.

² A quotation from A. Goodrich-Freer, *Some Jewish Folklore from Jerusalem*, Folklore, 1904, vol. 15, pt. 2, p. 186, in R. C. Thompson, *Semitic Magic*, etc., p. 102, as suggesting somewhat of a parallel to the last phase of the *kaut* described, may find, in much abridged form, a place here: When a Jew is afflicted with madness, the falling sickness, or the like, the witch-doctors (among other things) prepares a little wheat, barley, salt, water, milk, honey, four or six eggs, and some sweetmeats, or sugar, and mixing all this at midnight, she scatters some of the mixture round the sickbed, on the threshold, and in the four corners of the room, reciting in a whisper a prayer or an incantation which closes with the words: "And let this honey (or sugar) be to sweeten your mouths and palates, the wheat and barley to feed your cattle and sheep, and the water and salt to establish peace, friendship, love, brotherhood, and everlasting covenant of salt between us and you." Here she breaks the eggs and pours the same in the aforementioned places, kneels, and prostrates herself, kisses the ground several times, and proceeds with these words: "Here I offer you life for life, in order that you may restore the life of the patient."

³ Koreans at Home, p. 65.

⁴ By dint of sympathetic magic.

the disease, when danger is supposed to be passed, the Mutang is again summoned, and a farewell banquet is given to the spirit. A miniature wooden horse, loaded with food and some coins, and bedecked with a red umbrella and small flags, is placed upon the roof of the house. This outfit is provided for the spirit in taking his departure. (See plate 112.) The Mutang bids him farewell, asking him to deal kindly with the patient and the family, to let the sick fully recover without being badly marked.¹

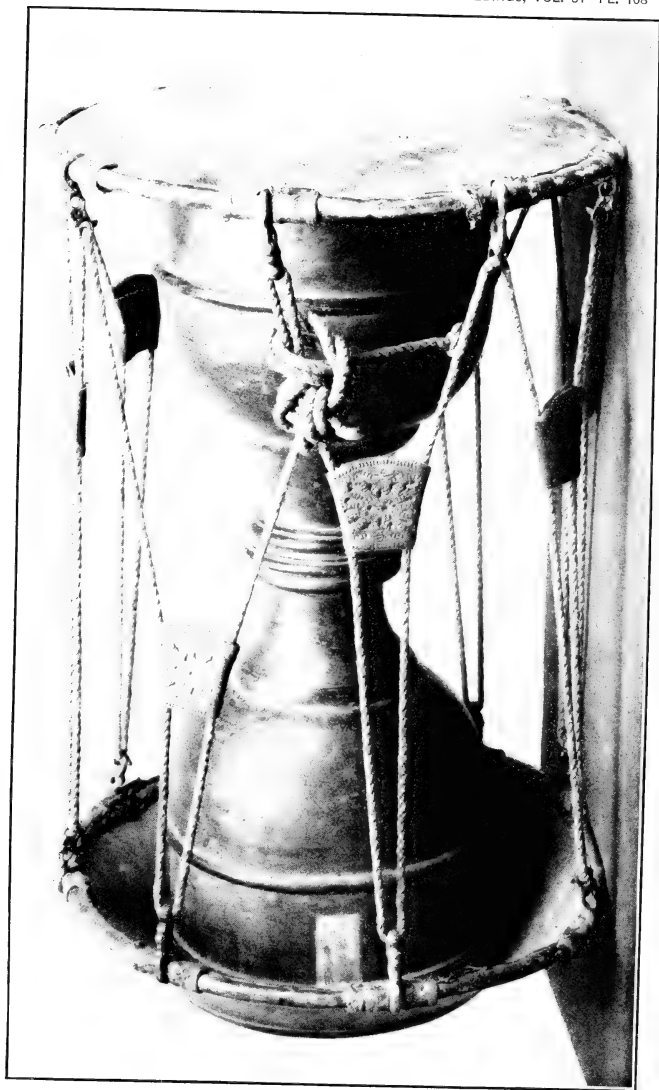
The death of a Korean does not terminate his dependence on the ministrations of the Mutang. The spirit of the departed is believed to hover about the house for some time after leaving the body, having some last words to speak. The Mutang is required to serve as his mouthpiece for his valedictory. Food is set out, the baskets are scraped to summon the spirit who then enters the Mutang and communicates through her to the family his last wishes, counsels, and exhortations. The members of the family have their cry and say their farewells, after which they fall to consuming the food. A more elaborate ceremony, with the never-wanting banquet, in connection with death, is performed by the Mutang at a shrine in honor of the judges or rulers of the nether world to secure their goodwill for the departed.

The surviving members of the family need no less the services of the Mutang. The unclean spirits of death (as also of birth) have for the time being driven out the guardian spirits of the household, and the Mutang has to bring them back. Their whereabouts is found by means of a wand cut from a pine tree to the east of the house which is set working by the spells of the Mutang, and by prayers and offerings they are induced to return to their place.

As public functionary, the Mutang comes into consideration in the triennial festa lasting three to four days, which is observed to propitiate the tutelary spirit of the locality and to obtain his favor during the coming three years.

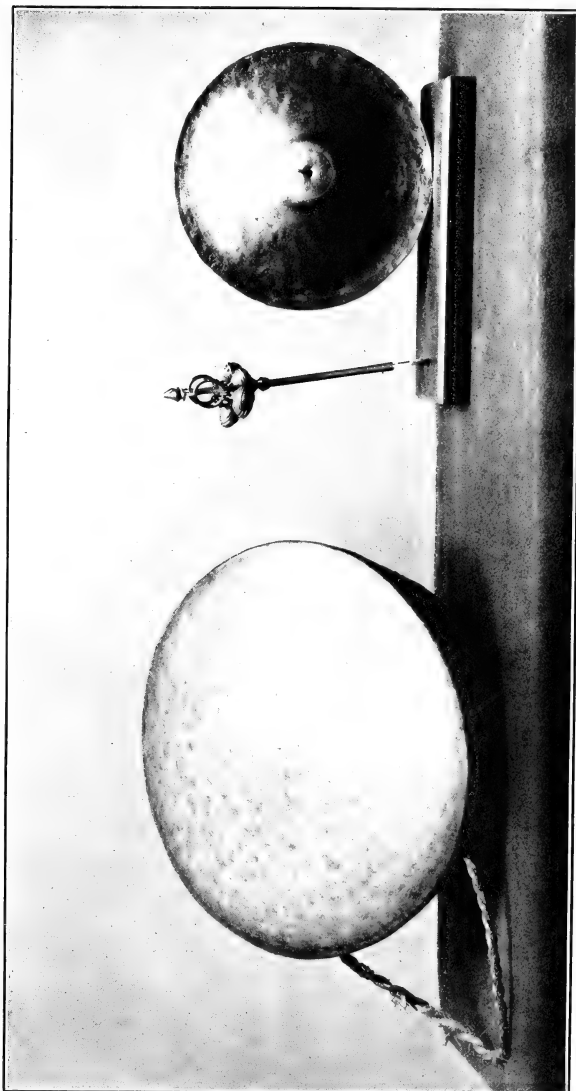
Divination is practiced by the Mutang by means of chimes and rice. The latter consists of throwing down some grains of rice on a table and noting the resulting combination. The divining chime is a hazel wand with a circle of tiny bells at one end, which the Mutang shakes violently, and in the din thus created she hears the answer of the spirit.

¹ It may be that the original idea underlying the sending away of the spirit on a horse was that he carry off the malady. A parallel to it would be Leviticus xiv, 4, where, for the purification of a leper, one bird is to be killed as an offering; the other, charged with the disease, is to be let loose into the open field. The horse seems in general to play something of the part of scapegoat in Korean magic. Thus in case the spirit of a disease is obstinate, and refuses to depart the Mutang orders the making of a picture of three or seven horses on paper, and with three or seven small coins wrapped up in it throw into the street (Korea Review, p. 148). For the transference of evils to animals in general, see J. G. Frazer, *The Golden Bough*, vol. 3, London, 1900, p. 1.



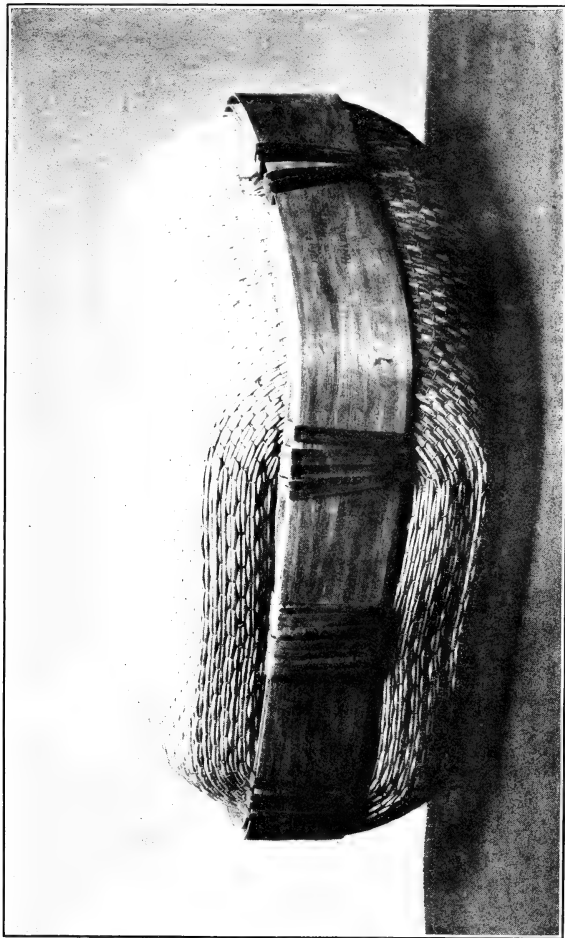
HOURL-GLASS-SHAPED DRUM.

FOR DESCRIPTION SEE PAGE 595.



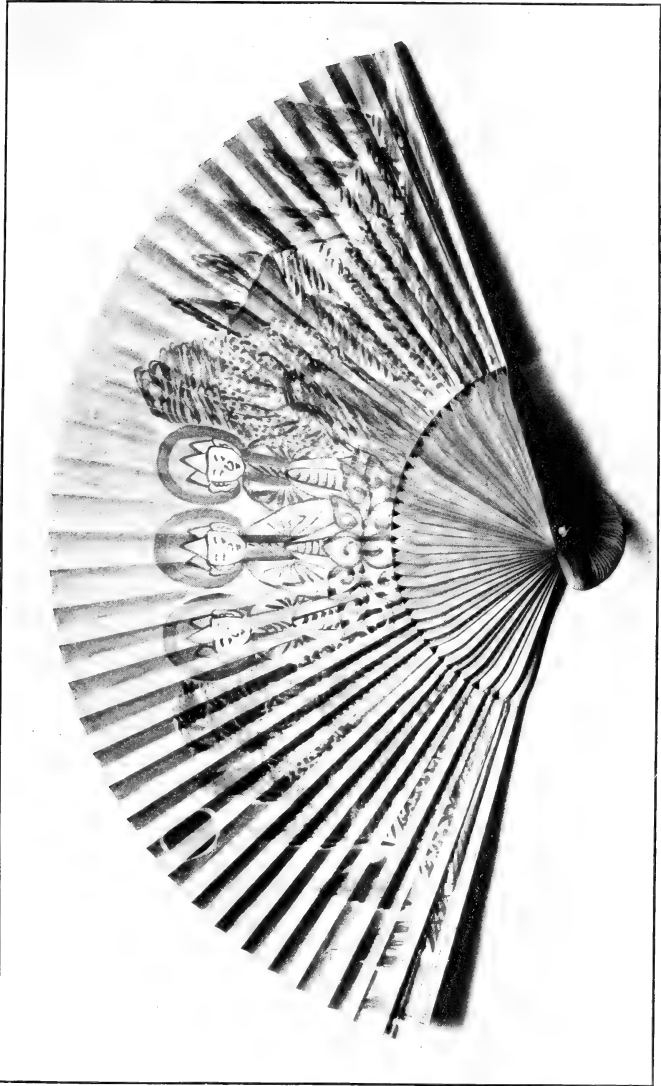
GONG, ROD WITH SMALL SUSPENDED BELLS, AND CYMBALS.

FOR DESCRIPTION SEE PAGE 595.



TELESCOPING BASKET.

FOR DESCRIPTION SEE PAGE 595.



FAN OF A KOREAN SORCESS.

FOR DESCRIPTION SEE PAGE 595.



MINIATURE WOODEN HORSE.

FOR DESCRIPTIONS SEE PAGE 597.

MOLLUSKS FROM THE TYPE LOCALITY OF THE CHOCTAWHATCHEE MARL

BY

WENDELL C. MANSFIELD

Of the United States Geological Survey

No. 2169.—From the Proceedings of the United States National Museum,
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Dr. Wm. H. Dall¹ in 1892 referred the beds of true Miocene age in Florida to the Chesapeake group, and recognized two subdivisions which he designated the Jacksonville limestone in the eastern area and the "Ecphora bed" in the area west of the meridian of Tallahassee. The same author in 1903 wrote:

After the elimination of the Oligocene series from the so-called Miocene of Florida we have remaining practically only one series of beds which has been identified over a considerable area of northern Florida. The Miocene appears as a soft limestone rock in the vicinity of Jacksonville, and has been traced by material from artesian wells on the east side of the peninsula as far south as Lake Worth. The layers of fossiliferous marl in the vicinity of Chipola River, at Alum Bluff, and other localities in western Florida are usually less than 30 feet in thickness, but counting unfossiliferous clays, etc., it has been estimated that the rocks of this age in Florida may have attained to a thickness of some 500 feet or less.²

In 1910, Matson and Clapp³ gave a geographical formational name to the "Ecphora bed"⁴ and "aluminous clay"⁵ of Dall, and say:

In Florida the limestones, clays, and sandstones of the Miocene are lithologically so unlike the shell marls, that in the absence of satisfactory paleontologic evidence for their exact correlation, it seems best to describe them separately. The two divisions are therefore retained, but a new name is given to the marl. The "Ecphora bed" of Dall is here called the Choctawhatchee marl, from the river in western Florida where it is well exposed. At Dall's type locality the Jacksonville formation is known only from well records and excavations; hence the name is not entirely satisfactory. However, the United States Geological Survey has decided to retain "Jacksonville" as the name of the formation.

The Choctawhatchee marl takes its name from Choctawhatchee River, where it is well exposed in the vicinity of Redbay, a small

¹ Dall, Wm. H., and Harris, G. D., Neocene of North America, Bull. 84, U. S. Geol. Survey, 1892, pp. 123, 124.

² Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1594.

³ Florida Geol. Survey, 2nd Ann. Rep., pp. 108, 114.

⁴ Bull. U. S. Geol. Survey, No. 84, 1892, p. 124.

⁵ Bull. Geol. Soc. America, vol. 5, 1894, pp. 168, 169.

settlement about 18 miles southeast of De Funiak Springs, Walton County, Florida. At Alum Bluff, Florida, this formation consists of a lower bed of dark gray to greenish fossiliferous sand above which is a steel gray unfossiliferous sandy clay to which Doctor Dall applied the name "Aluminous Clay," on account of the seepage from it of alum-bearing water.

The following is a list of species collected by George C. Matson on the John Anderson farm, 1 mile south of Redbay, Florida, identified by Dr. T. W. Vaughan¹ with his determination of the geologic horizon:

Turritella variabilis Conrad.

Dentalium attenuatum Say.

Arca staminea Say.

Pecten cf. *eboreus* Conrad.

Pecten madisonius Say.

Crassatellites melinus Conrad.

Chama arcinella Linnaeus. (Jackson bluff var.)

Cardium acutilaqueatum Conrad.

Venus rileyi Conrad.

Horizon—*Miocene*.—Jackson's bluff, Coe's Mill, upper bed at Alum Bluff.

During the autumn of 1914, Dr. C. Wythe Cooke and the writer visited Redbay, and obtained an additional collection of fossils near the place from which Mr. George Matson in 1908 obtained the collection identified by Doctor Vaughan. The exact location of Mr. Matson's collecting is on the Anderson farm, 1 mile south of Redbay, while the later collection was at a bluff beneath a spring, in E. Gommillion's field, about one-fourth mile east of Redbay. These two collections furnish the material for this paper.

According to Matson²

The Choctawatchee marl attains a thickness of over 50 feet in the vicinity of Redbay, Walton County, where it is exposed in some small ravines, and exceeds 30 feet on the banks of Mill Creek near Holland Post Office, Leon County. However, from observation elsewhere, it appears probable that the average thickness is not more than 25 to 30 feet. It rises to the surface in a belt 6 to 12 miles in width, extending from southern Walton County eastward to Leon County.

The following notes were taken in the vicinity of Redbay by Doctor Cooke:

The Choctawatchee marl is a bluish-gray argillaceous sand containing many fossils. Parts of it are micaceous. It outcrops in a bluff forming an escarpment which may easily be traced. The access to the outcrops is usually difficult, owing to the growth of dense tangled masses of vines and a covering of leaves and talus. An exposure of about 10 or 15 feet was found beneath a spring called "Dripping Spring," in E. Gommillion's field, about one-fourth of a mile east of Redbay. The material consists of blue argillaceous sand marl, replete with shells in the lower part but preserved only as casts in the laminated upper part. Above this bed is a yellow incoherent sand, which forms hill slopes. Springs issue from the top of the marl bed.

The character of the matrix in which the fossil collection one-fourth mile east of Redbay, Florida, was obtained, is as follows:

¹ Florida Geol. Survey, 2nd Ann. Rep., p. 117.

² Water Supply Paper 319, pp. 129-130.

Color, greenish-gray; size of grains varying from about 0.3 mm. to about 0.9 mm. in greatest diameter; feel, not harsh; effervescing rapidly in hydrochloric acid.

Under the microscope one sees:

(1) Small, angular, clear, sand grains, making up about seven-tenths of the mass. The size of the grains varies from about 0.2 mm. to about 0.4 mm. in greatest diameter, the average size of 10 grains taken at random being 0.297 mm.

(2) Small, mostly rounded, coal-black particles, the size of which varies from about 0.2 mm. to about 0.35 mm. greatest diameter, the average size of 10 particles taken at random being 0.2675 mm.

(3) Irregular, porous, very light gray particles, probably calcium carbonate, the size of which varies from about 0.3 mm. to about 0.9 mm., greatest diameter, the average size of 10 particles taken at random being 0.7965-mm.

(4) A few specimens of Foraminifera, broken spines of Echinoderms, and shell particles.

Observations under microscope after treatment of matrix with hydrochloric acid: Numbers 3 and 4 of the above disappeared, while 2 separated into fine particles. No. 2 was tested for phosphorus, but no convincing evidence of its presence was obtained. This material is probably of organic origin.

The following list gives the fauna from near Redbay, and the range of the species identified in other strata. A=upper bed at Alum Bluff; J=beds at Jackson Bluff; O=Oligocene; M=Miocene; P=Pliocene:

Fauna of Choctawhatchee marl near Redbay, Walton County, Florida.

Name.	A.	J.	O.	M.	P.
<i>Turritella variabilis</i> Conrad, variety (?)	*	*		*	
<i>Crucibulum auricula</i> Gmelin, variety (?)		*	?	*	*
<i>Dentalium attenuatum</i> Say	*	*		*	*
Shark's tooth					
<i>Leda choctawhatcheensis</i> , new species					
<i>Glycymeris</i> , species indeterminable					
<i>Arca</i> (<i>Scapharca</i>) <i>staminea</i> Say, <i>rubisiviana</i> , new subspecies.					
<i>Ostrea</i> (<i>yo.</i>)					
<i>Pecten gibbus</i> Linnaeus				*	*
<i>Pecten</i> , species indeterminable					
<i>Pecten madisonius</i> (?) Say			*	*	
<i>Crenella</i> , species (<i>yo.</i>)					
<i>Astarte</i> (<i>yo.</i>)					
<i>Astarte vaughani</i> , new species					
<i>Crassatellites melinus</i> Conrad	*			*	
<i>Venericardia</i> (<i>yo.</i>), species indeterminable					
<i>Chama arcinella</i> Linnaeus (Jackson Bluff variety)		*		*	*
<i>Phacoides crenulatus</i> Conrad	*	*		*	
<i>Phacoides choctawhatcheensis</i> , new species					
<i>Phacoides</i> , species indeterminable (specimen eroded)					

Fauna of Choctawhatchee marl near Redbay, Walton County, Florida—Continued.

Name.	A.	J.	O.	M.	P.
<i>Diplodonta</i> , 2 species, indeterminable.....					
<i>Diplodonta waltonensis</i> , new species.....					
<i>Diplodonta</i> (?), indeterminable.....					
<i>Sphaerella</i> (?), 2 species (fragments).....					
<i>Cardium acutilaqueatum</i> Conrad.....	*			*	
<i>Dosinia elegans</i> Conrad.....	*			*	*
<i>Macrocallista maculata</i> Linnaeus.....			*		*
<i>Venus rileyi</i> Conrad.....				*	*
<i>Semele</i> , species indeterminable.....					
<i>Corbula</i> , species (?), (1 specimen).....			?		
<i>Corbula</i> , species indeterminable.....					
<i>Panope goldfussi</i> Wagner.....	*			*	

The foregoing list contains one identified species which is represented in the Oligocene, five are exclusively Miocene, and none occur exclusively in beds younger than the Miocene.

Seven species are represented in the upper bed at Alum Bluff, Florida, and five at Jackson Bluff, southwest of Tallahassee, Florida.

The following observations are noted in regard to the seven species represented at Alum Bluff:

Turritella variabilis Conrad.—Not an Alum Bluff variety, but closer to the Jackson Bluff variety.

Dentalium attenuatum Say.—Specimen somewhat eroded; no variation can be detected.

Phacoides crenulatus Conrad.—Lacks the strong hinge of Alum Bluff var. *pemphigus* Dall, but possesses the fine concentric sculpture.

Cardium acutilaqueatum Conrad.—This is a poor specimen; no variation can be detected.

Panope goldfussi Wagner.—Close to, if not the same, variety found at Alum Bluff.

Crassatellites melinus Conrad.—Not the Alum Bluff variety.

Dosinia elegans Conrad.—This is a poor specimen; no variation can be detected.

Observations of other listed species are as follows:

Astarte vaughani, new species.—A closely allied form occurs in the De Funiak (Florida) *Cardium* zone, and also at Porter's Landing, Georgia.

Macrocallista maculata Linnaeus.—Has not been previously reported in the Miocene beds of the Gulf fauna.

Venus rileyi Conrad.—Variety occurs 3½ miles southwest of De Funiak Springs, Florida.

Corbula, species (?).—Is a near relative to an undescribed form at Flournoy's Mill near Argyle, Walton County, Florida.

Twenty genera of pelecypods and two of gastropods are listed from Redbay. On the other hand in the upper bed at Alum Bluff, there are 32 genera of gastropods and 27 of pelecypods listed by Doctor Dall.¹

On account of the small collections and the unidentifiable character of some specimens, it is not possible to determine the exact synchronism of the fauna with that of the upper bed at Alum Bluff, however, the species present indicate that the beds represent nearly the same if not precisely the same horizon.

The writer wishes to express his thanks to Dr. William H. Dall, of the United States Geological Survey; Dr. Paul Bartsch, of the United States National Museum, and Dr. T. Wayland Vaughan, of the United States Geological Survey, for suggestions kindly offered in the preparation of this paper.

ARCA (SCAPHARCA) STAMINEA Say, new subspecies RUBISINIANA.

Plate 113, figs. 1, 3.

Shell of moderate size, rhombic and inflated; beak prominent, slightly prosogyrate, and situated near anterior third of length of the valve. There are 32 transverse nodulose radiating ribs, which are a little narrower over the middle of the disk than intervening spaces. Those on the posterior angle and anterior arch are a little wider. The two radials at the angle on the posterior side and one on the anterior are divided by an incised line basally for about half their length. The nodules are quite evenly spread over the disk, except on the posterior side, where they are replaced by nearly square crenulated ribs. In front, the disk is rounded; posteriorly, it is nearly vertically truncated, forming a somewhat extended edge. Anterior margin rounded; basal margin nearly straight; slightly oblique to hinge line and meeting the posterior margin in a short rounded line. Cardinal area triangular, flattened beneath the beak, and sulcated by four angled impressed lines. Hinge line, short, direct except at extremities, where it is slightly curved downward. There are 12 anterior and 26 posterior oblique mesially crowded teeth. The inner margin of the valve is fluted; the interior radically striated.

Type (Cat. No. 166911, U.S.N.M.).—This measures—length, 36 mm.; height, 31 mm.; diameter (double), 35 mm.

Type-locality.—Miocene of Florida, bluff on John Anderson's farm, 1 mile south of Redbay, Walton County, Florida. George C. Matson, collector.

Discussion.—Other poorly preserved specimens from same locality are larger, one measuring: length, 40 mm.; height, 40.5 mm.; diame-

¹Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, pp. 1596-8.

ter, 45 mm. (double). Of these, one has 31 ribs and 5 have 30. Some of them show wider interspaces between radial ribs than type.

This subspecies differs from other forms of *A. staminea* Say, in having a straighter base line and more extended posterior edge. The ribs are squarer and show less tendency to be divided by longitudinal incised lines. The specimen¹ is the type of *A. staminata* Dall. Figure 13 is Miocene in age, and closer related to *A. staminea* than *A. staminata*. See also for comparison fig. 10 on plate 113.

LEDA CHOCTAWHATCHEËNSIS, new species.

Plate 113, figs. 2, 4.

Shell small, solid, subequilateral. The sculpture consists of 11 concentric, somewhat lamelliform ribs, which are finer and closer spaced near the beak and coarser, with wide interspaces, and very prominent over the middle of the disk. Anteriorly these lamellae become flattened and reflected beakward, but obsolete near a faintly indicated posterior ray. The large depressed escutcheon is set off by a nearly smooth carina, extends to the end of the rostrum, and is crossed by four low thread-like longitudinal lines. The narrow elongate lunule is set off by a broken ridge formed by the abruptly tapering of all of the concentric lamelliform ribs except three which continue as low, nearly longitudinal lines over the lunule. Anterior end rounded and much shorter than posterior; posterior end roundly pointed; base broadly rounded. There are 14 teeth on each side of the triangular-shaped chondrophore. The interior of valve has three concentric rounded folds corresponding to the depressions of the exterior sculpture.

Type (Cat. No. 166916 U.S.N.M.).—This measures—length, 5.4 mm.; height, 3.2 mm.; diameter (double), 3.2 mm.

This species is closely related to *Leda trochilia* Dall, but has coarser, wider spaced, and more prominent concentric ribs over the middle of the disk; a better defined lunule; absence of a depressed anterior ray; lack of sculpture on posterior ray; a nearly smooth escutcheon carina; and a more broadly rounded marginal base.

Type-locality.—Miocene of Florida, E. Gomillion's field, one-fourth mile east of Redbay, Walton County. C. Wythe Cooke, collector.

PHACOIDES (PLEUROLUCINA) CHOCTAWHATCHEËNSIS, new species.

Plate 113, figs. 5, 6.

Shell solid, suborbicular, slightly oblique, moderately convex, height and length nearly equal; anterior dorsal margin longer and sloping at a lower angle than the posterior dorsal margin; basal margin rounded and slightly undulated; beak small, prosogyrate and partly overhangs small depressed lunule; ligamental area depressed,

¹ Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, pl. 31, fig. 11.

quite deep, and long; anterior dorsal area slightly depressed and strongly separated from the rest of the surface by a wide shallow groove, which widens distally; posterior dorsal area arched, prominent, much larger than anterior, and resembles the first anterior radial rib. Surface with rather coarse raised concentric lamellae, which are slightly thickened over the radial ribs and dorsally reflected more near the margin and between the radial ribs. On the last half of the disk the lamellae are grouped into series and are separated by wide interspaces, between which are many fine rounded concentric threads. The radial sculpture consists of four diverging ribs, which are separated by moderately shallow distally widening interspaces. The median interspaces become nearly obsolete near the margin. The inner margin of the valve is crenate. The posterior lateral socket is about one-third the length of the valve from the cardinal teeth; the anterior socket is a little nearer; both are moderately deep and large. The two cardinal teeth are of nearly equal size, the posterior cardinal being a little eroded, and appears to be slightly bifid. The anterior socket is small and shallow.

Type (Cat. No. 166915 U.S.N.M.)—This measures—length, 10.3 mm.; height, 9.4 mm.; diameter (double), 7.4 mm. A broken and eroded specimen from the same locality is a little larger and more mature, but shows better the characteristic wide interspaced areas between the grouped concentric lamellae, which probably represent rapid-growth periods of the shell.

This species is related to the Oligocene *Phacoides* (*Pleurolocina*) *quadricostatus* Dall, and its closely allied form, the recent *Phacoides leucocyra* Dall, but differs from both in being larger and much longer and having a more prominent posterior area. It is less oblique and has a proportionately longer ligamental depression than *P. quadricostatus*. It is a little smaller than the Pliocene *Phacoides* (*Pleurolocina*) *amabilis* Dall, but appears to be less closely related to it than to either the Oligocene or recent species above cited.

This species records its subgenus "*Pleurolocina*" for the first time from the Miocene of Florida.

Type-locality.—Miocene of Florida, E. Gomillion's field, one-fourth mile east of Redbay, Walton County, Florida. C. Wythe Cooke, collector.

ASTARTE (ASHTAROTHA) VAUGHANI, new species.

Plate 113, figs. 8, 9.

Shell small, solid, subtriangular, nearly equilateral; beak moderately compressed and acute, inclined a little forward; anterior and posterior slopes nearly straight and of equal length; anterior and posterior basal margins rounded; basal margin broadly rounded; tip of beak smooth; beak sculptured with rounded concentric rib-

lets, which become higher and more broadly undulated to about the first third of the disk and then flatten out and become nearly obscure near the margin; whole surface with fine irregular growth lines, not sufficiently prominent to destroy the somewhat smooth appearance of the surface; posterior dorsal area depressed, nearly smooth and not sharply defined; lunule lanceolate, defined by a faint ridge, and is more distinct and depressed than posterior area. Anterior and posterior and basal inner margins crenulated with alternate ridges and pitted grooves. Anterior and posterior adductor scars prominent. Middle right cardinal tooth is large, slightly furrowed, elevated, and has crenulated inner sides. The anterior right cardinal is small, slightly elongate and lower than middle, but higher than posterior. Posterior terminal cardinal narrow and elongate. The lateral tooth and laminae not prominent and extend to about two-fifths length of valve.

Type (Cat. No. 166914 U.S.N.M.).—This measures—right valve, length, 9.5 mm.; height, 9.3 mm.; diameter (double), 5.2 mm.

This species is closely related to *Astarte (distans var. ?) floridana* Dall, but differs in the following respects: It is smaller; has less pointed and anteriorly inclined beaks; has shorter and more rounded posterior basal end; has more indistinct lunule and escutcheon areas; has shorter ligamental depression; and has more rounded undulations and smoother surface. The young forms of both *Astarte (distans var. ?) floridana* Dall and *Astarte distans* Conrad are much more depressed, thinner, more wrinkled, longer and more rostrate than the present species. In no specimen of these species examined was any of equal size found that possessed the crenulated inner margins which all unworn specimens of the new species show. *Astarte glenni* Dall lacks the undulated surface, has a more drawn out beak and a stronger hinge.

Type-locality.—Miocene of Florida, E. Gomillion's field, one-fourth mile east of Redbay, Walton County, Florida. C. Wythe Cooke, collector.

DIPLODONTA WALTONENSIS, new species.

Plate 113, fig. 7.

Shell medium size, ovate-trigonal, moderately convex, very thin, marked by many fine, closely spaced, inconspicuous, concentric rounded threads, which are nearly obscure on upper part of the disk, but visible near the margin. Anterior side shorter than the posterior, with the margin well rounded. Upper posterior part of disk rounded and somewhat truncated near the margin, the anterior side sloping more gradually. Beaks are low and small. Hinge plate narrow and channelled in front; cardinal teeth normal; the left anterior cardinal being short and distally sulcated, while the posterior is long.

Type (Cat. No. 166913 U.S.N.M.)—This measures—length of left valve, 16.5 mm.; height, 15 mm.

This shell recalls *Diplodonta radiata* Dall, from the Oligocene at Oak Grove, Florida, but differs from it as follows: The surface is smoother, the posterior side is more rounded, and the left posterior cardinal is proportionally longer.

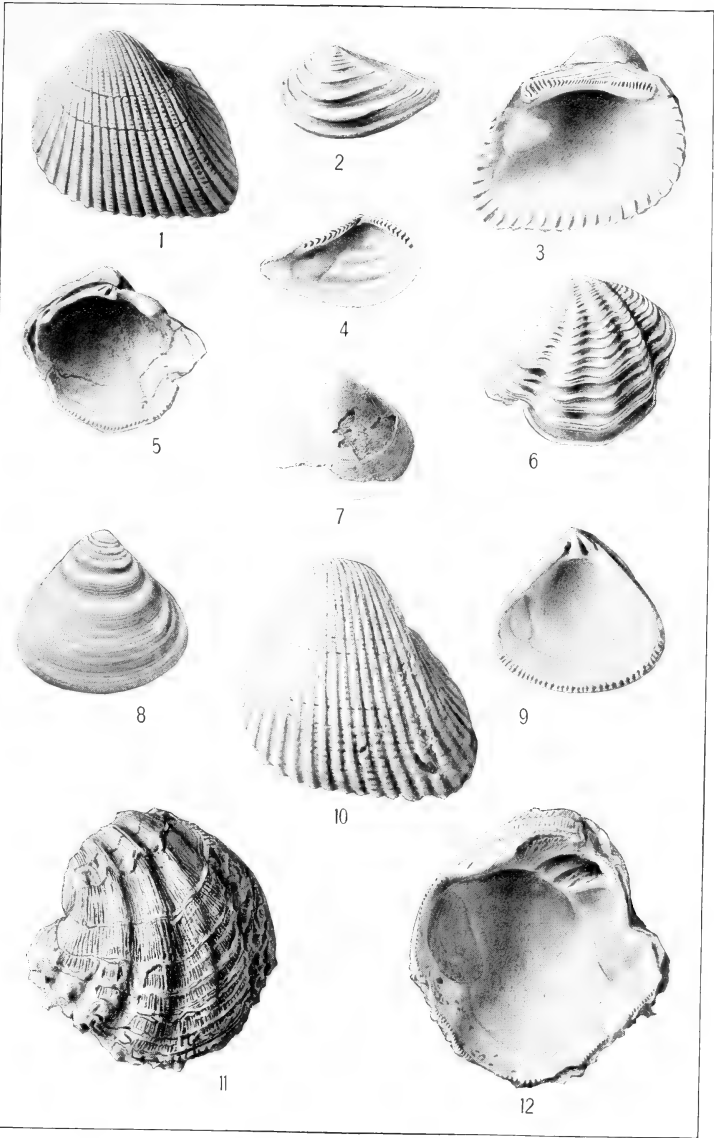
The described specimen is somewhat eroded; the lower ventral margin is wanting, which prevents a more detailed description.

Type-locality.—Miocene of Florida, E. Gomillion's field, one-fourth mile east of Redbay, Walton County, Florida. C. Wythe Cooke, collector.

EXPLANATION OF PLATE 113.

- FIG. 1. *Arca* (*Scapharca*) *staminea rubisiniana*, new subspecies; type; length, 36 mm. natural size; p. 603.
2. *Leda choctawhatcheënsis*, new species; type; length, 5.4 mm.; figure $\times 5$; p. 604.
3. Interior view of figure 1; p. 603.
4. Interior view of figure 2; p. 604.
5. *Phacoides* (*Pleurolocina*) *choctawhatcheënsis*, new species; type; length, 10.3 mm.; figure $\times 3$; p. 604.
6. Exterior view of figure 5; p. 604.
7. *Diplodonta waltonensis*, new species; type; length 16.5 mm.; figure $\times 1\frac{1}{2}$; p. 606.
8. *Astarte* (*Ashtarotha*) *vaughani*, new species; type; length, 9.5 mm.; figure $\times 3$; p. 605.
9. Interior view of figure 8; p. 605.
10. *Arca* (*Scapharca*) *staminea rubisiniana*, new subspecies; figured specimen; natural size.
11. *Chama arcinella* Linnaeus; Jackson Bluff variety; natural size.
12. Interior view of figure 11.

Figs. 11 and 12 serve to illustrate the variety which is not described in the text.



NEW MOLLUSKS OF THE CHOCTAWHATCHEE MARL.

FOR DESCRIPTION OF PLATE SEE PAGE 607.



THE CALIFORNIAN LAND SHELLS OF THE EPIPH-
RAGMOPHORA TRASKII GROUP

BY

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INTRODUCTION.

Some material recently received by the United States National Museum has made it necessary to subject this group to an examination, which has yielded some rather interesting results. Foremost among these may be mentioned the assigning of a final resting place to *Helix carpenteri* Newcomb, a name that has been applied erroneously to at least three different forms since it was established. It was therefore quite a satisfaction to find a shell in the type locality that satisfies all requirements of Doctor Newcomb's diagnosis and will fix, it is to be hoped, this name forever.

In this study I have been greatly aided by having had at my disposal the entire series of the group contained in the collection of the Philadelphia Academy of Natural Sciences, which was kindly loaned to me by Dr. H. A. Pilsbry. I am also indebted to Prof. G. D. Harris, of Cornell University, for the loan of Newcomb's four cotypes of *Epiphragmophora traskii*, and to Dr. S. S. Berry, of Redlands, California, for the loan of two paratypes of his *Epiphragmophora petricola*.

The figures accompanying the sketch are after photographs retouched by Mrs. E. B. Decker.

GROUP CHARACTERS.

The group of *Epiphragmophora traskii* is characterized by having the nucleus, which usually forms one and one-half to two turns, very finely axially wrinkled and provided with a scanty number of rather distantly spaced, slightly elongated papillae, that form obliquely, protractively slanting curved lines. The sculpture of the succeeding turns may be papillose or spirally striate or both. The postnuclear whorls may be all, or in part, marked by incised spiral striations, which vary in strength in the different races, from microscopic to strongly incised. The last whorl is never malleated, as in the group of *Epiphragmophora tudiculata*, which has the nuclear sculpture like that of the present group.

SPECIFIC CHARACTERS.

The material examined readily breaks up into two subgroups, which we shall consider species.

The southern species, *Epiphragmophora cuyamacensis*, has the last whorl uniform papillose above and below, while in the northern, *Epiphragmophora traskii*, the last whorl lacks the uniform papillations.

KEY TO SUBSPECIES.

- a*¹, Shell papillose above and below on all the whorls.....*E. cuyamacensis*, p. 610.
*b*¹, Umbilicus half closed by the reflected inner lip; greater diameter 25 mm.,
c. avus, p. 610.
*b*², Umbilicus not half closed by the reflected inner lip; greater diameter less than
 21 mm.
*c*¹, Papillations uniform over entire base.....*c. venturenensis*, p. 611.
*c*², Papillations not uniform over entire base.
*d*¹, Papillations obsolete on the rounded portion of base a little behind
 the aperture.....*c. cuyamacensis*, p. 611.
*a*¹, Shell not papillose above and below on all the whorls.....*E. traskii*, p. 610.
*b*¹, Obliquely protractively slanting lines of papillae on the nucleus, very faint.
*c*¹, Shell subglobose.....*t. tularica*, p. 615.
*c*², Shell decidedly depressed.
*d*¹, Shell large, diameter of type 31 mm.....*t. zechae*, p. 615.
*d*², Shell smaller, diameter of type, 20 mm.....*t. proles*, p. 616.
*b*¹, Obliquely protractively slanting lines of papillae on the nucleus, well developed.
*c*¹, Surface of shell with clothlike sculpture.....*t. coronadoensis*, p. 617.
*c*², Surface of shell not with clothlike sculpture.
*d*¹, Umbilicus narrow, more than half covered by the reflected inner lip.
*e*¹, Shell decidedly inflated.....*t. coelata*, p. 617.
*e*², Shell not inflated.....*t. carpenteri*, p. 617.
*d*², Umbilicus wide, less than half covered by the reflected inner lip.
*e*¹, Papillation on whorls succeeding the nuclear turns stronger than
 those on the nucleus.....*t. phlyctaena*, p. 618.
*e*², Papillation on whorls succeeding the nuclear turns not stronger
 than those on the nucleus.....*t. traskii*, p. 612.

EPIPHRAGMOPHORA CUYAMACENSIS AVUS, new subspecies.

Plate 116, figs. 16-18.

This is a giant race resembling the large form of typical *Epiphragmophora traskii*. It has the inner lip reflected over half of the rather narrow umbilicus. The entire upper surface and the inside of the umbilicus are strongly papillose, while the rounded basal portion is almost smooth, the lines of growth being the most conspicuous feature. The spiral sculpture is obsolete.

The type (Cat. No. 120588, U.S.N.M.) comes from Los Angeles County, California. It has 5.5 whorls and measures—greater diameter, 25 mm.; altitude, 14.6 mm.

EPIPHRAGMOPHORA CUYAMACENSIS VENTURENSIS, new species.

Plate 116, figs. 13-15; plate 117, fig. 7.

Shell very much like *Epiphragmophora cuyamacensis cuyamacensis*, but with coarser papillation, which does not become obsolete behind the aperture on the rounded portion of the base, but is as strongly developed here as on the rest of the shell.

The type (Cat. No. 39642a, U.S.N.M.) was collected by L. Yates in Ventura County, California. It has 5.6 whorls and measures—greater diameter, 20.3 mm.; altitude, 12 mm. Another specimen without specific locality (Cat. No. 60611, U.S.N.M.) has 5.7 whorls and measures—greater diameter, 20.1 mm.; altitude, 12 mm.

EPIPHRAGMOPHORA CUYAMACENSIS CUYAMACENSIS, new species.

Plate 116, figs. 10-12; plate 117, fig. 8.

Epiphragmophora traskii cuyamacensis (Hemphill) PILSBRY, Man. Conch., vol. 9, 1894, p. 199, *nomen nudum*.

Epiphragmophora traskii cuyamacensis (Hemphill) PILSBRY, Clas. Cat. with Loc. Land Shells of Amer. North Mex., 1907, p. 5, *nomen nudum*.

Shell openly umbilicated; inner lip only slightly reflected over the umbilicus. Surface evenly papillated above and below, excepting a small portion on the rounded part of the base a little behind the aperture, which may be almost smooth.

Cat. No. 62381, Philadelphia Academy Collection, contains the type, three adult and nine immature specimens, which were collected by Mr. Henry Hemphill at the Cuyamaca Mountains in San Diego County, California. These are the specimens referred to by Doctor Pilsbry in the citations given above. The type has 5.9 whorls and measures—greater diameter, 20.1 mm.; altitude, 11.7 mm.

We have seen the following adult specimens, all collected by Mr. Hemphill:

Collection.	Catalogue number.	Number of whorls.	Greater diameter.	Altitude.	Locality.
P.A.N.S.....	62387	5.9	20.1	11.7	San Diego County, California.
Do.....	62387	5.9	19.2	11.7	Do.
Do.....	62387	5.6	17.0	10.4	Do.
Do.....	62387	5.6	16.0	10.2	Do.
U.S.N.M.....	39646	5.6	20.1	12.5	San Diego mines.
Do.....	39646	5.3	19.3	12.0	Do.
Do.....	30520	5.4	20.2	11.0	San Diego County, California.

Two young specimens in Mr. F. W. Kelsey's collection from Paloma Mountains, San Diego County, California, were examined.

EPIPHRAGMOPHORA TRASKII TRASKII (Newcomb).

Plate 114, figs. 1-18; plate 117, figs. 1-3.

- Helix traskii* NEWCOMB, Proc. Cal. Acad. Nat. Sci., vol. 2, 1861, pp. 91-92.
Aglaja traskii TRYON, Amer. Journ. Conch., vol. 2, 1866, p. 314, pl. 5, fig. 16.
Arionta traskii W. G. BINNEY, Terr. Moll., vol. 5, 1878, p. 369.
Helix franki J. G. COOPER, err. typ.; teste J. G. C., in letters.
Epiphragmophora traskii PILSBRY, Tryon's Man. Conch., vol. 9, 1894, p. 199.
Epiphragmophora traskii major HEMPHILL, *nomen nudum*.
Epiphragmophora traskii verna HEMPHILL, *nomen nudum*.
Epiphragmophora traskii saucius HEMPHILL, *nomen nudum*.
Epiphragmophora petricola BERRY, Univ. Cal. Pub. Zool., vol. 16, No. 9, Jan. 1916, pp. 107-9.

In this subspecies the fine papillation of the nuclear whorls scarcely extends beyond the third turn and is never stronger on the turns that succeed the nucleus than on the nucleus.

I have seen Dr. Newcomb's cotypes, four specimens, which are in the collection of Cornell University, No. 27832, and I have figured one of these on plate 116, as figures 7-9. These four specimens which come from Los Angeles, California, yield the following measurements:

Number of whorls.	Greater diameter.	Altitude.
5.6	22.6	13.7
5.8	22.1	12.6
5.9	22.3	13.3
5.6	23.2	13.9

To this subspecies I must refer Hemphill's *Epiphragmophora traskii major*, *E. t. verna*, and *E. t. saucius*. The first of these simply represents the largest shells of the group, while the green tinge of *E. t. verna* Hemphill, which is fugitive, is characteristic of all fresh specimens. The somewhat smaller average in size of the series of shells, which Hemphill named *verna*, is due to a partially diseased condition of the whorls.

Epiphragmophora traskii saucius Hemphill, as selected by the author of that name, represents pathologic specimens. It is *E. t. verna* carried a little further, pathologically speaking.

I have seen two paratypes of Mr. Berry's *Epiphragmophora petricola*, and I give figures of one of these on plate 117, figures 1-3. These specimens must be assigned to typical *Epiphragmophora traskii traskii*. Mr. Berry's ecologic data given in the paper referred to above are rather interesting since they throw considerable light on the habits of these animals. I therefore quote from his paper:

Type.—Cat. No. 3480 of the writer's collection; paratypes in the collections of the University of California and the private collection of Mr. Allyn G. Smith.

Type-locality.—A rocky talus slope on the southeast wall of Mill Creek Canyon, San Bernardino Mountains, California, near the old road, about 1-1/2 miles from the canyon

mouth, altitude about 3,250 feet; 10 dead shells, A. G. Smith and S. S. Berry, January 7, 1914; three living specimens, A. G. Smith, May 12, 1914; one living specimen, S. S. Berry, April 8, 1915.

Remarks.—This fine helicoid, one of the largest of the southern fauna, is distinguished by the aforementioned characters from all others known to me. It perhaps resembles a very large and extremely flattened form of *E. traskii* more than any of the other Californian species, and I believe the two species to be rather nearly allied, though the situations in which they are respectively to be found are very dissimilar. *E. petricola* was first discovered while quarrying through a rocky slide in the possible hope of obtaining *Micrarionta* or *Sonorella*, genera as yet unknown from the San Bernardino Range. The species does not seem to be an abundant one, and several hours' arduous labor in turning over large blocks of stone and clearing out the detritus, repeated on several occasions, have yielded to date only a single adult living specimen, all the remainder being immature or merely dead shells. While probably occurring all through Mill Creek Canyon, and perhaps neighboring parts of the range in favorable situations, only the one slide of the few so far examined has yielded specimens. A find by Mr. Smith of several shells on or near the surface leads to the belief that the species is not always, if ever, of strictly subterranean habit, at least not in the same sense as *Sonorella*.

The two paratypes sent to us by Mr. Berry give the following measurements:

Number of whorls.	Greater diameter.	Altitude.
5.9	28.3	17.0
6.0	28.7	15.4

The following additional adult specimens have been examined. No measurements were taken of pathologic and injured material; hence, most of the specimens called *verna* by Hemphill and all of his *saucius* drop out.

Measurements of Epiphragmophora traskii traskii.

Collection.	Catalogue number.	Number of whorls.	Greater diameter.	Altitude.	Locality.
U.S.N.M.	58553	6.2	26.3	17.4	San Luis Obispo County.
Do.	58553	6.3	27.6	17.3	Do.
Do.	39643	5.8	26.2	15.5	Santa Barbara.
Do.	39643	5.7	24.0	15.0	Do.
Do.	39643	5.8	24.4	13.9	Do.
Do.	39643	5.8	23.9	14.8	Do.
Do.	181313	6.2	28.8	17.4	Little Pine Canyon, Santa Barbara County.
Do.	12336	6.3	30.2	19.0	Santa Barbara.
P.A.N.S.	10700	6.0	21.7	12.5	Do.
U.S.N.M.	58523	6.0	20.3	11.7	Fort Tejon.
P.A.N.S.	10698	6.0	23.0	13.1	Do.
U.S.N.M.	39640a	6.0	26.0	15.4	Hills of Ventura County.
Do.	39640a	5.5	21.9	14.2	Do.
Do.	39640a	5.8	23.7	15.5	Do.
Do.	39640a	5.2	21.2	12.5	Do.

Measurements of *Epiphragmophora traskii traskii*—Continued.

Collection.	Catalogue number.	Number of whorls.	Greater diameter.	Altitude.	Locality.
U.S.N.M.	39642	6.0	25.0	14.8	Ventura County.
Do.	58559	6.0	21.5	14.3	Near Los Angeles.
Do.	58559	5.7	21.9	12.2	Do.
Do.	58559	5.8	21.6	14.9	Do.
Do.	58559	5.8	21.0	14.3	Do.
Do.	174117	5.5	20.5	13.3	Los Angeles County.
Do.	174117	5.5	22.3	14.1	Do.
Do.	174118	6.2	26.5	17.5	Do.
Do.	174118	6.2	26.1	17.4	Do.
Do.	174119	6.0	28.9	18.6	Do.
Do.	174119	6.2	28.5	17.7	Do.
Do.	174120	5.7	24.4	15.0	Do.
Do.	174120	6.0	24.3	15.8	Do.
Do.	174121	5.7	22.7	15.3	Do.
Do.	174121	5.8	22.0	15.5	Do.
Do.	174122	5.5	21.3	14.0	Do.
Do.	174122	5.7	21.4	14.1	Do.
Do.	174123	5.4	20.0	13.1	Do.
Do.	174123	5.7	19.1	13.0	Do.
Do.	174125	5.5	21.8	13.0	Do.
Do.	174125	5.8	20.9	13.0	Do.
Do.	174126	5.7	24.4	14.5	Do.
Do.	174126	5.5	24.5	14.0	Do.
Do.	174127	5.8	26.1	14.6	Do.
Do.	174127	5.8	25.3	14.5	Do.
Do.	174128	5.8	28.7	16.0	Do.
Do.	174128	6.0	26.5	15.5	Do.
Do.	201207	6.7	28.4	19.8	Artesia, Los Angeles County.
Do.	201207	6.5	29.4	18.6	Do.
Do.	201207	6.5	28.7	18.8	Do.
P.A.N.S.	10685	6.0	23.4	14.8	Los Angeles
Do.	10685	5.8	22.7	14.5	Do.
Do.	10685	5.3	22.9	15.0	Do.
Do.	10685	5.7	23.0	14.3	Do.
Do.	10685	6.0	21.4	14.2	Do.
Do.	10685	5.7	22.2	13.1	Do.
Do.	10685	6.0	22.3	13.2	Do.
Do.	86873	5.7	25.5	16.1	Do.
Do.	86873	6.2	26.7	18.1	Do.
Do.	86874	6.0	26.4	16.8	Do.
Do.	86874	6.0	25.0	16.9	Do.
Do.	86875	6.0	24.0	15.6	Do.
Do.	86875	6.0	24.1	17.2	Do.
Do.	86876	5.7	20.6	13.6	Do.
Do.	86879	5.5	20.5	12.4	Do.
Do.	86879	5.5	22.4	13.5	Do.
Do.	86880	6.0	24.0	14.0	Do.
Do.	86880	5.7	22.0	13.3	Do.
Do.	86881	5.7	25.2	14.8	Do.
Do.	86881	5.8	25.5	14.6	Do.
U.S.N.M.	182627	6.4	26.4	18.0	San Diego.
Average.		5.88	24.07	15.09	
Greatest.		6.7	30.02	19.8	
Least.		5.2	19.1	12.2	

EPIPHRAGMOPHORA TRASKII TULARICA, new subspecies.

Plate 116, figs. 1-3.

Epiphragmophora traskii tularensis (Hemphill) PILSBRY, Man. Conch., 1894, p. 199, *nomen nudum*.

Epiphragmophora traskii tularensis PILSBRY, Clas. Cat. with Loc. Land Shells of Amer. North Mex., 1907, p. 5, *nomen nudum*.

Shell subglobose, very dark colored, with the chestnut band very broad. The axial wrinkling of the nuclear sculpture is very strongly developed, the individual wrinkles being finely granulated. The larger papillations, which form the obliquely protractively slanting lines on the nucleus, are not nearly as strongly developed here as on the other races and require search to be seen. This sculpture does not appear to extend beyond the nuclear turns, but is replaced by the incised spiral sculpture which consists of closely spaced microscopic spiral striations and deeper, distantly, irregularly distributed, stronger lines.

The type and another specimen (Cat. No. 60009, Philadelphia Academy of Natural Sciences Collection) come from Frasers Mills, Tulare County, California. The type has 5.6 whorls and measures, greater diameter, 21 mm.; altitude, 17.4 mm. The other specimen has 5.5 whorls and measures, greater diameter, 21 mm.; altitude, 15.6 mm.

EPIPHRAGMOPHORA TRASKII ZECHAE Pilsbry.

Plate 117, figs. 4-6.

Epiphragmophora traskii zechae PILSBRY, Nautilus, vol. 29, No. 9, pp. 104-5, pl. 3, lower figures (3), Jan., 1916.

Shell very large, decidedly flattened, widely, openly umbilicated, thin. "The whorls of the spire and as far as the front of the last whorl are dilute cinnamon, then changing to ecru-olive or dark olive-buff; there is a chestnut-brown band at the shoulder (about 2 mm. wide), bordered with inconspicuous, hardly noticeable bands paler than the ground color." The characteristic distantly spaced, obliquely protractively arranged papillation is almost obsolete in the nuclear whorls, as well as on the rest of the shell, appearing only as distantly scattered pustules, usually best expressed near the suture, excepting immediately behind the aperture where they are strongly developed on the upper surface and a little less so on the lower. In addition to the papillation the whorls are marked by rather strong incremental lines which are equally developed on the upper and lower surface. No spiral striations are present. Aperture broadly lunate, decidedly wider than high; lip thin, the upper margin scarcely expanded, the outer slightly expanded, the basal very narrowly reflected; columellar margin broadly dilated.

The type (Cat. No. 113426, Philadelphia Academy of Natural Sciences) measures: altitude, 15.2 mm.; diameter, 31 mm.; aperture: altitude, 14.3 mm.; width, 17.8 mm.

Habitat.—San Antonio Canyon, in the San Gabriel Mountains, western edge of San Bernardino County, California, at about 5,000 feet elevation (Miss Lilian Zech).

Miss Zech gives the following account of the locality:

The specimen was found in a narrow, winding canyon branching from the main San Antonio canyon at 4,700 feet, and at this point, some 200 or 300 feet higher, as near as I can guess, only wide enough for the creek bed, then full of rushing water, and the trail. It is a cool, moist, deep canyon, with columbine, lilies, and ferns, and on the slopes much bay laurel. The trees were incense cedar and big cone spruce. The snail lay on a pile of rock artificially heaped up at the creek's mouth and contained the dead animal when found.

EPIPHRAGMOPHORA TRASKII PROLES, new subspecies.

Plate 116, figs. 4-6.

Epiphragmophora traskii proles (Hemphill) PILSBRY, Man. Conch., 1894, p. 199, *nomen nudum*.

Epiphragmophora traskii proles (Hemphill) PILSBRY, Clas. Cat. with Loc. Land Shells of Amer. North Mex., 1907, p. 4, *nomen nudum*.

Shell decidedly flattened, widely, openly umbilicated, thin. The characteristic distantly spaced, obliquely protractively arranged, papillation is almost obsolete in the nuclear whorls as well as in the rest of the shell in the present race. Traces of this sculpture can only be seen on absolutely perfect specimens. Only one individual of all the material examined showed this character, the nuclear whorls in all the rest being slightly worn. The incremental lines of the post-nuclear turns are not strong and the spiral sculpture which consists of exceedingly fine, faintly incised lines, which are best seen on the penultimate whorl, becomes lost on the last turn, both above and on the base.

I have selected one of the three specimens collected by Mr. Henry Hemphill at Frasers Mills, Tulare County, California, which are listed as Cat. No. 62270, Philadelphia Academy of Sciences collection, as type. This has 5.1 whorls and measures—greater diameter, 20.1 mm.; altitude, 11.1 mm.

I have seen the following additional adult specimens:

Measurements of Epiphragmophora traskii proles.

Collection.	Catalogue number.	Number of whorls.	Greater diameter.	Altitude.	Locality.
P.A.N.S	62270	5.2	21.5	11.4	Frasers Mills, Tulare County, California.
Do.	62270	5.0	19.4	10.2	Do.
Do.	10702	5.0	20.3	11.0	Clarks, California.
Do.	10702	5.0	18.7	10.5	Do.
Do.	10702	4.7	18.0	10.4	Do.
U.S.N.M.	39644	4.8	18.5	10.3	Mariposa County, California.
Do.	39644	4.6	18.0	10.4	Do.
Do.	39644	4.7	17.7	10.2	Do.
Do.	106779	5.0	19.3	10.6	Clarks Ranch, Mariposa County, California, 65 feet altitude.
Do.	¹ 58538	-----	-----	-----	

¹ Two not quite matured from the same place.

EPIPHRAGMOPHORA TRASKII CORONADOENSIS, new subspecies.

Plate 115, figs. 10-12; plate 117, fig. 9.

Epiphragmophora carpenteri PILSBRY (part), Clas. Cat. with Loc. Land Shells of Amer. North Mex., 1907, p. 5.

In this island subspecies the incremental lines are much stronger and the spirally incised lines are much wider and more deeply cut than in the other races. The combination of these sculptural elements give a clothlike texture to the entire surface of the shell.

I have examined the following adult specimens:

Collection.	Catalogue number.	Number of whorls.	Greater diameter.	Altitude.	Locality.
U.S.N.M.....	39649	5.3	20.7	12.4	Coronado Island.
Do.....	30539	5.7	21.9	13.7	Do.
Do.....	58526	5.7	23.6	15.2	Do.
Do.....	58526	6.0	22.4	14.4	Do.
Do.....	58526	5.5	20.6	13.0	Do.
Do.....	58526	6.0	21.7	14.1	Do.
Do.....	58526	5.8	21.5	14.4	Do.

EPIPHRAGMOPHORA TRASKII COELATA, new subspecies.

Plate 115, figs. 7-9; plate 117, fig. 10.

This is a small decidedly inflated race having the inner lip reflected over the very narrow umbilicus covering this half or more than half. All the whorls excepting the last turn are papillose. The spirally incised sculpture is feeble on the upper side of the last one and one-half whorls, and scarcely indicated on the base of the last turn.

The type and another specimen, (Cat. No. 124747, U.S.N.M.) come from the Mesa, at Pacific Beach, California. The type has five and one-third whorls, and measures—greater diameter, 20.8 mm.; altitude, 13.7 mm. The other specimen has four and one-half whorls and measures—greater diameter, 21.8 mm.; altitude, 13.5 mm.

EPIPHRAGMOPHORA TRASKII CARPENTERI Newcomb.

Plate 115, figs. 4-6.

Helix carpenteri NEWCOMB, Proc. California Acad. Sci., vol. 2, 1861, p. 103.

Aglaja carpenteri TRYON, Amer. Journ. Conch., vol. 2, 1866, p. 313.

Arionta carpenteri, W. G. BINNEY, Terr. Moll., vol. 5, 1878, p. 366.

Epiphragmophora carpenteri PILSBRY, Tryon's Man. Conch., vol. 9, 1894, p. 199.

This race was described by Newcomb in the following terms:

Shell umbilicate, roundly conical; apex obtuse, obscurely marked with one brown band; well striated; under the lens numerous very minute spiral striations; whorls five and one-half rounded; suture well marked; aperture circular, with margins approximating; lip moderately expanded, at the columella broadly so, but not adherent. Diameter, 23 mm.; altitude, 16½ mm. Habitat "Tulare Valley." Mus. Cal. Acad. Nat. Sci. My cabinet.

Remarks.—This shell, about the size of *H. ramentosa*, (Gould) can scarcely be confounded with any known species. It belongs to the Cyclostomoid group of Helices, and has the aspect of a desert species. Dedicated to Philip P. Carpenter, L. L. D., of Warrington, England.

The name *Epiphragmophora carpenteri* has been applied to a number of shells to which it did not belong. I believe that the three specimens which Mr. L. J. Goldman of the Biological Survey collected at Maricopa and McKittrick, on the east slope of the Coast Range, belong here and will fix this fleeting name.

The shells are characterized by a very narrow umbilicus, narrower than in any of the other races, except *Epiphragmophora traskii coelata*. The incremental lines are rather coarse, while the wavy spirally incised lines are fine and rather closely spaced.

The two adult specimens measure:

Collection.	Catalogue Number.	Number of whorls.	Greater Diameter.	Altitude.	Locality.
U.S.N.M.	272943	5.4	19.5	12.5	McKittrick, California.
Do.	272942	5.5	21.0	13.7	Maricopa, California.

EPIPHRAGMOPHORA TRASKII PHLYCTAENA, new subspecies.

Plate 115, figs. 1-3; 13-15.

This is a rather large race in which the two whorls following the nuclear turns are strongly papillose, the papillae being much more numerous and much stronger than they are on the nuclear turns.

Cat. No. 12363, U.S.N.M., contains two specimens, cotypes, collected by W. G. Blunt, 40 miles north of Santa Barbara, California. One of these, an adult specimen, has six whorls, and measures—greater diameter, 28.2 mm.; altitude, 17.1 mm. The other, not quite matured, has only five turns, but in this the spiral sculpture is better preserved and has furnished the illustration of that feature.

The following specimens have been examined:

Measurements of Epiphragmophora traskii phlyctaena.

Collection.	Catalogue Number.	Number of whorls.	Greater Diameter.	Altitude.	Locality.
U.S.N.M.	12363	6.0	28.2	17.1	40 miles north of Santa Barbara.
Do.	58516	6.0	23.3	15.0	Santa Barbara.
Do.	58516	6.0	22.8	14.4	Do.
Do.	58516	5.5	18.7	12.8	Do.
Do.	58516	5.7	20.3	12.9	Do.
Do.	39645	5.3	18.7	11.1	Do.
Do.	39645	5.5	18.9	11.8	Do.
Do.	39645	5.3	18.6	11.2	Do.
P.A.N.S.	10699	6.0	25.0	15.3	Do.
Do.	94979	5.8	21.8	14.2	Near Bardsdale, Ventura County.

EPIPHRAGMOPHORA TRASKII ———, subspecies?

The collection of the United States National Museum contains an immature specimen (Cat. No. 106779a, U.S.N.M., from Mariposa County, California, which appears to belong to a race differing from those noted above. The papillations disappear shortly beyond the nuclear whorls. The spiral lines on the last whorl are strong and deeply incised on the upper surface and feeble on the lower.

EXPLANATION OF PLATES.

PLATE 114.

All figures on this plate are of *Epiphragmophora traskii traskii* Newcomb.

- FIGS. 1-3. Top profile and bottom of the largest specimen, Cat. No. 12336, U.S.N.M.
 4-6. Top profile and bottom of the smallest specimen, Cat. No. 174123, U.S.N.M.
 7-9. Top profile and bottom of the *norm.*, i. e., the average specimen, Cat. No. 39643, U.S.N.M.
 10-12. (The pathologic form called *Epiphragmophora traskii*, var. *saucius* by Hemphill), Cat. No. 174140 U.S.N.M.
 13-15. (The pathologic form called *Epiphragmophora traskii*, var. *verna* by Hemphill), Cat. No. 174129, U.S.N.M.
 16-18. The tallest specimen, Cat No. 201207, U.S.N.M.

PLATE 115.

- FIGS. 1-3. *Epiphragmophora traskii phlyctaena* Bartsch, type.
 4-6. *Epiphragmophora traskii carpenteri* Newcomb.
 7-9. *Epiphragmophora traskii coelata* Bartsch, type.
 10-12. *Epiphragmophora traskii coronadoensis* Bartsch, type.
 13-15. *Epiphragmophora traskii phlyctaena* Bartsch, type.

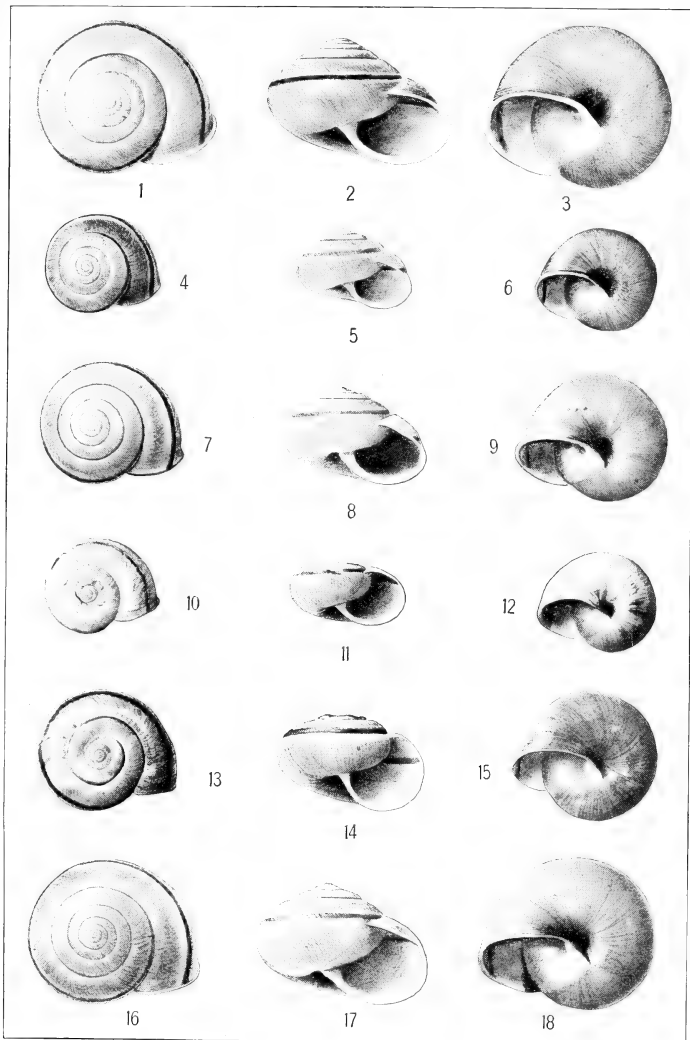
PLATE 116.

- FIGS. 1-3. *Epiphragmophora traskii tularica* Bartsch, type.
 4-6. *Epiphragmophora traskii proles* Bartsch, type.
 7-9. *Epiphragmophora traskii traskii* Newcomb, cotype.
 10-12. *Epiphragmophora cuyamacensis cuyamacensis* Bartsch, type.
 13-15. *Epiphragmophora cuyamacensis venturensis* Bartsch, type.
 16-18. *Epiphragmophora cuyamacensis avus* Bartsch, type.

PLATE 117.

- FIGS. 1-3. *Epiphragmophora petricola* Berry, paratype=*Epiphragmophora traskii traskii* Newcomb.
 4-6. *Epiphragmophora traskii zechae* Pilsbry, type.
 7. *Epiphragmophora cuyamacensis venturensis* Bartsch, type. A portion of the base a little behind the aperture, magnified about 25 diameters to show the strong papillations.
 8. *Epiphragmophora cuyamacensis cuyamacensis* Bartsch, type. A portion of the base a little behind the aperture magnified about 25 diameters to show the obsolete papillations.
 9. *Epiphragmophora traskii coronadoensis* Bartsch, type. A portion of the upper surface of the last whorl magnified about 25 diameters to show the clothlike texture.
 10. *Epiphragmophora traskii coelata* Bartsch, type. A portion of the upper surface of the last whorl magnified about 25 diameters to show the absence of clothlike texture.





NEW CALIFORNIAN LAND SHELLS.

FOR DESCRIPTION OF PLATE SEE PAGE 619.



1



2



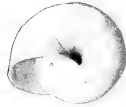
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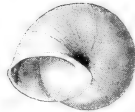
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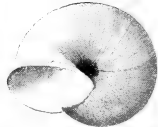
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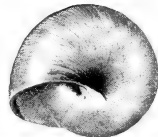
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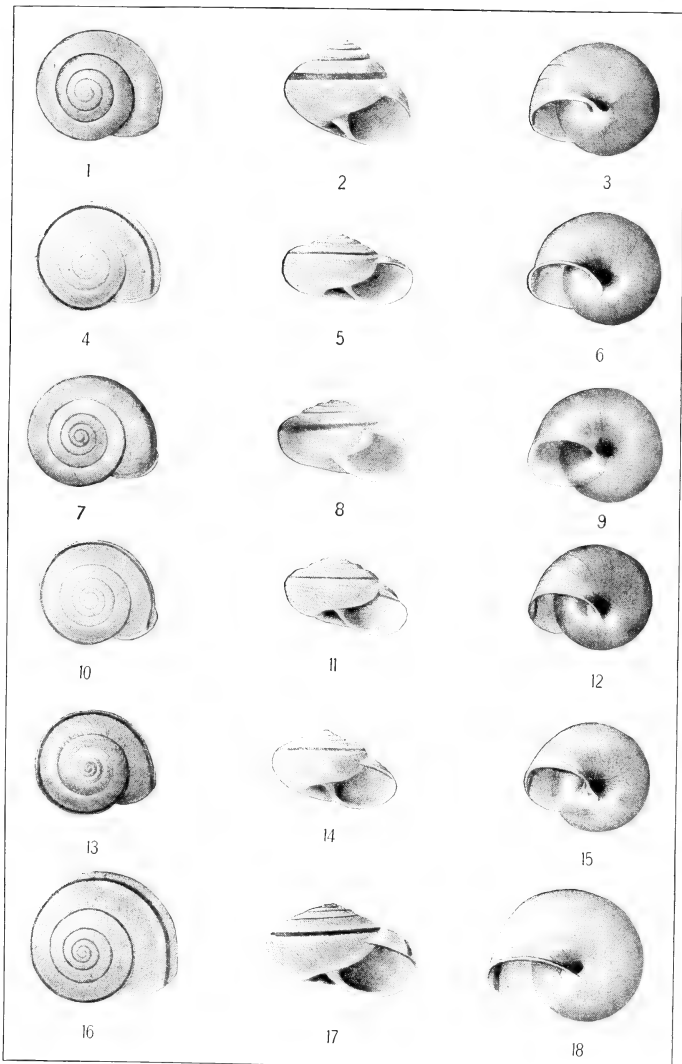
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NEW CALIFORNIAN LAND SHELLS.

FOR DESCRIPTION OF PLATE SEE PAGE 619.



NEW CALIFORNIAN LAND SHELLS.

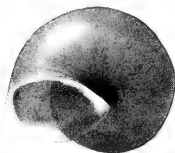
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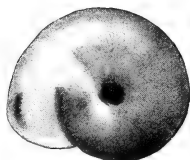
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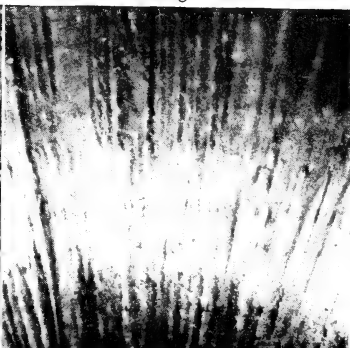
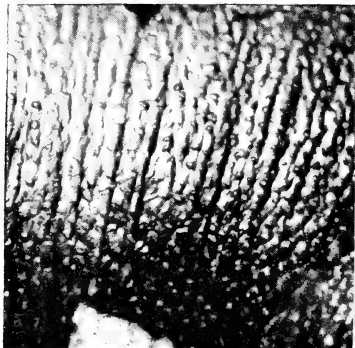
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A GENERIC SYNOPSIS OF THE COCCINELLID LARVAE
IN THE UNITED STATES NATIONAL MUSEUM,
WITH A DESCRIPTION OF THE LARVA
OF HYPERASPIS BINOTATA SAY

BY

ADAM BÖVING

Of the Bureau of Entomology, United States Department of Agriculture

No. 2171.—From the Proceedings of the United States National Museum,
Vol. 51, pages 621–650, with Plates 118–121

Published January 15, 1917



Washington
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INTRODUCTION.

This paper is a contribution from the Branch of Forest Insects prepared under an arrangement between Dr. A. D. Hopkins, in charge of Forest Insects, and Dr. A. L. Quaintance, in charge of Deciduous Fruit Insects of the Bureau of Entomology, United States Department of Agriculture, to supplement a biological paper by F. L. Simanton, Entomological Assistant, Deciduous Fruit Insects, entitled *Hyperaspis binotata*, A Predatory Enemy of the Terrapin Scale.¹

In connection with the author's investigations of Coleopterous larvae affecting forest and shade trees, he has been glad of an opportunity to study in details the morphology of the larva of *Hyperaspis binotata* Say, and to work out a synopsis of the larvae of the Coccinellid genera, represented in the United States National Museum. The systematic notes of the present paper are, however, only intended as an outline for further studies and as a small contribution in the discussion about the natural arrangement of the genera of this difficult group. The student of the family must rely upon earlier papers, among the most useful of which are L. Ganglbauer's critical abstract in his *Die Käfer von Mitteleuropa* (vol. 3, 1899), and especially the admirable paper of George Dimmock: *Algunas Coccinellidae de Cuba* in *Primer informe anual de la Estación Central Agronomica de Cuba* (1906). As the present synopsis is based on the morphological study of the larva of *Hyperaspis binotata*, the description of this larva has been placed first.

¹ Journ. Agric. Res., Dept. Agric., Wash., D. C., vol. 6, 1916, pp. 197-203, with two plates.

GENERAL DESCRIPTION OF THE FULL-GROWN LARVA OF *HYPERASPIS*
BINOTATA SAY.

The full-grown larva is about five millimeters long; oval in outline, strongly arched above, with flattened underside (figs. 1, 2, 3). The head is bent downwards; its posterior edge is covered by the fleshy anterior margin of the prothorax; the color is light greenish gray with the more strongly chitinized parts shiny dark brown, and with a dark brown pattern (as shown in figs. 8, 9, 10); it is rectangular, very broad, with an unusual capacious mouth cavity (fig. 7), capable of containing an entire larva of the *Lecanium*, which constitutes its principal prey. This increase of the mouth has been effected by the enlargement of the labrum and the labium and by the incorporation of the dorsal side of the maxillary stipes into the wall of the mouth (*std.* II, fig. 7); the labrum (fig. 1 and *lr*, figs. 8 and 9) is nearly perpendicular, covering and protecting the approximately horizontal mandibles (*md*, figs. 8 and 9) and the fleshy lobes of the ventral mouth parts (*la*, *li*, figs. 8 and 9). Due to the enlargement of the mouth cavity, the mandibles are so displaced (fig. 7) that they can only meet each other with their very pointed apex (*apx*, fig. 6), while the convex, broad and flattened molarlike bases (*mo*, fig. 6) are widely separated; these molarlike bases can, for that reason, not work against each other, but they work in the corner of the mouth against the concave end surfaces of a hypopharyngeal bridge peculiar to this family (*br*, figs. 7, 9), grinding and squeezing the juices out of the prey; the fleshy lobes of the ventral mouth parts close the mouth and retain the juice during mastication until it can be sucked in and swallowed by the movements of the pharynx (*ph*, figs. 4, 7). These remarkable morphological modifications of the mouth parts have not been recorded before and are probably not found outside the family *Coccinellidae*. There are three large ocelli (fig. 1, *oc*, fig. 8) on each side; the antennae are three-jointed with a tactile filament (*fil*, fig. 8) at the apex of the second joint; the maxillary palpi are normal, three-jointed, with the usual sensory papillae on the terminal joint; labial palpi minute and two-jointed (fig. 8).

The subglobose shape of the body, with the flat ventral side pressed against the supporting surface is similar to that of most of the coleopterous larvae, which live on leaves and twigs, and is well adapted to these surroundings; the color is pale, yellowish gray, somewhat lighter underneath and with small, brown, chitinous spots indicating muscle attachments (*ms*, fig. 1); the body is pubescent, bears well-developed setae, especially on the dorsal and lateral areas, and has numerous small pores in the skin on all segments (*por*, fig. 5); but all these characters are not apparent on the living larva because it is covered by tufts of long, pure white, waxy threads, which are exuded from

three rows of dorsal depressions on each side of the body. Some of the lateral setae (*cols*, fig. 5) are very large, very fragile, and of a peculiar structure, emitted from a collarlike prolongation of the basal cup. The fragile nature and specialization of these hairs suggest that they are defensive, either in a merely mechanical way or possibly containing a poison. Undoubtedly protective organs are certain large repugnatorial glands, which can emit drops of bloodlike fluid; these are placed dorsally in the intersegmental skin on each side of the first eight abdominal segments (*bg*, figs. 1 and 5). Small ring-shaped light brown spiracles (*sp*, figs. 1 and 5) occur on the mesothorax and on the first eight of the ten abdominal segments; a rudimentary pair is found on the metathorax. The spiracles are provided with an effective closing mechanism (fig. 5), which prevents the expiration of the air, when the larva contracts the body to press out the bloodlike fluid from the glands.¹

The three thoracic segments bear stout legs (fig. 3), which are inserted rather close together; their color is dark gray with the terminal margin of each joint shiny, black; the small, clawlike tarsi are black, with a seta near the base and are surrounded by curious, club-shaped hairs on the end of tibia (fig. 1). The anal segment (10 *abd*, figs. 1, 3) is bent downwards and forms a well-developed sucker, which is used in the locomotion.

STRUCTURAL DETAILS OF THE MATURE LARVA.

Cranium (figs. 8, 9, 10) symmetrical, rectangular, twice as broad as long; occipital foramen of the same width as the cranium; head reaches further back above than below; ventrally the foramen is without any distinct chitinous margin, because the two epicranial halves are widely separated and the gula region (*gu*) is without any chitination (fig. 10); hypostoma (*h*), strongly chitinated, with a distinct triangular posterior enlargement (*htri*, fig. 10). Labrum (*lr*, fig. 9), very large and semicircular, shaped like an eyeshade; anterior margin distally without any serration, ciliar fringe or marginal setae; clypeus (= postlabrum Lyonet) (*c*, fig. 9) indistinct because the chitination of epistoma (*ep*) is but slightly developed, and only obvious near the dorsal articulation of the mandibles; frons (*f*) completely fused with epicranium (*ecr*), no indication whatever of the frontal sutures nor any epicranial suture;² three well developed lateral ocelli (fig. 1, *oc*, fig. 8) arranged, as the figures show, in a triangle just behind the antennal ring. The laterally placed antennal ring (*a*, figs. 8, 9) is strongly chitinated and surrounds the whole basal membrane of the antenna; the antenna is of about the same length as

¹ Compare A. G. Böving, Natural History of the Larvae of Donaciinae (International Revue der gesamten Hydrobiologie und Hydrographie, vol. 3, Biol. Suppl. I, 1910, p. 73).

² Compare the first-stage larva, mentioned on page 628.

the mandible, conical with a big basal membrane (*bm*, fig. 8); first joint wide but rather short (*I*, fig. 8); second joint (*II*, fig. 8) as long as the first but only half as wide; from the membranous distal end of the second joint is emitted on the outside a small transversely divided third joint (*III*, fig. 8) and on the innerside a thin-walled, soft sensory filament (*fil*, fig. 8), which is a little longer and more slender than the third joint.

The mandible (fig. 6) is falciform with acute apex and with a large flattened base, which is developed into a convex molar shaped portion (*mo*) above the flexor muscle (*fl*), and which is also flattened out above the extensor muscle (*ex*); between the molar part and the apical part (*apx*) is inserted a thin, broad, perucid retinaculum (*rlm*); the basal portion bears externally one large scrobicular seta. The maxilla (fig. 10) is connected with hypostoma (*h*) by a large, oblong articulating membrane (*cm*, fig. 10) from the exterior margins of the cardo; the posterior half of this membrane contains a flat chitinous plate, in outline resembling a lobster claw (*lo*, fig. 10), but the plate is normally concealed, because that part of the membrane, as a rule, is invaginated below the cardo; cardo (*ca*) is rather large, well chitinized and dark separated from stipes by a fine suture; the ventral surface of the stipes is of the same size and character as cardo, but while cardo only consists of a ventral shell-shaped plate, stipes is a real tube-shaped joint, though its dorsal side, facing the mouth cavity, is chitinized only at its distal end (*std. I*, fig. 8), while the rest is soft-skinned and forms a part of the buccal membrane (*std. II*, fig. 7); the rest of the mouth cavity is formed by the underside of the labrum, the epipharynx (*eph*, fig. 4), the dorsal side of the rather indistinct ligula (*li*, fig. 9, 10), and the hypopharynx (*hy*, fig. 7), all of which are soft and fleshy; the distal end of stipes is closed by a membrane, (*stm*, fig. 10), which bears a big fleshy lacinia (*la*, fig. 10) and a short palpiger (*plg*, fig. 10); lacinia has ventrally a slightly chitinized brownish surface, which is very distinctly articulated with the rod-like, strongly chitinized interior margin of stipes (*str*, fig. 10); the anterior and dorsal part of the lacinia is soft skinned (*la*, figs. 9, 10), provided with a number of short sensory peg-like projections, with a few setae and with a two-jointed appendix, the rudimentary galea (*g*, figs. 8, 10);¹ palpiger (*plg*, fig. 10) is stiffened by a semicircular chitinization (*pgc*); it carries a three-jointed conical palpus, which is of nearly the same size and shape as the antenna, with the corresponding joints almost equal in length and width; the number and location of the setae are indicated in figure 10; apical joint with sensory papillae (*se*). Submentum (*sm*), mentum (*m*), and stipes labii (*l*) are fleshy and are fused to-

¹ Compare (a) A. G. Böving, Natural History of the Larvae of Donaciinae, p. 12, (b) G. Dimmock, Algunas Coccinellidae de Ieuba, p. 301, in translation from the Spanish text: "I am inclined to believe that this appendix . . . will prove to be a rudimentary lobe (see plate 51, fig. 17)."

gether to such an extent, that the different regions can hardly be discerned; there is no connecting lobe between submentum and cardo and only a very faint boundary line between submentum and the big fleshy soft-skinned gula region (*gu*); this latter region is again fused with the thick collar-shaped skin in front of prothorax (fig. 1).

At the base of mentum, close to the posterior margin of stipes, is found a pair of large, slightly chitinized and indistinctly defined plates, each with two setae; at the middle of submentum, adjoining cardo, is found a similar, but smaller pair of chitinous plates, behind each of which is a single seta. The labial palpus (*lp*, fig. 8) is very short, two-jointed, with a well chitinized ring-shaped basal joint, and with a rounded apical joint, which is but slightly chitinized; ligula (*li*, fig. 10), the fused laciniae labiales, is not well defined, subtriangular, obtusely pointed. The mouth cavity (fig. 7) has in its floor a strongly developed, chitinized bridge (*br*, fig. 7), which limits hypopharynx posteriorly and sharply defines the entrance to the pharynx (*ph*); from this chitinization extend two pairs of chitinous rods, which form the margins relatively of the hypopharynx (*hr*, fig. 7), and the epipharynx (*er*, figs. 4, 7); the hypopharyngeal rod has an interior branch at the base; laterally in the corner of the mouth between the upper and lower pair of rods, the chitinous bridge terminates in a concave masticating surface, against which the convex basal part of the mandible works.

The thoracic segments conform in shape and size with the abdominal segments more than is normally the case in coleopterous larvae and it is not necessary to describe them separately. The tergal region of each segment is ventrally defined by a longitudinal, curved suture (*tp*, figs. 1, 2), the tergo-pleural suture or lateral furrow, Dimmock¹ (= antipleural suture Böving²) which is determined by two muscle marks and by the upper ends of the vertical suture (*vps*, figs. 1, 2) between the posterior pleural areas (3, 4, fig. 1) of one segment and the adjacent anterior pleural areas (1, 2, figs. 1, 3) of the following segment. The outlying areas of tergum occupy a considerable portion of the whole tergum. Dorsally they are limited by a line which can be traced by a series of muscle marks; the line starts at a muscle mark just in front of the spiracle and runs vertically upwards to another muscle mark immediately below the blood-exuding, repugnatorial gland (*bg*, figs. 1, 2) and hence around and beyond this gland; on the thoracic segments, where there are no repugnatorial glands, the three muscle marks are, nevertheless, easily located; the next determining point is the terminus of a transverse dorsal suture (*tds*, figs. 1, 2),

¹ Geo. Dimmock, *Algunas Coccinellidae, etc.*, p. 295: en los segmentos abdominales de las larvas de muchas especies entre la segunda y tercera hilera dorsal hay un canal longitudinal más ó menos definido que ha sido llamada en este artículo "canal lateral," usando el mismo nombre en cuanto á las ninfas.

² A. G. Böving, *The Abdominal Structures, etc.*, p. 57.

which ends in a depressed, slightly chitinized rod, connecting two conspicuous muscle marks; the rod is approximately twice as long on the thoracic segments as on the abdominal segments; from the terminus of this rod the limiting line of the outlying tergal portion continues as a rather indistinct wrinkle to the mark below the gland of the next segment, and hence downward to the tergopleural suture.

This whole outlying tergal portion corresponds to what I before have called the spiracular area (*spa*, fig. 1). In most coleopterous larvae, however, including the majority of the Coccinellid larvae, the spiracles have moved away from this area on the thoracic segments, and the term "spiracular area" would consequently be misleading applied to these segments; while the term will be retained for the spiracle bearing abdominal areas, the homologous thoracic areas should be named "*the alar areas*,"¹ because it is from these areas, (*al*, figs. 1, 2) that the wing pads start on the second and third thoracic segments.² The central part of tergum is divided by the deep transverse suture (*tds*, figs. 1, 2) ending in the depressed chitinizations just mentioned in the foregoing; in front of this suture lies the anterior, trapezoidal portion of scutum (*sc I*, fig. 2), which contains a central transverse ridge of setae and a small, triangular prescutum (*psc*, fig. 2); behind the transverse line is the posterior portion of scutum (*sc II*, fig. 2) with a small, triangular, faintly outlined scutellar area (*scl*, fig. 2) opposite prescutum. Parascutum (*pasc*, figs. 1 and 2) is small and not sharply defined.

The outline of the pleural or lateral zone is concave above and below; dorsally it is defined by the tergopleural or lateral suture (*tp*, figs. 1, 2), ventrally by the sternopleural or sublateral suture (*stp*, fig. 3); the latter formerly referred to by the writer³ as the pleural suture. On the thoracic segments this suture runs immediately above the conspicuous double chitinization with which coxa articulates, and on the abdomen³ it connects the anterior and posterior cuneal notches (*an* and *pn*, fig. 3) and contains a small muscle mark on the middle of each segment. The pleural or lateral zone is large and bulges out prominently, so that only half of it can be seen from above, the other half from below. The pleural lobe (*pll*, fig. 3) is central and surrounded by the proto-, deuter-, trito- and tetrapleurites (1, 2, 3, 4a, 4b, figs. 13); these are all well developed, especially is the lower part (4b) of the tetrapleurite unusually large and cushion-like.

Both in the thoracic and the abdominal segments the areas below the pleural or lateral zone are the following: Hypopleurum, parasternum, presternum, sternum or eusternum, and sternellum. The hypopleurum (*pcx*, fig. 3) is comparatively small in the thoracic seg-

¹ Following suggestion from Mr. F. C. Craighead.

² This can be observed in larvae which for any reason abnormally have developed wing pads.

³ See Böving, *The Abdominal Structures*, etc., pp. 56-57.

ments, but is here easily recognized by the double chitinization, into which the condyle of the coxa fits; the anterior portion of this chitinization is located at the end of a lateral armlike extension from eusternum in front of coxa; the abdominal parasternum (*past*, fig. 3) is large; the eusternum (*eust*, fig. 3) is separated from the sternellum (*stl*, fig. 3) by a transverse suture, which in thorax contains the furcal notches (*fn*, fig. 3); sternellum is approximately trapezoidal, posteriorly defined by a curved line through the unpaired ventral notch (*vn*, fig. 3) in the middle line of the body.

Between the head and the thorax is a broad, fleshy collar; the ventral side of this collar contains a median area (*mea*, fig. 3) in which is found a small unpaired chitinization; on either side of this area is a triangular area (*ta*, fig. 3); this latter area is correspondingly developed along the anterior margin of the sternum of meso- and metathorax, but is rudimentary on the abdominal segments; it is considered a lateral presternum (*prst*, fig. 3); in front of it on meso- and metathorax is a median notch-bearing area, the morphological nature of which can be decided only by a thorough study of the muscles, for which the available material is not in proper condition; this area (fig. 3) may, for the present, with equal right be regarded as a separate piece of the preceding sternellum, as a special posterior sternal area, as a median part of presternum, or as a special area, homologous with the median area (*mea*) of the collar. It is possible that the areas containing the large, repugnatorial glands (*bg*, fig. 1) may be interpreted as remains of the intersegmental skin, which otherwise can only be traced on the abdomen as a line. The tenth abdominal (10 *abd*, fig. 3) or anal segment is bent downwards, so that the ventral portion becomes anterior and the dorsal posterior; the anterior portion is a little smaller than the posterior and the latter is divided by a wedge-shaped depression; anus is central.

Legs are well developed; the base of coxa (*cox*, fig. 3) is large and oblique. The general form and relative size of the trochanter (*tro*), femur (*fe*), tibia (*tib*) and tarsus (*tars*) can be gathered from figures 1 and 3. The claw-shaped tarsus is rather small, curved, pointed with rounded heel; it is surrounded by peculiar club-shaped setae situated on the end of the tibia.

The spiracles (*sp.*, figs. 1 and 5) are all of the same size, ring-shaped and, what is especially noteworthy, placed dorsally both on the thoracic and on the abdominal segments. The rudimentary metathoracic spiracle is represented by a minute chitinous dot. The atrium is not developed and there are no hairs in the spiracular opening; the closing mechanism is two-armed; beneath the base of the one arm (*arm*, fig. 5) the tracheal wall is invaginated into a soft-walled cushion, slightly chitinized only on the upper surface; by the contraction of the closing muscle these underlying portions of the tracheal wall are

pressed against each other, resulting in a very effective closing of the trachea.

There are in all, four larval stages; the second and third agree in general with the fourth stage here described, but the first larval stage presents a few deviations. The head of this first stage larva is comparatively larger than in the later stages, the body is more slender and the legs comparatively longer; but the most interesting difference is found in the last joint of the maxillary palpus, which relatively is more than twice as long as in the mature larva, and in the cranium being uniformly black with a trifurcated white pattern indicating the two frontal sutures and the epicranial suture. Otherwise this first larval stage agrees with the last larval stage in the structure of the mandibles, the hypopharyngeal bridge, the number of ocelli, and the arrangement of the body areas.

SYNOPSIS OF THE LARVAE OF THE COCCINELLIDAE IN UNITED STATES NATIONAL MUSEUM.

The larvae of the family Coccinellidae exhibit a great variation of structure. They can, however, only be confused with certain larval types of the family Chrysomelidae, which they resemble in general shape and in the development and arrangement of the chitinous plates and spines of the body areas. Except the very deviating herbivorous larvae of the Epilachnini the rest of the Coccinellid larvae may definitely be separated from those of the Chrysomelids with which they may be confused by the following differences in the structures of the head and mouth parts.

In the Coccinellidae the mandible is sickle-shaped with the base enlarged and (except in the small genus *Microweisea*) with a retinaculum present; a hypopharyngeal bridge is developed. In the Chrysomelid types referred to, on the other hand, the mandible is broad with base not especially enlarged and without retinaculum; the hypopharyngeal bridge not developed. All the *Coccinellid* larvae examined by the writer possess three ocelli, while in the Chrysomelidae the number of eyes varies from none to six. It has been maintained that the larvae of the family Coccinellidae could be definitely distinguished by two depressions on the middle of the frontal suture, but our knowledge of these structural details is too limited to definitely establish them as a family character.

The *Hyperaspis* larva described above represents the primitive type of the Coccinellidae, while the *Chilocorini* possess the most highly developed larvae; between these two extremes is found a series of intermedian forms; the *Epilachnini* and the *Psylloborini* are branches from the main stem with biological adaptations, such as specialized mandibles (in both of the groups), and reduction of the hypopharyngeal bridge (in the *Epilachnini*).

The following genera are represented in the United States National Museum, several of them by more than one species:¹ *Hyperaspis*, *Thalassa*, *Brachyacantha*, *Microweisea*, *Stethorus*, *Scymnus*, *Cephaloscymnus*, *Cryptolaemus*, *Novius* (*Vedalia*), *Lindorus*, *Rhyzobius*, *Micraspis*, *Anisosticta*, *Megilla*, *Hippodamia*, *Adalia*, *Coccinella*, *Harmonia*, *Neda*, *Cycloneda*, *Anatis*, *Synonycha*, *Thea*, *Psyllobora*, *Epilachna*, *Lasia*, *Cynegetis*, *Curinus*, *Axion*, *Exochomus*, *Egius*, *Orcus*, *Chilocorus*. In the subsequent synopsis these genera are arranged in nine groups, namely (1) *Hyperaspini*, (2) the genus *Microweisea*, (3) *Scymnini*, (4) *Noviini*, (5) *Rhyzobiini*, (6) *Coccinellini*, (7) *Psylloborini*, (8) *Epilachnini*, and (9) *Chilocorini*.

These nine groups are differentiated, as shown on plate 120, by the following characters:²

Primarily:

(1) The location of the thoracic spiracles; these are situated either in tergum or in the protopleurite.

(2) The arrangement of the pleural areas of meso- and metathorax; these are either similar to the corresponding, normally arranged pleural areas of the abdomen, or differ from these in having the *protopleurite* more or less fused with the adjacent part of tergum into a triangular region, which extends downwards to the sterno-pleural suture, and in having the *pleural lobe* fused with the *posterior pleurites* into another triangular region, which extends upwards from the sternopleural suture.

(3) The presence or absence, distribution, or modification of processes, tubercles, plates, or spines on the thoracic and abdominal areas.

Secondarily:

(4) The different development and chitinization of the hypopharyngeal bridge.

(5) The shape of the apex and the retinaculum of the mandibles.

The relationship of the genera and groups is, as far as possible, indicated by the sequence within the columns of plate 120.

It is noteworthy that this systematic arrangement, based on structures of the larvae, corroborates the classification based on structures of the adults, proposed by Col. Thomas L. Casey,³ deviating only in a few points; thus the study of the larvae does not support a separation between a tribe *Hypodamiini* and a tribe *Coccinellini*. The genus *Microweisea* (=T. L. Casey: the genus *Smilia*, Weise) forms, as Weise and Casey have pointed out for the imagoes, an extremely remarkable and isolated type which can not be included within the

¹ The large number of Danish forms is due to the gifts of Messrs. Kryger and Rosenberg, of Copenhagen.

² As muscle impressions corresponding to those described in *Hyperaspis binotata* are present in all Coccinellid larvae, and as the areas defined by them consequently can be identified with the homologous areas in *Hyperaspis*, all tubercles, sclerites, spines, or glands are referred to these special areas and named after them.

³ A Revision of the American Coccinellidae, Journ. New York Entom. Soc., vol. 6, 1898.

tribe *Scymnini*; the larvae also indicate that this genus constitutes a separate tribe. Colonel Casey states that the two genera *Psyllobora* and *Thea* are so closely related to each other, "that it might scarcely be conducive to taxonomic convenience to maintain them distinct"; the study of the larvae which are readily identified by the characteristic shape of their mandibles (fig. 10, pl. 120), support this view. On the other hand, the comparison between the larvae of the *Psylloborini* and the *Epilachnini* does not support Colonel Casey's opinions, when he regards the *Psylloborini* and the *Epilachnini* so closely related, that he considers the *Epilachnini* merely as slightly modified *Psylloborini* "by reason of perverted food habits and attendant environments." While the larvae of the *Psylloborini* are rather close to the *Coccinellini*, the larvae of the *Epilachnini* differ considerably from both of them in a great many characters. The *Epilachnini* are truly derived from the *Coccinellini*, but are so adapted and changed that they form a very distinct tribe.

Group I (HYPERASPINI).

Plates 118-120.

Of this group the following genera and species have been studied: *Hyperaspis lugubris* Randall (N. Amer.), *Hyperaspis binotata* Say (N. Amer.), *Thalassa montezumae* Mulsant (Arizona), *Brachyacantha ursina* Fabricius (Washington, D. C.), *Brachyacantha*, sp. (Texas).

The body in dorsal view is ovate, with greatest width on the third and fourth abdominal segments; much flattened ventrally and very convex dorsally. Prothorax oblong-oval, more than twice as broad as long, the dorsal outline of the other segments, both thoracic and abdominal, is approximately rectangular, laterally rounded, comparatively broader and shorter than prothorax; the ninth abdominal segment nearly semicircular, more than twice as broad as long, with an unserrated margin. The folds and areas of mesothorax and metathorax are very similar to those of the abdominal segments, which indicates the primitive nature of the group; the spiracles are all tergal and the spiracle-bearing areas are developed nearly alike in the thoracic and the abdominal segments. The tergo-pleural suture is horizontal and well defined throughout its whole length; the pleural lobe is convex, cushion-like, ovate, and the protopleurite is not fused with the adjacent part of tergum. Both thorax and abdomen have small chitinizations, indicating the attachment of muscles, but have no setiferous tubercles or spines. The hypopharyngeal bridge is strongly chitinized with a cavity in each end, into which the molar-shaped interior base of the mandible fits; the apex of the mandible is single, and the retinaculum is thin-walled with a single-pointed tip.

Group II (Genus *MICROWEISEA*).Plates 120 and 121, figs. 22 *a*, *b*.

The group contains only the one genus *Microweisea*. Three species are present in the collections of United States National Museum, viz: *Microweisea misella* LeConte (N. Amer.), *Microweisea coccidivora* Ashmead (N. Amer.) and *Microweisea ovalis* LeConte (= *felschei* Weise) (Florida).

The body is depressed, fusiform, greatest width on metathorax; prothorax oblong-oval, about twice as broad as long; mesothorax and metathorax also oblong-oval, only slightly broader and longer than prothorax; the abdominal segments subrectangular, laterally rounded, relatively broader and shorter than the thoracic segments; the ninth abdominal segment conical, much narrower than the eighth, half as broad as long. The folds and areas of mesothorax and metathorax and of the abdomen are similar to those found in the *Hyperaspini*, with which group *Microweisea* also agrees in shape and nature of the spiracle-bearing areas of mesothorax and metathorax and in the transverse-oval dorsal outline of these segments as well as in the shape and position of the thoracic pleural areas below a well defined, horizontal tergopleural suture. A pair of longitudinal dark chitinizations is found on the tergum of the prothorax and is indicated on the tergum of mesothorax and metathorax; a ring-shaped dark chitination surrounds the eighth, and a similar chitination the ninth abdominal segment; the rest of the body is soft skinned, without setae-bearing tubercles or sclerites. The head (fig. 22 *a*, pl. 121) is quite different from that of any other Coccinellid larva. It is elongate with a comparatively narrow spear-like frons, which on its inner side has a long, thin, dark chitinized rod-like thickening along the median line. The hypopharyngeal bridge and the mandibles (fig. 17, pl. 120) have the same general shape as in the preceding group, and the apex of the mandible is single-pointed as in this group, but the retinaculum is absent in all three species examined, a condition which the writer has not observed in any other Coccinellid larva. The claws are unusually slender, rather straight, pointed and about four times longer than the width of the base. *Microweisea* is undoubtedly close to the *Hyperaspini* and also shows affinity to the *Scymnini*, but it constitutes a sharply defined, distinct type.

Group III (SCYMNINI).

Plates 120 and 121, figs. 23, 24, 25 *a*, *b*, and 26.

The following genera and species, included in this group, have been studied: *Stethorus punctum* LeConte (N. Amer.), *Stethorus utilis* Horn (Florida), *Scymnus cervicalis* Mulsant (Texas), *Scymnus coniferarum* Crotch (Arizona), *Cephaloscymnus* (?), *sp.* (Arizona) and *Cryptolaemus montrouzieri* Mulsant (California).

The form of the body varies much; in some species, as *Scymnus coniferarum*, it is elongate fusiform with prothorax obovate, more than twice as long as broad, and, with the ninth segment conical, twice as long as broad, much narrower than the eighth segment; in other species, as *Scymnus cervicalis*, the form is rather broad with the segments of about the same size and only slightly tapering posteriorly, the prothorax is trapezoidal, anteriorly broadest, laterally rounded, about twice as broad as long, and the ninth segment is semicircular, about twice as broad as long, and not much narrower than the eighth segment; still in other species, as *Cephaloscymnus* (?), the general shape is the same as in *Scymnus cervicalis*, but all segments have laterally peculiar large prolongations. The outline of mesothorax and metathorax of the group is that typical for the majority of the Coccinellid larvae; it is trapezoidal, broadest in front, and differs from the transversal-oval dorsal outline, characteristic of the foregoing groups and still characteristic of the abdominal segments of the present and the subsequent group. This trapezoidal form is mainly due to the following development of the mesothoracic and metathoracic pleural areas (fig. 13, pl. 120). As mentioned previously (page 629), the mesothoracic and metathoracic spiracles move down into the protopleurite; and this area fuses more or less closely with the adjacent part of the tergum and also with the deutero-pleurite into a subtriangular region, thus giving the impression as if the anterior portion of the spiracle bearing tergal area had been enlarged and dropped downward to the sternopleural suture. There it touches and is more or less confluent with the upper edge of the elongate, triangular, swollen, presternal area (*prst*, fig. 3, pl. 118) which points downward to and normally touches the unpaired ventral notch. The spiracle-bearing extension does not carry any setiferous tubercle or spine. By the development of this anterior pleurite the rest of pleurum is forced backward, and fused into the swollen, subtriangular region, which extends upward from the sternopleural suture in its entire length to the terminus of the tergopleural suture. On the thoracic segments a pair of longitudinal chitinizations occur on the terga, and, on the abdominal segments a small setae-bearing tubercle is developed on the scutal area, on the spiracular area just below the small parascutal area, on the pleural lobe, and on some of the sternal areas. In *Cephaloscymnus* (?), deviating in many ways, the pleural lobe is extraordinarily developed into a broad horizontally flattened, setae-bearing process (fig. 24, pl. 121); similar structures have been described in other *Scymnini*. The hypopharyngeal bridge is strong; the mandible has a molar-like base and the apex of the mandible is single in all the genera and species represented in the United States National Museum, except *Cryptolaemus montrouzieri*, in which form the apex is divided into two teeth; in the literature, however, several

other species of Scymnid larvae have been described with a bifurcate mandibular apex; the retinaculum is always thin-walled and has a single-pointed tip.

The *Scymnini* are difficult to define and place as a group. Based on the few characters used in the present paper, a form as *Crypto-laemus*, for instance, with its bifurcate mandibular apex should logically be included in the following group, the *Coccinellini*, but the general habitus of the larva is very different from that of the *Coccinellini* and agrees well with that typical for many *Scymnini*. It seems advisable for the present to include all the genera mentioned as *Scymnini* in this one group.

Group IV (NOVIINI).

Plates 120 and 121, fig. 27.

This group contains but the one genus *Novius* upon which Ganglbauer¹ has based his tribe the *Noviini*.

The only species represented in the National Museum is *Novius cardinalis* Mulsant.

The dorsal outline of the body is ovoid with its maximum width at the third abdominal segment. Prothorax is trapezoidal, about half as broad as long, anteriorly and laterally broadly rounded; the ninth abdominal segment is nearly semicircular, half as long as broad, anteriorly somewhat narrower than the eighth abdominal segment, posteriorly without any serration or crenation. The thoracic spiracles are placed in the protopleurite, and the shape of the pleural areas is as in the foregoing group, but the *Noviini* differ from the *Scymnini* by having a setiferous tubercle developed in the subtriangular extension from tergum. Prothorax has on each side of the middle line two longitudinal chitinous patches; on mesothorax and metathorax is a small setae-bearing tubercle on each scutal area, close to a large chitinization in the alar area (see page 626).

Small chitinizations with a few setae occur on each of the scutal areas of the abdominal segments and still smaller chitinizations are found on the abdominal spiracular areas. Well developed setae-bearing tubercles are present on the pleural lobes of all segments. The areas below the sternopleural suture exhibit no special structures. The hypopharyngeal bridge is strong, the interior portion of the base of the mandible is molar-shaped, the tip of the mandible single-pointed; retinaculum is simple and thin-walled.

Group V (RHYZOBIIINI).

Plates 120 and 121, figs. 32a, b,

The two following genera and species, included in this group, have been examined: *Rhyzobius ventralis* Erichson (California) and *Lindorus lophantae* Blaisdell (California).

¹ Die Käfer von Mitteleuropa, vol. 3, pt. 2, p. 977.

The general form of the body as in the *Noviini*; the prothorax and ninth abdominal segment are crenated; setae-bearing processes from the pleural lobe are developed as in *Cephaloscymnus* (?), but characteristic for the group is the possession of setae-bearing processes, also from the lateral margins of the tergum of the segments. The mesothoracic and metathoracic spiracles are placed in the protopleurite, and the protopleurite of these segments is incorporated in a subtriangular extension from tergum, as in the *Scymnini* and *Noviini*; the protopleural portion of the extension is clearly separated from the tergal part by the well-defined tergopleural suture. A setae-bearing tubercle is found on this extension as in the *Noviini*. The hypopharyngeal bridge is strong, the interior portion of the mandibular basis is molar-shaped; the tip of the mandible is bifurcate; retinaculum simple and thin-walled.

Group VI (COCCINELLINI).

Plates 120 and 121, figs. 28, 29.

The following genera and species of this group have been studied: *Micraspis 12-punctata* Linnaeus (Denmark); *Anisosticta 19-punctata* Say (Denmark); *Megilla fuscilabris* Mulsant (= *M. maculata* Degeer (N. Amer.)), *Hippodamia convergens* Guérin (N. Amer.), *Hippodamia ambigua* LeConte (California), *Hippodamia glacialis* Fabricius (N. Amer.), *Hippodamia 13-punctata* Linnaeus (N. Amer., Denmark); *Adalia bipunctata* Linnaeus (Washington, D. C.), *Coccinella 7-punctata* Linnaeus (Denmark, Hungary), *Coccinella repanda* Thunberg (Hawaii); *Coccinella variabilis* Illiger (Denmark); *Coccinella oculata* Fabricius (N. Amer.); *Coccinella 9-notata* Herbst. (N. Amer.); *Coccinella sanguinea* Linnaeus (Cuba, Florida); *Harmonia picta* Randall (N. Amer.); *Neda marginata* Linnaeus (Mexico, N. Amer.); *Cycloneda abdominalis* Say (?) (Mexico, N. Amer.); *Anatis 15-punctata* Olivier (N. Amer.); *Synonycha grandis* Thunberg (Java).

The body is fusiform, in most genera with the greatest width at metathorax; the sides of the abdomen are straight and the segments diminish gradually posteriorly; the outline of prothorax varies from nearly trapezoidal, about twice as wide as long, with the largest width posteriorly, to approximately crescent shaped. The ninth abdominal segment is somewhat conical, half as broad as long, or longer, considerably narrower than the eighth segment, laterally unarmed, never serrated or crenated as in many preceding forms and never darkly chitinized as in *Microwisea*. The mesothoracic and metathoracic spiracles are situated in the large protopleurite. This is subtriangular blunt, downwards directed, in some genera not limited dorsally by any distinct tergopleural suture, in other genera with a distinct suture. A setiferous tubercle is never developed in the spiracle-bearing region as is the case in the *Noviini* and *Rhyzobiini*. The rest of pleurum has

the triangular shape typical of the majority of the Coccinellid larvae. In most of the genera sclerites are developed in prothorax, and, when present, the sclerites of scutum and the marginal area of tergum are fused together; they are flat, covered with setae or developed into setiferous spines. On mesothorax and metathorax a rather small flat or spinose scutal sclerite is more or less confluent with a large, flat or spinose sclerite in the alar area just below the parascutum. The triangular pleural lobe, the hypopleural area and the eusternum have only small chitinizations. The abdominal segments have a setiferous flat or tubercle-shaped or spinose sclerite on the scutal area, another similar one on the spiracular area and a third on the pleural lobe; the surface of the hypopleural area, the parasternum and the eusternal area is normally only slightly chitinous. The hypopharyngeal bridge is strong, the inner portion of the basis of the mandible is molar-shaped, the apex of the mandible is bifurcate; in *Synonycha grandis*, however, the tip of each of the principal teeth is divided into two teeth, a large distal and a smaller proximal one. The retinaculum is developed as a straight, single, strongly chitinous tooth.

Group VII (PSYLLOBORINI).

Plates 120 and 121, fig. 30.

The tribe *Psylloborini* has been established by T. L. Casey on the genera *Psyllobora*, *Thea*, *Halyzia*, and *Neohalyzia*. The tribe is represented in the United States National Museum by larvae of the following species: *Psyllobora parvinctata* Casey (Cuba, Florida), *Psyllobora vigintimaculata* Say (N. Amer.), and *Thea 22-punctata* Linnaeus (Denmark).

In the general shape of the body and its parts, in the development of the mesothoracic and metathoracic spiracle-bearing protopleurite into a triangular extension from the tergum, in the character, presence and distribution of sclerites or setiferous tubercles this group is closely connected with the less specialized genera of the *Coccinellini*. The body is soft-skinned; on each side of the tergum of prothorax one (*Psyllobora*) or two (*Thea*) setae-bearing sclerites; setae-bearing tubercles are found in mesothorax and metathorax in the scutum, the alar area and the pleural lobe; setae-bearing tubercles are also found in the same areas on the abdominal segments. The ventral areas below the sternopleural suture have small tubercles on the hypopleural parasternal and eusternal areas. The hypopharyngeal bridge and interior base of the mandible as in the *Coccinellini*, but the rest of the mandible differs from that of all the other *Coccinellini* in having the apex produced into five teeth and the thin-walled retinaculum into five teeth (*Psyllobora*) or several small rounded elevations (*Thea*).

Group VIII (EPILACHNINI).

Plate 120 and plate 121, figs. 31a, b.

The following genera and species of this group are represented in the United States National Museum: *Epilachna corrupta* Mulsant (Mexico, Colorado, Panama), *Epilachna borealis* Fabricius (N. Amer.), *Lasia globosa* Schneider (Denmark) and *Cynegetis impunctata* Linnaeus (Denmark).

This group is allied to the *Coccinellini*, having like this tribe an unarmed spiracle-bearing extension from the terga of mesothorax and metathorax. The protopleural portion of the extension is sharply defined by the tergo-pleural and the sterno-pleural sutures, which separates the portion respectively from the alar area and the pre-sternum. The development of long, more or less conspicuously branched spines on all the segments is a specialization, which is only indicated in the *Coccinellini*; on the ventral areas small tubercles are present in the same distribution, number and development, as in the *Coccinellini*. In the form of the hypopharyngeal bridge and of the mandibles, this group, however, occupies as already mentioned (page 628) an isolated position among all Coccinellid larvae. It is noteworthy that the anterior portion of the head and the development of antennae and palpi also exhibit special characters; finally an epicranial suture is present, a character, which, outside this group, only occurs in the three closely related genera, *Chilocorus*, *Egius*, and *Orcus*.

The dorsal side of the prothorax is well chitinized and has on each side two large spines with an intervening small spine; in *Cynegetis* a small spine is developed from the small prothoracic pleural lobe. The scutal areas of thorax and abdomen, the alar areas of mesothorax and metathorax as well as the corresponding spiracular areas of the abdominal segments and the pleural lobes of both the thoracic and the abdominal segments all carry a flat, thick sclerite with a long setiferous spine. The first abdominal spiracle is placed much more dorsally than on the other abdominal segments. This is especially so in *Cynegetis*. The hypopharyngeal bridge is lamelliform, slightly chitinized, in *Epilachna* with only a dark chitinous line along the posterior margin (fig. 16, pl. 120), and in *Cynegetis* even without that marginal thickening; there are no hard-walled lateral cavities in the bridge, and the grinding and squeezing mechanism, which is found in all the carnivorous Coccinellid larvae, is therefore totally lacking in the larvae of this herbivorous tribe. The mandible (fig. 21, pl. 120) is strongly chitinized at the base; it is not so broad as in the other groups and it has no molar-shaped portion. The retinaculum is not present in its normal place; as it, however, is strongly developed in the allied group *Coccinellini*, it is possible that it really is represented by the lower teeth of the unusually multidentate apex of the mandible.

These teeth are of different length and in some of the species the larger ones are serrated. The inner margin of the mandible below the teeth is convex and comparatively long, one-half to two-thirds of the whole length of the mandible.

Group IX (CHILOCORINI).

Plate 120 and plate 121, figs. 33a, b; 34; 35a, b.

Of this group the following genera and species have been examined: *Curinus coeruleus* Mulsant (Guatemala), *Axion*, sp. (Arizona), *Exochomus cubensis* Dimmock (Cuba); *Egius platycephalus* Mulsant (Cuba), *Orcus australasiae* Boisduval (Australia), *Chilocorus bivulnerus* Mulsant (N. Amer.), *Chilocorus renipustulatus* Scriba (Denmark), *Chilocorus cacti* Linnaeus (Mexico, Arizona).

The group *Chilocorini* represents, as stated above, the final stage in the evolution of the normal, carnivorous Coccinellid larva; they belong to the subovate type, which includes the broader forms of the *Scymnini* larvae, the *Noviini* and the *Rhyzobiini*, rather than to the fusiform type, which includes the elongate forms of the *Scymnini* larvae, the Coccinellini and the Psylloborini. The maximum width is at metathorax, but this segment is only slightly wider than prothorax and mesothorax and the first three abdominal segments; the other abdominal segments narrow gradually to the ninth abdominal segment; this segment is about twice as broad as long, anteriorly not much narrower than the posterior edge of the eighth segment, broadly rounded posteriorly with an unserrated margin. The areas of the whole body carry spines of varying length. The pleurum is developed as in the foregoing groups; on mesothorax and metathorax with a spiracle-bearing, subtriangular protopleurite and with the opposite subtriangular region large. The protopleurite is separated from the tergum by a distinct tergo-pleural suture, but is confluent with presternum. On mesothorax the protopleurite carries a large setiferous spine; on metathorax it also bears a spine, but this differs considerably in the different species; it is for example rudimentary in *Chilocorus renipustulatus*, half as long and thick as the corresponding spine of mesothorax in *Chilocorus cacti* and *bivulnerus*, and it is as long and thick as the spine of mesothorax in *Exochomus cubensis*.

The alar area carries according to the genus one, two, or three spines.¹ A well-developed setiferous spine is always present on the larger subtriangular area behind the protopleurites of mesothorax and metathorax, while the arrangement of the other spines on thorax varies as described below. On the abdominal segments, except in some genera on several of the posterior abdominal segments, the scutal, the spiracular areas and the pleural lobe are armed with a well developed spine; no spines on the areas below the sternopleural sutures. The hypo-

¹ In reality a single spine with one or two large branches coming out from the base of the spine.

pharyngeal bridge is strongly chitinized; the inner portion of the base of the mandible is molar-shaped; the retinaculum is present, in some genera well chitinized, in others delicate and simple. The apex of the mandible varies within the tribe. It is simple in *Curinus*, *Axion*, and *Exochomus*, but bifurcate in *Egius*, *Orcus*, and *Chilocorus*. This development of the mandible may indicate a division of the tribes into two natural groups, and other characters support the same view.

In the first group no epicranial suture is present, the posterior angle of the frons reaching the occiput; no medio-posterior spine on each side of the tergum of prothorax; one to four marginal spines; no scutal spine or only a rudiment of it on mesothorax and metathorax.

In the second group a very conspicuous epicranial suture is present (fig. 35*a*, pl. 121); one rather short medio-posterior spine on each side of the tergum of prothorax; four or more marginal spines; a scutal spine is always developed on mesothorax and metathorax.

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EXPLANATION OF PLATES.

- a*.....Antennal ring
- abd*....Abdominal segment.
- al*.....Alar area.
- an*.....Anterior cuneal notch.
- apx*....Apex of the mandibles.
- arst*....Armlike extension from eusternum.
- bg*.....Repugnatorial gland.
- bm*.....Basal membrane of the mandible.
- br*.....Hypopharyngeal bridge.
- c*.....Clypeus (= postlabrum Lyonet).
- ca*.....Cardo.
- ccz*....Chitinization with which coxa articulates.
- cm*.....Articulating membrane between cardo and hypostoma.
- cols*....Seta emitted from a collar-like prolongation of the basal cup.
- cox*....Coxa.
- ecr*....Epicranium.

- ep*.....Epistoma.
eph.....Epipharynx.
er.....Epipharyngeal rod.
eust.....Eusternum.
ex.....Place where extensor muscle of mandible attaches.
ext.....Spiracle-bearing extension from tergum.
f.....Frons.
fe.....Femur.
fil.....Filament at the apex of the second antennal joint.
fl.....Place where flexor muscle of mandible attaches.
fn.....Furcal notch.
g.....Rudimentary galea.
gu.....Gular region.
h.....Hypostoma.
hr.....Hypopharyngeal rod.
htri.....Triangular enlargement of hypostoma.
hy.....Hypopharynx.
l.....Stipes labii.
la.....Lacinia maxillaris.
li.....Ligula.
lo.....Chitinous plate in membrane between cardo and hypostoma.
lp.....Labial palpus.
lr.....Labrum.
m.....Mentum.
md.....Mandibles.
mea.....Median ventral area of the collar between head and prothorax.
mo.....Molar portion of the mandible.
ms.....Small chitinous spots indicating muscle attachments.
oc.....Ocellus.
pasc.....Parascutum.
past.....Parasternum.
pcx.....Hypopleurum.
pgc.....Chitinized portion of palpiger.
ph.....Pharynx.
plg.....Palpiger maxillae.
pll.....Pleural lobe.
pn.....Posterior cuneal notch.
por.....Pore in the skin.
prst.....Presternum.
psc.....Prescutum.
rlm.....Retinaculum.
sc I.....Anterior portion of scutum.
sc II.....Posterior portion of scutum.
scl.....Scutellum.
sc.....Sensory papillae of the apical joint of the maxillary palpus.
sm.....Submentum.
sp.....Spiracle.
spa.....Spiracular area.
st.....Stipes.
std I.....Distal portion of the dorsal surface of stipes maxillaris.
std II.....Basal portion of the dorsal surface of stipes maxillaris.
stl.....Sternellum.
stm.....Membrane of the distal end of stipes.
stp.....Sternopleural or sublateral suture.

- str.*.....Rod-like chitinization of the interior margin of stipes maxillaris.
ta......Paired ventral area of the collar between head and prothorax.
tars......Tarsus.
tds......Transverse dorsal suture.
tib......Tibia.
tp......Tergopleural or lateral suture.
tro......Trochanter.
vn......Ventral notch.
vps......Vertical suture between the posterior pleural areas of one segment and the adjacent pleural areas of the following segment.
1......Protopleurite.
2......Deutero-pleurite.
3......Tritopleurite.
4......Tetrapleurite.

PLATE 118.

Hyperaspis binotata Say.

- FIG. 1.¹ Full grown larva; lateral view; nat. length, 2.5 — 6.25 mm.
 2. Full grown larva, dorsal view.
 3. Full grown larva, ventral view.
 4. Anterior portion of the dorsal half of the cranium; from the inner side.
 5. Portion of the skin.
 6. Right mandible, dorsal view.

PLATE 119.

- FIG. 7. Mouth cavity and the anterior, ventral portion of the pharynx (slightly diagrammatically).
 8. Head, dorsal view; the mandible and the hypopharyngeal bridge, below the labrum, are indicated by a striated shadow on the labrum; the joints of the antenna are marked I, II, III.
 9. Head, half dorsal, half front view; mandible and hypopharyngeal bridge below the labrum indicated by a striated shadow on the labrum.
 10. Head, ventral view.























PLATE 120.

- FIG. 11. *Thalassa montezumae* Mulsant, lateral view of meso and metathorax, first and second abdominal segments.
 12. *Rhyzobius ventralis* Erichson, lateral view of meso and metathorax and first abdominal segment.
 13. *Coccinella 7-punctata* Linnaeus, lateral view of meso and metathorax and first abdominal segment.
 14. *Chilocorus bivulnerus* Mulsant, lateral view of meso and metathorax, first and second abdominal segments.
 15. *Hippodamia convergens* Guérin, hypopharyngeal bridge, seen from above.
 16. *Epilachna borealis* Fabricius, hypopharyngeal bridge, seen from above.
 17. *Microweisea coccidivora* Ashmead, right mandible, dorsal view.
 18. *Azya* sp., right mandible, dorsal view.
 19. *Harmonia picta* Randall, right mandible, dorsal view.
 20. *Psyllobora parvinotata* Casey, right mandible, dorsal view.
 21. *Epilachna borealis* Fabricius, right mandible, dorsal view.

¹I am indebted to Miss E. Hart, who has executed the final copy of figs. 1-10.

PLATE 121.

- FIG. 22a. *Microweisea ovalis* LeConte, dorsal view of head.
22b. *Microweisea ovalis* LeConte, dorsal view of larva; length about 2 mm.
23. *Stethorus punctum* LeConte, dorsal view of head; length of entire larva about 2 mm.
24. *Cephaloscymnus* (?), dorsal view of larva; length, about 2½ mm.
25a. *Scymnus coniferarum* Crotch, dorsal view of head.
25b. *Scymnus coniferarum* Crotch, dorsal view of larva; length about 5 mm.
26. *Scymnus cervicalis* Mulsant, dorsal view of larva; length about 3 mm.
27. *Novius cardinalis* Mulsant, dorsal view of larva; length about 4½ mm.
28. *Micraspis 12-punctata* Linnaeus, dorsal view of larva; length about 4½ mm.
29. *Neda marginata* Linnaeus, dorsal view of larva; length about 11 mm.
30. *Psyllobora parvnotata* Casey, dorsal view of larva; length about 3½ mm.
31a. *Epilachna borealis* Fabricius, dorsal view of head.
31b. *Epilachna borealis* Fabricius, dorsal view of larva; length about 10 mm.
32a. *Lindorus lophantae* Blaisdell, dorsal view of head.
32b. *Lindorus lophantae* Blaisdell, dorsal view of larva; length about 3½ mm.
33a. *Exochomus cubensis* Dimmock, dorsal view of head.
33b. *Exochomus cubensis* Dimmock, dorsal view of larva; length 6 mm.
34. *Orcus australasiae* Boisduval, dorsal view of the right side of thorax; length of the entire larva about 6 mm.
35a. *Chilocorus bivulnerus* Mulsant, dorsal view of head.
35b. *Chilocorus bivulnerus* Mulsant, dorsal view of the right side of thorax; length of entire larva about 8 mm.

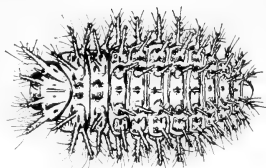
SYNOPSIS OF THE LARVAE OF THE COCCINELLIDAE IN THE U. S. NATIONAL MUSEUM WASHINGTON DC 1916		Meso- and Metathorax: Spiracle in proboscite; tergo-pleural spiracle not always defined; praonotopercite developed as a large subtriangular extension from tergum; extension is without or with setiferous tubercle; pleural lobe fused with tritopercite and tetrapleuante into a subtriangular area.		Meso- and Metathorax: Spiracle in proboscite; tergo-pleural spiracle not always defined; praonotopercite developed as a large subtriangular extension from tergum; extension is without or with setiferous tubercle; pleural lobe fused with tritopercite and tetrapleuante into a subtriangular area.		Meso- and Metathorax: Spiracle in proboscite; tergo-pleural spiracle not always defined; praonotopercite developed as a large subtriangular extension from tergum; extension is without or with setiferous tubercle; pleural lobe fused with tritopercite and tetrapleuante into a subtriangular area.	
 Hypostomal organ of bridge with molar base.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	
							 Apex of mandible entire.
 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	
 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	 Apex of mandible entire.	

SYNOPSIS OF THE LARVAE OF THE COCCINELLIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 649.



31a *Epilach.*



31b *Epilach*



35a. *Chilar.*



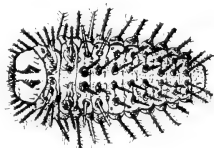
34 *Orcus* 35b *Chiloc.*



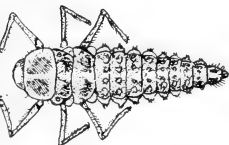
30 *Psyllob.*



33a *Exochom.*



33b *Exochom.*



29 *Neda*



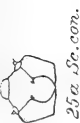
32a *Lindor*



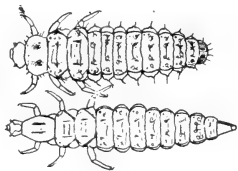
32b *Lindorus*



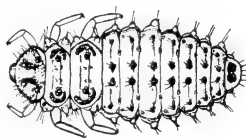
28 *Microsp.*



25a *Sc. con.*



25b *Sc. con.* 26 *Sc. cerv.*



27 *Novius*



22a *Microv.*



22b *Microv.*



23 *Steth.*



24 *Cephalosc.*

TYPES OF THE LARVAE OF COCCINELLIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 650.

NEW SPECIES AND VARIETIES OF FORAMINIFERA FROM THE PHILIPPINES AND ADJACENT WATERS

[SCIENTIFIC RESULTS OF THE PHILIPPINE CRUISE OF THE FISHERIES STEAMER "ALBATROSS" 1907-1910.—No. 35]

BY

JOSEPH A. CUSHMAN

Of the Boston Society of Natural History

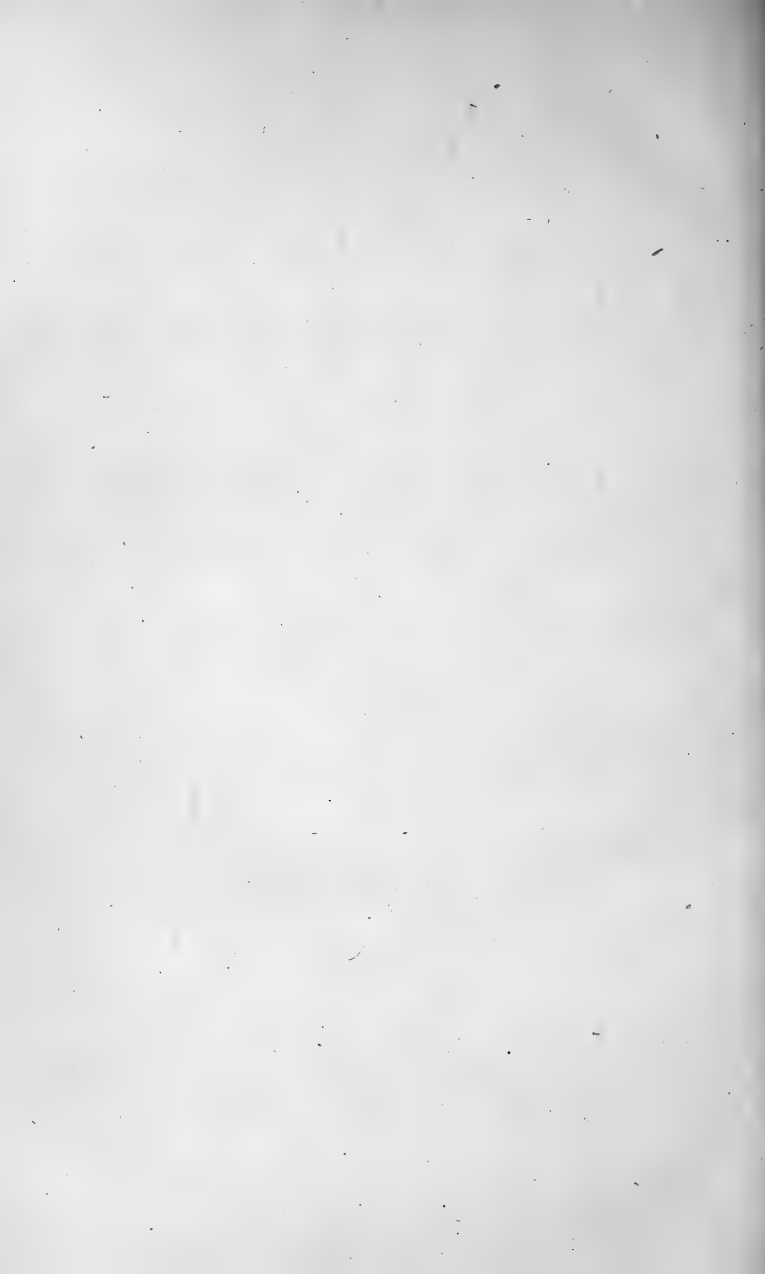


No. 2172.—From the Proceedings of the United States National Museum,
Vol. 51, pages 651-662

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NEW SPECIES AND VARIETIES OF FORAMINIFERA FROM
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The species and varieties of foraminifera described briefly here are believed to be new and are from the rich material dredged by the fisheries steamer *Albatross* in the Philippine cruise. Figures and fuller notes will be published later in the finished work on this collection.

BATHYSIPHON RUFESCENS, new species.

Test elongate, very slightly if at all curved, very slightly tapering, slender, wall marked by annular rings, surface rough, very light yellowish or reddish brown, dull.

Diameter up to 0.5 mm.; length up to 15 mm.

Type-specimen.—(Cat. No. 9098, U.S.N.M.) from *Albatross* station D 5236, in 494 fathoms, Pacific Ocean, off eastern coast of Mindanao.

BATHYSIPHON FLAVIDUS deFolin, var. GIGANTEUS, new variety.

Variety differing from the typical mainly in size, the test being much larger, up to nearly 3 mm. in diameter and 40-50 mm. in length, the wall smooth and polished instead of dull as in the smaller, typical form.

Type-specimen.—Cat. No. 9099, U.S.N.M. from *Albatross* station D 5609, in 1,092 fathoms, Gulf of Tomini, Celebes.

BATHYSIPHON PAPYRACEUS, new species.

Test much elongate, irregularly curved, cylindrical, of even diameter; wall thin, friable, of sponge-spicules with a small amount of cement, white in color with the surface of light grayish-green in irregular bands; lines of growth very prominent.

Diameter up to 3 mm.; length up to 50 mm.

Type-specimen.—(Cat. No. 9100, U.S.N.M.) from *Albatross* station D 5247, in 135 fathoms, Gulf of Davao.

RHABDAMMINA ABYSSORUM W. B. Carpenter, var. **RADIATA**, new variety.

Test with a globular central chamber from which radiate numerous arms, with annular constrictions, largest diameter of the arms near the central chamber thence tapering toward the outer end; wall of fine texture, smooth, reddish brown in color.

Type-specimen.—(Cat. No. 9101, U.S.N.M.) from *Albatross* station D 5654, in 805 fathoms, Gulf of Boni.

SACCAMMINA SPHAERICA G. O. Sars, var. **CATENULATA**, new variety.

Saccammina sphaerica H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 253, pl. 18, fig. 16.

Test with a wall like that of typical *S. sphaerica* in structure, but several chambers present, joined together in a linear series. The largest chamber adherent.

One specimen almost exactly like the figured specimen of Brady was found at *Albatross* D 5637, in 700 fathoms, off Bouru Island. In the figure given by Brady a pebble forms the base for attachment, in our specimen it is attached to another foraminifer.

Type-specimen.—(Cat. No. 9150, U.S.N.M.) from *Albatross* station D 5637, in 700 fathoms, Bouru Island.

DENDROPHYRA ATTENUATA, new species.

Test elongate, compressed, consisting of a central, elongated body with slightly projecting, apertural branches on either border, irregularly alternating; wall composed of sand grains with many spicules; color light gray.

Length up to 15 mm.

Type-specimen.—(Cat. No. 9102, U.S.N.M.) from *Albatross* station D 5670, in 1,181 fathoms, Macassar Strait.

AMMODISCUS INCERTUS d'Orbigny, var. **DISCOIDEUS**, new variety.

Variety differing from the typical in having the sides rapidly increasing in diameter, the width of the coils in side view very much less than in the typical and the border in apertural view very broadly rounded, the periphery often nearly straight in the central portion.

Diameter of microspheric specimens up to 2.5 mm.

Type-specimen.—(Cat. No. 9103, U.S.N.M.) from *Albatross* station D 5658, in 510 fathoms, Gulf of Boni.

The microspheric form of this variety is only about one-half the size of the microspheric form of the typical.

HAPLOPHRAGMOIDES SPHAERILOCULUM, new species.

Test biconvex, composed of about three coils, chambers comparatively few, five in each coil, subspherical, sutures deeply depressed; wall composed of fine sand grains with a reddish-brown cement, the sutures and umbilical depression more or less filled with a light col-

ored, fine, amorphous material; aperture a narrow slit at the base of the chamber.

Diameter about 2 mm.

Type-specimen.—(Cat. No. 9104, U.S.N.M.) from *Albatross* station D 5637, in 700 fathoms, in Pitt Passage.

CYCLAMMINA COMPRESSA, new species.

Cyclammina cancellata (part) CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 111, fig. 171 (not figs. 168–170).

Test nautiloid, biconvex, compressed, peripheral margin subacute, umbilicus often notably excavated; chambers numerous, 14 to 16 in the last formed coil, usually 15; sutures subangular in the middle in side view, clearly depressed, surface smooth when perfect; aperture and color as in *C. cancellata*.

Diameter up to 3.5 mm.

Type-specimen.—(Cat. No. 9105, U.S.N.M.) from *Albatross* station D5470, in 560 fathoms off the east coast of Luzon.

CYCLAMMINA PAUCILOCLATA, new species.

Test compressed, nautiloid, biconvex, peripheral margin subacute, umbilical region depressed, chambers 10 to 11 in number, sutures nearly straight to somewhat curved; surface smooth when perfect; supplementary apertural pores few in number.

Diameter up to 2 mm.

Type-specimen.—(Cat. No. 9106, U.S.N.M.) from *Albatross* D5538, in 256 fathoms, between Negros and Siquijor, Philippines.

NODOSARIA (GLANDULINA) LAEVIGATA d'Orbigny, var. STRIATULA, new variety.

Variety differing from the typical in having the surface ornamented with numerous very fine longitudinal costae.

Type-specimen.—(Cat. No. 5107, U.S.N.M.) from *Albatross* D5236, in 494 fathoms, Pacific Ocean, east coast of Mindanao.

NODOSARIA PYRULA d'Orbigny, var. LONGI-COSTATA, new variety.

Variety with the whole of the chamber body ornamented by longitudinal costae even connecting across the connecting necks; aperture with the costae running to the edge of the opening.

Type-specimen.—(Cat. No. 9108, U.S.N.M.) from *Albatross* D5388, in 226 fathoms, between Burias and Luzon, Philippines.

NODOSARIA ANTENNULA, new species.

Test elongate, slightly arcuate, composed of numerous short chambers, sutures projecting, of clear shell material, proloculum bulbous, apertural end of chamber tapering to a rounded point, wall smooth.

Length up to 8 mm.

Type-specimen.—(Cat. No. 9109, U.S.N.M.) from *Albatross* D5236 in 494 fathoms, Pacific Ocean, east coast of Mindanao.

NODOSARIA SUBPOLYGONA, new species.

Test elongate, only very slightly tapering except in the microspheric form, polygonal in end view, chambers numerous, not at all inflated, sides parallel or nearly so, sutures very slightly, if at all depressed, apertural end with a short stout neck, aperture large, circular; surface ornamented by six raised ridges giving a hexagonal appearance in end view.

Length up to 5 mm.

Type-specimens.—(Cat. No. 9110, U.S.N.M.) from *Albatross* D5318 in 340 fathoms, China Sea, vicinity of Formosa.

NODOSARIA SUBSCALARIS, new species.

Test elongate, composed of few chambers, mucronate at the apical end, earlier chambers close set, the later ones often somewhat separated, inflated, sutures depressed, surface ornamented with numerous (up to 40) longitudinal costae, apertural end with a thick, tapering neck with 9 or 10 prominent, plate-like costae extending from the upper end of the ornamentation of the body of the chamber to the apertural end of the neck; aperture small, rounded.

Length up to 5 mm.

Type-specimens.—(Cat. No. 9111, U.S.N.M.) from *Albatross* D5178 in 78 fathoms, vicinity of Romblon, Philippines.

NODOSARIA SUBSCALARIS, new species, var. **PAUCICOSTATA**, new variety.

Variety differing from the typical in the lesser number of costae (12–25) and in the apertural characters which in the variety consist of a stout, nearly cylindrical neck, with about 15 costae which are continuations of the costae of the body portion.

Type-specimens.—(Cat. No. 9112, U.S.N.M.) from *Albatross* D5152, in 34 fathoms, Tawi Tawi Group, Sulu Archipelago.

NODOSARIA MILLETTII, new species.

Nodosaria scalaris, var. *separans* MILLETT, Journ. Roy. Micr. Soc., 1902, p. 520, pl. 11, figs. 11, 12 (not var. *separans* H. B. Brady).

Test elongate, nodose, consisting of a few chambers, the early ones close set, the later ones remote, chambers pyriform or elongate, elliptical in side view, very finely costate, the basal portion sometimes slightly hispid, apertural necks very long and slender, aperture with a phialine lip.

Length, up to 3 mm.

Type-specimen.—(Cat. No. 9113, U.S.N.M.) from *Albatross* D5281, in 201 fathoms, China Sea, off Southern Luzon.

NODOSARIA LEPIDULA Schwager, var. **HISPIDULA**, new variety.

Test differing from the typical in its larger size, and the ornamentation, which in the variety consists of a series of interrupted fine

costae, and hispid roughenings of the surface over nearly the whole surface of the chamber.

Length, up to 3 mm.

Type-specimens.—(Cat. No. 9114, U.S.N.M.) with the typical in considerable numbers at *Albatross* D5236, in 494 fathoms, Pacific Ocean, off eastern Mindanao.

NODOSARIA SUBSTRIATULA, new species.

Nodosaria subcanaliculata H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 512, pl. 64, figs. 23, 24 (not *Dentalina subcanaliculata* Neugeboren).

Test usually consisting of four chambers, the proloculum with a globular body, an apical spine, and with definite longitudinal costae; the second chamber much more elongate, flask shaped, with a long neck; when partially covered by the third chamber becoming subcylindrical, ornamented like the proloculum; third chamber still more elongate, with a long neck, the surface ornamentation consisting of short, broken, longitudinal striae; the fourth chamber similar but remote, a large part of the neck between the two chambers visible; final chamber with the apertural neck long and slender, smooth; the apertural end with four or more flange-like costae extending up and beyond the aperture and incurving somewhat over the aperture.

Length up to 2 mm.

Type-specimen.—(Cat. No. 9115, U.S.N.M.) from *Albatross*, D5123, in 283 fathoms, east coast of Mindanao.

NODOSARIA PAUCILOCULATA, new species.

Test nodose, composed of few chambers, usually not more than five, two or three closely set, later ones remote, inflated, sutures even in the early chambers much depressed, wall ornamented by longitudinal costae, few and large, usually limited to the middle portion of the chamber and becoming obsolete toward each end, neck long, swollen toward the top, then again rapidly contracted to the aperture, in the early chambers the neck with costae, in later ones with the costae limited to the last tapering portion near the aperture.

Length up to 3.5 mm.

Type-specimens.—(Cat. No. 9116, U.S.N.M.) from *Albatross*, D5201, in 554 fathoms, Sogod Bay, southern Leyte, Philippines.

NODOSARIA SUBPERVERSA, new species.

Test elongate, subcylindrical, composed of several chambers, proloculum larger than the succeeding chambers, all chambers close set, the breadth being much greater than the length, sutures deeply constricted, wall finely marked by longitudinal striations; aperture without a neck.

Length up to 3 mm.

Type-specimen.—(Cat. No. 9117, U.S.N.M.) from *Albatross*, D5236, in 494 fathoms, Pacific Ocean, east coast of Mindanao.

NODOSARIA LAEVICOSTATA, new species.

Test elongate, arcuate, composed of but few chambers, early ones more or less rounded, closely set, ornamented with longitudinal costae, later chambers pyriform, with the last formed chamber often remote, wall smooth; apertural end tapering into an apertural neck.

Length up to 2 mm.

Type-specimens.—(Cat. No. 9118, U.S.N.M.) from *Albatross*, D5178, in 73 fathoms, near Romblon, Philippines.

NODOSARIA SPIROSTRIOLATA, new species.

Test much elongate, very slightly tapering toward the initial end, which is broadly rounded, chambers numerous, short, elliptical in side view, sutures but slightly depressed, surface ornamented throughout with numerous (40 to 50) fine longitudinal costae, spirally arranged; apical end without a neck, broadly rounded.

Length up to 10 mm.

Type-specimen.—(Cat. No. 9119, U.S.N.M.) from *Albatross*, D5236, in 494 fathoms, Pacific Ocean, east of Mindanao.

LINGULINA GRANDIS, new species.

Test large, compressed, early portion, and in some specimens all but the final chamber distinctly keeled, chambers about eight in number, broad and short, somewhat inflated, sutures depressed, not noticed on the keel, wall smooth and shining, yellowish-brown or reddish-brown in color; aperture a very elongate slit extending half the width of the test.

Length up to 6 mm., width 3 mm.

Type-specimen.—(Cat. No. 9120, U.S.N.M.) from *Albatross*, D5268, in 170 fathoms, Batangas Bay, Philippines.

CRISTELLARIA CULTRATA (Montfort), var. **DECORATA**, new variety.

Variety differing from the typical in the addition of a distinct type of ornamentation, consisting of a large umbilical knob above the umbilical region and the sutures with costae which are gradually larger toward the periphery.

Type-specimen.—(Cat. No. 9121, U.S.N.M.) from *Albatross*, D5113, in 159 fathoms, China Sea off southern Luzon.

CRISTELLARIA ROTULATA (Lamarck), var. **UMBONATA**, new variety.

Variety with the umbonal region greatly produced by a large mass of clear shell substance standing out clearly above the rest of the test.

Type-specimen.—(Cat. No. 9122, U.S.N.M.) from *Albatross*, D5217, in 105 fathoms, between Burias and Luzon, Philippines.

CRISTELLARIA ORBICULARIS (d'Orbigny), var. **SUBCARINATA**, new variety.

Variety differing from the typical by having instead of a thin, broad keel a very narrow one, which is thickened with a rounded periphery, otherwise like the typical.

Type-specimen.—(Cat. No. 9123, U.S.N.M.) from *Albatross* D5654, in 805 fathoms, Gulf of Boni.

CRISTELLARIA ORBICULARIS (d'Orbigny), var. **SUBUMBONATA**, new variety.

Variety differing from the typical in its development of ornamental characters, having a cluster of closely set raised knobs over the umbilical region, giving a decidedly umbonate appearance in face view, remainder of the test smooth.

Type-specimen.—(Cat. No. 9124, U.S.N.M.) from *Albatross* D5259, in 312 fathoms, off northwestern Panay, Philippines.

CRISTELLARIA ORBICULARIS (d'Orbigny), var. **PAPILLATA**, new variety.

Variety with the keel reduced in width, and the earlier portion with an ornamentation consisting of fine papillæ rather evenly scattered over the surface, in later growth gradually becoming peripheral and in the last-formed chambers gradually becoming obsolete.

Type-specimen.—(Cat. No. 9125, U.S.N.M.) from *Albatross* D5152, in 34 fathoms, Tawi Tawi group, Sulu Archipelago.

CRISTELLARIA CALCARATA, new species.

Test biconvex, but much compressed, closely coiled, about 7 or 8 chambers in the last formed coil, sutures curved and marked by raised ridges running to the umbonal region, where they unite in a central boss of clear shell material, which is typically excavated in the center, forming a ring of material, periphery with a narrow keel from which are rowel-like spines, the two sides often unequal in their angles, apertural face flattened or even concave, aperture radiate.

Diameter, about 2 mm.

Type-specimen.—(Cat. No. 9126, U.S.N.M.) from *Albatross* D5370, in 159 fathoms, off Marinduque Island, Philippines.

CRISTELLARIA SUBMAMILLIGERA, new species.

Cristellaria mamilligera H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 553, pl. 70, figs. 17, 18 (not *C. mamilligera* Karrer).—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 74, pl. 34, fig. 6a (not 6b which should read 5b).

Test biconvex, close coiled, periphery with a thin keel, sutures curved, limbate externally, ornamented by a raised ridge which ends near the umbilical region in a protuberant knob, often a distinct raised boss over the center of the umbilical region, keel entire and not denticulate in well-preserved specimens; wall between the raised ridges smooth; aperture radiate.

Diameter, up to 3 mm.; usually less.

Type-specimen.—(Cat. No. 9127, U.S.N.M.) from *Albatross* D5388, in 226 fathoms, between Burias and Luzon, Philippines.

CRISTELLARIA EXPANSA, new species.

Test biconvex, with a very wide, prominent, very thin keel, chambers with a large alar projection on the umbilical end extending beyond the umbilicus and onto the previous whorl; sutures with raised ribs ending in a knob near the umbilicus, remainder of the surface smooth; aperture radiate, apertural face concave.

Diameter, up to 3 mm.

Type-specimen.—(Cat. No. 9128, U.S.N.M.) from *Albatross* station D5467, in 480 fathoms, east coast of Luzon.

CRISTELLARIA EXPANSA, new species, var. PLANULATA, new variety.

Variety differing from the typical mainly in the lack of ornamentation characteristic of the type, and, if at all ornamented, consisting of indistinct costæ in the axis of growth; alar projections more distinct than in the type, due to the lack of ornamentation hiding the sutures, usually more compressed than in the typical.

Type-specimen.—(Cat. No. 9129, U.S.N.M.) from *Albatross* D5220, in 50 fathoms, between Marinduque and Luzon, Philippines.

CRISTELLARIA COSTATA (Fichtel and Moll), var. MULTICOSTA, new variety.

Variety very much compressed, camplanate, with the costæ along the limbate sutures obsolete; the sutures lightly depressed; the ornamentation of each chamber consisting of a large number of fine raised costæ spreading fan-like from the aperture as a center backward, and covering the entire surface of the chamber; aperture radiate, protruded.

Diameter, up to 4 mm.

Type-specimen.—(Cat. No. 9130, U.S.N.M.) from *Albatross* D5538, in 256 fathoms, between Negros and Siquijor, Philippines.

CRISTELLARIA COSTATA (Fichtel and Moll), var. SUBDECORATA, new variety.

Variety with the costæ of the sutures the predominant factor in the ornamentation, the areas between with fine costæ or striæ, anastomosing; the costæ of the sutures large and well marked, sharply raised above the surface of the test; the umbilical region covered with a thick cluster of irregular bosses; periphery with traces of a keel between the sutures.

Diameter, up to 4 mm.

Type-specimen.—(Cat. No. 9131, U.S.N.M.) from *Albatross* D5454, in 153 fathoms, east coast of Luzon.

CRISTELLARIA COSTATA (Fichtel and Moll), var. **SUBLAEVIS**, new variety.

Variety differing from the typical in having the ornamentation of the test so developed that the limbate sutures and their resulting costae are developed at the complete expense of the other costae of the chambers or nearly so. The costae of the sutures being very high and ending on the inner border of each in a large raised knob; peripheral margin of the test keeled, somewhat interrupted at the sutures; wall of the chambers smooth or marked with obsolescent striae in some cases.

Diameter 3–4 mm.

Type-specimen.—(Cat. No. 9132, U.S.N.M.), from *Albatross* D5374, in 190 fathoms, off Marinduque Island, Philippines.

CRISTELLARIA BRADYI, new species.

Cristellaria costata H. B. BRADY (in part ?), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 555, pl. 71, fig. 8.

Test ovate, thick, last few chambers more or less elongated; sutures hidden by the surface ornamentation which consists of longitudinal rounded costae, more or less broken especially toward the umbilical area and becoming less distinct or entirely disappearing on the last formed chambers; peripheral margin, rounded; aperture radiate.

Diameter up to 3 mm.

Type-specimen.—(Cat. No. 9133, U.S.N.M.), from *Albatross* D5313, in 150 fathoms, China Sea off Hong Kong.

CRISTELLARIA CASSINOIDES, new species.

Test elongate, much compressed, arcuate, early chambers coiled, later ones uncoiling and forming an elongate growth several times the length of the coiled portion, inner margin slightly keeled, peripheral margin bluntly rounded, sutures with a raised portion along the central portion of the peripheral half of the test; surface otherwise smooth and unornamented; aperture radiate.

Length up to 5 mm.

Type-specimen.—(Cat. No. 9134, U.S.N.M.), from *Albatross* D5381, in 88 fathoms, Raygay Gulf, Luzon.

CRISTELLARIA DORSO-COSTATA, new species.

Test composed of numerous chambers, the early ones close coiled, the later ones becoming elongate and tending toward uncoiling, test thick, periphery broadly rounded, sutures little depressed, wall smooth except toward the peripheral border where there are several rounded costae running lengthwise of the test, becoming obsolete toward the later growth; aperture radiate.

Length up to 3.5 mm.

Type-specimen.—(Cat. No. 9135, U.S.N.M.), from *Albatross* D5268, in 170 fathoms, off Batangas Bay, Philippines.

CRISTELLARIA TUMIDO-COSTATA, new species.

Test very broadly convex, close coiled, chambers comparatively few in the whorl, sutures marked by a series of very strong raised ribs uniting at the umbilicus, remaining surface between the sutures marked by a series of short well-rounded, parallel costae running obliquely to the axis of growth; peripheral portion of the test also marked by a series of costae parallel to the periphery, or nearly so; apertural face flattened or concave with a broad rim about the margin; aperture radiate, at the peripheral angle of the chamber.

Diameter up to 3 mm.

Type-specimen.—(Cat. No. 9136, U.S.N.M.), from *Albatross* D5570, in 330 fathoms, north of Tawi Tawi, Philippines.

CRISTELLARIA TUMIDO-COSTATA, new species, var. LABYRINTHICA, new variety.

Variety differing from the typical in its shape, which is more tumid, the periphery more broadly rounded than in the typical and the ornamentation which consists of a peripheral series of costae as in the typical, but the costae above the sutures obsolescent and the intermediary costae becoming the prominent sculpture and becoming shorter, irregular, making a labyrinth-like net work of raised ridges.

Type-specimen.—(Cat. No. 9137, U.S.N.M.), from *Albatross* D5567, in 268 fathoms, north of Tawi Tawi, Philippines.

CRISTELLARIA PAUCICOSTATA, new species.

Test much compressed, composed of few chambers, peripheral border with a prominent keel; the earlier portion of the test with two sharp raised costae toward the periphery and parallel to it, becoming obsolete on the later developed chambers; remainder of surface smooth; sutures slightly depressed; aperture radiate, somewhat protruded.

Length up to 2 mm.

Type-specimen.—(Cat. No. 9138, U.S.N.M.), from *Albatross* D5586, in 347 fathoms, off Sibuko Bay, Borneo.

CRISTELLARIA HELICINA, new species.

Test unequally convex, close coiled, chambers numerous, on one side coming to the umbilicus or nearly so, on the other coming only a little farther than the periphery of the previous whorl; in face view subcarinate; apertural face unequal; sutures ornamented by raised areas, obsolescent at the periphery but gradually increasing in size toward the umbilical end, becoming in some cases a distinct boss toward the umbilicus. Those of the earlier whorls fusing into a partial ring about the umbilicus; main surface of the chambers smooth and unornamented; aperture radiate and projecting, on the peripheral margin of the chamber.

Diameter up to 3 mm.

Type-specimen.—(Cat. No. 9139, U.S.N.M.), from *Albatross* D5272, in 118 fathoms, China Sea off southern Luzon.

CRISTELLARIA HELICINOIDES, new species.

Test unequally biconvex, especially in the later chambers; earlier chambers close coiled, biconvex, numerous; later chambers becoming developed more strongly on one side of the axis of growth and extending farther toward the umbilicus, giving the test a one-sided appearance, aperture in the last formed chamber with a tubular neck; wall smooth and unornamented

Diameter, up to 2.5 mm.

Type-specimen.—(Cat. No. 9140, U.S.N.M.) from *Albatross* D5301, in 208 fathoms, China Sea, vicinity of Hongkong.

CRISTELLARIA ITALICA DeFrance, var. ACUTO-CARINATA, new variety.

Test similar to typical *C. italica* in its general characters, but the angles greatly extended in thin carinæ from apex to aperture, the lines of growth being apparent even in the carinæ.

Length, 3 mm.

Type-specimen.—(Cat. No. 9141 U.S.N.M.) from *Albatross* D5523, off Mindanao.

VAGINULINA BRADYI, new species.

Vaginulina brukenthalii H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 532, pl. 66, figs. 18, 19 (not *V. brukenthalii* Neugeboren).

Test elongate, tapering toward the basal end, which is armed with one or more short spines, somewhat compressed; chambers numerous, distinct, early ones coiled, later ones in a linear series, but with the sutures oblique throughout; limbate in the central portion, not keeled, in transverse view, ovate; aperture at the dorsal side of the chamber, radiate.

Length, up to 4 mm.

Type-specimen.—(Cat. No. 9142, U.S.N.M.) from *Albatross* D5580, in 162 fathoms, Darvel Bay, Borneo.

VAGINULINA ACICULA, new species.

Test elongate, slender, tapering from a point at the initial end to the largest chamber at the apertural end, initial end with one or more short spines, chambers very numerous, rather indistinct in the early portion with oblique sutures, later becoming transverse and slightly depressed, wall smooth and polished; aperture radiate, terminal.

Length, up to 5 mm.

Type-specimen.—(Cat. No. 9143, U.S.N.M.) from *Albatross* D5613, in 752 fathoms; Gulf of Tomini, Celebes.

SIPHOGENERINA BIFRONS (H. B. Brady), var. **STRIATULA**, new variety.

Differing from the typical in having the surface ornamented with numerous longitudinal striations, rather more elongate, and the central indented portion deeper and more defined.

Type-specimen.—(Cat. No. 9144, U.S.N.M.) from *Albatross* D5201, in 554 fathoms, Sogod Bay, southern Leyte Island.

SIPHOGENERINA RAPHANUS (Parker and Jones), var. **COSTULATA**, new variety.

Variety differing from the typical in its much more cylindrical form, its few very definite costae and the very short, wide neck without a lip.

Type-specimen.—(Cat. No. 9145, U.S.N.M.) from *Albatross* D5143 in 19 fathoms, vicinity of Jolo.

CHILOSTOMELLA GRANDIS, new species.

Test broadly elliptical in side view, in end view circular; two chambers visible from the exterior; wall thick and opaque, smooth; aperture in end view semicircular with a flange-like truncated lip.

Length, up to 4 mm. and more.

Type-specimen.—(Cat. No. 9146, U.S.N.M.) from *Albatross* D5449, in 300 fathoms, east coast of Luzon, between San Bernardino Strait and San Miguel Bay.

GLOBIGERINA AEQUILATERALIS (H. B. Brady), var. **INVOLUTA**, new variety.

Variety differing from the typical in being much more closely coiled, although planospiral; the last formed coil decidedly overlapping the previous coils in side view; visible aperture instead of semicircular in the typical. in the much broader variety less delicately formed.

Type-specimen.—(Cat. No. 9147, U.S.N.M.) from *Albatross* D5236, in 494 fathoms, Pacific Ocean, off eastern coast of Mindanao.

ANOMALINA POLYMORPHA Costa, var. **CERVICORNIS**, new variety.

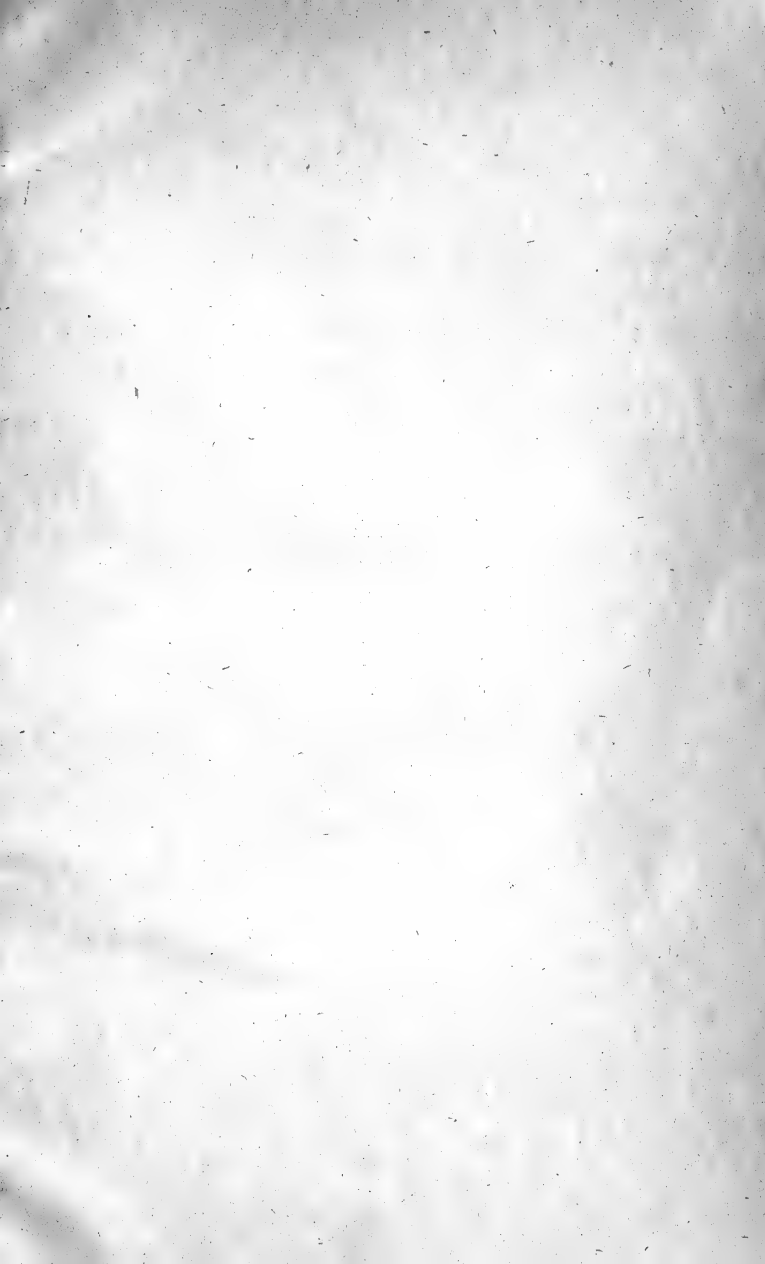
Test differing from the typical by having a marginal crown of short, stout, more or less branching, or bifid spines on the angular margin of the chamber.

Type-specimen.—(Cat. No. 9148, U.S.N.M.) from *Albatross* D5236, in 494 fathoms, Pacific Ocean, east coast of Mindanao.

ANOMALINA POLYMORPHA Costa, var. **SIPHONIFERA**, new variety.

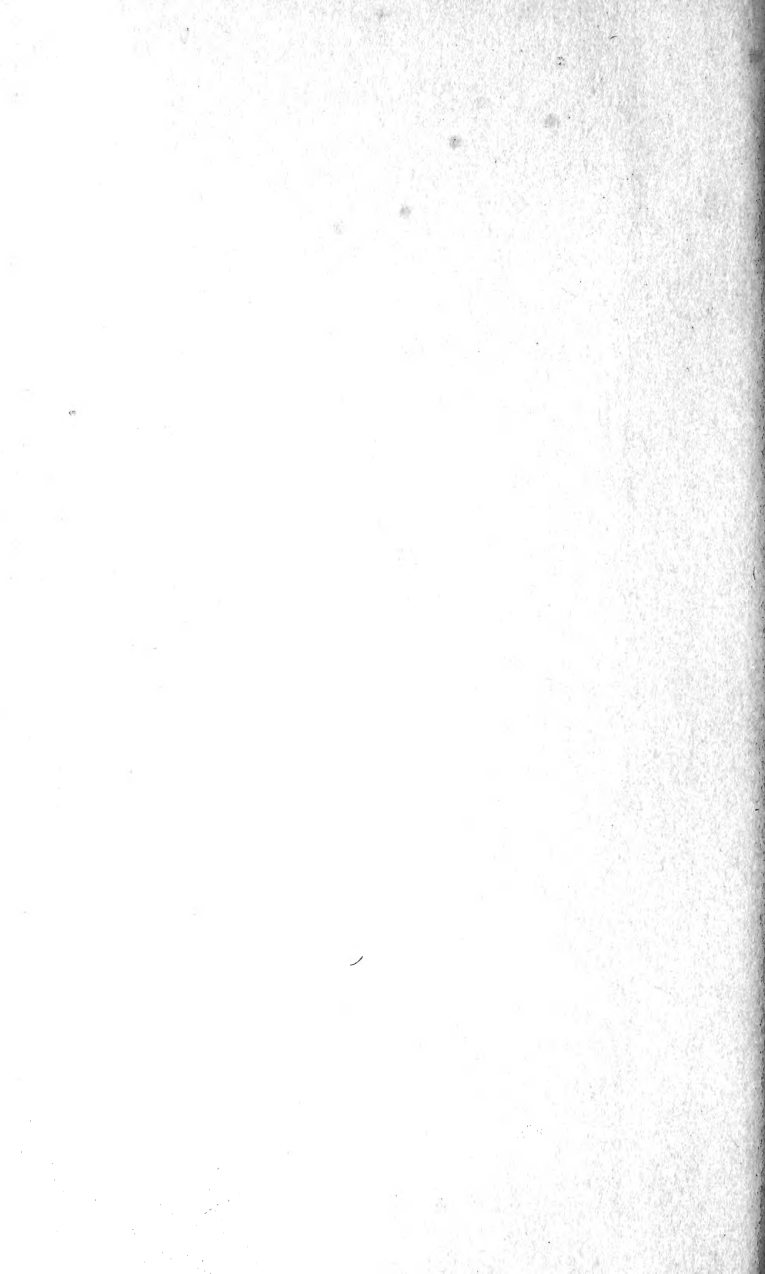
Test differing from the typical by having short, tubular projections from the exterior, rather indefinitely placed, wall otherwise smooth.

Type-specimen.—(Cat. No. 9149, U.S.N.M.) from *Albatross* D5236, in 494 fathoms, Pacific Ocean, east coast of Mindanao.





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