





25

ANNALS
OF THE
CARNEGIE MUSEUM

VOL. XV.

1923-1924

W. J. HOLLAND, *Editor*



PUBLISHED BY THE AUTHORITY OF THE
BOARD OF TRUSTEES OF THE CARNEGIE INSTITUTE
SEPTEMBER, 1924

CARNEGIE INSTITUTE PRESS
PITTSBURGH

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DATES OF ISSUE OF PARTS OF VOLUME, AS SEPARATES.

Articles 1-8, March 10, 1923;
 Article 9, May 22, 1924;
 Article 10, July 1, 1924;
 Article 11, July 3, 1924;
 Article 12, July 5, 1924;
 Article 13, July 9, 1924;
 Article 14, July 9, 1924;
 Article 15, October 8, 1924;
 Article 16, October 8, 1924.

507.73
P4PG842

Publications of the Carnegie Museum

Serial No. 116

ANNALS



OF THE

CARNEGIE MUSEUM

VOL. XV. No. 1.

March, 1923

For sale by Messrs. Wheldon & Wesley, Ltd., 2-4, Arthur St., New Oxford St., London, W. C. 2, England: Messrs. R. Friedländer u. Sohn, 11 Carlstrasse, Berlin, N. W. 6, Germany: Maruzen Company, Ltd., 11-16, Nihonbashi, Tori-Sanchome, Tokyo, Japan: and at the Carnegie Museum, Schenley Park, Pittsburg, Penna., U. S. A.

PUBLICATIONS OF THE CARNEGIE MUSEUM SERIAL NO. 116

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MARCH, 1923

PRESS OF
THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

ANNALS

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VOLUME XV, NO. I.

EDITORIAL NOTES.

SINCE the Thirteenth Volume of the ANNALS appeared, the Fourteenth Volume, consisting of a single monographic paper upon the birds of the Santa Marta district by Messrs. W. E. Clyde Todd and M. A. Carriker, Jr., has been published. The present issue contains a number of papers, which were held back because of the precedence given to the lengthy ornithological monograph, to which reference has just been made. There are in the hands of the Editor a number of other papers of great interest and value, which will be published as soon as they can be prepared for the press.

Two papers, forming parts of Volume IX of our *Memoirs*, have recently been published. The first is a lengthy paper by Professor C. H. Eigenmann upon the fishes of the northwestern portions of South America, including Panama; the second is a paper by Dr. Carl J. Drake upon the Neotropical Tingitidæ in the Carnegie Museum. The first number of the Tenth Volume of the *Memoirs* has also appeared. It is a Revised List of the Fishes of the Hawaiian Islands, including descriptions and figures on the plates of a number of new species, the types of which are in the Carnegie Museum. The authors of this Memoir are Dr. David Starr Jordan and his son, Mr. Eric Jordan.

THE Museum continues to be, as it always has been, a focal point for the young people of the schools in the city. Hundreds of classes from the schools during the past twelve months have visited the

Museum accompanied by their teachers, and members of the Staff have been detailed to accompany them on their rounds, and give explanations of the objects which attract their attention. This work in recent months has been enlarged and systematized by Mr. Douglas Stewart, the Director, in conjunction with the Department of Fine Arts, in such a way that the pupils of the Eighth Grade in the Schools, for the instruction of whom systematic provision in recent years has been made by the Department of Fine Arts, are, when coming to the Institute, also conducted through the Museum of Science.

SINCE the last issue of "Editorial Notes" in this series of publications considerable time has elapsed, during which the Museum has been honored by the presence of a number of very distinguished visitors.

On the 11th day of November, 1921, we conducted through the Museum Marshal Foch, whom the Director of the Museum had had the honor a few moments previously of presenting at the Soldiers and Sailors Memorial Hall before the University of Pittsburgh for the degree of Doctor of Laws. It happened that the degree was conferred upon the Marshal at almost the very hour, which marked the triennial anniversary of the receipt by him in the field of a wireless telegram announcing that the German Government accepted the terms of the armistice which he had proposed. The writer of these lines had the pleasure in presenting him of calling attention to this fact, and, when the Marshal took his seat again beside the writer, he remarked: "Vous avez raison, Monsieur. C'est presque exactement le troisième anniversaire de l'heure où j'ai reçue la réponse des Allemands."

Another notable visit to the Museum was that of Mrs. Herbert H. Asquith, whom the Director had the pleasure of conducting through the Museum in company with Colonel S. H. Church, and subsequently of introducing to the large audience which greeted her on the evening of February 24, 1922, in the Hall of Music, where she spoke very entertainingly. In her recent book, entitled "My Impressions of America," Chapter VII, Mrs. Asquith speaks pleasantly of her visit to the Museum and calls the Carnegie Institute "the most wonderful institution of its sort that exists." Among other things she says: "Stuffed animals in huge glass cases do not usually attract me, but

at the Carnegie Institute they are presented with such life-like skill that I begged to be introduced to the man who had arranged them. He was brought down in a lift from his work, and, after shaking him warmly by the hand, I told him how proud I was to meet so great an artist."

On Saturday, November 19, 1921, we had the pleasure of welcoming Viscount Shibusawa, who, being in attendance upon the Disarmament Conference in Washington, stole away to Pittsburgh in order to present to the Museum a gift which he had had prepared, representing a Japanese lady of rank attired in the costume which she would have worn when going to Court about the middle of the last century. The attention of the Viscount had been attracted a number of years before to a lay-figure seated in a norimono to the details of which he objected, as showing some anachronisms. With the greatest kindness and at large expense he had a new figure modelled and attired to replace the one to which reference has been made. The occasion of the Viscount's visit was seized as an admirable opportunity for enabling him to meet the Trustees of the Institute and many of our more distinguished citizens and incidentally of showing our goodwill to the great country which the Viscount and his friends, who came with him, represented.

Only within recent days we have enjoyed the pleasure of a visit from Mr. Y. Sakurauchi, a member of the Japanese Parliament whose home is in Tokyo.

On September 14, 1922, a committee of the Sulgrave Institution, on behalf of the association, presented to the City of Pittsburgh a bust of William Pitt. On that afternoon the Carnegie Museum was honored by a visit from certain members of this Committee, including Sir Charles E. Wakefield, who was Lord Mayor of London during the years 1915 and 1916, Mr. McCallum Grant, the Lieutenant-Governor of Nova Scotia, and Mr. D. B. Edwards of Australia. This party commented in enthusiastic terms upon what they saw in the Museum.

On Armistice Day, November 11, 1922, we had the pleasure of entertaining at the Museum General Tasker H. Bliss, former Chief of Staff of the United States Army.

The usual stream of scientific friends and acquaintances which sets through "The Gate-way of the West," eastward and westward, has not failed to eddy into the Museum. Entomologists and paleontol-

ogists, conchologists and botanists, ichthyologists and mineralogists, the whole tribe of those who are interested in the "ologies" have week after week gladdened us by their presence, some in quest of knowledge, others simply calling to look around and express their kind regards. We are always glad to welcome "the faithful."

ON the 1st of July, 1922, the writer of these pages, for nearly twenty-four years the Director of the Museum and a member of the Board of Trustees both of the Library and of the Institute at their inception, was informed that he had been honorably retired with the title of Director Emeritus and that Mr. Douglas Stewart, who for nearly the whole period of his incumbency had been associated with him, had been made Director. The Director Emeritus was informed that he would still be required to render service as Editor of the publications of the Museum and that liberty was given him to prosecute the work of scientific research along congenial lines without being compelled to attend to the innumerable minor details of administration. The kind action of the Trustees, which was entirely unsolicited and unexpected, was accompanied by a friendly suggestion that the writer of these lines had earned a title to "rest." It may be said that "rest" is something for which the writer has never sighed. He has found his chief joy in successful activity and is decidedly of the opinion that if he wanted surely to "go to the devil" he would seek "rest."

"Satan finds some mischief still
For idle hands to do."

ON September 5, 1922, a loan exhibition of "Applied Chemistry in the Pittsburgh District" was opened in the Hall of Mineralogy and Geology of the Museum, in honor of the Annual Meeting of the American Chemical Society. The exhibits were for the most part secured by Dr. H. C. P. Weber of the Westinghouse Research Laboratories and consisted of iron and steel, glass, electrical equipment, bricks of different kinds, by-products of coal, products of magnesia, as well as models of a blast-furnace, open hearth furnace, a blooming mill, and a Bessemer converter. The delegates to the convention took great interest in the collection, and a letter of thanks was sent to

the Director of the Museum from the Secretary of the American Chemical Society, stating that the entire body had derived great enjoyment from "this unique exhibit."

DURING the month of October a large collection of birds and insects were received from Mr. Samuel Klages, taken on the Rio Purús in Brazil. A considerable collection of birds taken in the higher mountains of Venezuela south of Merida has also been received from our collector, Mr. M. A. Carriker, Jr. From Cameroon we have received a small collection of birds taken by Rev. J. A. Reis, Jr.

Our ornithological collections are constantly growing, and, as has been previously stated in these pages, has come to be the largest collection of birds in the State of Pennsylvania, and, with two, or perhaps three, exceptions, the largest in the United States.

THE entomological collections of the Museum, which are among the most important in the New World, contain an enormous quantity of undetermined material, much of it from localities which have been but little explored hitherto. One of the duties incumbent upon the Museum is to bring to the knowledge of the world the thousands of undescribed species which are contained in these collections. In the present number of the *ANNALS* we have the privilege of presenting two papers from the pen of Dr. Herbert Osborn, who has undertaken the study of our neotropical Homoptera. In these two papers he describes eighty-five species hitherto unnamed and undescribed and he informs the writer that this represents a mere fraction of the undescribed material which has been submitted to him for study. In this part of the *ANNALS* we also give a brief paper from the pen of Mr. William Schaus on some hitherto undescribed Notodonts (Lepidoptera) from South America. There are in our collections, including those of the writer, about one hundred thousand specimens of Lepidoptera obtained in recent years from all parts of the South American continent. Among them, as is well known to the writer, are many hundreds, possibly a couple of thousands of species, which have not up to the present time been named or described. It is high time that the task of determining this valuable material should be

attacked in earnest, but one man, even with the help of a couple of assistants more or less competent, cannot do everything. One of the pressing needs of the Carnegie Museum is the addition of one or two thoroughly skilful men to be added to the working force in the section of entomology.

THE Trustees of the Carnegie Museum more than a year ago extended to Dr. P. Tolmachoff, formerly associated with the late Dr. Tschernychev as Curator of the Geological and Paleontological Section of the Imperial Museum at Petrograd, an invitation to become the Curator of Invertebrate Paleontology in this Museum. Dr. Tolmachoff arrived in Pittsburgh on November 25, 1922, and at once entered upon his duties. In view of the possession by the Carnegie Museum of the great collection obtained a number of years ago from Baron Ernest Bayet of Brussels, the largest collection of European invertebrate fossils at present on the soil of the New World, it is hoped that this latest addition to our Staff will result in the complete arrangement of this great collection and the publication of the wealth of hitherto undescribed material which it is known to contain. The fossil fishes from Monte Bolca and Solenhofen obtained through the acquisition of the Bayet collection were studied and reported upon by the late Prof. C. R. Eastman, whose papers appeared in the *Memoirs* of the Carnegie Museum a number of years ago, but there remains a large amount of highly important material, especially among the invertebrates, which calls for study and description.

The explorations which have been carried on continuously in Uinta County, Utah, at what is now known as "The Natural Dinosaur Monument," have been continued during the past year by Mr. Earl Douglass. The results have been upon the whole quite satisfactory, involving the recovery of a good deal of material calculated to throw light upon many of the extinct forms of Mesozoic Reptilia which are found at this point. The collections made in Utah have yielded a good deal of material which has already been figured and upon which reports will shortly appear.

THE attention of the writer has been called by Dr. O. E. Jennings of the Herbarium to the fact that *Eois ptelearia* (Riley) has appeared

as a museum-pest in sundry fascicles of plants collected during the past year in Pennsylvania. A brief article upon the subject has been communicated to the *Journal* of the American Association of Economic Entomologists. This vicious little creature, while doing damage in herbaria, is certain to do more damage in haymows. It has for a long time been known to be a most annoying pest in southern California, Arizona, and New Mexico. Its appearance in force in Pennsylvania is to be regretted, not merely from the standpoint of the botanist, but also from that of the agriculturist.

I. NEOTROPICAL HOMOPTERA OF THE CARNEGIE
MUSEUM.

PART I. REPORT UPON THE UNDESCRIBED SPECIES OF *Agallia* AND
Idiocerus FROM TROPICAL AMERICA CONTAINED IN THE
CARNEGIE MUSEUM, 1920.

BY HERBERT OSBORN.

(PLATES I-III.)

INTRODUCTORY.

The extremely rich collections of Homoptera in the Carnegie Museum, which have been secured from a number of sources and which appear to include a large number of hitherto undescribed species, have been placed at my disposal for study. The present paper is the first of a series, which it is hoped may be made to cover a number of the groups in the near future. The species are so numerous and the additions are still coming in in such numbers, that it seems inadvisable to offer synopses or keys at present; but it is hoped that such treatment may be possible for many of the genera as the work progresses. Ultimately it is hoped that some one may be able to give a comprehensive treatise on the fauna as a whole.

The magnificent volumes of the *Biologia-Centrali-Americana* naturally include some of the Homoptera of South America, but it is evident that especially in the southern portions of the continent there is a great wealth of species as yet but scarcely touched.

I am deeply indebted to Dr. W. J. Holland, the Director of the Carnegie Museum for the opportunity to study these collections, and to Mrs. W. V. Balduf for the drawings, which accompany this part of my report.

Genus AGALLIA CURTIS (1883).

Agallia CURTIS, Entomological Magazine, I, 1833, p. 193.

1. *Agallia declivata* sp. nov.

Head scarcely wider than pronotum; eyes prominent; vertex very short, scarcely wider next the eye; face as in *A. major* sp. nov., *q. v.*

Pronotum short, distinctly elevated behind, or declivous to head. Scutellum with deep transverse suture, before which are two well marked depressions. Elytra distinctly reticulate; claval areoles with several cross-nervures; cross-nervures of corium occupying all cells, except basal half of costal.

Dark gray, tinged with fuscous; two irregular spots on vertex, four on anterior portion of pronotum, blackish; femora and tibiæ dull whitish; veins of elytra white, bordered with fuscous, the central parts of the areoles whitish.

Length 5 mm.

A large species, with the pronotum humped and the elytra distinctly reticulate. It very distinctly resembles *A. balli* Baker (*reticulata* Ball) in the character of the elytra, but is much larger, and differs decidedly in the shape of the pronotum.

One specimen (*holotype*) Carnegie Museum Acc. No. 4,043, from San Antonio de Guaporé, Brazil, July 26, 1909 (Haseman *coll.*).

2. *Agallia major* sp. nov.

Head broad; eyes conspicuous; vertex very short; face flattened; front narrowing uniformly to clypeus; cheeks scarcely sinuate; pronotum short, elytra broad, extending slightly beyond end of abdomen. *Genitalia*: female ventral segment short, apparently crowded out of position.

Dark gray to light fuscous with black spots; two black spots and central black line on vertex; facial sutures and row of spots on front, two large triangular spots on hinder disk of pronotum, central line, the claval areoles, and a dull spot on middle of elytra, black or smoky.

Length 5.5 mm.

Resembling *A. oculata* Van Duzee, but larger.

One specimen, a female (*holotype*), Carnegie Museum, Acc. No. 5064, from Province del Sara, Bolivia (Steinbach *coll.*).

3. *Agallia furculata* sp. nov.

Head considerably broader than pronotum; eyes prominent; vertex very short, a mere line at center extending narrowly behind the eyes; face flattened in profile, scarcely convex; front broad at base, narrowed sharply below antennæ, curving to clypeus; clypeus nearly twice as long as wide; loræ narrow; cheeks with margins slightly sinuate and reflexed; pronotum short, about three times as long as broad, carinate on middle line; scutellum broad; elytra broad; claval nervures forked and with cross-nervures in the inner angle; nerves of corium branched, as usual, but in addition to usual cross-nervures

there are a number of cross-nervures in apical and anteapical cells irregularly placed. *Genitalia*: the female ventral segment short, posterior margin truncate.

Dark gray, fuscous markings much as in *A. oculata* Van Duzee; dark spot next eye; central line and sutures of face, black; series of fuscous arcs on front; margins of clypeus dark; two rather large triangular spots on hind border of pronotum; central carinae and marginal patches behind eye fuscous; elytral nervures at base whitish, at tip fuscous; the areoles dull whitish. Beneath dark gray; femora sub-annulate with fuscous. Length 5 mm.

Resembling *A. oculata* Van Duzee, but more robust, and quite distinct in the forking of the claval veins and the reticulation of the elytra, the apical part of the corium having numerous cross-veins.

One specimen, female (*holotype*) Carnegie Museum, Acc. No. 3533, from Bom Fim, Bahia, Brazil, Oct. 30, 1907 (Haseman *coll.*).

4. *Agallia multipunctata* sp. nov.

Head distinctly wider than pronotum; vertex short, strongly concave behind, but not perceptibly elevated, nearly twice as long at eye as at middle, not continued back of eye; front rather narrow, long, narrowed gradually to clypeus; clypeus long, broadly expanded on apical half, apex emarginate; loræ large, outer margin circular; cheeks narrow; pronotum produced between eyes, lateral margin short, posterior margin scarcely concave; scutellum large, much wider than long, furrowed behind transverse suture so as to appear bifid; elytra long, extending well beyond abdomen, cross-vein before two central apicals straight and continuous. *Genitalia of male*: last ventral segment truncate, plates elongate, nearly as wide at base as ultimate segment, tapering nearly uniformly to acute upturned tips. Pygofer short, terminating in a truncate, dentate apex.

Light gray; vertex in front mostly yellowish, with two basal dots, four dots along anterior border, the outer two connecting with an oblique fuscous band running back to center of hind margin, a black dot near eye below ocellus, and margin of front and clypeus, dark brown; frontal arcs faint; pronotum gray-brown with faint yellowish spots and brown dots on front margin; scutellum gray-brown at base with brown and yellow triangles; apex yellowish; elytra grayish subhyaline, a fuscous patch near center of costa, veins white with brownish margins. Beneath yellowish varied with brownish.

Length: 5 mm.

This species differs somewhat from typical members of the genus in having the ocelli a little higher up on the face and nearer the margins of the eyes. The prevalent color is light gray, the head yellowish, marked with fuscous spots and lines.

One specimen, male (*holotype*), Carnegie Museum, Acc. No. 3793, from Sapucay, Paraguay, April 4, 1909 (Haseman *coll.*).

5. ***Agallia lineata*** sp. nov.

Head slightly wider than thorax; vertex arcuate, slightly wider next eye than at middle; front long, abruptly narrowed just below antennæ, then tapering gradually to clypeus; clypeus long, apex not widened; loræ elongate; cheeks sinuate; pronotum evenly arched in front, slightly concave behind; scutellum acuminate; elytra apparently without cross-veins, except for the apical series. *Genitalia of male*: plates broad at base, narrowed to beyond center, with short blunt tips.

Fulvous, vertex somewhat yellowish with large black spots, with a projection touching hind border; dark circles around ocelli, a very broad V-shaped line at base of front antennal pits; a double row of frontal dots, two spots on suture between front and clypeus, apical half of clypeus and inner border of cheek, fuscous; pronotum fulvous with darker discal band projected forward at middle, front border broadly black, with two oblique projections on the disk near median line; scutellum black at base, brownish on disk, lighter at apex; elytral veins tawny, interspaces darker subhyaline; wings opaque with brown veins. Pectus beneath black; legs pale fulvous.

Length: 4 mm.

This species is somewhat similar in appearance to *A. novella* (Say) but the shape of the head differs and the male genitalia are quite distinct. The general color is tawny with fuscous lines, two large spots on vertex, two oblique spots on front; frontal series of dots and apex of clypeus, dark brown or fuscous.

One specimen, male (*holotype*), Carnegie Museum, Acc. No. 4549, from Province del Sara, Bolivia, November, 1909 (Steinbach, *coll.*).

6. ***Agallia interrogationis*** sp. nov.

Head slightly wider at pronotum, distinctly arched; vertex short, scarcely longer at eyes than at middle; front long, margin sinuate; clypeus long, slightly widened apically; loræ elongate; cheeks narrow, and margin slightly sinuate; pronotum short, strongly arched in front, nearly straight behind; scutellum broad, apex acute, but not produced; elytral venation much as in *A. lineata*, sp. nov. (*q. v.*) *Genitalia: Female*, last ventral segment broadly notched; *male*, valve triangular, narrow; plates narrow, parallel to middle, tapering to points, extending to tip of pygofer.

Head black, vertex yellow with two large spots connected at base behind and with black area in front by extension of black median line;

front black with slender median line, two short yellow oblique lines just below ocelli; pronotum black with hind margin at lateral angles and interrogation mark bordering anterior margin on each side, two discal spots, and apical margin, yellow; elytra black, veins yellow, except costa and apical part; scutellum black. Beneath black, legs dull fuscous.

Length: ♂ 3.5 mm.; ♀, 4 mm.

This species somewhat resembles *A. lineata*, sp. nov., but has a quite different color-pattern, being prevalently black, marked with yellow lines; and the genital segment is different.

Three specimens, one male, two females (*type, allotype, paratype*), Carnegie Museum, Acc. No. 2966, from Chapada, Brazil, November (H. H. Smith, *Coll.*).

7. *Agallia sticticollis* (Stål).

Bythoscopus sticticollis STÅL, Eug. Resa., Ins. Hem., 1859, p. 291.

Head distinctly wider than pronotum; vertex short, strongly and subangularly rounded, as long at middle as at eye; front broad, rounded near apex to clypeus; clypeus narrow at tip, nearly elliptical; loræ broad; cheeks wide, sinuate; pronotum with hind border scarcely concave, hinder part faintly carinate and granulate; scutellum very small, granulate; elytra with usual venation. *Genitalia of male*: valve short, rounded behind; plates slender, tapering to blunt tip; about length of pygofer.

Dull yellowish, with numerous spots and lines of black; vertex with two large roundish black spots touching hind border; a faint double median line; two oblique lines next eye; a lunate line at base of front; a number of short arcs; sutures of front and clypeus black or fuscous; pronotum yellowish, with an irregular black band near anterior border; three faint longitudinal lines and numerous granules black; scutellum black, apical margins whitish; elytra pellucid, with blackish veins, except tips of the claval veins, which are white.

Length: 3 mm.

A dark species with pronotum and scutellum distinctly punctate or granulate with black.

The specimen before me seems to agree very closely with Stål's description, based on specimens from Rio Janeiro, although he does not speak of the pronotal punctations as granular, nor does he give details of the genitalia.

One specimen, male, Carnegie Museum, Acc. No. 5064, from Province del Sara, Bolivia, February, 1913 (Steinbach, *coll.*).

Genus IDIOCERUS Lewis.

Idiocerus LEWIS, Trans. Ent. Soc. London, I, 1835, p. 47.

8. *Idiocerus magnus* sp. nov.

Head broad, much exceeding width of pronotum, hind margin evenly curved; vertex short, a little longer next the eyes than at middle; ocelli near the eyes, small, black; front broad, sides nearly parallel to below antennæ, then curving sharply to clypeus; clypeus twice as long as width at base, slightly widened toward tip; loræ broad, outer margin circular; cheeks narrow, margins nearly straight, slightly reflexed; pronotum nearly twice as wide as long, posterior angles rounded, hind margins slightly concave; scutellum large, depressed at center; elytra rather narrow, apical cells transverse. *Genitalia of male*: last ventral segment slightly shorter than preceding, hind margin straight; plates elongate, strongly upcurved on outer third and enclosing slender upturned styles of equal length.

Dull gray; head and pronotum tinged with rufous or brown; dark spot on vertex next eye, numerous irregular arcs and dots or dashes on front, and large spot on base of clypeus, its apex and facial sutures black; pronotum with irregular black irrorations; scutellum black on disk, two basal triangular fuscous or blackish spots; elytra hyaline, nervures blackish, fuscous spots at middle and apex of clavus, transverse fuscous or blackish bars across hyaline apical cells. Legs and underside dull yellowish with fuscous markings on hind coxæ and venter.

Length: 10 mm.

This striking species, having the pronotum and front brown, coarsely irrorate with black, is recorded as having been taken in sweeping on an island in the Rio Guaporé, and, if similar in habit to North American forms, may have occurred on willows or poplars.

One male specimen (*holotype*) Carnegie Museum Acc. No. 4043, from San Antonio de Guaporé Brazil, July 26, 1909 (Haseman *coll.*).

9. *Idiocerus quadrangularis* sp. nov.

Head broad, much wider than pronotum; vertex short, rounding uniformly to front, profile quite uniformly curved from vertex to tip of clypeus; front convex hexagonal, lateral angles at antennal pits; pronotum short, lateral margins reduced to angle, hind margins distinctly concave; scutellum broad, apex acute.

Vertex light green, with two quadrangular spots with open court at sides, separated by a median space about equal to width of the red mark; front darker at sides; clypeus infuscated; pronotum light green with faint reddish stripes on disk and tinged with reddish at sides;

scutellum brownish green at base, light green on apex, two triangular spots at base in basal angles; elytra brownish smoky, base of costa brown, base of costal cells and costal vein green. Beneath dull green; pectus and coxæ blackish; legs greenish; posterior femora and tips of tibiæ brownish.

Length: 4 mm.

A small greenish species with quadrangular spots on head and a black triangle at base of scutellum.

One specimen, female (*holotype*), Carnegie Museum, Acc. No. 4043, from Villa Bella, Bolivia, October 6, 1909 (Haseman *coll.*).

10. **Idiocerus flavidus** sp. nov. (Plate I, fig. 1).

Head slightly wider than pronotum, uniformly curved; vertex rounding uniformly to front; front broad at base, distinctly angled at antennal pits, narrowing with a sharp curve at apex to meet clypeus; loræ rather broad; pronotum with lateral posterior angles rounded, hind border straight; scutellum large, almost equilaterally triangular; elytra long, extending far beyond tip of abdomen. *Genitalia of male*: last ventral segment short, truncate; plates with parallel sides to middle, then contracting to sharp spine-like tips.

Head, pronotum, and scutellum light yellow, unmarked, strongly contrasting with black basal parts of elytra; face unmarked, but faintly tinged with fulvous; ocelli black; elytra blackish hyaline, opaque blackish at base and on most of clavus, the blackish spot on costal, basal and apical cells and base of membrane rather dark smoky. Beneath yellowish, tips of male plates brownish.

Length: 4.5 mm.

This small, slender species is very distinctly marked by the sharply contrasting colors of the body and the bases of the elytra, the head, pronotum, and scutellum being yellow, and the elytra, especially at base, being blackish.

Two males (*type* and *paratype*), Carnegie Museum, Acc. No. 4043, ticketed "Brazil along Rio Guaporé below Rio S. Miquel, VIII, 22, 1909. Haseman."

11. **Idiocerus maculifrons** sp. nov. (Plate I, fig. 2).

Head much wider than pronotum; eyes prominent; vertex short, rounding evenly to front; front with parallel sides to below antennæ, then narrowed abruptly to clypeus; clypeus twice as long as wide, widening slightly toward tip; loræ large; cheeks narrow, margin bordering loræ slightly reflexed; pronotum wide, short, scarcely emarginate behind; scutellum very broad. *Genitalia of male*: hind border of last ventral segment truncate; plates thick, and narrowing, tapering to acute point behind.

Greenish, with brownish central line on vertex; a round spot near eye, broken transverse band between eyes, ocelli, arcs on front, apex of front and all of clypeus, six spots on pronotum, basal angles and discal spots on scutellum, spots on claval and elytral veins, black; elytra transparent, veins white, except for alternating black spots. Beneath pale, legs pale, with apices of femora and hind tibiæ fuscous.

Length: 5.5 mm.

This species is recognized by being pale yellowish or greenish yellow, maculate with fuscous or black on face, pronotum, scutellum, and elytra.

One male specimen, (*holotype*) Carnegie Museum, Acc. No. 2966, from Taperina, Brazil (H. H. Smith, *coll.*).

12. **Idiocerus rotundifrons** sp. nov. (Plate I, fig. 3).

Head broad; vertex narrow, merging without any trace of angulation into rounded front, which tapers rather sharply to clypeus; cheeks narrow, overhung by loræ at the tips; pronotum short, hind margin scarcely concave.

Dull yellowish or greenish, probably pale green in life, without markings, except that the ocelli are dark, each set in a blackish dot, and the costa at base is yellowish; veins indistinct, and entire elytra hyaline with faint iridescent reflections.

Length: 5 mm.

This species may be recognized by its being uniformly dull yellowish, except the black ocellar spots, and by its rounded head.

One female specimen (*holotype*) Carnegie Museum, Acc. No. 4043, from Brazil, ticketed, "Along Rio Guaporé, August 22, 1909" (Hase-man *coll.*).

13. **Idiocerus hyalinus** sp. nov. (Plate I, fig. 4).

Head broad; vertex uniformly curved, margins parallel, evenly curved to the front; ocelli below transverse blackish bar; front broad at base, tapering rather uniformly to base of clypeus; clypeus longer than broad, sides nearly parallel; loræ narrow, outer margins slightly curved; cheeks narrow, margins nearly straight; pronotum short; scutellum large, acute at apex; elytral veins indistinct, except where marked with black. *Genitalia: female*, last ventral segment concave; *male*, valve wanting, plates elongate, narrowed, and acuminate at tip. Greenish yellow; vertex with central dark line; broad sinuate band extending across between eyes, ocelli each in black dot, rest of face whitish; pronotum greenish with a central dark line expanded posteriorly, two large triangular spots near hind border, two oval transverse brownish spots near front border a little nearer the center;

scutellum greenish with fulvous patches in basal angles and across hinder part of disk; elytra very clear transparent, with densely black claval sutures, black or fuscous on part of claval veins, and on inner sector and parts of apical veins.

Length: 6 mm.

This striking species does not seem to have any counterpart in our North American fauna, but shows some resemblance to *Idiocerus duzei* Provancher. It is large, robust, greenish yellow, having the elytra hyaline, except the veins.

There are three specimens from Brazil, taken on the Rio Guaporé below Rio S. Miguel, August 22, 1909, by Haseman; and four specimens from Bolivia, Rio Mátupo, near Rio Guaporé, taken August 25-29, 1909, by Haseman. Carnegie Museum, Acc. No. 4043, *type* ♂, and *allotype* ♀, Carnegie Museum; *paratypes* in Carnegie Museum and Osborn Collection.

14. *Idiocerus minutus* sp. nov.

Head broad, vertex rounding to front; front broad at base narrowing sharply from antennal pits to base of clypeus; clypeus long; pronotum broad, short, posterior margin concave; scutellum large.

Gray, head marked with brownish bars, each forming an indistinct quadrangular mark with black dot at center; ocelli dark; front with a row of short, fuscous arcs on each side; pronotum with very faint reddish stripes at each side of center, some blackish dots behind the eye; scutellum dull yellowish, a dark stripe at center, bifid at tip; black triangles in basal angles; elytra hyaline, nerves indistinct, but with a fuscous line on disk of clavus, and a discal cross-nervure infuscated. Beneath thorax and basal segments of abdomen blackish, legs and pygofer dull yellowish.

Length: female, 3 mm.

A very small wedge-shaped species, dark gray, marked with reddish and brown, easily distinguished by its color-pattern.

Two specimens, both females, Carnegie Museum, Acc. No. 2966, taken at Chapada, Brazil, November. *Type* in Carnegie Museum; *paratype* in Osborn Collection, Ohio State University.

15. *Idiocerus tumidulus* sp. nov.

Vertex rounded, front tumid, narrowed abruptly from antennal pits to base of clypeus; pronotum very short, concave behind. *Genitalia of male*: ventral segment long, narrowed toward tip and truncate at apex.

Dull yellowish brown; front, clypeus, and loræ deeper brown; ocelli

and antennal pits fuscous; pronotum lighter anteriorly, with faint brownish markings in depressions; scutellum yellowish with brownish discal spots in basal angles; elytra brownish hyaline, a large fuscous patch just back of center and inner apical area, fuscous. Beneath brown, apical margins of abdominal segments and terminal segment with central line, yellow.

Length: 3.5 mm.

A small obscurely marked species with tumid frons.

A single male specimen, Carnegie Museum, Acc. No. 2966 (*type*), from Chapada, Brazil, November (H. H. Smith *coll.*).

16. **Idiocerus areatus** sp. nov. (Plate II, fig. 1).

Head broad; eyes prominent; vertex rounding uniformly to front; front curved at base, lateral angles distinct, lateral suture nearly straight to base of clypeus; clypeus not quite twice as long as width at base, widening slightly at tip; loræ reaching reflexed margin of cheeks; pronotum broad, posterior angles very broadly rounded, hind border distinctly concave; elytra slightly longer than exerted ovipositor. *Genitalia of female*: ventral segment short, very shallowly notched, ovipositor extending about one-fourth its length beyond the pygofer.

Light greenish; head with trapezoidal reddish spots including a round spot opening on outer margin; ocelli reddish; front with two obscure fulvous stripes, rest of face greenish; pronotum greenish with a broad L-shaped reddish mark, the short limb of the L paralleling the middle line; scutellum yellowish with faint mark at center and triangle in basal angles, fulvous. Elytra hyaline, base of clavus with a greenish opaque area, costal nerve greenish, apices faintly smoky. Beneath greenish; legs and ovipositor light testaceous; apex of hind tibia and tarsal claws dark.

Length: 4 mm.

This is a handsome little species, closely resembling *I. fulvus*, sp. nov. (*q. v.*), but smaller, with a different pattern for the reddish areas on head and thorax, and distinctly blackened apices of hind tibiæ and tarsal joints; it differs also in the length of the ovipositor.

One specimen, female (*type*) Carnegie Museum, Acc. No. 2966, from Chapada, Brazil (H. H. Smith *coll.*).

17. **Idiocerus fulvus** sp. nov. (Plate II, fig. 2).

Head broad, strongly curved; vertex short, rounded to front; front broad, base curved, antennal angles sharp, sides narrowing abruptly to narrow base of clypeus; clypeus narrow, twice as long as wide,

slightly expanded at tip; loræ large, approaching closely to margin of cheek; pronotum rather long, strongly arched in front, distinctly concave behind; scutellum large, apex acuminate; elytra exceeding ovipositor. *Genitalia of female*: last ventral segment short, posterior margin concave.

Light yellow, somewhat tinged with greenish, with two large quadrate fulvous areas on vertex extending down to ocelli, somewhat narrowed below, separated by narrow greenish stripe; pronotum tinged with fulvous, somewhat lighter laterally; scutellum greenish; elytra hyaline, scarcely colored, tinged with fulvous basally, apex faintly smoky. Underside, including face, body, and legs, pale greenish.

Length: 5 mm.

This species is prevalently light yellowish, with two broad fulvous stripes on vertex, the pronotum light fulvous.

Two females (*type* and *paratype*) Carnegie Museum, Acc. No. 2966, from Chapada, Brazil (H. H. Smith *coll.*).

18. **Idiocerus intricatus** sp. nov. (Plate II, fig. 3).

Head broad; eyes large; vertex slightly longer at middle than next the eye, rounded to front; front broad at base, sides converging gradually to near clypeus, much widened at tip; loræ large, elongate, triangular; antennæ slender without disks; pronotum strongly curved in front, lateral angles short, hind border straight; scutellum, broad, margins straight; elytra long, much exceeding body. *Genitalia of male*: last ventral segment truncate; plates broad, slightly tumid at base, narrowing uniformly to thick spur-like pointed tips.

Yellowish tinged with green; vertex with two elliptical spots on disk, a round spot next eye, two transverse broken bars above and below ocelli, two discal stripes and lateral patch on pronotum, reddish or tawny; a central line, dot on inner margin of each eye, ocelli, antennal pits, spot on base of loræ, and apex of clypeus, central line on posterior margin of pronotum, hind border of lateral angles, central line and suture and basal angles of scutellum, claval veins, dot at base and on cross-nervure, and transverse band at tip of clavus and apical cells, brownish fuscous to blackish. Underside of body and legs yellowish, more or less tinged with brownish.

Length: 4.5 mm.

The prevalent color of this species is light yellowish, with numerous reddish and fuscous markings in rather intricate patterns.

One male specimen (*holotype*) Carnegie Museum, Acc. No. 2966, from Chapada, Brazil, October (H. H. Smith *coll.*).

19. *Idiocerus fasciatus* sp. nov. (Plate II, fig. 4).

Head slightly wider than pronotum; eyes forming part of outline of head; vertex rounding uniformly to front; front broad, narrowed roundly to clypeus; clypeus slender, widening toward apex; loræ with outer margin concave; cheeks narrowed abruptly, their margins closely contiguous to loræ; pronotum broad, short; scutellum broad; vertex, front, pronotum, and base of scutellum, minutely rugulose. *Genitalia: Female*, ultimate ventral segment short, slightly convex; *male*, plates broad at base, outer margin sinuate, tips narrowly rounded, scarcely attaining tip of pygofer.

Brown; margin of face, apex of clavus, broad stripe extending from base to beyond scutellum in outer cell of clavus bright yellow; borders of this stripe, an oblique patch at tip of clavus, and broad cross-band at base of apical cells and narrow apical margin, dark brown to fuscous. Underside pale, dull whitish; tips of tibiæ and tarsal claws brown; abdomen in male sanguineous above.

Length: 4. mm.

This is a very beautiful little species and has not been connected with any described form. It is prevalently brown, with apex of scutellum and broad stripe on outer base of clavus, bright yellow.

Two specimens, male and female (*type* and *allotype*) Carnegie Museum, Acc. No. 2966, from "Chapada, Brazil, October" (H. H. Smith coll.).

20. *Idiocerus trifasciatus* sp. nov. (Plate III, fig. 1).

Head broad, vertex longer than usual, rounded to front; front convex, sutures indistinct, roundly narrowed to clypeus; clypeus and loræ tumid; pronotum scarcely concave behind; scutellum with margins straight, almost equilaterally triangular, apex minutely pointed; elytra long, exceeding tip of ovipositor. *Genitalia of female*: ventral segment short, truncate behind.

Grass-green; vertex with curved reddish spots; ocelli black; pronotum with three fulvous stripes, one at center and one on either side in line with fulvous spot in angle of scutellum; disk of scutellum and elytra fulvous hyaline, tips faintly smoky. Beneath light green, femora paler; hind tibiæ and tarsi darker green with dusky apical spines and claws.

Length: 4 mm.

A small greenish species, with two spots on vertex, and three stripes on pronotum in line with the spots of scutellum.

One specimen, female (*holotype*), Carnegie Museum Acc. No. 4043, from Brazil "along Rio Guaporé, below Rio S. Miguel" (Haseman coll.).

21. **Idiocerus ocellatus** sp. nov. (Plate III, fig. 2).

Head broad, bluntly rounded; vertex short, rounded to front; front slightly convex, basal sutures curved, lateral margin nearly straight from antennal pit to clypeus; pronotum broad, hind margin scarcely sinuate; scutellum large, margins nearly straight, tip minutely pointed; elytra long, much exceeding abdomen. *Genitalia of male*: valve large, hind border rounded, plates broad at base narrowed abruptly near the center, tips slender and upturned.

Uniformly dull greenish, ocelli and antennal setæ and a dot on disk of elytra, apical spines of hind tibiæ and tarsi, brownish. Beneath light green, darker at apex of abdomen.

Length: 3.5 mm.

The species is uniformly dull green, except ocelli and a small dot on disk of elytra, which are black.

One specimen, male (*holotype*) from Brazil, "along Rio Guaporé below Rio S. Miguel," August 22, 1909 (Haseman *coll.*).

22. **Idiocerus viridicatus** sp. nov. (Plate III, fig. 3).

Head broad, strongly curved in front, slightly longer at middle than next eye, rounded to front; front hexagonal, widening from base to antennal pits, then narrowed to base of clypeus; clypeus narrow, nearly twice as long as width at base, widened slightly at tip, apex notched; loræ elongated, touching reflexed margin of cheek at tip; pronotum rather long, nearly one-half as long as wide, posterior angles hardly perceptible, hind margins slightly concave next scutellum; scutellum acuminate; elytra extending well beyond ovipositor. *Genitalia of female*: ventral segment short, with a deep excavation, rounded at bottom, reaching over half-way to base.

Green, somewhat bluish on hind margin of vertex and between the reddish spots; spots on vertex reddish or dark fulvous, these spots enlarged at either end and touching the ocellus; ocellus yellowish, face somewhat yellow or whitish centrally, margins pale green; pronotum with oblique fulvous stripes meeting at anterior edge; scutellum pale green, scarcely marked; elytra with a fulvous stripe next to scutellum and another bordering claval suture, hyaline-greenish at base, clear hyaline toward apex, tips slightly smoky. Beneath pale green to whitish including pygofer and edges, except tarsal claws, which are dusky.

Length: 4 mm.

This is a very striking little species, especially characterized by the much rounded head and the pattern of spots and stripes. Similar to *I. areatus* sp. nov. (*q. v.*) in size, but with head much more rounded in front, frontal marks of different shape, and with fulvous stripes on pronotum and elytra.

One specimen, female, (*holotype*) Carnegie Museum, Acc. No. 4043. "Sweeping in forest" August 22, 1909, Villa Bella, Bolivia (Hase-man *coll.*).

23. **Idiocerus acuminatus** sp. nov. (Plate III, fig. 4).

Head broadly rounded, vertex slightly shorter at middle than next the eye; eyes prominent; front broad, lateral margin roundly narrowing to base of clypeus; clypeus small, slightly elevated on disk; pronotum broad, hind border distinctly concave; scutellum distinctly impressed on disk and acuminate; elytra with nervures faintly punctured. *Genitalia of female*: ventral segment short, truncate on hind edge, notched at middle; ovipositor scarcely exceeding pygofer.

Green, a broad band across front of vertex partially divided on median line; pronotum and scutellum light green, unmarked; elytra greenish hyaline, nervures pale, costa greenish. Beneath light green.

Length: 4 mm.

Size and form of *areatus* sp. nov. (p. 17) but with no markings on pronotum and the spots of vertex meeting at the middle.

One specimen, female (*holotype*) Carnegie Museum, Acc. No. 5064, from Province del Sara, Bolivia, November, 1912 (Steinbach *coll.*).

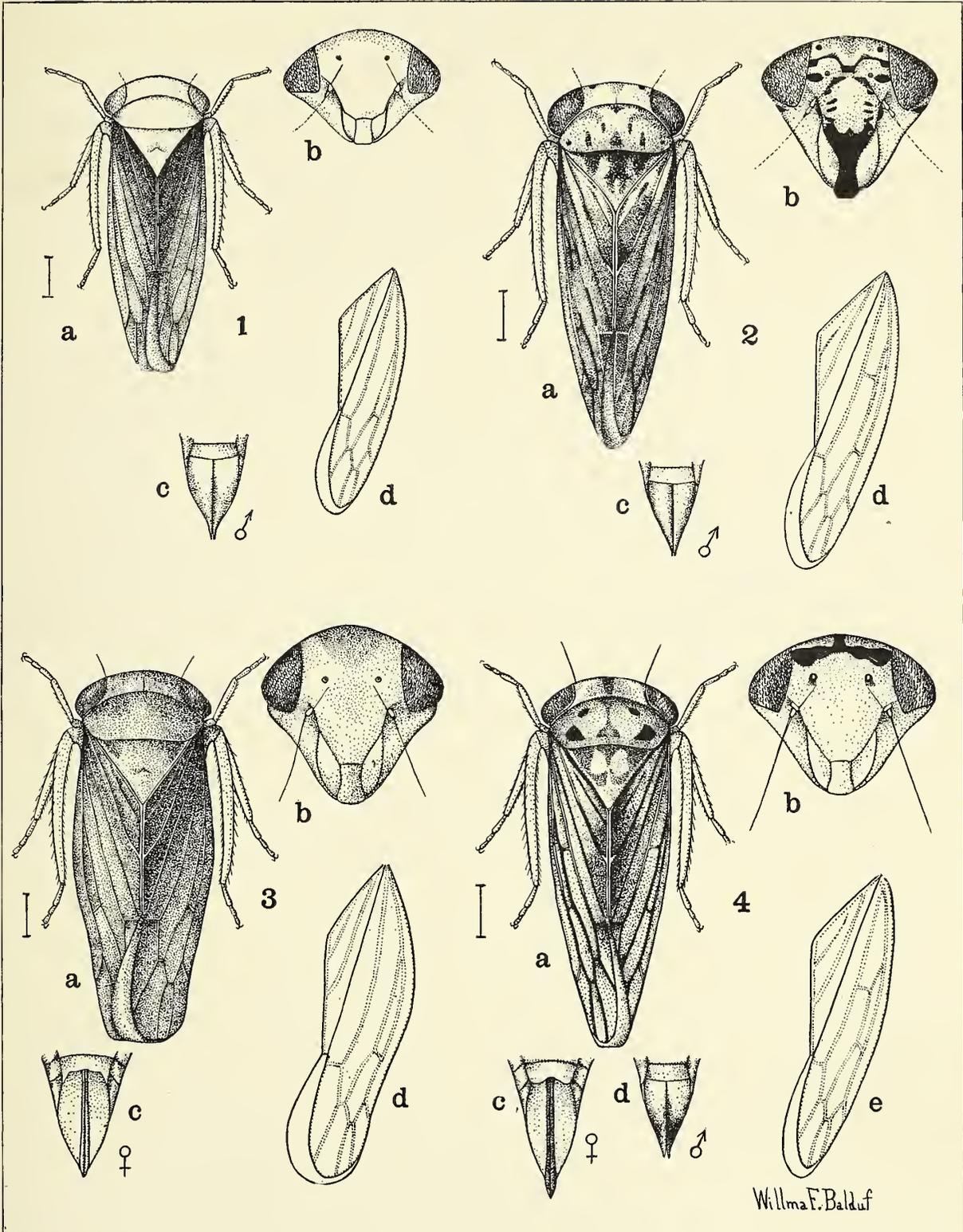
EXPLANATION OF PLATE I.

FIG. 1. *Idiocerus flavidus* Osborn, sp. nov. (See p. 14.) *a*, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.

FIG. 2. *Idiocerus maculifrons* Osborn, sp. nov. (See p. 14.) *a*, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.

FIG. 3. *Idiocerus rotundifrons* Osborn, sp. nov. (See p. 15.) *a*, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.

FIG. 4. *Idiocerus hyalinus* Osborn, sp. nov. (See p. 15.) *a*, dorsal view; *b*, face; *c*, female genitalia; *d*, male genitalia; *e*, elytron.



Idiocerus.

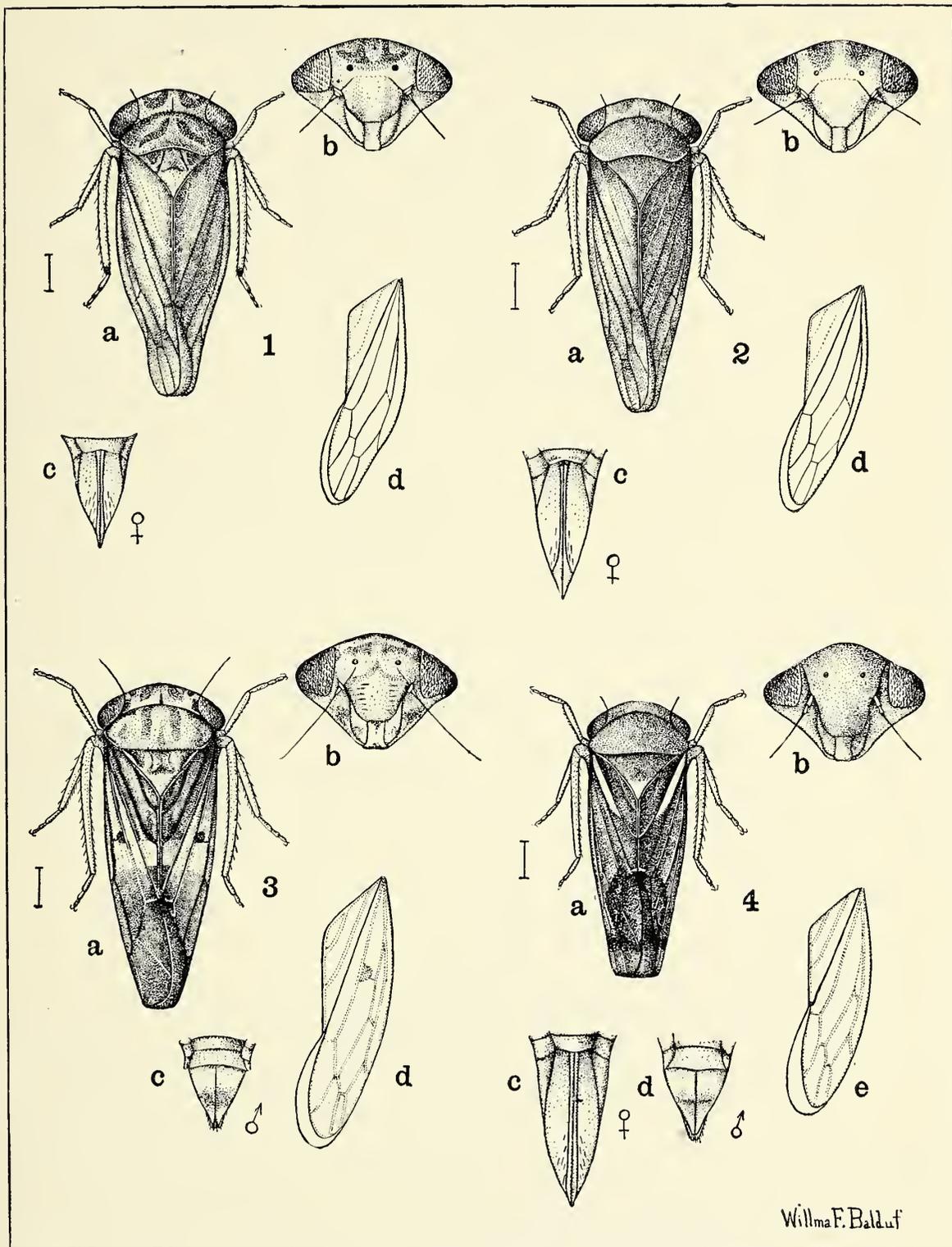
EXPLANATION OF PLATE II.

FIG. 1. *Idiocerus areatus* Osborn, sp. nov. (See p. 17.) *a*, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.

FIG. 2. *Idiocerus fulvus* Osborn, sp. nov. (See p. 17.) *a*, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.

FIG. 3. *Idiocerus intricatus* Osborn, sp. nov. (See p. 18.) *a*, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.

FIG. 4. *Idiocerus fasciatus* Osborn, sp. nov. (See p. 19.) *a*, dorsal view; *b*, face; *c*, female genitalia; *d*, male genitalia; *e*, elytron.



Idiocerus.

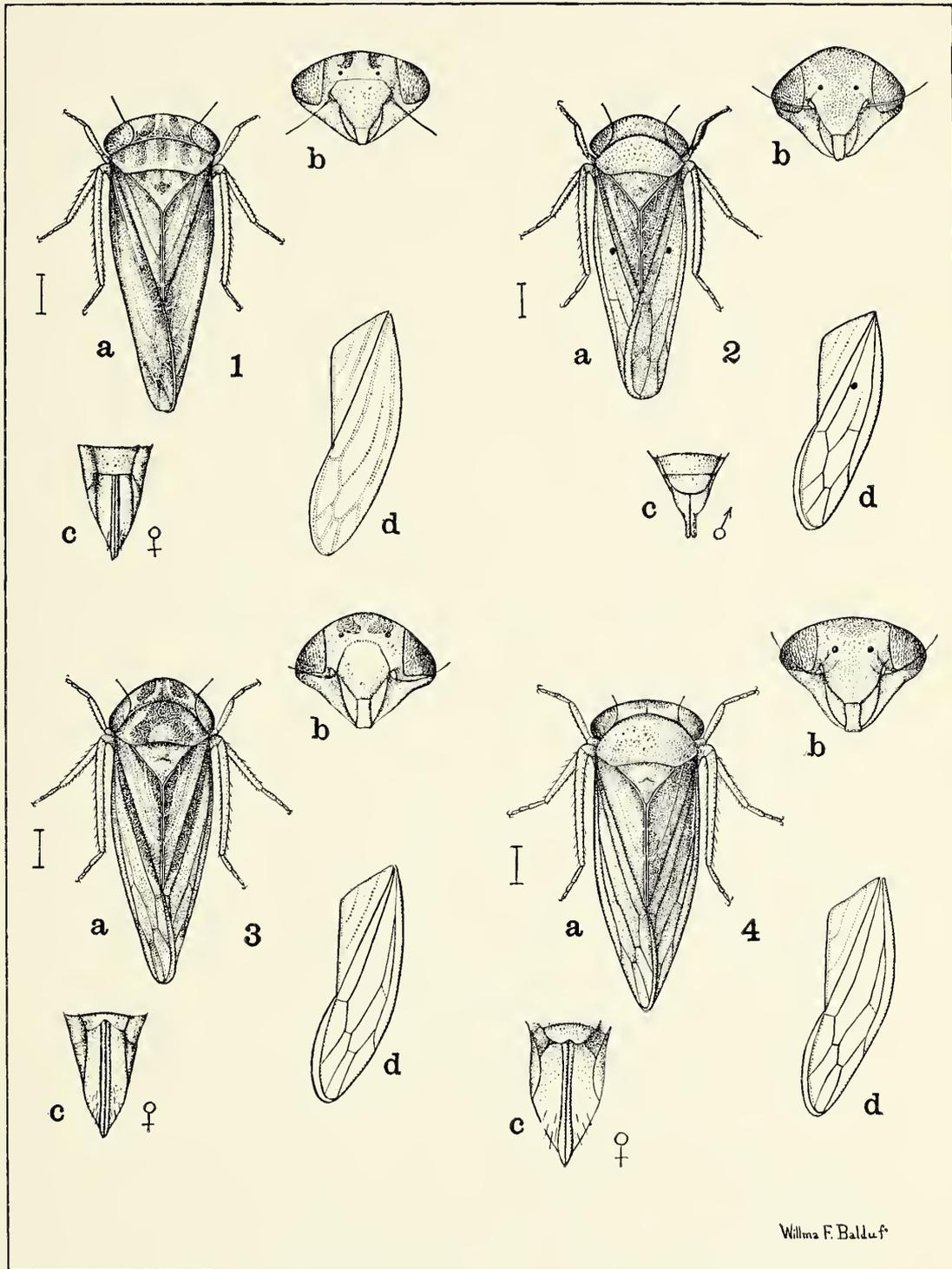
EXPLANATION OF PLATE III.

FIG. 1. *Idiocerus trifasciatus* Osborn, sp. nov. (See p. 19.) *a*, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.

FIG. 2. *Idiocerus ocellatus* Osborn, sp. nov. (See p. 20.) *a*, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.

FIG. 3. *Idiocerus viridicatus* Osborn, sp. nov. (See p. 20.) *a*, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.

FIG. 4. *Idiocerus acuminatus* Osborn, sp. nov. (See p. 21.) *a*, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.



Idiocerus.

II. NEOTROPICAL HOMOPTERA OF THE CARNEGIE MUSEUM.

PART 2. RECORDS AND DESCRIPTIONS OF FIVE NEW GENERA AND SIXTY-FIVE NEW SPECIES OF THE SUBFAMILY JASSINÆ.

BY HERBERT OSBORN.

The records and descriptions of new species here included all pertain to the subfamily *Jassinæ* of the Cicadellidæ (formerly *Jassidæ*). Practically all are from the interior basin of the Amazon in Western Brazil, from eastern Bolivia, and from Colombia. The material described indicates a great wealth of peculiar forms. The species collected by H. H. Smith, Dr. John D. Haseman, Jr., and Señor José Steinbach are of particular interest. They are from the Amazonian watershed east of the Andes, and in the descriptions given are duly credited to the collectors. A number of species occur, which have a wide distribution in the tropics, some of which extend even into temperate regions both to the north and the south. It seems evident that the region from which the material has been derived may present as great a variety of species as occurs in the plains-region of our western Mississippi Valley.

Family **CICADELLIDÆ**.

Subfamily **JASSINÆ**.

Genus **HECALUS** Stål. (1864).

Hecalus Stål, Ann. Soc. Ent. France, (4) IV, 1864, p. 65.

1. **Hecalus notatus** sp. nov.

Head scarcely as wide as pronotum, flattened, sub-angulate; vertex scarcely as long as wide, twice as long at middle as next the eye; front slightly convex; clypeus narrow, nearly twice as long as wide; loræ large; cheek margin sub-angulate, the lower border concave and the margin faintly reflexed; antennæ small, scarcely longer than head; pronotum broad, uniformly rounded in front, deeply concave behind; scutellum large; clavus with two veins. *Genitalia: female*, last ventral segment nearly twice as long as preceding, outer angles rounded, produced into a short tooth and distinctly carinate; *male*, valve small,

produced into a blunt tooth behind; plates short, thick, one-half longer than the valve, tips rounded.

Brown-gray; two large discal patches on the vertex; the anterior border and four somewhat obscure spots across the base of the pronotum, the basal portion and apex of scutellum, a dot on outer and inner margin of clavus, and a deep spot at base of antepical areoles, the veins and outer part of apical areoles, fuscous. Beneath, disk of the front, base of clypeus, most of loræ, and the femora of hind legs, dark fuscous.

Length: female, 4.5 mm; male, 4 mm.

A small, broad, depressed species; the head margins thin and acute, with fuscous patches or dots on vertex, pronotum, scutellum, and elytra.

Described from two specimens; one female (*type*) from Santarem, Brazil, Dec. 28, 1909, C. M., Acc. 4043 (Haseman, *coll.*); and male (*allotype*) from Province del Sara, Bolivia, Nov. 1912, C. M., Acc. 5064 (Steinbach *coll.*).

HECALOIDIA gen. nov.

Head moderately expanded, not widely foliaceous, sub-angulate in front; vertex depressed; front in profile concave at base, nearly flat; cheeks broad; pronotum with carinate lateral margins; clavus with two veins united by two cross-veinlets; costa with reflexed veinlets beyond the middle. Type of genus *Hecaloidia nervosa* sp. nov.

2. *Hecaloidia nervosa* sp. nov.

Head distinctly flattened, wider than pronotum, margin acute, but slightly foliaceous, obtusely angulate; vertex nearly twice as long at middle as next the eye; ocelli on the margin about their diameter from the eye; antennæ short, scarcely longer than the head; front broad, margins nearly parallel, narrowing rapidly below antennæ; clypeus twice as long as broad, scarcely widened toward the apex; loræ not reaching margin of cheeks; margins of cheek distinctly sinuate; pronotum one-fourth longer than vertex; lateral margins short, carinate; hind border concave; scutellum wider than long; clavus with two veins joined by two cross-veinlets and the outer one joined to the claval suture by one or two veinlets; one cross-vein between inner and outer sector; about five or six cross-veinlets in the costa beyond the middle.

Dull brown; vertex with broad patches of fuscous; pronotum with four broken divergent fuscous stripes; scutellum with a median line and transverse impression, fuscous; elytral veins dark fuscous; areoles sub-hyaline; claval and discal areoles milky; and, including dusky patches, the costal-veinlets and narrow apical border, blackish;

face brown, with yellowish arcs on front and darker sutures; legs obscurely banded, tarsal claws black.

Length: ♂ 6 mm.

This species is prevalently brownish, with patches of fuscous on head, pronotum, scutellum and elytra; costa with numerous cross-veins beyond the middle. It appears to belong near *Hecalus* or *Hulperia*, but differs in too many important characters to be placed in either of these genera. The head is less foliaceous than in *Hecalus*, but more so than in *Parabolocratus*.

Described from one specimen (*holotype*) from Villa Bella, Bolivia, October 6, 1909, C. M., Acc. No. 4043 (Haseman coll.).

Genus SPANGBERGIELLA Signoret.

Spangbergiella Signoret, Annales Soc. Ent. France (V) IX, p. 273.

3. *Spangbergiella fasciata* sp. nov.

Head wider than pronotum; hind border strongly arched; vertex as long as wide, acutely angular, convex; ocelli minute, distant from the eye; front narrow, constricted toward the tip; clypeus longer than broad, rounded at apex; loræ small, scarcely touching the front, but merging into the cheek-border; cheek-margin strongly sinuate beneath the eye; pronotum scarcely as long as vertex, wide, margin very short, postero-lateral margin short, angle rounded, behind deeply concave; scutellum longer than wide, acuminate at tip; distinct claval vein near the center and apparent second vein merging with the border at the inner angle; veins of corium obsolete. *Genitalia: male*, valve large, nearly semi-circular behind; plates thick, compressed toward the tips, the base reddish, disc yellowish, and the tips dark brown.

Above, vertex, pronotum, and scutellum with alternating ocher-fulvous and olive-gray stripes, the former converging and uniting toward the tip of the vertex, the outer ones terminating at the postero-lateral angle of the pronotum, the inner ones continuing across the scutellum, and the median stripe occupying the disc of the scutellum; another ocher-red stripe borders the base of the face, and the black of the face is narrowly bordered with the same color; the tip of the clypeus brownish; legs brownish; the fuscous bands on the femora and the tips of tibiæ and tarsi smoky; elytral veins hyaline; abdominal segments fuscous, bordered with reddish yellow; the terminal segment more distinctly reddish.

Length: 5.5 mm.

Elongate, head strongly angled; four broad ocher-fulvous stripes merging on sides of vertex and nearly meeting at the tip, diverging across the pronotum, the inner pair extending across the scutellum

where they form the lateral spots and are separated by a narrow olive-gray stripe from a broad median stripe; elytra transparent; lower part of face and sternum, black; abdomen dark brown, segments with yellowish margins.

In the apparent single vein of the clavus this species agrees with *Spangbergiella*, but, if the female agrees with the male in the blunt border of the head, it would perhaps more properly constitute a new genus. It appears to be distinct from *Bergiella* Baker, which agrees with *Spangbergiella* in the single claval vein, but according to Berg's description the head is foliaceous even in the male.

Described from fourteen males (*type* and *paratypes*), labelled "S. Antonio de Guaporé, Brazil, July and August, 1909, Haseman."

4. *Spangbergiella vulnerata* (Uhler).

Glossocratus vulnerata UHLER, Bull. U. S. Geol. Survey, III, 1877, p. 464.

Head narrower than pronotum; vertex obtusely angled, nearly twice as wide as long, rounded to front; front somewhat swollen; clypeus nearly twice as long as wide; loræ close to margin of cheek; border of cheek distinctly sinuate. Pronotum a little longer than vertex, hind margin concave. *Genitalia: male*, the valve very small, almost concealed; plates narrow, tapering to acute slightly upturned tips; pygofer strongly setose.

Light green; vertex and pronotum with orange-red converging stripes, nearly meeting anteriorly; a fainter short median stripe on pronotum; elytral veins greenish-yellow; beneath dull greenish.

Length: male 4.75 mm.

Head short, margin obtuse, the orange-red stripes strongly convergent, median stripe on pronotum reaching two-thirds of the distance from the base. The male specimens are much smaller than stated for *S. lynchii* Berg, and agree with *S. vulnerata* ♂ in the obtuse border of the head. The female specimens are a little smaller than average specimens of *S. vulnerata*, but I believe come easily within the range of variation for this species.

Two males and five females from Province del Sara, Bolivia, November, 1912, C. M., Acc. No. 5064 (Steinbach *coll.*); one female, Santarem, Brazil, December 10, 1909, C. M., Acc. No. 4043 (Haseman *coll.*); and one female from Puerto Suarez, Bolivia, elev. 150 M. (Steinbach *coll.*). The species ranges from the southern United States to Brazil.

LUHERIA gen. nov.

Allied to *Huleria*. Head short, broad; pronotum with strong carina on the rather long side margin; claval veins approximately at middle; middle anteapical cell strongly constricted behind the middle; outer anteapical broad, pedunculate at base; apical areoles short; type of genus *Luheria constricta* sp. nov.

5. *Luheria constricta* sp. nov.

Head distinctly wider than pronotum, broadly arched; vertex twice as wide as length of pronotum, one-third longer at middle than next the eye, flattened, depressed anteriorly; margin acute; front as wide as long; ocelli small, little more than their diameter from the margin of the eye; clypeus twice as long as width at base, enlarged toward the tip; apex truncate; loræ large, nearly touching cheek-margin; cheeks distinctly sinuate below the eye. Pronotum nearly twice as long as vertex; side margins prominent, about one-third the length of pronotum at middle, strongly carinate; hind margin distinctly concave; scutellum moderately large; clavus with two distinct nervures nearly fused or with short connecting vein at middle; corium hyaline; veins conspicuous; a very short or rudimentary second cross-vein forming a short angular inner anteapical; the middle anteapical much constricted, the veins almost touching and forming two angular divisions; outer anteapical short; apical areoles short and angular; apex obliquely rounded; abdomen slender, reaching beyond tip of clavus. *Genitalia: male*, valve broad, short, rounded behind; plates narrow, tapering gradually to upturned blunt tips; the ventral surface swollen and sparsely setose.

Gray-fulvous above; yellow beneath; vertex with narrow anterior border of black; scutellum with three brown stripes; the elytral veins brown, somewhat infuscated, and with distinct fuscous margins in the apical areoles; face unmarked; legs brownish yellow; abdominal segments with fulvous brown laterally.

Length: male 7 mm.

Fulvous gray above, the vertex margined with black; face yellow; elytra sub-hyaline with brown veins margined apically with fuscous. This is a striking species, apparently most nearly related to *Huleria*, but with different shape of head, and distinctly different venation.

Described from five specimens, males, (*type* and *paratypes*) labelled "Barra, Bahia, Brazil, December 9, 1907, C. M., Acc. No. 3533" (Haseman coll.)

Genus NIONIA Ball.

Nionia BALL, Proc. Biol. Soc. Washington, XXVIII, 1915, p. 165.

6. *Nionia* (?) *rugosa* sp. nov.

Body broad; head wider than pronotum, very short, about half as long at middle as next to eye, coarsely punctate; ocelli on the border of vertex, about half way between eye and middle; front wider than long, margin rounded to clypeus, roughly punctate and rugose; clypeus short, slightly longer than broad, coarsely punctate and rugose; loræ wide, not reaching margin of cheek; margins of cheeks excavated under eye, convexly rounded to clypeus; pronotum nearly twice as wide as long, produced forward, the apex slightly in advance of the eyes; lateral margin carinate, surface coarsely transversely striate and rugose, especially on anterior portion; scutellum punctate; elytra punctate, veins elevated. *Genitalia: female*, last ventral segment elongate, longer than four preceding segments, hind border dentate, a broad tooth at lateral angle a broad central produced tooth, truncate at apex; pygofer short, not quite reaching tip of elytra.

Dark brown, the coxæ and femora darker and the abdomen beneath lighter.

Length: female, 7 mm; width, 2.75 mm.

Dark brown, broad; pronotum coarsely striate; front and clypeus rugulose. Much larger and pronotum less produced than in *Bythoscopus gaganinus* Breddin, but evidently nearly related to *Nionia*, to which I refer Breddin's species. It may require the erection of a new genus, especially if additional species emphasize its separation from that group.

Described from one specimen "Sta. Cruz de la Sierra, Bolivia, elev. 450 M., November 1910, Car Mus., Acc. No. 4549" (Steinbach coll).

GENUS PARABOLOCRATUS Fieber.

Parabolocratus FIEBER, Verh. Zoöl.-Bot. Gesellsch. Wien, XVI, 1866, pp. 502, 513.

7. *Parabolocratus bolivianus* sp. nov.

Head as wide as pronotum; vertex flat with a faint transverse elevation before the eyes, a little longer than width at base; front rounded, subangulate, in front slightly convex, minutely punctate; clypeus longer than broad, apex truncate; loræ lobate; margin of face marginate to below the eye, broadly angulate; pronotum short, broadly rounding in front, hind border scarcely concave; the middle anteapical cell narrowed toward the tip, forming a nearly hexagonal cell in end, outer anteapical widened apically, its base nearly touching the costa. *Genitalia: female*, last ventral segment a little longer than the preceding, the hind margin notched at the center, the center slightly elevated and blackish.

Whitish; scutellum and elytra marked with yellowish, especially on the veins. A broad spot on the disk of pronotum and inner angle of clavus; apex of clavus, spot across the middle of the corium, and anteapical cells, dark brown or fuscous. Beneath: face and legs, light brownish yellow; the base of the front with a broad yellowish band, margined with fuscous; abdomen beneath yellowish with fuscous sutures; the last ventral segment with a black spot in the center.

Length: 4 mm.

Light yellowish and whitish with nearly hyaline elytra; dark fuscous patches on disk of pronotum, disk of clavus, middle of the elytra, apex of clavus, and across the apical cells.

Described from several specimens (*type*, *allotype*, and *paratypes*) from Province del Sara, Bolivia, elev. 450 M., November 1909, C. M., Acc. No. 4549 (Steinbach *coll.*). Specimens from Puerto Suarez, Bolivia, elev. 150 C. M., Acc. No. 3844 (Steinbach *coll.*) differ from the typical form in being slightly smaller, less distinctly maculate, and with the pronotal spot obsolete or very faint. If constant, it may be known as variety *pallida*.

Genus PLATYMETOPIUS Burmeister.

Platymetopius BURMEISTER, Genera Insectorum, I, 1838, Subgenus 4, Pl. 14.

8. *Platymetopius lineolatus* sp. nov.

Head scarcely as wide as pronotum; vertex a little longer than width at base, about twice as long at the middle as next the eye, flattened and slightly depressed, margins acute; front faintly concave in profile, strongly convex transversely; clypeus nearly twice as long as basal width; loræ long, almost touching margin of cheek; cheek convex, scarcely emarginate under eye; pronotum about three-fourths the length of vertex, strongly arched, deeply concave behind; scutellum wide; elytral veins distinct; claval veins closely approximate at cross-vein; costal veinlets strongly reflexed. *Genitalia: male*, valve triangular, distinctly angulate behind; plates widening at base, then contracting rapidly to compressed tips, the united plates forming a sharp keel on the median line.

Olive-green, marked with light stripes and dark lines; vertex with two stripes slightly divergent extending to near the apex, slightly passing the origin of the apical median wedge; pronotum with five longitudinal stripes bordered with fuscous; scutellum with two slightly divergent stripes bordered with fuscous, their origin midway between the median and inner lateral stripe of pronotum; veins of elytra black, mostly margined with light olive; areoles hyaline, partly

occupied with blackish lines. Beneath: face light fuscous; a sub-basal stripe on the front bordered with blackish; clypeus and loræ lighter; abdomen black with the narrow margin of segments light yellowish; legs dull yellowish; hind tibiæ with black dots, and the tarsi with tips of segments blackish.

Length: 4 mm.

Distinctly marked on vertex, pronotum, and scutellum with whitish stripes bordered with blackish; and with the elytral veins lined with black, margined with whitish; the costal areoles with numerous oblique black veinlets.

This quite unusual species is described from a single specimen (*holotype*) from Villa Bella, Bolivia, October 6, 1909, Car. Mus., Acc. No. 4043 (Haseman *coll.*).

9. *Platymetopius fuliginosus* sp. nov.

Head scarcely as wide as pronotum; vertex nearly twice as wide in front of eyes as at base, bluntly angulate; margin acute; front narrow, sloping uniformly to the narrow clypeal base; clypeus widening toward the tip; loræ elongate, but not reaching outer third of clypeus; pronotum short, anterior border somewhat sinuate for the reception of the eyes; the elytral venation indistinct, but normal. *Genitalia: female*, last ventral segment one-half longer than preceding, narrowed and sub-truncate behind, with a broad shallow notch at middle; *male*, valve long, broad at base, rounded at apex; the plates short, the part beyond the valve scarcely as long as the valve, broad at base narrowing sharply to near the middle and tapering to rather sharp, slightly divergent, and upturned tips.

Vertex dark fuscous with a spot at the tip, a transverse row of six elliptic spots forming a light band in front of the eyes, and two spots at base, yellow; eyes yellowish transparent; face and legs yellow; pronotum, scutellum, and elytra uniformly dark chocolate-brown, or fuscous, with five very faint lines of yellow dots on pronotum; tip of scutellum and faint oblique yellowish lines along the costal border and a small triangular spot and narrow margin of second apical cell, yellow; abdomen above and below black, with tip of valve and plates yellowish.

Length: female 4 mm.; male, 3.75 mm.

Above dark smoky or chocolate, the vertex with a transverse row of yellow spots; the eyes, face, and legs yellow.

This species comes very close to *P. nanus* Van Duzee, described from Jamaica, but, aside from the larger size, there are sufficient differences in the marking to preclude its reference to that species, unless intermediate forms are found.

Described from one specimen, male (*type*) from Minca, Colombia, June, 19, C. M., Acc. No. 1999 (H. H. Smith *coll.*); and one female (*allotype*) in author's collection from Costa Rica.

10. **Platymetopius sulphureus** sp. nov.

Head as wide as pronotum; vertex longer than wide, bluntly angular at tip, with a median and two lateral impressed lines; front narrow, convex; clypeus narrow; loræ elongate, reaching almost to tip of clypeus; pronotum short, strongly arched in front, slightly concave behind, lateral margins short. *Genitalia: male*, valve long, rounded behind; plates rather short, about the length of the valve, angulate at tip.

Vertex yellow, little more whitish than the pronotum, with faint brownish lines near the apex and in the depressed lateral lines; face brown, becoming blacker toward the margin; base of the front with alternating brown and yellow lines and one or two faint arcs on each side; pronotum, scutellum, and clavus with broad yellow stripe and bordered with whitish; the outer part of pronotum, angle of scutellum, outer base of clavus, and corium and membrane dark brown with fuscous and blackish patches; the costal cell with about six oblique angular milky bars. Beneath blackish; hind tibiæ whitish, with black dots at base of black spines.

Length: 4 mm.

A fuscous and smoky-black species with vertex, disk of pronotum, scutellum, and most of clavus sulphur-yellow with a whitish border.

Described from a single specimen (*holotype*) from Province del Sara, Bolivia, C. M., Acc. No. 5064 (Steinbach *coll.*).

11. **Platymetopius loricatus** Van Duzee.

Platymetopius loricatus VAN DUZEE, Bull. Buffalo Soc. Nat. Sci., V, 1894, p. 205.

Head narrower than pronotum; vertex one and one-half times as long as broad; apex bluntly angular, margin sub-acute; front narrow; clypeus widening to tip; loræ elongate; margin of cheeks nearly straight from eye to clypeus; pronotum sharp, distinctly sinuate behind the eyes, while on margin slightly concave; venation of elytra of the typical form. *Genitalia: male*, valve rather short; hind margin rounding; plates broad at base; outer margins straight; tips acute, each plate forming half of an equilateral triangle.

Yellowish gray above, the vertex slightly brownish, with light lines running from the margin on to the disk; the pronotum with five faint whitish longitudinal lines; scutellum with whitish dots; elytra with rounded whitish hyaline spots on a ground-work of brownish with

minute fuscous dots; costal margin with about ten oblique fuscous veinlets; face yellowish with minute fuscous dots and a pale spot at base; legs and abdomen yellowish, dotted with fuscous.

Length: 3.60 mm.

This species bears some resemblance to the *verecundus*-group, but is minutely dotted on the face, and the male plates are short, almost equilaterally triangular.

Two males and one female from Cacagualito, Colombia, May 19, 1898; two females from Bonda, Colombia, June and July 1898, C. M., Acc. No. 1999 (H. H. Smith *coll.*).

These, with previous records from the southern United States and Guatemala, give a wide range for the species.

Genus SCAPHOIDEUS Uhler.

Scaphoideus UHLER, Trans. Maryland Acad. Sci., I, 1889, p. 33.

12. *Scaphoideus bicolor* sp. nov.

Head as wide as pronotum; antennæ very long; vertex bluntly angulate, about twice as long at middle as next to eye, margin bluntly angulate; front slightly convex, lateral border sinuate; clypeus nearly twice as wide as long, truncate at apex; loræ large, reaching margin of cheek; margin of cheek slightly sinuate; pronotum a little longer than vertex, strongly arched, hind border slightly concave. *Genitalia: female*, last ventral segment produced at middle into a blunt tooth, this and the bristles of pygofer fuscous; *male*, valve small, tubular, resembling small terminal segment, with broad triangular tooth on tip; plates narrow, strongly upcurved into slender tips with long delicate setæ.

Above entirely dark chocolate-brown, except a white dot at end of each claval vein and a whitish hyaline spot on the costa at middle, another including a cross-vein below outer anteapical cell and a few whitish dots on veins. Beneath whitish, the apex of hind tibiæ and tarsal joints fuscous.

Length: female 4.5 mm.; male, 4 mm.

The species is dark chocolate-brown or fuscous above; white or soiled whitish below, tips of hind tibiæ and bands on tarsal joints and tarsal claws fuscous.

It is a handsome species, quite similar in size and coloration to *Platymetopius fuliginosus* sp. nov., but with very different details of structure.

Described from a series of fourteen specimens, two females, twelve

males. One female (*type*) labelled "Las Juntas, Bolivia, J. Steinbach, December 1913, Car. Mus., Acc. No 5066." Another female (*paratype*) "J. Steinbach Cuatro Ojos, Bolivia, November 1913; Car. Mus., Acc. No. 5056." The males (*allotype*) and (*paratypes*) are all but one from the Province del Sara, Bolivia, December 1912, C. M., Acc. No. 5064 (J. Steinbach *coll.*). One is from Province del Sara, Bolivia, elev. 450 M., Car. Mus., Acc. No. 6443 (J. Steinbach *coll.*).

13. **Scaphoideus punctulatus** sp. nov.

Head wider than pronotum; vertex one-half longer at middle than next to eye; ocelli half-way between margin of eye and apex; vertex with margin obtuse; front narrow, nearly twice as long as width between antennæ, margin sinuate, apex truncate; loræ large, extending to margin of cheeks; cheeks narrow, margin scarcely sinuate; pronotum slightly longer than vertex, hind margin almost straight. *Genitalia: male*, valve triangular, plates narrow, apices long and upcurved, closely appressed to pygofer, densely ciliate, fuscous at base and tip.

Light fuscous; vertex with very minute or obsolete dots and a median line forked at the apex, whitish; ocelli included in whitish marginal band; pronotum minutely dotted with whitish; scutellum whitish toward apex; elytral veins fuscous, with numerous whitish dots, the areoles brownish white. Beneath dirty white, legs darker toward the tips.

Length: 4 mm.

Dark brown or fuscous above with minute whitish dots on pronotum and elytral veins. Beneath dirty or soiled whitish.

Described from six specimens, males, three from Province del Sara, C. M., Acc. No. 5064 (*type* and *paratypes*) (Steinbach *coll.*); two from Ft. Principe, Rio Guaporé, Brazil, August 1909, C. M., Acc. No. 4043 (Haseman *coll.*); one from Bahia, Brazil, Dec. 8, 1907, C. M., Acc. No. 3702 (Haseman *coll.*).

14. **Scaphoideus longicornis** sp. nov.

Head as wide as pronotum, vertex rather narrow, as long as width between the eyes, nearly twice as long at middle as next to eye; ocelli half-way to apex a little above the usual position, conspicuous from above; front narrow, nearly twice as long as width between antennal pits, margin sinuate; clypeus nearly twice as long as wide, sides nearly parallel, and very slightly widened to apex; apex truncate, loræ very large, reaching margin of cheek; cheek-margin rounded, slightly sinuate beneath eye; pronotum a little longer than vertex,

hind margin slightly concave. *Genitalia: male*, valve small; plates elongate, densely ciliate toward the tips, and with rather strong dark bristles on the disk.

Dull brown and fuscous, minutely dotted with yellowish white and white on the vertex, front, scutellum, and veins of elytra, with a more pronounced whitish spot behind eye; base of clavus, ends of claval veins, side margins of scutellum, whitish; a whitish semitransparent band behind the middle including a zigzag fuscous line on basal cross-veins of anteapical cells. The cross-veins at base of apical cells and outer part of areoles smoky. Beneath dull brownish white, abdominal segments brown with whitish margin. Tarsal claws darker.

Length: male, 5.5 mm.

Antennæ extremely long, almost as long as body; front, vertex, pronotum, scutellum, and veins of elytra, minutely dotted with white.

Described from three specimens, males (*type* and *paratypes*) from Province del Sara, Bolivia, December 1912, C. M., Acc. No. 5064, (Steinbach *coll.*).

15. *Scaphoideus hyalinus* sp. nov.

Head as wide as pronotum; vertex more than half longer at middle than next to the eye, obtusely angulate; front narrow, tapering nearly uniformly from base to clypeus; clypeus nearly twice as long as wide, truncate at apex; loræ large, reaching margin of cheek; cheek-margin distinctly sinuate; pronotum little longer than vertex, hind margin slightly concave; elytra transparent, the veins more opaque. *Genitalia: female*, last ventral segment twice as long as preceding, lateral angles rounded, slightly produced at middle; *male*, valve short; plates narrow, elevated on the disk, tips very slender and extended into large ciliated filaments.

Light straw-color, with fuscous dots along the commissure, one at end of each claval vein, one at apical angle of clavus, usually one at each cross-vein against outer anteapical, and in some specimens a discal cross-vein and base of fork with fuscous dot.

Length: female, 5 mm.; male, 4.25 mm. to 4.5 mm.

Uniformly light straw-color. Elytra hyaline, with black points at tips of claval veins, apex of clavus, and two cross-veins of costa at outer anteapical cell.

Described from twelve specimens: five from Province del Sara, Bolivia, elev. 450 M. (Steinbach *coll.*); three males, one female (*type*) from Province del Sara, C. M., Acc. No. 5064, November-December 1912, and February 1913, (Steinbach *coll.*); one male (*paratype*) Barra, Brazil, December 6, 1907, Car. Mus., Acc. No. 3533 (Haseman *coll.*).

16. *Scaphoideus affinis* sp. nov.

Head as wide as pronotum; vertex one-third longer at middle than next to eye; front narrowing uniformly to clypeus; clypeus long, widening to apex; loræ large, reaching margin of cheek; cheek-margins sinuate; pronotum one-fourth longer than vertex, hind margin concave; elytra transparent. *Genitalia: female*, last ventral segment produced into a long acute tooth, nearly as long as the segment at the side; *male*, valve broad and short; plates narrowing rapidly to very slender tips and extended into delicate filaments.

Light to straw-color; the vertex, pronotum, and scutellum somewhat suffused with yellow. Dots at end of claval nerves and apex of clavus, faint, almost obsolete; cross-nervures not infuscated.

Length: female, 4.5 mm.; male, 4 mm.

Very similar to *S. hyalinus* Osborn (No. 15) but with distinctly produced ventral segment.

One specimen, female (*type*) from Las Juntas, Bolivia, December 1913, C. M., Acc. No. 5066 (Steinbach *coll.*); one female (*paratype*) and one male (*allotype*) from Minca, Colombia, May 1898, C. M., Acc. No. 1909 (H. H. Smith *coll.*).

17. *Scaphoideus fulvomaculatus* sp. nov.

Head little wider than pronotum, strongly angulate; vertex as wide as long, nearly half longer at middle than next to eye; ocelli close to the eye; front convex, narrowing evenly to clypeus; clypeus nearly twice longer than width at base, distinctly wider toward apex; loræ nearly touching margin of cheek; cheek-margin distinctly sinuate; pronotum one-half longer than vertex, hind margin faintly concave; elytral veins distinct, two cross-veins in costa, one at each end of outer anteapical cell. *Genitalia: male*, valve short, transverse, hind margin nearly straight; plates wide at base, narrowing to slender tips, which are extended into delicate filaments; pygofers long, expanded, and with dense coarse dark bristles.

Gray-brown; vertex with anterior border including ocelli, a transverse spot within the apex, and the basal third, whitish; a submarginal band and the borders of the transverse fulvous band, fuscous; pronotum gray, somewhat suffused with brown, a conspicuous spot anteriorly, two rather faint spots on disk, fulvous; scutellum with four spots on the basal margin and two on lateral margin, ivory-white; central area yellowish bordered with brown; elytra transparent, with milky patches on clavus; veins and spots at end of claval veins, claval apex, cross-nervures, costa, and apical border, infuscate. Beneath dull straw-color, the venter infuscate with margin whitish; legs dull straw-color. Hind tibiæ and joints of tarsi with fuscous dots and bands.

Length: male, 4 mm.

This species is very close to our North American *S. auronitens* Provancher, but smaller. It is characterized by the fulvous band on vertex margined with fuscous and the fulvous spots on pronotum and scutellum. It is doubtless derived from the same stock as *S. auronitens*, but, besides the much smaller size, there are differences in detail, which must separate this form, unless intermediate forms are found to connect them.

One specimen, male (*holotype*) from Minca, Colombia, May 1898, C. M., Acc. No. 1999 (H. H. Smith *coll.*).

18. *Scaphoideus obliquus* sp. nov.

Head as wide as pronotum, distinctly angulate; vertex somewhat depressed, margins obtusely angulate, one-half longer at middle than next the eye; front narrow, tapering nearly uniformly to clypeus; clypeus slightly widening toward the tip, one-half longer than wide; loræ large, long, almost touching margin of cheek; cheek-margin slightly sinuate below the eye; pronotum one-half longer than vertex; hind border distinctly concave; elytral venation of the usual pattern, except that the cross-veinlets in the discal areole are distinct and so located that one of them appears like a second cross-vein. Two nodal veins from lower border of outer antepical. *Genitalia: male*, valve obtusely angulate behind; plates elongate, outer borders slightly sinuate with delicate setæ, somewhat spoon-shaped, the tips acute.

Yellowish fulvous, two roundish spots on vertex, two on anterior border of pronotum and two large spots at sides of scutellum orange-fulvous; elytra light brownish with milky and hyaline areas, a conspicuous black dot below the claval cross-vein, a large discal spot in the inner discal areole, an oblique line from end of clypeus across the ends of antepical cells, and following the first apical veinlet the cross-veinlets, fuscous; the veins mostly brownish and the membrane bordering the oblique fuscous line, smoky. Face dark fuscous with a faint purplish bloom, the cheeks somewhat darker and the front with narrow yellow arcs; legs yellowish white; femora with broad fuscous bands; a dot near the apex, and a series of dots on the tibiæ, and bands of the tarsal joints, fuscous.

Length: male, 5 mm.

Somewhat resembling *S. jucundus* Uhler, but with the face entirely dark, and the orange-fulvous spots of vertex and pronotum and scutellum differently arranged. Discal areole of elytra with a number of cross-veinlets. This species presents a distinct facies for the genus, apparently belonging to the *jucundus*-group with which it agrees in the nodal veins and the type of the genitalia.

Described from a single male specimen (*holotype*) from Chapada, Brazil, C. M., Acc. No. 2966 (H. H. Smith *coll.*).

SCAPHOIDULA gen. nov.

Somewhat like *Scaphoideus*; head broad; vertex rounded to the front; ocelli large, scarcely their diameter from margin of the eye; pronotum short, as long as vertex; side margin short; hind margin emarginate; scutellum large; elytra with two strongly oblique cross-veinlets below anteapical cell. Type of the genus *Scaphoidula cingulata* sp. nov.

19. *Scaphoidula cingulata* sp. nov.

Head wider than pronotum, sub-angulate; vertex as wide as length at middle, half longer at middle than next the eye, convex, rounded to front; ocelli large, conspicuous, less than their diameter from the eye; front longer than broad, tapering evenly to the clypeus; clypeus widening slightly toward tips, twice as long as width at base; loræ large, margins rounded; cheek-margins sinuate; pronotum short, as long as vertex; hind border distinctly concave; elytral veins obscure. *Genitalia: female*, last ventral segment with the angles produced and the hind border nearly truncate; lateral angles produced into teeth.

Milky white; vertex with a central and basal band; pronotum with a central band; scutellum with a basal and sub-apical band; most of the clavus, oblique stripes on apical part of the corium, and borders of the apical veins, fuscous; three black lines on the border of vertex and front, one just above and two below the ocelli; face and underside white, except a band on the femora and dots on the middle and hind tibiæ and bands on the hind tarsi, which are black.

Length: female, 5.5 mm.

This species is characterized by being milky white with bands, stripes, and lines of fuscous. It shows affinity to *Scaphoideus*, but the rounded border of the vertex and the picturing of the apex of the wing seem to make it fall into a group different from any of the known species.

One female specimen, (*holotype*) from Province del Sara, Bolivia, November, 1912, C. M., Acc. No. 5064 (Steinbach *coll.*).

Genus DELTOCEPHALUS Burmeister.

Deltocephalus BURMEISTER, Genera Insectorum, I, 1838, Subgenus 3, Pl. 14.

20. *Deltocephalus marginellus* sp. nov.

Head slightly wider than pronotum, subangular; vertex wider than long, half longer at middle than next the eye; margin sub-acute;

front as broad as long; clypeus with sides nearly parallel, one-half longer than broad; cheek-margins nearly straight. Pronotum slightly longer than vertex, faintly concave behind; elytra with two cross-veins and a cross-vein in the middle anteapical cell. *Genitalia: female*, last ventral segment slightly longer than preceding, truncate; pygofer short, set with short stiff bristles toward the apex.

Light brown or dull straw-color; the eyes brown; border of vertex ivory-white, with a black line above and below; elytral veins dull whitish, faintly bordered with darker brown.

Length: female, 3.75 mm.

Somewhat flattened; vertex broad, subangulate, light brown, edge of vertex ivory-white margined with black above and below.

Described from two females (*type* and *paratype*) from Province del Sara, Bolivia, elev. 450 M., Nov. 1909, C. M., Acc. No. 4549 (Steinbach *coll.*).

21. *Deltocephalus tumidus* sp. nov.

Head wider than pronotum, strongly angulate; margin obtuse; vertex as long as wide, nearly twice as long at middle as next the eye; front tumid; clypeus one-half longer than wide, slightly expanded at tip; loræ large; cheek-margin rounded; pronotum as long as vertex, almost truncate behind; costa narrow; outer anteapical long. *Genitalia: male*, valve triangular; plates narrow, compressed; tips acute and upturned, scarcely exceeded by the pygofer.

Dull whitish; vertex with two oblique spots; front at base with two stripes almost meeting at middle, dark orange. Pronotum with four brown stripes; scutellum with brown spots at base and before the apex; elytra smoky, the inner border of clavus with white patches, the costa with a broad hyaline patch, the anteapical and apical areoles partially hyaline, the nervures darker. Beneath: face below the middle of front dusky; pectus and venter blackish; legs and borders of abdomen whitish; tibiæ dusky toward the tip and the tarsal joints tipped with dusky.

Length: male, 3.75 mm.

White, with conspicuous orange spots on vertex; fuscous stripes on pronotum; and elytra irregularly smoky with hyaline patches.

Described from five male specimens (*type* and *paratypes*), four from Province del Sara, Bolivia, elev. 450 M., December, 1912–February, 1913, C. M., Acc. No. 5064; and one from the same region, taken November 1909, C. M., Acc. No. 4549 (Steinbach *coll.*).

Genus EUSCELIS Brullé.

Euscelis BRULLÉ, Exped. Scientif. de Morée, III, 1832, p. 109 (?).

20. *Euscelis quadrimaculata*¹ sp. nov.

Head distinctly wider than pronotum, broadly arched; vertex short, scarcely longer at middle than next to eye; front longer than broad, margins scarcely sinuate; clypeus half longer than wide; loræ small, scarcely touching front, distant from margin of cheek; cheek-margin faintly sinuate; pronotum twice as long as vertex; side margin reduced to angle, hind border rather deeply concave; scutellum with deep transverse depression; elytra hyaline, veins narrow, becoming obscure toward the apex. *Genitalia: male*, valve large, longer than preceding segment; hind border broadly rounded; plates compressed, narrowing to acute upturned tips, sparsely setose, distinctly spoon-shaped, a white band across base of the median part.

Dark gray; vertex with black spot next the eye, and three red lines merging into a rather indefinite reddish patch on each side of the median fuscous spot; front broadly bordered with fuscous, enclosing a central lance-shaped spot; clypeus entirely black, an oblique spot below ocellus; lobe above antenna, outer part of loræ, and lower part of cheek, whitish. Pronotum gray, darker on disk, with four large rounded black spots nearly touching the border anteriorly; scutellum black at base and on transverse impression, with an orange-yellow band before impression, connected at sides with light yellowish apex; elytra transparent milky, the veins fuscous, except the costal and outer apical, which are whitish hyaline; thorax black, pleural pieces bordered with whitish, legs dirty white, distal part of tibiæ and tarsal joints somewhat brown; abdomen black, segments narrowly margined with whitish.

Length: male 5 mm.

This species is characterized by being dark gray, the pronotum having four large round black spots anteriorly; the face being black with a central lance-shaped spot on front, and the oblique spots next ocelli, the lobe above antenna, the outer margins of loræ, and outer margins of cheek being whitish.

Two male specimens (*type* and *paratype*) from Chapada, Brazil, November C. M., Acc. No. 2966 (H. H. Smith *coll.*).

¹ Σχελίς or σκελίς, ἡ, being a feminine noun, the adjective qualifying it should have a feminine ending, a fact hitherto overlooked by numerous writers, who have named species in this genus. *W. J. Holland.*

23. **Euscelis quinquemaculata** sp. nov.

Head wider than pronotum, broadly rounded; vertex scarcely as long at middle as next to eye, rounded evenly to front; front as wide as long, minutely punctate; clypeus with sides parallel, apex convex, with a broad median carina; loræ faintly tumid at upper angle, small, not reaching margin of cheek; cheek-margin nearly straight; pronotum more than twice as long as vertex, deeply concave behind; elytra longer than abdomen. *Genitalia: male*, valve small, angular; plates compressed, tips strongly upcurved, sparsely hairy.

Dark fuscous and black, vertex whitish with six dark fulvous spots one on each side near eye, two oblique, touching hind border, and two anteriorly, which send branches to unite on the median line below, enclosing an angular whitish spot; eyes bordered with black; front, clypeus, loræ, and cheeks all black; pronotum fuscous, the anterior border with three large roundish spots, and the lateral angles whitish and separated with brown; scutellum black, apex yellowish; elytra milky hyaline, veins whitish, apex broadly fuscous. Beneath: thorax and femora and venter black; a spot on anterior pleural piece, tips of femora, anterior and middle tibiæ and tarsi, narrow margin of abdominal segments, whitish.

Length: male, 4.5 mm.

Very similar to *E. quadrimaculata* (No. 22), but with five whitish spots bordering pronotum anteriorly. The face black, and elytra broadly fuscous at apex.

One specimen, male (*holotype*) from Chapada, Brazil, January 10th, C. M., Acc. No. 2966 (H. H. Smith *coll.*).

24. **Euscelis quadratula** sp. nov.

Head wider than pronotum, vertex broad and short, slightly broader at middle than next eye, rounding to front; front broad, polished at the sides, minutely punctate and somewhat flattened on the disk; clypeus with nearly parallel sides, about half longer than wide, with elevated ridge; loræ large, reaching nearly to margin of cheek; cheek-margin subangulate under the eye, then nearly straight to clypeus; pronotum short, broadly arched in front, faintly concave behind; elytral veins distinct; no cross-veins in clavus or costa. *Genitalia: female*, last ventral segment about twice as long as preceding, hind border produced medially, slightly carinate; *male*, valve short, rounded behind; plates short, narrowed rather abruptly to middle, then tapering to slender upturned tips.

Milky-white, the vertex with white quadrate spots; border, middle, and posterior band on pronotum, edge of scutellum, arcs on front, margins of clypeus, spots on loræ, and inner angle of cheek, tips of femora, base of tarsal joints, white; the broad band on vertex median

stripe, large included areas in the white quadrant, front, median stripe on clypeus, borders of loræ and inner angle of cheek, median transverse band anteriorly, and a broad band across base of pronotum, most of scutellum and elytral veins, femora, apex, and parts of tarsi, black; elytra hyaline, with veins dark fuscous or blackish, the apex very faintly smoky.

Length: female, 4.5 mm.; male, 4 mm.

Milky-white with shiny black bars and spots, forming two large squares on the vertex and basal front; the white quadrate areas separated by a broad median stripe and enclosing two shiny squarish spots, which merge below into a transverse basal band on the front.

One specimen, female (*type*), and one male (*allotype*), from Boqueirão, Rio Grande, Brazil, January 8, 1898, C. M., Acc. No. 3533 (Haseman *coll.*). A second female (*paratype*) from Province del Sara, Bolivia, elev. 450 M., C. M., Acc. No. 6443 (Steinbach *coll.*), differs in being lighter colored, but appears to be structurally identical. The black included spots on the vertex are not as angular, with basal band on front broken on lower edge; the lower part of front is white, and there is less black on clypeus and loræ; the legs mostly white, beneath tinged with fuscous; pronotum with anterior cross-band faint, posterior cross-band narrow, and all elytral veins more narrowly lineate with black or fuscous. This specimen may represent a distinct species, or a variety, but has the appearance of being immature or teneral, and the fainter coloration may be due to this condition. In size and color-pattern they agree closely with and resemble *E. exitiosa* (Uhler) in general appearance, but the color-pattern of the vertex and front are decidedly different. The male closely agrees with the light female in color, although from the same locality as the darker female.

25. *Euscelis lineata* sp. nov.

Head broad, wider than pronotum, with a strongly arched vertex, twice as wide as long, slightly longer at middle than next the eye, somewhat depressed, margin bluntly angulate; front broad, narrowing sharply to clypeus; clypeus half longer than wide; cheeks gently sinuate; pronotum half longer than vertex, hind border nearly straight; clavus with inner vein close to the angle, no cross-veins. *Genitalia: female*, last ventral segment about twice as long as preceding, slightly concave behind; pygofer with whitish cilia toward the tip; *male*, valve transverse, rounded behind; plates long, triangular, with acute tips.

Above olive-brown; vertex with anterior border yellow, basal

margin whitish; a black sub-marginal line between ocelli; front black, with faint arcs; a short central line on apical half, margins of clypeus, a band across the loræ, margins of cheeks, yellowish; pronotum with a basal margin of yellowish; the elytral vein and costa whitish. Beneath black; the beak, tibiæ, tarsi, and hind margins of ventral segments dull whitish.

Length: female 3.75 mm.

A small olive-gray species, with yellowish bands on vertex and pronotum, and yellowish lines on elytra; beneath black; tibiæ and tarsi light.

Described from three specimens, a female (*type*) and male (*allotype*) from Province del Sara, Bolivia, elev. 450 M., November 1912, C. M., Acc. No. 5064; and one female (*paratype*) from the same locality, December 1918, C. M., Acc. No. 6443 (Steinbach *coll.*).

EUSCELOIDIA gen. nov.

Venation similar to that of *Euscelis*; the vertex strongly sloping, and with the front forming a prominent almost snout-like expansion, which angles bluntly to the clypeus; the loræ rather small, wedge-shaped; cheeks narrow; scutellum large, acuminate at tip; claval veins obscure, with the cross-vein, no cross-vein over the middle anteapical; outer anteapical short, less than half of middle anteapical, and located toward its end; apical areoles indistinct, leaving the apex apparently membranous, somewhat as in *Clastoptera* Germar; (the membranous part is bent downward, but apparently by accident). Type of genus *E. nitida* sp. nov.

26. *Eusceloidia nitida*.

Head wider than pronotum, strongly arched; vertex declivous and merging directly with front; front strongly convex, narrowed below the antennæ, lower part bluntly produced; clypeus oblong, faintly carinate; loræ nearly touching margin of cheek; cheek narrow, border nearly straight from back part of eye to clypeus; ocelli nearly half-way from eye to middle line; antennæ with rather deep sockets overhung by a blunt ridge at the side of the front; pronotum concave behind, lateral border very short; elytra with three anteapical areoles, one cross-vein; the veins of corium conspicuous. *Genitalia: male*, valve short, apparently rounded behind; the plates broad, rounded to a blunt apex, the central part spoon-shaped.

Ivory-white on lateral part of vertex and front; central part of pronotum and scutellum, lower part of the face and femora, except at tip, the central part of vertex and front, jet-black, with black or piceous lines running into the white area; the lower pair touching the inner border of ocellus; the cheek below the eye and including

the antennal pit, black; apex of front, all of clypeus, loræ, and lower part of cheek, white; pronotum with a narrow black line paralleling the anterior border on the middle, the sides with a piceous patch and the entire pronotum tinged with greenish; scutellum ivory-white, except for the lateral angles, which are greenish; elytra whitish semi-transparent, with the nervures and lines in the areoles broadly fuscous; membrane smoky; base and tip of femora and the tibiæ blackish; abdomen beneath black.

Length: 3.5 mm.

Polished; vertex and front ivory-white, with brilliant jet-black median stripe; pronotum and scutellum ivory-white, suffused with greenish or olive, especially toward the sides.

One male specimen (*holotype*) from Las Juntas, Bolivia, December 1913, C. M., Acc. No. 5066 (Steinbach *coll.*).

Genus MESAMIA Ball.

Mesamia BALL, Proc. Davenport Acad. Sci., 1907, pp. 31, 59, 75. (As subgenus of *Eutettix*.)

27. *Mesamia fasciata* sp. nov.

Head broad, distinctly wider than pronotum, strongly arched; vertex one-third longer at middle than next to eye, flattened on disk, angulate to front; front about as broad as long, narrowing from antenna to clypeus which is broad, nearly as wide as long; loræ narrow, not reaching border of cheek; cheek broadly sinuate; pronotum half longer than vertex, broadly concave behind; three or four reflexed nodal veins, outer antepical narrowed toward tip, first veinlet arising from its end. *Genitalia: male*, valve short evenly rounded; plates narrowing to bluntly acuminate tips; compressed to form a ventral keel.

Gray suffused with brown, vertex with narrow border of yellow; transverse bands of vertex fuscous, white, brown, and white; pronotum gray, faintly irrorate with fuscous, darkening into two rather faint broken transverse bands; elytra brownish sub-hyaline, with milky spots, the claval areoles, and ends of inner and outer apical cells, and veins, fuscous; costal and apical veins blacker; front with lightish arcs above clypeus; loræ and cheek dirty white; legs whitish with dots on tibiæ and bands on same, fuscous. Abdomen yellow with fuscous bands, margined with whitish.

Length: male, 5 mm.

About size and general appearance of *M. straminea* (Osborn), but distinct black, brown, and whitish bands on the vertex; front with distinct whitish arcs; abdomen yellowish, segments banded with fuscous and edged with white.

Described from one specimen, male (*type*) from Province del Sara, Bolivia, C. M., Acc. No. 5064 (Steinbach *coll.*).

28. **Mesamia hyalina** sp. nov.

Head slightly wider than pronotum, sub-angulate; vertex at middle twice as wide as length; about one-fourth longer at middle than next eye, obtusely angulate to front; front longer than wide, narrowing from antenna to clypeus; clypeus one-half longer than wide; cheeks slightly sinuate; pronotum one-half longer than vertex, scarcely concave behind; elytra hyaline, veins faint, a single costal veinlet near base of outer anteapical, first apical arising from end of anteapical, three apical cells. *Genitalia: female*, last ventral segment a little longer than preceding, somewhat produced on the hind border and with a blunt median tooth; *male*, valve nearly semicircular; plates short, not as long as pygofer, broad at base, sinuate on margin and acuminate at tips.

Bright yellow, somewhat tinged with fulvous; vertex on anterior border and base ivory-white with six black dots on the margin and one on each side touching eye; pronotum with milky whitish median line, a broader stripe on each side, and lateral borders; scutellum with lighter dot near apex and dusky dot near end on each side; elytra hyaline with milky spots in clavus; veins faint, the costal and apical veinlets fuscous. Beneath: yellowish; front with faint whitish arcs; tarsi tipped with fuscous.

Length: female, 4 mm.; male, 4 mm.

With many resemblances to *M. johnsoni* Van Duzee, but smaller. Elytra more hyaline. Abdominal segments of female above punctate at spiracles.

Described from one female (*type*) Cacaqualito, Colombia, May, C. M., Acc. No. 1909, and three specimens, including one male (*allotype*) Minca, Colombia, C. M., Acc. No. 1999. Two specimens with abdomens lost. (H. H. Smith *coll.*). A damaged specimen in the author's collection "W. Ind. (?) Summers" seems to belong here also, although the vertex is a little more produced.

Genus EUTETTIX Van Duzee.

Eutettix VAN DUZEE, *Psyche*, VI, 1892, p. 307.

29. **Eutettix cinctus** Osborn and Ball.

Head wider than pronotum, subangulate; vertex a little longer at middle than next the eye; front about as broad as long; clypeus one-third longer than broad; loræ large, touching margin of cheek; pronotum nearly twice as long as vertex, distinctly concave. *Genitalia:*

female, last ventral segment long, hind border sinuate and produced at the middle; *male*, valve short; plates with margins sinuate; tips acute and upturned.

Light gray, faintly irrorate with fuscous; base of elytra milky, white, except an oblique irregular spot on clavus; the anteapical cells infuscated and about four triangular black spots on the apical part of the costa. Beneath: dark fuscous; front with lighter arcs; the clypeus, loræ, and cheeks bordered with light fuscous; legs annulate with fuscous.

Length: female, 5.25 mm.; male, 4.5 to 5 mm.

Light gray, irrorate; a broad broken fuscous band crossing the anteapical cells, contrasting with the milky white band back of the scutellum.

Specimens of this species are in hand from Pará, Bahia, and from Januaria, Minas Geraes, Brazil, December 1907 (Haseman *coll.*); also from Province del Sara, Bolivia, elev. 450 M. (Steinbach *coll.*). They agree very closely with North American specimens of this species, but are uniformly a little smaller and in some specimens, especially the males, the bands are less distinct. Probably they might be regarded as representing a geographical variety, but it is probable that a sufficient number of specimens from intermediate localities would connect the two extremes. The range of the species is extensive, running from Iowa and Ohio in the north, to central Brazil and Bolivia in the south.

30. *Eutettix neocinctus* sp. nov.

Head wider than pronotum, broadly rounded; vertex three times as wide as long, slightly longer at middle than next to eye, faintly depressed, rounded to front; front about as wide as long, narrowing abruptly to clypeus; clypeus half longer than wide, widening slightly toward tip, faintly carinate; loræ reaching nearly to margin of cheek; cheek-margin distinctly sinuate; pronotum twice as long as vertex, concave behind; costal veinlets slightly reflexed, three or four in number, two or three arising from outer anteapical; first apical arising from end of anteapical cell. *Genitalia: female*, last ventral segment about twice as long as preceding, with three distinct lobes formed by a shallow incision; *male*, valve short, rounded behind; plates broad at base, narrowing to beyond the middle, then tapering to acute tips.

Dark gray; vertex, pronotum, and scutellum rather faintly irrorate with gray and fuscous; elytra sub-hyaline; areoles of clavus and inner areoles of corium milky; veins brown; costal and apical veinlets fuscous. Beneath darker; face, legs and abdomen infuscate; front

with faint whitish arcs; base of clypeus, inner part of cheeks, tips of femora, and bases of tarsi, dirty white.

Length: female, 5.5 mm; male, 5 mm.

Very similar to *Eutettix cinctus* Osborn and Ball, but lacking the distinct band of that species, and with the female segment more deeply incised, and the bands of femora not distinct. The male seems properly placed here, but differs somewhat in the markings, the elytral areoles, especially next to claval sutures, rather distinctly punctate with fuscous dots. The markings throughout are more distinct, nevertheless there seems no sufficient character for separation, and the differences are no greater than are found in the sexes of some other species.

One female (*type*) from Province del Sara, Bolivia, December 1911, C. M., Acc. No. 5064; male (*allotype*) from same locality, November 1909, C. M., Acc. No. 4549 (Steinbach *coll.*).

31. *Eutettix punctatus* sp. nov.

Head a little wider than pronotum; vertex one-fourth longer at middle than next the eye, convex, rounded to front; front narrow, tapering almost uniformly from base to clypeus; clypeus nearly twice as long as width at base, slightly widened beyond the middle; loræ elongate, distinctly angled above and below, and reaching the margin of the cheek; cheek-margin distinctly sinuous; pronotum a little more than one-half longer than vertex, broadly arched in front, hind margin truncate; elytra with reticulations of pigment-lines on discal and antepical areoles. *Genitalia: female*, last ventral segment slightly concave.

Light gray; vertex irrorate dusky; scutellum ivory-whitish, with a black point on each side and a minute dot on each side of apex; elytra milky-white, the basal part next scutellum tinged with yellow, a smoky oblique band from near the base to inner margin next to scutellum; a point at base of clavus, a large spot on the center covering the cross-veins, another large spot on discal cell, the veins and the costal transverse veinlets near base and at either end of outer antepical cell, fuscous or brownish; a patch at tip of the first apical vein, black; face yellowish white, with rather faint brownish arcs; legs light yellowish, with black spots and dots; abdomen dull yellowish white.

Length: female, 5.5 mm.

This appears to be a very distinct species, and, though similar to *Eutettix cinctus* Osborn and Ball, has a different color-pattern. The elytra are milky white with a faint oblique smoky band just be-

hind the scutellum, a large fuscous spot covers the claval cross-vein, another is seen on the inner discal cell, and a broad black cross-vein occurs at each end of outer anteapical cell. Beneath yellowish, legs dotted with black.

Described from a single female specimen (*holotype*) from Quatro Ojos, Bolivia, November 1913, C. M., Acc. No. 5065 (Steinbach *coll.*).

32. ***Eutettix irroratus*** sp. nov.

Head scarcely wider than pronotum, short; vertex nearly four times as wide as long, scarcely longer at middle than next eye, evenly rounded at front, a distinct transverse furrow in front of the middle, margin distinctly angular; front broad, slightly convex, lateral margins narrowing from the antennal pits to base of clypeus; clypeus long, about twice as long as broad; loræ ovate, nearly reaching the margin of the cheek; pronotum about four times the length of the vertex, broadly rounded in front, scarcely concave behind. lateral border carinate; elytra broad, claval veins connected by a single cross-vein, outer anteapical cells small, narrowing behind the reflected costal veins, apical cells short. *Genitalia: female*, last ventral segment long, about three times as long as preceding, truncate or slightly concave and faintly sinuate behind with distinct median carina from base to the faintly notched hind margin; *male*, valve short, narrow, apparently mostly hidden by preceding segment; plates broad at base, narrowing to behind middle and extending into slender acute up-curved tips; disk of the valve and a large spot on each plate yellowish.

Brownish fuscous, with whitish or yellowish white patches; vertex with fuscous margin and transverse spots in anterior disk; front black, with light brown spots; clypeus black; loræ black, with yellowish spots on disk; outer margins of cheek yellow; pronotum irrorate with fuscous, yellowish, and brownish; scutellum yellowish on the disk with fuscous spots on each side of base with a black spot on the border near the base, and on each side of the yellow pointed apex; elytra milky-subhyaline with the fuscous veins brownish on their borders; reflex costal veins blackish. Beneath: blackish, with yellowish bands and stripes on the legs and at the sides of the abdominal segments and the connexivum.

Length: 7.5 mm.

This is a striking species, larger and darker colored than *Eutettix cinctus*, Osborn and Ball, and without the distinct transverse band, but with the terminal third of clavus white, or grayish whitish, forming a small angular saddle. With one or two other species it would seem to form a group closely related to *E. cinctus*.

Four females (*type* and *paratypes*) six males (*allotype* and *paratypes*) from Province del Sara, Bolivia, elev. 450 M., C. M., Acc. No. 5064 (Steinbach *coll.*).

33. **Eutettix infuscatus** sp. nov.

Head wider than pronotum, very short; vertex rounded in front, as long at middle as next eye, with a deep transverse furrow just at the anterior margin, striate and angular; front broad and short, narrowing sharply from antenna to clypeus; clypeus long, narrowing slightly to the tip, central part slightly tumid; loræ nearly touching the margin of cheeks; pronotum short, distinctly concave behind; scutellum large, broad at base, deeply impressed at center; elytra with claval veins joined by a distinct cross-vein, also a cross-vein to the claval suture, discal veins distinct, antepical cells small, nodal cell broad, with about three strongly reflexed veinlets in costa. *Genitalia: female*, last ventral segment long, lateral angles rounded, hind border truncate, a strong carina extending from base to apex.

Mainly fuscous; the posterior part of vertex brown, with fuscous spots on hind margin; face nearly black; the front with a faint brown arc, and the suture between loræ and cheek light brown; legs fuscous, touched with brown; front tarsus soiled whitish; pronotum dark fuscous with light brown irrorations; scutellum fuscous, with brownish patches on disks, four light spots on base and three on the apical part; elytra brownish, with dark fuscous nerves and patches in the cells; a whitish angulate spot in the clavus at tip, forming with the spot on opposite vein a short angulate saddle.

Length: female, 5 mm.

This is a handsome species smaller and darker than *E. irroratus*, with a banded vertex, and very strongly carinate female segment. Its occurrence in the two somewhat widely separated localities, would give it a rather extended distribution, although both localities belong to the Amazon basin. There are two males, which probably should be associated with this species, one (*allotype*) from Puerto Suarez, Bolivia, elev. 150 M. (Steinbach *coll.*) and the other (*paratype*) from Asunción, Paraguay. These agree very closely in all characters with the females, but are only 4.5 mm. long. The genitalia are peculiar in that the valve appears trilobate, the tips of the three small lobes being obtusely angular. The plates are small, sides nearly straight, closely setose, the tips acute and up-turned. The trilobate appearance is probably due to the valve being very small and narrow and to triangular elevations on base of plates.

Described from two females, one (*type*) from Chapada, Brazil, C. M., Acc. No. 2966 (H. H. Smith *coll.*); and the other (*paratype*) from Province del Sara, Bolivia, C. M., Acc. No. 5064 (Steinbach *coll.*).

34. **Eutettix femoratus** sp. nov.

Head wider than pronotum, short; vertex about four times as wide as long, slightly longer at middle than next to eye, margin angular, rather distinctly striate, approaching the transverse frontal furrow of *Selenocephalus* (Germar); front broader than long, convex, narrowing very abruptly to base of clypeus; clypeus longer than wide, with a broad ridge on the middle; loræ large, reaching nearly to the margin of cheek; cheek-margin distinctly sinuate; pronotum short, about three times as long as vertex, hind margin distinctly concave; outer antepical cell not narrowed apically; three or four reflexed nodal veins; the first apical vein arising from end of outer antepical cell. *Genitalia: female*, last ventral segment elongate, nearly four times as long as preceding segment; sides narrowing, lateral angles rounded, hind border sinuate, central part elevated, the surface uneven.

Brown; vertex with yellowish marginal lines, a transverse fuscous line reaching border of eye, behind which the disk is fulvous brown; face brown, with light fuscous transverse stripe near base of front; apex of clypeus fuscous; pronotum irrorate with light yellowish brown and fuscous; scutellum brown, with yellow spots on margin; elytra subhyaline, with brown veins; ivory spots in clavus forming the small saddle; inner angle of clavus, reflexed veins of costa, apical veins, and margin of apical cells, fuscous; legs brown, more or less fuscate, especially the femora.

Length: female 6 mm.

Resembling *E. irroratus* and *E. infuscatus* spp. nov.; body broad; three or four prominent reflexed nodal veins; anterior femora enlarged on basal two-thirds; female segment narrowed toward tip and sinuate behind.

One female specimen (*type*) from Las Juntas, Bolivia, December, 1913, C. M., Acc. No. 5066 (Steinbach *coll.*).

35. **Eutettix elegans** sp. nov.

Head broad, wider than pronotum; vertex wide, three times as wide as long, slightly longer at middle than next to the eye, not depressed, obtusely angled to front; front broad, short; clypeus one-half longer than wide; loræ large, almost touching margin of cheek; cheek-margin sinuate; pronotum short, about twice the length of vertex, side margin distinctly carinate, hind margin distinctly concave; elytra with dis-

tinct cross-nervure, three conspicuous cross-nervures on the costa. *Genitalia: male*, valve short, hind border broadly convex; plates narrowing to rather cone-like acute tips, their borders finely ciliate.

Grayish brown with fulvous tinge; broad transverse band on vertex, front border, and behind the middle, fulvous, a light yellow band bordered with black on the anterior edge; hind border yellow; face uniformly light yellow, with trace of brown at the base of front; scutellum brownish, with yellow spots on the margin and two dark dots on the disk; elytra with whitish spots; the vein and spots in areoles brown; reflexed veins of costa and apical veins, black. Beneath: legs yellowish, basal part of abdomen mostly blackish.

Length: male 4.5 mm.

Light fulvous; vertex banded with fulvous and yellow; anterior yellow band margined with black. This handsome little species is represented only by males, and with *E. laticeps* forms a rather distinct type for the genus.

Described from four specimens, males, two (*type* and *paratype*) from Puerto Suarez, Bolivia, elev. 150 M., C. M., Acc. No. 3844 (Steinbach *coll.*); and one specimen (*paratype*) from Villa Bella, Bolivia, October 6, 1909, C. M., Acc. No. 4043 (Haseman *coll.*); and one (*paratype*) from Province del Sara, Bolivia, C. M., Acc. No. 5064 (Steinbach *coll.*).

36. *Eutettix laticeps* sp. nov.

Head very broad and strongly arched; vertex scarcely longer at middle than next the eye, a distinct depressed furrow anteriorly, margin subacute; front broader than long, narrowing abruptly to clypeus; clypeus short, tumid; loræ reaching margin of cheek; cheek-margin excavated under the eye, slightly sinuate; pronotum short, strongly arched, side margins short, distinctly concave behind; elytra transparent, with a golden lustre, costal cross-veins distinct, reflexed. *Genitalia: male*, valve narrow, obtusely angulate behind; plates narrowed abruptly at about one-third their length, then tapering gradually to blunt tips, together somewhat spoon-shaped.

Fulvous with golden reflections; vertex with broad fulvous band on basal half, narrow yellow bands margined with black on anterior and posterior borders; face yellow, narrow line at base of front and clypeal sutures, brown; pronotum irrorate with fulvous-brown; scutellum fulvous, with four yellow spots on base and one on each side near apex; elytra golden iridescent, with some milky-white patches, veins in part brownish, and the costal and apical veins fuscous. Beneath: pale yellowish brown, spots on tibiæ and tips of tarsal joints darker.

Length: male, 5 mm.

This is a striking species related to *E. elegans* sp. nov. (No. 35) but the vertex is more distinctly depressed. The fulvous band is farther back and hind border margined with black, while the pronotum is irrorate and the elytra more nearly transparent and golden.

Male (*holotype*) labelled "Brazil, along Rio Guaporé, below Rio S. Miguel, VIII, 22, 1909," C. M., Acc. No. 4043 (Haseman *coll.*).

37. ***Eutettix reflexus*** sp. nov.

Head broad, distinctly wider than pronotum, strongly arched; vertex short, scarcely longer at middle than at eye, faintly depressed near front margin; front broad, wider than long, narrowing rapidly to clypeus; clypeus short, tumid; loræ broad, not reaching margin of cheek; cheeks wide, slightly sinuate; pronotum twice as long as vertex, slightly concave behind; elytral veins obscured by color-marking; the outer antepical cell distinctly narrowed toward apex, with three broad reflexed costal veinlets arising from its base; first apical veinlet separate from outer antepical. *Genitalia: male*, valve narrow, subangular; plates short, broad spoon-shaped with bluntly rounded tips.

Light gray, marked with olive-brown and fuscous; vertex olive; with transverse fuscous spots on the disk, two small fuscous dots on the front margin near the center; pronotum with four large fuscous spots across the disk; scutellum with two basal spots, lateral angles and apex ivory-white; clavus whitish at base, a broad oblique fuscous patch from inner angle to end of second vein, including two narrow oblique whitish lines, apical part beyond second vein white, followed by triangular fuscous patch; corium with brownish and fuscous veins, fuscous patches in the areoles, two large fuscous spots near the base, and broad fuscous spots on the reflexed costal veinlets, apical veins, and apical margin. The general effect is that of three whitish bands, one at base, one at middle (including the claval cell), and one at apex, and two brownish fuscous bands, the forward one from tip of scutellum to claval saddle, the outer one including the reflexed veinlets and most of the antepical cells. Beneath: front olive, base and apex fuscous; clypeus dark fuscous or blackish, polished; loræ and cheeks yellowish, the former embrowned toward tips; femora polished black, with white apices; tibiæ and tarsi whitish, the hind ones with black lines and dots, and with the tarsi ringed with black; abdomen blackish, bordered with ivory-white.

Length: male, 5 mm.

Light gray with two brownish fuscous bands on the elytra. The venation of this species resembles that of the Hawaiian genus *Nesophrosyne* in the shape of the outer antepical cell and the position of the reflexed veins. Otherwise it agrees with the *laticeps*-group.

One specimen (*holotype*) from Puerto Suarez, Bolivia, elev. 150 M., C. M., Acc. No. 3844 (Steinbach *coll.*).

38. **Eutettix fulvulus** sp. nov.

Head slightly broader than pronotum; vertex more than twice as wide as long, slightly longer at middle than next the eye; front longer than broad, convex; clypeus one-half longer than broad; loræ wide, almost reaching margin of cheek; cheek-margin sinuate; pronotum twice as long as vertex, hind margin slightly concave; cross-veins in costal areoles slightly reflexed, outer antepical with two faint cross-veinlets. *Genitalia: male*, valve short, polished black; plates tapering uniformly to acute tips.

Gray, mostly suffused with fulvous above; narrow front margin of vertex with alternating black and yellow; pronotum rather faintly irrorate with brown; scutellum with five brown dots; elytra nearly uniformly fulvous, with a golden sheen, the veins darker, the costal and apical veinlets nearly black. Beneath: face yellowish, with fuscous transverse lines and arcs; the apical part of clypeus deeply fuscous; loræ and cheeks yellowish; legs light brown, with dots on tibiæ, and tips of tarsal joints and claws fuscous.

Length: male, 4 mm.

In general gray, suffused with fulvous, a broad fulvous band on vertex; vertex scarcely depressed.

Two male specimens (*type* and *paratype*) from Bahia, Brazil, December 1907, C. M., Acc. No. 3533 (Haseman *coll.*).

39. **Eutettix tessellatus** sp. nov.

Head wider than pronotum, subangulate; vertex a little longer at middle than next the eye; front rather long, sides tapering nearly uniformly to clypeus; clypeus widened at tip, one-half longer than wide; loræ large, nearly touching margin of cheek; cheek-margin sinuate; pronotum one-half longer than vertex; hind border slightly concave. *Genitalia: female*, last ventral segment about twice the length of preceding, hind border slightly produced, and minutely dentate at middle.

Olive-gray, tinged with yellow and fulvous; vertex whitish fulvous, with yellowish areas on base and two faintly fuscous spots near apex; face yellowish, the arcs faintly indicated; pronotum with about six faint fuscous dots near the anterior border; scutellum with two fuscous dots on the disk; elytra hyaline, tinged with golden yellowish; clavus with two milky spots; abdomen distinctly checkered with black on the anterior five segments, showing plainly through the transparent elytra. Beneath: yellowish brown; the tibiæ dotted with

black; abdomen somewhat infuscated on the sides of the abdominal segments.

Length: female, 4 mm.

Olive-gray; clavus with milky spots; elytra hyaline; abdomen above tessellate at sides. This is a beautiful little species very distinctly marked by the checkerboard dorsum of abdomen.

Described from two females (*type* and *paratype*) from Chapada, Brazil, November, C. M., Acc. No. 2966 (H. H. Smith *coll.*).

40. *Eutettix dentatus* sp. nov.

Head wider than pronotum; vertex rounded, slightly longer at middle than next the eye, not depressed, rounded to the front; front longer than broad, slightly sinuate; clypeus nearly twice as long as broad; loræ not reaching border of cheek; cheek-margins nearly straight; pronotum one-half longer than vertex; hind border rather deeply concave; claval veins approximate near the middle. *Genitalia: female*, last ventral segment long; posterior angles rounded, hind border produced at center into a rather broad prominent tooth.

Olive-green, tinged with yellow; vertex irregular; faint fuscous markings; front with faint arcs; a distinct black point on the cheek just outside the border of loræ; elytra sub-hyaline; the claval areoles with milky elongate spots, bordered with fuscous; veins of corium mostly fuscous; apical cells a little smoky.

Length: female, 3.75 mm.

This species is prevalently greenish-yellow, marked with light fuscous; the female segment provided with a prominent median tooth. It approaches *tessalatus* sp. nov. (No. 39), but the checkerboard marking of the abdomen is much less regular, and the female segment is distinctly produced at the middle.

Two female specimens from Province del Sara, Bolivia, C. M., Acc. No. 5064, one taken February 1913, (*type*); and the other taken November 1911 (*paratype*) (Steinbach *coll.*).

Genus PHLEPSIUS Fieber.

Phlepsius FIEBER, Verh. Zoöl.-Bot. Gesellsch. Wien, XVI, 1866, p. 503.

41. *Phlepsius gracilis* sp. nov.

Head scarcely as wide as the pronotum; vertex twice as wide as long, slightly wider at the middle than next the eye; front rather narrow; clypeus distinctly widened at tip; loræ broad, with the clypeus forming a nearly complete circle interrupted by the apex of the front; pronotum more than twice as long as vertex, hind margin

truncate; elytra narrow, the apices somewhat compressed. *Genitalia: female*, with a short tooth on the penultimate segment overlying a broad thin plate of the ultimate segment, occupying the central two-thirds, central part black.

Light gray; vertex with four spots on the anterior border, two large squarish spots near base, median line fuscous; face dirty yellow, with fuscous lines and sutures, the frontal arcs being yellow on fuscous base and a central elongate yellowish area nearly touching the base of the apex; cheeks yellowish; pronotum gray, minutely irrorate with fuscous; clavus with a square black dot near the base on the claval suture; elytra with the ramose lines more conspicuous on the inner half, a distinct fuscous spot at the first cross-vein, and the middle antepical and second apical cells with a fuscous stripe; the costa with four distinct black dots arranged below outer antepical and before first apical. Beneath: gray, spotted with fuscous.

Length: female, 6.5 mm.

This species is to be recognized particularly by its long slender form with narrow wings and by the peculiar lobate expansion of the last ventral segment. It is light gray, with rather faint ramose lines and distinct fuscous spot on vertex, clavus, and elytra.

Described from a single female specimen (*holotype*) from Province del Sara, Bolivia, C. M., Acc. No. 5064 (Steinbach *coll.*).

42. *Phlepsius hasemani* sp. nov.

Head wider than pronotum; vertex about one-third longer at the middle than next the eye, slightly depressed, anterior third horizontal; front broad, about as wide as long; clypeus with parallel sides, about one and one-half times as long as wide; cheeks broadly sinuate; pronotum strongly arched in front, slightly concave behind; elytral veins distinct; the ramose lines, especially on the clavus, forming rather distinct reticulations; corium next to clavus with numerous cross-veinlets; costa with veinlets of the outer antepical cell reflexed. *Genitalia: male*, valve a little longer than the preceding segment, distinctly rounded behind; plates broad at base, narrowing rather uniformly, with elongate acute tips, a deep submarginal furrough, and the sutural margin, blackish.

Light gray, with dark fuscous dots and ramose lines; anterior border of vertex with two black spots, and with lighter fuscous spots at ocellus; front irrorate with fuscous and whitish; border of eyes whitish, antennal pits black; clypeus yellowish, with a median brown line; loræ yellow, brownish on the inner apical part; cheeks yellowish; above generally gray; pronotum and scutellum with fuscous irrorations; elytra with the veins and ramose lines dark fuscous; the reflexed veins of the costal border black; tip of elytra smoky;

second and third apical cells, including a fuscous spot beneath pectus, black; legs yellowish, dotted with black; abdomen yellowish with sub-marginal lines blackish.

Length: male, 4.75 mm.

Gray, irrorate with fuscous; the ramose lines of elytra rather scant, and mostly merged into reticulations; front strongly convex.

Described from one male specimen (*holotype*) from Brazil, "along Rio Guaporé, below Rio S. Miguel, VII, 22, 1909," C. M., Acc. No. 4043 (Haseman *coll.*).

43. *Phlepsius saranensis* sp. nov.

Head wider than pronotum; vertex one-fourth longer in middle than next the eye, sloping, slightly depressed before middle; margin sub-acute; front broad, rather short; clypeus nearly twice as long as broad; margin of cheeks strongly sinuate; pronotum short, about two and one-half times as long as vertex, front margin semi-circular, hind margin concave, lateral angles broadly rounded; elytral venation distinct; ramose lines rather scant, about five veinlets in the outer costal cell, three of which spring from the outer anteapical. *Genitalia: male*, valve short; plates broad at base, tapering evenly to the slightly acuminate upturned tips; margins with dense cilia.

Dark gray; vertex yellow, with brownish irregular patches; pronotum, scutellum, and elytra uniformly light gray, with fuscous or light brown irrorations, veins, and ramose lines; the scutellum with a yellowish band across the apical part, broken at center with fuscous; face yellowish; the front with fine fuscous irrorations, somewhat arranged in series, but not in regular arcs; tip of clypeus fuscous; femora fuscous; tibiae yellowish with blackish spots.

Length: male, 5 mm.

Dark gray with light fuscous irrorations and lines; apex of clypeus fuscous.

Described from one male specimen (*holotype*) from Province del Sara, Bolivia, December 1912, C. M., Acc. No. 5064 (Steinbach *coll.*).

44. *Phlepsius sparsus* sp. nov.

Head distinctly wider than pronotum; the eyes large and very oblique; vertex nearly twice as wide as length at middle, nearly twice longer at middle than next the eye, distinctly angulate; margin acute at tip; ocelli close to the eye; front wide at base, narrowing sharply from antennal pits; clypeus twice as long as wide, gradually widened to tip; loræ wide, almost touching margin of cheeks; cheeks broadly rounded and rather deeply sinuate beneath the eyes; pronotum short, lateral margin reduced to an angle, anterior border semi-

circular, hind border nearly straight; elytra with distinct veins, but with very scant ramose lines or dots. *Genitalia: female*, last ventral segment rather long, more than twice as long as preceding; lateral angles rounded; hind margin truncate with elevated polished fuscous area each side of middle; *male*, valve small, about half as long as preceding segment, plates narrow, tapering nearly uniformly from base to acute slightly convergent upturned tips.

Light gray; the vertex with fuscous spots on each side of tip and a rather large brownish fuscous patch on each side on disk; face darker above antennal pits; the base of front with light arcs on a fuscous ground; base of front fulvous; border of central part with light arcs on fuscous ground; apical portion dull whitish; clypeus with a central smoky patch; loræ with basal angles fuscous; pronotum sparsely irrorate with fuscous; elytra milky, the veins brownish, the sub-basal dot, oblique dash, dots, the sparse ramose lines and the costal expansions of reflexed veins, dark fuscous or blackish; apical veins and border smoky; bands of femora, basal spots of tibial spines, median stripe, and posterior border of abdominal segments, fuscous.

Length: male and female, 5 mm.

Light gray, sparsely marked with ramose lines and dots, the costa with four rather widely separated reflexed veins and black spots. This species falls into the group with produced acute vertex, but differs decidedly from any of the North American forms of this group.

Two specimens, one female (*type*) and one male (*allotype*) from Province del Sara, Bolivia, elev., 450 M., C. M., Acc. No. 6443 (Steinbach *coll.*).

45. *Phlepsius loricatus* sp. nov.

Head wider than pronotum, broadly subangulate; vertex broad, nearly three times as wide as long, about one-fourth longer at middle than next the eye, transversely depressed behind apex; apex subacute; front strongly convex, wide at base, narrowing from antennal pits; clypeus about half longer than broad; loræ broad, short, not reaching margin of cheeks; cheeks deeply excavated beneath the eye; broadly rounded below; pronotum twice as long as vertex, hind border slightly concave; elytra rather densely reticulate, three reflexed veins in region of the nodal cell. *Genitalia: male*, valve and plates small, the valve short, obtusely angled; plates triangular, tips acute and upturned.

Dark fuscous on milky or whitish ground; vertex with two black spots on the anterior border, a pair of white lines next the median depressed line; face dark fuscous; the front with a few light arcs and dots; clypeus black, or black with a yellow base; loræ with a large

round light yellow spot; cheeks below yellowish; pronotum coarsely irrorate with fuscous and whitish; scutellum with two dark dots on disk, ivory-whitish spots at basal angle, middle margin, and apex; elytra milky-white, largely occupied by dark fuscous or black lineations and dots, the veins mostly brown; costal veinlets black; apical cells with discal spots and margin smoky; legs black, with tips of femur, tibial spines, and base of tarsal segments, whitish.

Length: male, 4.5 mm

Dark fuscous; rather densely reticulate; loræ with a large yellowish spot.

Three male specimens, from Province del Sara, Bolivia, C. M., Acc. No. 5064, two (*type* and *paratype*) taken November, 1912; one (*paratype*) taken December, 1912 (Steinbach *coll.*).

46. *Phlepsius costomaculatus* Van Duzee.

Phlepsius costomaculatus VAN DUZEE, Bull. Buffalo Soc. Nat. Sci., V, 1894, p. 207.

Head wider than pronotum, obtusely angulate; vertex slightly longer at middle than next the eye, rounded to front; front long, narrowed evenly from antenna to clypeus; clypeus one-third longer than broad; loræ large, reaching margin of cheek; cheeks broadly rounded, sinuate beneath the eye; pronotum nearly twice as long as vertex. *Genitalia: female*, last ventral segment truncate; *male*, valve rounded behind; plates short, triangular; apex acute.

Ashy gray; vertex and front minutely mottled with fuscous; pronotum irrorate with whitish; elytra milky-white, sub-hyaline, a conspicuous oblique spot on clavus, and three or four distinct spots on costa, dark fuscous or black.

Length: male 4 mm.

It is characterized by being light gray with fuscous ramose lines on the elytra, and rather conspicuous black spots on clavus and along the costa. The records give the species a distribution from the southern United States through Mexico and Central America to central Brazil.

Specimens referred to this species are at hand from Ft. Principe, Rio Guaporé, August 26, 1909, C. M., Acc. No. 4043; from Santarem, Brazil, December 11, 1909, C. M., Acc. No. 4043; and from Pará, Brazil (Haseman *coll.*).

47. *Phlepsius annulatus* sp. nov.

Head wider than pronotum, distinctly angulate; vertex about one-half longer at middle than at eye; front long; sides sinuate; clypeus

nearly twice as long as wide; loræ large, reaching nearly to border of cheek; cheek-margin rather deeply sinuate under eye; pronotum one-half longer than vertex, sub-angulate in front, scarcely concave behind. *Genitalia: female*, last ventral segment longer than the preceding, lateral angles somewhat produced, hind border nearly straight, an elevated median black polished patch on the border.

Light gray, irrorate with fuscous; vertex with pale brown spots near apex; a small fuscous dot between this and the ocellus; pronotum faintly irrorate, and with a double spot enclosed in a lighter area just behind each eye; scutellum with two fuscous dots on each side; elytra milky subhyaline; the veins and cross-veinlets black; costal space whitish hyaline; a spot below the cross-vein, one at each end of outer anteapical, and one at the end of the first apical vein, black. Beneath: light gray; front with faint brownish arcs; anterior and middle femora and the tarsi annulate with black.

Length: female, 4 mm.

Light gray; elytra with heavy black veins and nervures, and three large spots in the costa, one at the apex; the legs annulate with black.

Two female specimens (*type* and *paratype*), Pará, Brazil, December 6, 1907, C. M., Acc. No. 3533 (Hasemann *coll.*).

48. *Phlepsius clypeatus* sp. nov.

Head wider than pronotum, distinctly angulate; vertex one-fourth longer at middle than next to eye, scarcely depressed, margin sub-acute; front broad at base, narrowing nearly uniformly to base of clypeus, scarcely sinuate at antennal pits; clypeus nearly twice as long as wide, sides nearly parallel, apex slightly convex; loræ broad, nearly reaching to margin of cheeks; cheek-margin broadly sinuate; pronotum twice as long as vertex, side margin very short, hind margin distinctly concave; elytral venation distinct, with cross-veins between claval veins; numerous cross-veins in the inner areole of corium and outer half of costal areole, the latter of which are slightly reflexed, one or two in front of the outer anteapical cell, three from its border, and one at the apical end. *Genitalia: male*, valve short, broadly rounded behind; plates broad at base, narrowing rapidly to middle, tapering to narrow acute slightly upturned tips.

Grayish brown, somewhat mottled with yellow on head, pronotum, and scutellum; vertex anteriorly light yellow with two brownish patches connected with a narrow line extending to the ocellus; pronotum irrorate with whitish fuscous and yellow, anterior border with about six fairly distinct yellow spots; scutellum with four basal, one marginal on each side, and apical spots, yellow; elytra gray, with dark brown or fuscous veins and pigment-lines, and about five opaque

whitish spots, three of which form an oblique line from tip of claval vein to base of middle anteapical cell; the costal cross-veins, and margin of apical areoles, blackish; face yellowish, with brownish dots, forming arcs on the front; apical half of clypeus fuscous; legs yellowish, banded with obscure fuscous. Beneath: abdomen obscure fuscous, somewhat marked with yellow, especially on the fifth and sixth segments; all segments with a narrow whitish border.

Length: male, 4.25 mm.

Size and general color of *signatus*, sp. nov. (No. 49) but without white spot on front, distinct black spots on the margin of vertex or oblique fuscous mark on clavus. The markings on face are also different and the male plates more slender, elongated, and acute, approaching closely to the form of *P. irroratus* (Say).

Described from a male specimen (*type*) from Province del Sara, Bolivia, elev. 450 M., taken December, 1918, C. M., Acc. No. 6443 (Steinbach *coll.*); one male (*paratype*) from Pará, Brazil, December 6, 1907, C. M., Acc. No. 3533; two males (*paratypes*) from Rio Guaporé, near Porto Principe, Brazil, (Haseman *coll.*); and a fifth male (*paratype*) from Province del Sara, Bolivia, C. M., Acc. No. 5064 (Steinbach *coll.*).

49. *Phlepsius signatus* sp. nov.

Head wider than pronotum; vertex twice as wide as long, one-third longer at middle than next the eye, slightly depressed, nearly horizontal, margin sub-acute; front slightly convex, flattened toward the tip; clypeus narrow at base, widening toward apex, about one-half longer than wide; loræ large, nearly touching margin of cheeks; cheeks notched beneath the eye, broadly rounded laterally; pronotum about twice as long as vertex, uniformly rounded in front, distinctly concave behind; elytral ramose lines rather coarse, costal reflexed veinlets distinct. *Genitalia: female*, last ventral segment about one-half longer than preceding, the outer angles slightly extended in rounded lobes, the central part broadly notched, with an elevated carina on the middle, a slight indentation just within the lateral lobe; *male*, valve short, rounded behind; plates short, broad at base, acute at tip.

Above generally ivory-whitish; the vertex with two large marginal spots, a dot on each side on the hind border, and the disk of posterior portion, fuscous; pronotum irrorate with brown and fuscous; scutellum with two dark spots on the disk, four basal and three apical spots ivory-white; elytral veins and ramose lines fuscous; reflexed veins of costa expanded on the costal border, black. Beneath: light gray and fuscous; the front with a series of dots at base; about seven

or eight arcs, a broken median line connecting with the distinct round spot below the middle, yellowish; clypeus, loræ, and cheeks yellowish, with fuscous spots; abdomen on the underside yellowish with fuscous patches.

Length: males and females 5 mm.

In general gray, with distinct fuscous irrorations and lines; two dark fuscous spots on front border of vertex; the front with distinct light arcs and a round spot below middle.

Described from one female specimen (*type*) from Barra, Bahia, Brazil, December 6, 1907, C. M., Acc. No. 3533; male (*allotype*) and three females (*paratypes*) from Bahia, C. M., Acc. No. 3702 (Haseman *coll.*); and also six specimens (*paratypes*) from Pará, Brazil (Haseman *coll.*).

Genus THAMNOTETTIX Zetterstedt.

Thamnotettix ZETTERSTEDT, Ins. Lapponica, 1840, Column 292.

50. *Thamnotettix hyalinipennis* Stål.

(*Thamnotettix*) *hyalinipennis* STÅL, Bidrag til Rio Janeiro Traktens Hemiptera Fauna, 1858, p. 52.

Head wider than pronotum; vertex slightly longer at middle than at eye, rounded to front; front narrow, convex; clypeus widened at tip, tumid on disk; loræ reaching margin of cheek; pronotum twice the length of the vertex, hind border scarcely concave; elytral veins faint. *Genitalia: female*, last ventral segment elongated at sides, obliquely truncate, and deeply notched or cleft in the middle nearly to base.

Light yellowish, vertex with two large oval black spots; front with two broad light brown stripes on outer border, enclosing a lance-shaped yellow median area and with faint transverse arcs; clypeus mostly brown; pronotum with brownish fuscous transverse band near base, more or less obscure or interrupted at middle; scutellum yellowish brown at base, with a transverse curved line across the disk, the apical portion light yellow; elytra transparent, with the claval nerves, claval suture, discal and costal nerves, fuscous; abdomen black on the dorsum, beneath yellowish, with two black spots on mesopleuræ.

Length: female, 5.5 mm.

Light yellowish with transparent elytra, marked with brownish or fuscous stripes; two broad stripes on front merging on clypeus; two large spots on vertex, subbasal band on pronotum, curved line on disk of scutellum, and part of the elytral veins, fuscous. The specimens at hand agree closely with Stål's description, but he gives no details as to the genitalia. They extend the distribution over a much wider

territory, the original description having been based on specimens from Rio Janeiro, Brazil.

Three female specimens, one from Minca, Colombia, March, 1898, C. M., Acc. No. 1999 (H. H. Smith *coll.*); one from Chapada, Brazil, C. M., Acc. No. 2966 (H. H. Smith *coll.*); one from Bahia, Brazil, December, 1907, C. M., Acc. No. 3533 (Haseman *coll.*).

51. **Thamnotettix amazonensis** sp. nov.

Head wider than pronotum, subangulate; vertex nearly three times as wide as long, scarcely longer at middle than next to eye, rounded to front; front narrow, slightly sinuate; clypeus twice as long as width at base, widening distinctly toward tips; loræ long, reaching margin of cheek; cheeks wide, broadly sinuate; pronotum about three times as long as vertex, minutely punctate, hind border slightly concave; elytral veins very indistinct, except those marked with fuscous. *Genitalia: male*, valve minute or wanting; plates elongate, rather deeply spoon-shaped, tips upcurved, reaching tip of pygofer.

Dull yellowish; three transverse spots on vertex, two oblique spots on front, two oval oblique spots on pronotum, and transverse curved spot on disc of scutellum, fuscous; claval veins suture, discal veins, and costa, smoky or fuscous; abdomen blackish on disk of tergum; beneath dull yellowish, with black spots on propleura.

Length: male, 5.5 mm.

Recognized by its being yellowish gray, with blackish spots on vertex, front, pronotum, and scutellum; elytra transparent, with part of nerves fuscous. The species somewhat resembles *T. hyalinipennis* Stål, but differs distinctly in the markings of the vertex and front. The genital segment is of very distinct form and should readily distinguish the species.

Described from one male (*holotype*) from Chapada, Brazil, January 10, C. M., Acc. No. 2966 (H. H. Smith *coll.*).

52. **Thamnotettix braziliensis** sp. nov.

Head wider than pronotum; vertex twice as wide as length at middle, one-fourth longer at middle than next to eye; front narrow, convex; clypeus widened at tip, distinctly tumid on basal two-thirds; loræ large, reaching to the margin of cheek, outer suture very indistinct; cheek-margins nearly straight; pronotum strongly arched, nearly twice as long as vertex, hind border slightly concave; elytral venation obscure. *Genitalia: female*, last ventral segment short, lateral angles rounded, a broad median notch extending nearly half-way to base, bordered with fuscous.

Dull yellowish, vertex with two large oval black spots; front with broad stripes at sides, merging on the clypeus; a broad transverse band occupying disk of pronotum; basal half of scutellum, broad lines on claval veins, suture, discal vein, and costa, dark fuscous or blackish; central expanded line of front, cheeks, anterior border of pronotum, apical half of scutellum, light yellow. Elytra semitransparent, slightly milky, especially on claval suture; apical portion somewhat smoky.

Length: female, 4.5 mm.

Dull yellowish, with brown or fuscous stripes on front and elytra; transverse bands on pronotum and scutellum; female segment with shallow median notch. This species is evidently closely related to *hyalinipennis* Stål, and, were it not for the very different genital segment, I would be inclined to call it a variety of that species. However, it is much smaller and the fuscous color is more pronounced.

Three female specimens (*type* and *paratypes*), all from Chapada, Brazil, C. M., Acc. No. 2966, two labelled November, and one January 19 (H. H. Smith *coll.*).

53. *Thamnotettix marginalis* sp. nov.

Head as wide as pronotum; vertex nearly twice as wide as long, and nearly one-third longer at middle than at eye, subangulate, convex; front widening to antennal pits, then narrowing to clypeus; clypeus long, sides nearly parallel; loræ short; pronotum nearly twice as long as vertex, depressed behind the eyes; elytral veins indistinct. *Genitalia: female*, last ventral segment short, hind border sinuate and slightly dentate.

Above olive-gray, tinged with testaceous; vertex a little lighter, with two large black spots on each side of the margin and two spots at apex; front with a series of distinct arcs enclosed within a black margin, leaving a light expanded line in middle; clypeus light, margin blackish; cheeks sinuate; elytra with claval veins, suture, and inner vein, whitish; costa yellowish, margined within with fuscous. Beneath: black, last ventral segment and pygofer yellowish.

Length: female, 4 mm.

Dull olive-gray; costal margin yellowish white, two large spots and two large dots at apex of vertex.

One female specimen (*holotype*) from Chapada, Brazil, January 10, C. M., Acc. No. 2966 (H. H. Smith *coll.*).

54. *Thamnotettix sordidus* sp. nov.

Head broad, much wider than pronotum, short, angulate; vertex as long at middle as next to eye, rounded to front; front as broad as

long, margin rounded to clypeus; clypeus short, one-half longer than wide, moderately tumid; loræ small, not reaching margin of cheeks; cheek-margins nearly straight; pronotum nearly three times as long as vertex, distinctly rugulose, hind border concave, lateral margin very short; elytral veins obscure. *Genitalia: male*, last ventral segment deeply excavated; valve triangular; plates elongate, rough, hairy, with acute tips, a broad yellow band across base.

Vertex in front mostly orange; three spots touching base of vertex, two on margin connected by curved line, two on each side of front, one next eye, and a median elongate spot at apex of front, lavender or light purplish; four orange stripes on pronotum, separated by greenish stripes; scutellum orange, with two purplish stripes; lower margin of front, clypeus (except small basal spot), loræ (except small basal margin), basal part of femora, pleural pieces, inner surface of hind tibiæ and most of elytra, soiled whitish; the claval suture, inner sector, and inner part of apical area, smoky.

Length: male, 5.5 mm. to 6 mm.

Head orange-red, with purplish spots; pronotum striped with orange; elytra dirty whitish, with part of nerves fuscous, and costa black. This is a striking species, and, while not distinctly a *Thamnotettix* in facies, seems to fit in this genus as far as the structural parts are concerned.

Described from three males, one (*type*) labelled as from Brazil "along Rio Guaporé below Rio S. Miguel, VII, 22, 1909"; another, "S. Antonio de Guaporé, VII, 26, 1909, sweeping on island in Rio Guaporé"; the third from Ft. Principe, Rio Guaporé, Brazil, August 20, 1909. They all belong to C. M., Acc. No. 4043 (Haseman *coll.*).

55. *Thamnotettix pallidus* sp. nov.

Head distinctly wider than pronotum, strongly arched; vertex scarcely wider at middle than next to eye, broadly rounded to front; front convex, not as wide as long; clypeus one-half longer than wide, apex truncate; loræ small, distant from margin of cheek; cheek-margin faintly sinuate; pronotum more than twice as long as vertex, side margin very short, hind margin distinctly concave; elytral veins very obscure. *Genitalia: male*, last ventral segment entire; valve short, subangulate behind; plates narrow, elongate, deeply spoon-shaped, blunt at tip, with white band across base; pygofer with a broad orange spot.

Vertex and pronotum greenish white; a narrow median line, a dot on each side next to eye, two large spots on border next to vertex, two transverse spots at base of front, two at sides of apex on front, central apical spot on clypeus, spot on antennal pit, two large spots

anteriorly on pronotum, base of clavus next to scutellum, disc of tergum and venter, black; a smoky stripe starting at the inner angle of clavus and running obliquely to center of corium thence to border of apex and widening on apical cells, the commissure and membrane, smoky. In the second specimen (*paratype*) the apex of front and all of clypeus black; an additional spot at sides on pronotum and scutellum, except apical border, black.

Length: male, 4.75 mm. to 5 mm.

In general whitish, with numerous black spots; two on vertex; two on base of front; two large ones on anterior part of pronotum; elytra milky-hyaline.

One specimen (*type*) from Province del Sara, Bolivia, elev. 450 M., C. M., Acc. No. 6443 (Steinbach *coll.*); a second darker specimen (*paratype*) from Chapada, Brazil, January 19, C. M., Acc. No. 2966 (H. H. Smith *coll.*).

56. *Thamnotettix pictus* sp. nov.

Head slightly wider than pronotum, short, angulate; vertex a little longer at middle than next eye; front longer than broad; clypeus nearly twice as long as wide, apex slightly expanded and faintly emarginate; loræ small, not reaching margin of cheeks; cheek-margin distinctly sinuate; pronotum about three times as long as vertex, side margin faintly carinate, hind border deeply concave; elytra mostly hyaline, veins delicate. *Genitalia: female*, last ventral segment long, more than twice as long as preceding, rounded behind, with deep central notch bordered with yellow; *male*, valve very small, almost hidden; plates broad at base, narrowing rapidly to middle, then extended in acute upturned tips.

Vertex, four large spots on pronotum (the inner ones reniform), most of the scutellum and dislocated stripe on clavus, orange-red; three large spots on margin of vertex (one median, and one on each side of the eye), tip of scutellum, inner margin of cheek, loræ, outer margin of clypeus, pectus and abdomen (except lateral margin), black; front and cheeks (except a narrow inner margin), legs, margin of abdomen, margin of last ventral segment, pygofer, and tip of ovipositor, yellowish or faintly testaceous; pronotum, except orange-red spots, three basal triangles, two discal spots on scutellum, and clavus, olive-green; elytra mostly hyaline, veins unicolorous, or very faintly fuscous.

Length: female, 5 mm.; male, 3.5 mm.

In general olive-gray, marked with red and black. Front, central line of clypeus, and cheeks, yellow. The male (*allotype*) differs from

the female in being much smaller in size, in having two conspicuous dark fuscous stripes separated by a narrow yellow line on the front, and a very narrow yellow line on the clypeus, with faint lateral arcs. The abdomen of the male is black above and beneath (except the apical parts of the plates below). There is a large yellow stripe on clavus, completely broken, composed of a short basal stripe, and a longer stripe lying between the claval veins.

The female (*type*) and male (*allotype*) are from Chapada, Brazil, collected respectively in November and October, C. M., Acc. No. 2966 (H. H. Smith). There is a second male (*paratype*) which certainly seems to belong to this species. It is labelled "Prov. del Sara, Bol., J. Steinbach, C. M., Acc. No. 5064, Feb. 1913." In this last specimen the dislocated stripe on clavus is almost completely broken, while in the female (*type*) there is a connecting line. These stripes occupy the basal outer part and the space between the claval veins.

57. ***Thamnotettix bifasciatus*** sp. nov.

Head scarcely as wide as pronotum, bluntly angulate; vertex as long as basal width, one-half longer at middle than next to eye; front narrow, nearly twice as long as wide; clypeus with sides parallel, apex convex; loræ rather short, scarcely touching front, but reaching margin of cheek; cheek broad, margin rounded; pronotum a little longer than vertex; outer anteapical cell elongate, small, costal cross-vein at its base. *Genitalia: female*, last ventral segment twice as long as preceding, hind border rounded, with a median tooth apparently rising from base; *male*, valve rather large, transverse hind border sinuate; plates broad at base, narrowing very abruptly and with rather slender acuminate upturned tips.

Head, pronotum, scutellum, and elytra milky-white, with orange stripes from anterior margin of vertex bordering eye, continued on pronotum and, a trifle more separated, on scutellum; also a yellowish lateral stripe on each side of pronotum; anterior border of vertex with broken blackish line, the outer part encircling the ocelli, which touch the margin of the eye; a fuscous spot on disc of clavus, another on disc of corium on inner sector before the fork, and another beyond clavus at base of membrane extended obliquely, but faintly, across the anteapical cells, and merging into the smoky border of apical areoles; face dark fuscous above, whitish below, apical third of front, all of clypeus, loræ (except outer margin), and lower part of cheeks, white; legs white; femora banded with black; elytra milky-white, veins opaque whitish.

Length: male, 3.5 mm.; female, 4.5 mm.

Milky-white, with two orange stripes running from margin of vertex across pronotum and scutellum; elytra with fuscous patches on cross-vein of clavus and corium and at base of membrane. This species appears to be related to the *shermani*-group, but has only a faint trace of a second cross-nervure and the middle anteapical cell has no cross-vein.

Two female specimens (*type* and *paratype*), from Province del Sara, Bolivia, C. M., Acc. No. 5064 (Steinbach *coll.*); male (*allotype*) from Province del Sara, Bolivia, elev. 450 M., November 1909, C. M., Acc. No. 4549 (Steinbach *coll.*).

58. **Thamnotettix lineiceps** sp. nov.

Head wider than pronotum, vertex a little wider than long, obtusely angulate, one-third longer at middle than next to eye; front broad at base, narrowing sharply from antennal pits; clypeus long, widened slightly at the tip, basal suture indistinct, or wanting; loræ rather small, not reaching cheek-margin; cheek-margin excavate below eye, broadly rounded to clypeus; pronotum one-fourth longer than vertex, side margin faintly carinate, hind border slightly concave; elytra with second cross-vein and a cross-vein in middle of anteapical cell. *Genitalia: female*, last ventral segment nearly as long as preceding, lateral angles rounded, posterior margin distinctly convex, thin, almost hyaline.

Light ocher; sides of vertex orange; a yellowish white median stripe starting at apex of vertex, widening to tip of scutellum and continued as a narrow border of commissure to tip of clavus; sides of pronotum and elytral veins also white; front orange, with central whitish expanded line; cheeks yellowish; under side of body light yellowish; tarsal claws black.

Length: female, 4.5 mm.

Ocher-yellow to orange above; sides of vertex fulvous, narrowly margined with white, bordered with black line.

Similar to *T. shermani* Ball in the elytral venation and orange stripes, but differing in details of markings and the genitalia.

Described from three female specimens from Province del Sara, Bolivia, elev. 450 M.: one labelled "Dec. 1918, C. M., Acc. No. 6443 (*type*); two labelled "Nov. 1909, C. M., Acc. No. 4549" (*paratypes*) (Steinbach *coll.*).

59. **Thamnotettix pulchellus** sp. nov.

Head wider than pronotum, subangulate; vertex twice as wide as long, about one-third longer at middle than at eye; margin obtusely

angulate; front longer than broad, margin sinuate; clypeus twice as long as width at base, margin widened toward tip, apex truncate; loræ large, almost touching margin of cheek; cheek-margin sinuate; pronotum one-half longer than vertex, hind margin concave; elytral veins very indistinct. *Genitalia: female*, last ventral segment half longer than preceding; lateral lobes and a conspicuous median tooth, bordered with brown.

Mostly golden yellow; the borders of vertex lighter yellow, enclosing a broad fulvous band; face light yellow, with triangular fulvous patches between eyes connected by narrow fulvous line; clypeus and cheeks sulphur-yellow; elytra entirely transparent; legs light yellow; tarsi tinged with greenish.

Length: female, 4.5 mm.

This species is bright golden yellow with a broad fulvous band on vertex and fulvous patches on base of front.

Described from a single female (*holotype*) from Chapada, Brazil, May, C. M., Acc. No. 2966 (H. H. Smith *coll.*).

60. *Thamnotettix lobatus* sp. nov.

Head wider than pronotum, sub-angulate; vertex nearly twice as wide as length at middle, one-fourth longer at middle than next the eye, obtusely angulate to front; ocelli close to the eye; front longer than broad, slightly convex; clypeus widened to tip, nearly twice as long as width at base; loræ broad, nearly touching margin of cheek: cheek-margin sinuate; pronotum one-third longer than vertex, faintly concave behind; middle antepical cell much constricted behind the middle; two cross-veins in costa from edge of outer antepical. *Genitalia: male*, valve short, broadly rounded behind; plates wide at base, contracting rapidly to about the middle with slender up-curved acute tips.

Light-gray or whitish; vertex with lobate fuscous spots on disk and four dots on the margin, two near the center and one just above ocellus; pronotum with fuscous irrorations, darker on the anterior half; scutellum with brownish spots margined with fuscous; clavus with dark patches near the inner margin; two conspicuous milky spots behind the veins; veins of corium fuscous; a fuscous patch in the discal cell; milky hyaline patches form an irregular band across the outer part of antepicals and base of apicals; tip of apicals dusky; front olive-gray with short whitish arcs and a central whitish line; clypeus, loræ, and cheeks yellowish white, with the sutures dusky; legs dirty white; tarsal claws dark.

Length: male, 4 mm.

In general light-gray, marked with fuscous; elytra with milky hyaline spots.

Described from one male specimen (*holotype*) from Province del Sara, Bolivia, elev. 450 M., November 1909, C. M., Acc. No. 4549 (Steinbach *coll.*).

Genus CHLOROTETTIX Van Duzee

Chlorotettix VAN DUZEE, Psyche, VI, 1892, p. 306.

61. **Chlorotettix breviceps** Baker.

Chlorotettix breviceps BAKER, Canadian Entomologist, XXX, 1898, pp. 220.

Head rounded, faintly subangulate; vertex scarcely longer at middle than next eye; pronotum arched in front, slightly emarginate behind. *Genitalia: female*, last ventral segment greatly elongated, four or five times as long as the preceding segment, lateral angles bluntly angulate, central part produced, forming a broad tooth; *male*, valve narrow, long, bluntly angulate behind; the plates elongate, broad at base, tapering evenly to the truncate tips; disk somewhat inflated and the tips upcurved, forming a rather narrow spoon-shaped structure.

Dried specimens are dull yellowish or straw-color, with a faint iridescence; probably in life the insect is greenish and distinctly iridescent.

Length: female, 6.25 mm.; male, 6 mm.

Similar in appearance to *C. galbanatus*, Van Duzee, but with an extremely long female segment and elongate male plates. Baker's description is based on specimens from the same locality, Chapada, Brazil, and, while his description of the female genitalia does not agree with these specimens, all other characters are evidently identical. The male has not hitherto been described.

Three specimens, two females and one male, from Chapada, Brazil, C. M., Acc. No. 2966 (H. H. Smith *coll.*).

62. **Chlorotettix aberrans** sp. nov.

Head scarcely wider than pronotum, subangulate; vertex slightly longer at middle than next the eye; margin of front sinuate; clypeus scarcely widened at tip; sides parallel, one-half longer than wide; loræ almost touching margin of cheek; margin of cheek sinuate; pronotum twice as long as vertex. *Genitalia: male*, valve very broad, apparently fused with the plates at the middle; plates very broad, narrowing abruptly to near the broad bluntly rounded tips. The inner basal part of plates appears to be fused with the valve, but the outer part shows a very distinct suture between the two plates.

Light testaceous or pale straw-color, apparently somewhat faded; eyes brown; tarsal claws fuscous; elytra hyaline, the veins in part milky opaque.

Length: male, 5.5 mm.

Generally light testaceous, elytra transparent, male valve broad.

Described from one specimen, (*holotype*) from Januaria, Minas Geraes, Brazil, December 17, 1907, C. M., No. 3702 (Haseman *coll.*).

63. *Chlorotettix delicatus* sp. nov.

Head broad, subangulate, slightly longer at middle than next the eye; sides of front sinuate; clypeus nearly twice as long as width at base; loræ nearly touching the cheek; cheek-margin swollen beneath the eye, broadly sinuate; pronotum about twice as long as vertex, hind border concave. *Genitalia: female*, last ventral segment long, overhung by preceding segment, bearing brownish bars, hind border produced at the middle; *male*, valve small, angled behind; plates small, narrowing to blunt tips, scarcely reaching end of pygofer.

Almost uniformly light green, with deeper tints of yellowish on vertex and claval veins, sides of front, the clypeus, and the pleural pieces and margins of the abdomen; the faint fuscous spot on each side of the last ventral segment of the female and the tips of the elytra, faintly smoky.

Length: female, 5 mm.; male, 4-5 mm.

In general light green, tinged with yellow; eyes brown, elytra transparent.

One female specimen (*type*) and one male (*allotype*) from Bahia, Brazil, December 1907, C. M., Acc. No. 3702 (Haseman *coll.*); one female, (*paratype*) from Pará, Brazil, December 1907, C. M., Acc. No. 3533 (Haseman *coll.*); one male (*paratype*) from Province del Sara, Bolivia, C. M., Acc. No. 5064 (Steinbach *coll.*); and one male (*paratype*) from Paraguay River, Matto Grosso, Brazil, May 17, 1909, C. M., Acc. No. 4043 (Haseman *coll.*).

64. *Chlorotettix dilutus* sp. nov.

Head wider than pronotum, sub-angulate; vertex a little longer at middle than next the eye; front longer than wide, narrowing uniformly to clypeus; clypeus one-half longer than wide; loræ long, reaching nearly to the border of cheek; cheeks slightly sinuate; pronotum twice as long as vertex, faintly concave behind. *Genitalia: female*, last ventral segment slightly longer than the preceding, hind border concave; narrowly bordered with fuscous at center.

Pale straw-color; elytra hyaline, veins whitish; disc of abdomen above, dusky.

Length: female, 4.5 mm.

Small, pale; elytra transparent. This appears to be almost identical with *C. minimus* Baker, but the dusky markings on the tergum and the different female segment will distinguish it.

One female specimen (*type*) from Bonda, Colombia, June 10, C. M., Acc. No. 1999 (H. H. Smith *coll.*).

65. *Chlorotettix minimus* Baker.

Chlorotettix minimus BAKER, Canadian Entomologist, XXX, 1898, p. 220.

Head wider than pronotum, sub-angulate; vertex a little longer at middle than next the eye; front longer than wide, narrowing uniformly to clypeus; clypeus one-half longer than wide; loræ long, reaching nearly to the border of cheek; cheeks slightly sinuate; pronotum twice as long as vertex, faintly concave behind. *Genitalia: female*, last ventral segment slightly longer than the preceding, hind border concave; a deep incision at the center; *male*, valve broad, sub-angulate behind; plates broad at base, tapering uniformly to acute tips.

Pale straw-color; elytra hyaline, veins whitish.

Length: female, 4.5 mm.

In general small, pale, elytra transparent.

One female specimen from Pará, Brazil, December 6, 1907, C. M., Acc. No. 3533 (Haseman *coll.*); one male specimen Cachoeira, E. Santos, Brazil, June 19, 1908, C. M., Acc. No. 3579 (Haseman *coll.*).

66. *Chlorotettix bakeri* Sand and DeLong.

Chlorotettix bakeri SAND and DELONG, Proc. Ent. Soc. Wash., XXIV, 1922, p. 97.

"This species resembles *Ch. minimus* Baker in size and form, but differs strikingly in the genital characters.

"Female: last ventral segment about twice as long as preceding segment; lateral angles broadly rounded to posterior margin which is broadly and roundly notched one-third distance to base of segment. Male valve equals preceding segment in length, broadly and evenly rounded; plates about four times as long as valve, broadly and convexly expanded toward the base, then abruptly and concavely narrowed two-thirds their distance to apex forming narrow rounded tips." (S. & DeL.).

"A male (*holotype*) and female specimen in the Baker collection, United States National Museum, labelled 'Corumba, Brazil, May.' U. S. Nat. Mus. Type No. 24951."

"The male specimen was labelled originally '*Chlorotettix minima*'; and the female as '*Ch. minima*, var' by C. F. Baker."

I refer to this species a specimen labelled "Pará, Brazil, Dec. 6, 1907, C. M., Acc. No. 3533" (Haseman *coll.*).

67. **Chlorotettix truncatus** sp. nov.

Head broader than pronotum, sub-angulate; vertex one-fourth longer at middle than next the eye; front long, sides sinuate; clypeus one-half longer than wide, widening slightly at tip; loræ reaching margin of cheek; sutures faint; cheek-margin sub-angulate; pronotum nearly twice as long as vertex. *Genitalia: female*, last ventral segment long, about twice as long as the preceding segment; hind border truncate, faintly notched at the middle; *male*, last segment long; valve wanting, or concealed; plates triangular; tips acute.

Pale greenish-white; eyes brown; elytra hyaline, faintly milky; tarsal claws fuscous.

Length: female, 4.75 mm.; male, 4.87 mm.

.Pale greenish; elytra hyaline; female segment truncate. The male agrees in general with the female, but is a trifle larger, and a little darker in color.

One female specimen (*type*) from Province del Sara, Bolivia, December 1911, C. M., Acc. No. 5064 (Steinbach *coll.*); and one male specimen (*allotype*) same locality and collector, November 1912.

EXOLIDIA gen. nov.

Head broader than pronotum; vertex broad and rounded to the front; ocelli minute, about four times their diameter from border of the eye; front short, convex; antenna short, the setæ very slender; pronotum narrowing posteriorly; scutellum small; elytra opaque, nervures indistinct to tip of clavus; the apical portion transparent, with three conspicuous apical veins; two anteapical cells; the costa broad without cross-veinlets. Type of genus *E. picta* sp. nov.

68. **Exolidia picta** sp. nov.

Head wider than pronotum; vertex short, rounded to front; front short, convex; pronotum narrowing posteriorly; scutellum small; elytra broad, longer than abdomen, tips rounded, veins indistinct, except the three broadly fuscous apical veins. *Genitalia: male*, plates compressed, narrowing to a blunt tip behind.

White, three transverse rows of orange spots between eyes, the middle one including the ocelli at the ends; elytra mottled with white and fuscous to base of apical cells; the costa with two whitish transparent spots, some fuscous dots in the basal spot, and a broad fuscous band next the apical cells; apex of elytra milky hyaline, with three

broad curved fuscous stripes apparently covering the apical veins. Beneath: face white; the lower border of front, clypeus, and most of loræ, black; legs white; outer border of tibiæ and the tarsi blackish; abdomen black; margins of the segments and genitalia whitish.

Length: male, 5 mm.

A handsome whitish species, with three transverse rows of oblong orange spots between the eyes, the middle one including the ocelli at the outer ends. This is a very striking species, apparently distinct from any hitherto known genus, but apparently belonging with the *Jassinæ* and remotely related to *Jassus* and *Neocalidia*, but approaching *Tinobregmus* in the smallness of the scutellum.

Described from one male, *type*, taken "near Forte Principe, Rio Guaporé, Brazil, Aug. 26, 1909," C. M., Acc. 4043 (Haseman *coll.*).

GENUS *CICADULA* Zetterstedt.

Cicadula ZETTERSTEDT, *Ins. Lapponica*, 1840, Column 296.

69. *Cicadula* (?) *valvata* sp. nov.

Head wider than pronotum; vertex narrow, scarcely longer at middle than next the eye, rounded to front; ocelli midway between eye and center; front narrow, tapering uniformly to clypeus; clypeus short, narrowing to the rounded apex; loræ and cheeks narrow; pronotum with sides nearly parallel, twice as long as vertex, hind border faintly concave; elytral venation obscure. *Genitalia: male*, valve extremely large, extending to borders of preceding segment, rounded behind; plates narrow, elongate, acute, densely set with fine whitish setæ.

Milky-white above; eyes fuscous; ocelli brownish; beneath yellowish white, tarsi and tips of plates, greenish. The colors are indistinct and the specimen may not be fully colored, but the structures seem mature.

Length: male, 4.5 mm.

In general elongate, head broadly rounded; elytra milky-hyaline; male valve very large, twice as long as preceding segment, rounded behind. This insect resembles *Chlorotettix*, but appears slenderer. The head is more transverse and the elytral venation, although very indistinct, appears to place it in *Cicadula*. The costa bears an extended patch of whitish waxy secretion.

Described from a single male specimen, (*type*) from Province del Sara, Bolivia, C. M., Acc. No. 5064 (Steinbach *coll.*).

Genus NEOCÆLIDIA Gillette and Baker.

Neocalidia GILLETTE and BAKER, Hemiptera of Colorado, 1895, p. 103.

70. *Neocœlidia inflata* sp. nov.

Head narrower than pronotum; vertex widening forward; front somewhat tumid, rather narrow; clypeus elongate, about twice as long as wide; loræ elongate, but not reaching to margin of cheeks; border of cheek faintly sinuate; pronotum short, scarcely longer than vertex, rounded in front, slightly sinuate behind eyes, posterior border distinctly concave; scutellum large, with a distinct transverse impression behind the middle: elytral venation obscure. *Genitalia: male*, valve invisible; plates elongate, deeply spoon-shaped, closely appressed, with short tooth-like upturned apices; pygofer compressed, apex rounded, inferior border near tip with a sharp recurved tooth on each side.

Light yellowish, or pale straw-color; the vertex with two oval oblique orange spots; anteriorly two orange spots at base of front; basal joint of antennæ, basal patch on the scutellum, central part of the apical third, orange; pronotum with two large round black spots behind the inner angle of the eye, bordered with orange and a black spot on each side of the scutellum at the ends of the transverse impressed lines; commissure smoky brown; elytra hyaline, faintly suffused with milky white; the veins scarcely visible.

Length: male, 6 mm.

In general a light yellowish species, with orange spots on the vertex and front, and two conspicuous black spots on front border of pronotum and sides of the scutellum. The peculiar expanded plates and form of pygofer will at once distinguish this species.

Two male specimens (*type* and *paratype*) taken at "San Antonio de Guaporé, Brazil, 7-26-1909, sweeping on island in Rio Guaporé," C. M., Acc. No. 4043 (Haseman *coll.*).

71. *Neocœlidia punctata* sp. nov.

Head considerably narrower than pronotum; vertex short, rounded in front, anterior border bluntly rounded; front slightly swollen; pronotum broad at base, hind border scarcely concave; scutellum broader than long; elytral veins indistinct, except towards the tip. *Genitalia: male*, valve elongate triangular, about one-third as long as plates; plates slender, elongate, very slightly sinuate, tips acute, margins densely set with whitish cilia.

Light yellowish, almost whitish; with two conspicuous spots on the margin of the front; lateral posterior angles of pronotum, two dots on the disk of scutellum, apical parts of claval veins, and the large roundish spots on the cross-nerve, black; the basal margin of the

clavus also dark fuscous or blackish, and the inner margin of clavus, the apical part of claval suture and the appendix, smoky; the veins of inner antepical cell brownish; elytra transparent, faintly milky. Beneath: greenish white, unmarked, except the tarsal claws, which are embrowned.

Length: male, 6.75 mm.

Light yellowish with two conspicuous spots on the margin of vertex, lateral angles of pronotum on the disk of scutellum of elytra and tips of claval nerves, black; the basal and inner margin of clavus smoky.

Male specimen (*type*) from Province del Sara, Bolivia, C. M., Acc. No. 5064 (Steinbach *coll.*); a second specimen (*paratype*) labelled "Feb. 1913" agrees entirely with the above description, except for lacking the dark spots on the scutellum.

72. *Neocœlidia croceata* sp. nov.

Head rather broad, but not as wide as pronotum, hind border evenly arched; vertex broad, wider than long, lateral margins nearly parallel, anterior border rounded and subangulate, the disk slightly sloping, flattened, anterior border angulate; front convex; clypeus elongate, narrowed at base; loræ long, nearly touching border of cheek; margin of cheek slightly sinuate; pronotum short, nearly as long as vertex, evenly arched in front, hind border angularly emarginate; elytral veins obscure. *Genitalia: female*, last ventral segment slightly convex; *male*, valve hidden; plates fused, spoon-shaped, about twice as long as broad tips.

Quite uniformly light yellowish, or straw-color, with croceous stripes on vertex continued on the pronotum, with a croceous submarginal band in front of the eyes; elytra hyaline.

Length: female, 5.5 mm.; male, 5.25 mm.

In general pale yellowish, with faint croceous stripes on vertex and pronotum, those on the vertex connected by the curved band bordering the margin of the vertex; vertex subangulate, somewhat flattened above.

Described from a female (*type*) collected at Barra, State of Bahia, Brazil, Dec. 6, 1907, C. M., Acc. No. 3533 (Haseman, *coll.*); and a male (*allotype*) taken at Cachoeira, State of Santos, June 19, 1908, C. M., Acc. No. 3579 (Haseman *coll.*), which evidently goes with this species, but differs in having the croceous color more intense. There is a third specimen, a female (*paratype*) before me from the Province del Sara, Bolivia, C. M., Acc. No. 5064 (Steinbach *coll.*).

73. *Neoccelidia crenulata* sp. nov.

Head much narrower than pronotum; vertex somewhat narrower at base, about one and one-third times as long as width at base, widening before the eyes; the apex nearly rectangular, the whole surface nearly pentagonal; front convex, narrow, abruptly narrowed at clypeus; clypeus nearly twice as long as wide; loræ narrowed toward the tip, not extending to the margin of cheek; cheek-margin extending beyond tip of clypeus in a rounded lobe, lateral border nearly straight. *Genitalia: male*, valve wanting; plates slightly tumid, spoon-shaped, the outer part narrowed, and with blunt tips reaching to tip of pygofer.

Light yellow; a dark stripe running from apex of vertex to end of elytra, the border crenulate, four lobes on vertex, three on clavus, and one at base of membrane; elytra milky, transparent, more opaque next the dark stripe.

Length: male, 4.25 mm.

Very similar to *N. fuscodorsata* (Fowler), but smaller, with a longer, more acute vertex, and without the distinct black spot on margin of scutellum. It may prove to be one of a series of variations of the species described by Fowler. He, however, gives no description of the genitalia, and does not even mention the sex. His reference of the species to *Tettigonia* seems to indicate that he disregarded the position of the ocelli and other characters, which separate the species from that group.

Described from one male specimen (*type*) taken at Minca, Colombia, May 1898, C. M., Acc. No. 1999 (H. H. Smith *coll.*).

III. NEW SPECIES OF NOTODONTIDÆ FROM SOUTH AMERICA IN THE CARNEGIE MUSEUM.

BY WILLIAM SCHAUS.

(PLATE IV.)

INTRODUCTORY NOTE.

From time to time we have had the pleasure of welcoming at the Carnegie Museum Mr. William Schaus and his friend Captain Barnes. Mr. Schaus, with engaging kindness and characteristic enthusiasm, has volunteered to devote himself to the arrangement of certain groups of neotropical lepidoptera, with which his studies have made him familiar, and with which he is probably better acquainted than any other student in America. Among the moths recently in part arranged by him are the *Notodontidæ* of tropical America. As a result of his investigations he has discovered that certain of the species in the collection of the Carnegie Museum are nondescript, and he has kindly furnished us with descriptions of them, which are now printed. The plate includes, besides figures of the types of the new species, figures of several others named by previous writers and by Mr. Schaus, who has determined them. W. J. HOLLAND, *Editor*.

Genus NYSTALEA Guenée.

1. *Nystalea albipicta* sp. nov. (Plate IV, fig. 3).

Male:—Head and palpi cream-white; the palpi streaked above with mahogany-red on second joint, the third joint with a similar point at tip; oblique lines on frons; crest on vertex and also collar, orange-cinnamon. Thorax purplish fuscous, with white spots on shoulders; a few mahogany-red hairs on patagia. Abdomen above benzo-brown; a lateral tuft at fourth segment, underside light buff. Legs partly white; the tibiæ and base of tarsi with long tufts of hairs mottled with violaceous brown and mahogany-red; the hind tibiæ with a large white spot on first joint. Fore wings natal-brown; edge of costa, subcostal, and submedian basally, brownish gray; a white streak on costa from base to antemedial line; antemedial line double, black, filled in with orange-brown and white, interrupted on subcostal, be-

low submedian fold consisting of a single rufous line, followed on costa and across median by white spots, and a small white spot beyond the latter in cell; space between antemedial and medial lines suffused with purplish fuscous; medial line double, wavy, partly hazel followed by a large white space from costa not reaching median except at discocellular, around which the reniform, which is broad and incurved, is outlined in black; between veins five and six the white space extends to post-medial; some purplish fuscous suffusion from vein three to below vein two; postmedial line partly double, defined by tawny shading, vertical from costa to vein three, then slightly inbent; veins two to four with white and black points; a white space from post-medial to apex constricted medially, its lower edge irregular proximally from just above vein five, at subterminal reaching vein six, at termen from just below vein seven to vein eight; some brown spots on costa towards apex; some white scaling beyond post-medial between veins two and four, and an interrupted fine white line, outset between four and six; a velvety dark brown subterminal line from costa before apex slightly incurved below vein seven and touching termen at vein three, then inset irregularly to tornus; the white spaces are partly irrorated with black; veins from cell terminally wood-brown; cilia fuscous with white spots from vein four to tornus, and with white points at veins towards apex. Hind wings benzo-brown, the base whitish; cilia tipped with whitish. Fore wings below fuscous, the costa tinged with buff; termen white, cut by veins and subterminal lines into spots. Hind wings below white, the costa tinged with ochraceous-tawny; the outer margin fuscous. *Expanse*: 54 mm.

The species comes nearest *N. guzmani* Schaus.

Habitat: Pied Saut, Oyapok River, French Guiana.

The *type* is in the Carnegie Museum, C. M., Acc. No. 6173, March 1918 (S. M. Klages coll.).

2. *Nystalea arimathea* sp. nov. (Plate IV, fig. 8).

Male:—Palpi whitish buff, with a dark chestnut-brown streak above and a fine lighter brown streak below. Head mottled dark brown and light buff, the frontal tuft whitish, collar dark chestnut-brown, tipped behind with buff and whitish. Thorax cinnamon-buff. Abdomen above buffy brown, underneath pale ochraceous-buff. Legs pale ochraceous-buff, the tibiæ and hind tarsi fringed with hair. Fore wings cinnamon-buff; a dark antemedial point on submedian, a black point at origin of vein two; a fine dark line on median from vein two to vein four; a brownish cinnamon shade from base of costa through cell; a fine dark brown line on costa from before middle to post medial line and four similar lines below it, becoming shorter proximally, the

lowest on subcostal bifurcating beyond cell; a post-medial whitish shade oblique to vein three, then down bent, preceded by short streaks on veins five to one including submedian fold, outwardly by an ochraceous-brown shade becoming cinnamon-brown towards a fine outer white line, which is inbent on vein eight then wavily outcurved to near subterminal and not extending below vein three, preceded between veins five and eight by still darker trigonate streaks; space beyond fuscous crossed by a fine dark chestnut-brown line almost straight from vein nine to vein three, incurved to vein two, and inset below it, edged proximally by a fine yellow-buff line, distally by a fine whitish gray shade; some brownish marginal shading from vein four to costa at apex; cilia dark brownish gray with fuscous spots at veins. Hind wings smoky-white, the termen broadly fuscous at apex, narrowly at anal angle; cilia white. Fore wings below brownish buff, becoming darker towards subterminal line, this latter preceded by a whitish shade widest on costa, not extending below vein five; termen narrowly whitish gray.

Hind wings below white; a pinkish buff shade at base of costa; termen with fuscous shading from below apex to anal angle. *Expanse*: 34 mm.

A very distinct species.

Habitat: Pied Saut, Oyapok River, French Guiana, *type*, C. M., Acc. No. 6173, Feb. 1918 (S. M. Klages *coll.*).

Genus KALKOMA Schaus.

3. *Kalkoma cynedryda* sp. nov. (Plate IV, fig. 5).

Male:—Palpi light buff with a broad lateral dark reddish brown streak on its upper edge, not quite reaching end of second joint. Frons whitish buff; vertex drab-gray. Collar and thorax mottled drab-gray and whitish buff; a large chestnut-brown spot on collar medially. Abdomen above drab, with whitish segmental lines; subdorsal dark spots at base and a chestnut-brown transverse band on next to last segment; underneath light buff. Legs light buff; the fore tibiae with fuscous brown and white spots. Fore wings light cinnamon drab, shaded with whitish buff at base; subbasal paired spots on costal edge; a streak above subcostal, paired antemedial spots on costal edge and paired spots at subcostal, two upright streaks across costal margin post-medially, all dark chestnut-brown; a wavy dark line basally below cell; from antemedial and post-medial spots paired cinnamon-drab lines cross the wing; the antemedial macular, the post-medial proximal line heavier, inangled on costa before spot, outbent, wavy and vertical to vein two, then incurved to inner margin; the distal line very fine, lunular, followed by a series of chestnut-brown spots on interspaces, the spot above submedian more heavily marked; a faint subterminal

whitish drab shade very irregular, somewhat macular, preceded on costa by an olive-brown shade; dark angled lines on interspaces before termen; cilia ochreous. Hind wings buffy-avellaneous. Wings below buffy-avellaneous. *Expanse*: 37 mm.

Near *K. pylaon* Druce.

Habitat: Pied Saut, Oyapok River, French Guiana, *type*, C. M., Acc. No. 6173, March 1918 (S. M. Klages *coll.*).

MARTHANTIA gen. nov.

Male:—Antennæ fasciculate to beyond middle. Palpi upturned; second joint stout, smoothly scaled, with short fringe below, reaching frons; third joint short, smooth, the tip round. Abdomen smooth, with dorsal crests on three basal segments; mid and hind tibiæ fringed, the inner spurs twice the length of outer. Fore wings short for width; the apex rounded; termen straight below apex, bulging and rounded from vein four to tornus; veins three and four apart from lower angle; vein five from above middle of discocellular; areole short and narrow from end of cell; vein six from base of areole; veins seven, eight, nine, and ten from areole; cell below clothed with long hairs. Hind wings broad; termen rounded, appearing produced; termen obliquely truncate from vein two to anal angle; veins three and four from a point; vein five from middle of discocellular; veins six and seven stalked; costa nearly straight, with upturned fringe; vein eight close to seven to near end of cell, then diverging widely.

The genus belongs near *Antiopha* Schaus. *Type* of genus *M. stelligera* Schaus.

4. *Marthantia stelligera* sp. nov. (Plate IV, fig. 6).

Male:—Palpi fuscous-brown, first joint with lateral white spot and fringed with white below, second joint terminally white, except above, third joint white. Head dark grayish brown. Collar and thorax brownish drab. Abdomen above grayish brown with pale segmental lines; underneath light buff. Legs light buff streaked with fuscous-brown; fore femora white; tibiæ white with black rings. Fore wings saccardo's umber at base, the outer half isabella; veins black, irrorated with white; an isabella antemedial line defined by dark brown starting from a white crescent on costa, lunular, slightly outcurved, followed by some white scales below cell; a double fuscous-brown medial shade, the two lines apart on costa; interrupted above subcostal, almost suffusing below cell, then widely diverging, the proximal shade curved and inbent along inner margin to near base, the distal shade curved to inner margin preceded below fold by another dark broken line and followed below vein two by the faint post-medial

brownish line, this line being outcurved below cell and inbent at vein three and is barely traceable, but marked by a white line on costa; a faint pale line on discocellular, defined by brown; post-medial line followed by white points on veins, those from vein five to costa on a dark brown shade; costa before apex brown, with three white points, a fourth at apex being the beginning of a series of marginal white spots with fuscous edging; faint traces of a subterminal dentate macular line with black spots above and below vein seven; terminal white points on veins; cilia gray-brown with darker spots at veins.

Hind wings fuscous, the costa and base indistinctly whitish.

Fore wings below purplish brown, the costa narrowly and termen, whitish; costa brown towards apex with three white points; marginal black points and a broken dark terminal line; cilia white tipped with purplish brown. Hind wings below whitish; brown irrorations forming a medial line; a large fuscous spot on terminal space from vein seven to below vein two. *Expanse*: 35 mm.

Habitat: Pied Saut, Oyapok River, French Guiana, *type*, C. M., Acc. No. 6173, Feb. 1918 (S. M. Klages *coll.*). A *co-type* in National Museum.

Genus FARIGIA Schaus.

5. *Farigia benepicta* sp. nov. (Plate IV, fig. 4).

Male:—Palpi snuff-brown shaded above with black-brown, the fringe tipped with some whitish hairs, especially on third joint. Head hazel with some white hairs. Collar and front of thorax and patagia chestnut-brown thickly mottled with white hairs, the shoulders white; thorax and patagia posteriorly aniline-yellow. Abdomen above black-brown, the dorsal crests mottled chestnut-brown and aniline-yellow; body below ochraceous-tawny; throat and fore coxæ cinnamon-rufous, fore tibiæ outwardly white, and with large hazel markings in front. Fore wings chiefly cinnamon-drab thickly irrorated with white, especially on medial space; double subbasal chestnut-brown line, out-angled on costa, then inbent to base, edged with white, containing some light greenish yellow scales; some pale blue-green irroration on costa antemedially; from before middle of costa a rather broad greenish yellow line, well inbent and straight to submedian, outset and outcurved on inner margin, preceded and followed by pale blue-green irrorations, those on distal side edged by some chestnut-brown lunules; some dark scales on discocellular with small white spots above and below; a fine indistinct post-medial line wavyly outcurved followed by light blue-green irrorations, then by a broad chestnut-brown shade evenly outcurved, outwardly edged with aniline-yellow, and then on costa by a triangular chestnut-brown spot and some white scaling from costa to vein six; marginal chestnut-brown streaks, inset

below veins and oblique to termen at following vein; cilia fuscous-brown, with faint white points at veins. Hind wings brussels-brown; cilia with white points at veins. Wings below suffused with light buffy-brown. *Expanse*: 40 mm.

Habitat: Pied Saut, Oyapok River, French Guiana, *type*, C. M., Acc. No. 6173, March 1918 (S. M. Klages *coll.*).

Genus NOTOPLUSIA Schaus.

6. *Notoplusia oyapoca* sp. nov. (Plate IV, fig. 13, ♂).

Male:—Palpi, throat, and frons anteriorly mikado-brown mottled with light buff; frons otherwise and collar pinkish buff; hairs on vertex and a transverse line on collar in front mikado-brown. Thorax reddish brown in front, fuscous behind, the patagia also fuscous with some mars-brown on shoulders. Abdomen above fuscous, the terminal segment and anal hairs light olive-gray; underneath whitish. Legs mostly mars-brown, the tibiæ paler, with fine white rings. Fore wings pale olive-gray; basal third mars-brown with blackish streaks on costa, in cell, and on submedian vein, the outer edge inbent from costa to median, then slightly incurved below it; inner margin to tornus mouse-gray; reniform finely outlined in black, slightly incurved and with some brown scales on its outer edge; a fine dark dentate medial line outcurved close around discocellular; very faint traces of a fine double post-medial line followed on costa by a mars-brown spot, from which a black line extends along vein six to termen, where it has a smaller brown spot above it; a post-medial brown patch below vein two; vein five black terminally, the other veins irrorated with black; a subterminal mars-brown line slightly sinuous from vein eight to vein three, then somewhat inset on each interspace below it; cilia dark gray or brown at apex with white spots at veins. Hind wings whitish, suffused with brownish gray especially on inner margin; the termen narrowly brown; cilia mostly gray-brown. Fore wings below whitish with brownish gray suffusion; costa to beyond middle mars-brown; two indistinct shades beyond cell from spots on costa to submedian fold; apex suffused with brown; a subterminal shade. Hind wings below whitish; a medial shade on costa followed by a gray line to inner margin; some darker shading terminally from apex narrowing to a fine line below vein four. *Expanse*: 33 mm.

Near *N. eunoteloides* Schaus. Distinguished at once by the black line on vein six.

Habitat: ♂, *type*, Pied Saut, Oyapok River, French Guiana. C. M., Acc. No. 6173, Feb. 1918 (S. M. Klages *coll.*). ♀, *allotype*, Puerto Suarez, Bolivia, Nov. 1908 (Steinbach *coll.*). A *co-type* in National Museum.

7. *Notoplusia boliviensis* sp. nov. (Plate IV, fig. 14).

Male:—Palpi mouse-gray, the first joint light buff. Head and collar light ochraceous-buff. Thorax above and below, abdomen dorsally, fore and mid tibiæ mouse-gray; abdomen below and hind tibiæ buff-white; tarsi with black rings. Fore wings olive-gray faintly suffused with light avellaneous on post-medial interspaces; base of costa and cell avellaneous crossed by a double subbasal black line; a brown-black antemedial shade, slightly outcurved on costa, its inner edge with projecting lines, inbent below cell not extending below vein one, closely followed by a fine brown-black line, faintly curved from costa to median, inbent, outcurved from fold to submedian and outbent below it; a faint wavy medial line, and a post-medial fine lunular black line, curved around end of cell, both starting from light brown streaks on costa; a brown lunule on costa beyond; veins from cell irrorated with black; a subterminal black-brown spot below vein two, with a similar shading below it on inner margin; a fine black line on vein six from near the costal lunule to termen; a subterminal fine black-brown line from vein seven to vein four, preceded by a short dark streak on vein five; small dark spots on interspaces from vein four to submedian; no terminal line; cilia white with avellaneous spots. Hind wings whitish, the veins light buff; costal margin with brownish scales. Fore wings below shaded with gray, the inner margin and outer half of costa whitish; the costal lunule well marked, followed by three brown points on costal edge, these being present but fainter on upper side; traces of post medial and subterminal lines. Hind wings below white. *Expanse*: 32 mm.

Habitat: Chiquitos, Eastern Bolivia, *type*, C. M., Acc. No 4543, March 1909 (José Steinbach *coll.*).

Genus TALMECA, Schaus.

8. *Talmeca offa* sp. nov. (Plate IV, fig. 10).

Male:—Palpi white, a dark lateral streak on second joint, and a short fine lateral paler streak on third joint. Frons white; tuft on vertex, collar, and thorax light drab, the tuft mottled with benzo-brown; a similar shade on collar and thorax medially adjoining collar. Abdomen above benzo-brown; some white hairs at base; anal segment with whitish mottling; body below and legs whitish, the latter mottled with gray, the tarsi drab-gray. Fore wings light drab with some dark irrorations on costal margin and from submedian fold to inner margin; a benzo-brown streak at base of costa and a broad shade from base of cell to termen between veins four and five; these veins and a streak on interspace still darker; a white shade from

base below cell to termen between veins two and four with light drab shading and streaks near termen; veins six and seven indistinctly whitish, with darker shading above and below vein seven; veins six and eight terminally with fuscous streaks; a faint dark terminal line with black points on interspaces; cilia white. Hind wings white, the veins terminally with fine brownish irrorations. Fore wings below whitish, the anterior half shaded with drab, becoming paler towards apex. *Expanse*: 33 mm.

Near *Talmeca perplexa* Schaus.

Habitat: Province del Sara, Bolivia, March 1911, *type*, C. M., Acc. No. 5058 (José Steinbach *coll.*).

Genus CHADISRA, Walker.

9. *Chadisra hollandi* sp. nov. (Plate IV, fig. 7).

Male:—Palpi mummy-brown above, underneath white with some brown hairs. Frons white, laterally mottled with brownish hairs; vertex, collar, and front of thorax dresdren-brown, mottled with light buff hairs, the portion on thorax forming the apex of a triangle, the two sides edged with mummy-brown; thorax otherwise and patagia white, the latter with a few brown hairs. Abdomen white; a dorsal ochraceous tawny spot at base. Legs white partly mottled with buff-brown, the tarsi buff-brown. Fore wings white; a triangular spot resting on costa near base, its apex reaching median vein, two points on costa medially and a large triangular space resting on costa post-medially, all dresdren-brown, with slightly darker edges; the post-medial triangle has a blunt apex near vein four and expands slightly at vein six; a few brown scales on inner margin, and a small terminal spot above tornus. Hind wings white. Wings below thinly scaled, white, the post-medial triangle partly indicated with four white points on costa. *Expanse*: 40 mm.

It is a pleasure to name this beautiful species in honor of Dr. W. J. Holland.

Habitat: Pied Saut, Oyapok River, French Guiana, *type*, C. M., Acc. No. 6173, March 1918 (S. M. Klages *coll.*).

Genus RIFARGIA, Walker.

10. *Rifargia elgiva* sp. nov. (Plate IV, fig. 1).

Male:—Palpi fuscous black, with four fine ochraceous-buff lines. Head and thorax thickly mottled with brown-gray, fuscous, and light buff hairs. Collar paler, mostly light ochraceous-buff, with a transverse central dark line. Abdomen above army-brown, with whitish

mottling on last segment, the anal hairs spotted with brown-black; underneath pale ochraceous buff. Tibiæ hairy, mottled like thorax, the hind tibiæ paler, with fewer dark hairs; tarsi dark brown with paler rings. Fore wings thickly mottled with brown, smoke-gray, and black, only the outer half being predominantly wood-brown; a fine black-brown line below cell from base to antemedial line; a sub-basal fine brown-black line inbent from costa to submedian, followed from costa to fold by a broader line, then by some whitish points on subcostal; a small orbicular spot defined by some whitish scales; antemedial line double, brown-black, wavyly curved and inbent to inner margin; reniform linear, brown-black, surrounded narrowly by a whitish shade, its center mottled smoke-gray and white, followed by a double medial dentate line, the inner line more heavily marked; post-medial line double, the proximal line brown-black, the distal line paler and faint, oblique from costa and slightly upbent at vein seven, down-turned to six, slightly inset from six to four, outcurved to three, inbent to two, vertical to submedian, incurved on inner margin; the veins all darker, with some white points and irrorations; a sub-terminal irregular dentate shade, darker and broader between veins six and eight, intensified by short black streaks; a marginal fine black line parallel with termen; cilia with white points at veins and dark brown shading on either side.

Hind wings dull buffy brown, the inner margin broadly clothed with darker hairs; a faint post-medial pale shade darker on either side; a slightly darker marginal and terminal line with some whitish scaling between them; a fuscous black spot at anal angle, crossed by a white crescent; cilia tipped with white. Fore wings below whitish, irrorated with wood-brown; inner margin buffy gray-brown; a dark streak at end of all; post-medial and subterminal dentate brownish shades; outer half of costa with fuscous brown and whitish gray spots. Hind wings below white; medial, post-medial, and subterminal buffy brown shades on costa, and also on vein two above termen, and at anal angle. *Expanse*: 55 mm.

A cotype in National Museum.

Habitat: Pied Saut, Oyapok River, French Guiana, *type*, C. M., Acc. No. 6173, February 1918 (S. M. Klages *coll.*).

GENUS *HYPERÆSCHRA*, Butler.

11. *Hyperæschra tropicalis* sp. nov. (Plate IV, fig. 9).

Male:—Head, collar, and thorax snuff-brown mottled with a few whitish hairs. Abdomen above darker brown, with faint fuscous segmental lines. Body below buffy brown, fore tibiæ mottled with snuff-brown. Fore wings snuff-brown mottled with whitish hairs, the

lines and shadings darker; a subbasal line followed and preceded by small whitish patches on costa, in and below cell; a similar patch antemedially below cell; a double medial line interrupted below subcostal and by veins, slightly inbent from costa to inner margin; a dark line through cell, and spots at end; a black line on discocellular followed by some whitish scaling, veins from cell partly black, especially on terminal space; a faint post-medial shade outangled on vein six, followed by a fine fuscous line wavyly outbent to near middle of inner margin with white scales beyond it on costal margin; a parallel subterminal shade somewhat macular; a marginal fine line followed by white scaling above vein seven; a faintly marked terminal line. Hind wings clear snuff-brown tinged with light buff at base, and similar hairs on inner margin. Fore wings below buffy brown, the inner margin whitish. Hind wings below whitish shaded with buffy brown especially on costal margin. *Expanse*: 40 mm.

Habitat: Pied Saut, Oyapok River, French Guiana, *type*, C. M., Acc. No. 6173, March 1918 (S. M. Klages *coll.*). A *co-type* in National Museum.

EXPLANATION OF PLATE IV.

- FIG. 1. *Rifargia elgiva* sp. nov., ♂, type.
 FIG. 2. *Phedusia riachuela* Jones, ♂.
Phedusia riachuela F. D. Jones, Trans. Ent. Soc. Lond., 1912, p. 426. Puerto Suarez, Bolivia, November 1908, C. M., Acc. No. 3758 (Steinbach coll.).
 FIG. 3. *Nystalea albipicta* sp. nov., ♂, type.
 FIG. 4. *Farigia benepicta* sp. nov., ♂, type.
 FIG. 5. *Kalkoma cynedryda* sp. nov., ♂, type.
 FIG. 6. *Marthantia stelligera* sp. nov., ♂, type.
 FIG. 7. *Chadisra hollandi* sp. nov., ♂, type.
 FIG. 8. *Nystalea arimathea* sp. nov., ♂, type.
 FIG. 9. *Hyperaschra tropicalis* sp. nov., ♂, type.
 FIG. 10. *Talmeca offa* sp. nov., ♂, type.
 FIG. 11. *Nystalea olivescens* Dognin, ♂.
Nystalea olivescens Dognin, Hétérocères Nouveaux de l'Amérique du Sud, No. 12, 1916, p. 7, Mana River, Fr. Guiana, May 1917, C. M., Acc. No. 6008 (Klages coll.).
 FIG. 12. *Lepasta lignistriata* Schaus, ♂.
Lepasta lignistriata Schaus, Trans. Ent. Soc. Lond., 1901, p. 278. Puerto Suarez, Bolivia, November 1908, C. M., Acc. No. 2758 (Steinbach coll.).
 FIG. 13. *Notoplusia oyapoca* sp. nov., ♂, type.
 FIG. 14. *Notoplusia boliviensis* sp. nov., ♂, type.
 FIG. 15. *Lepasta lignistriata* Schaus, ♀.
 FIG. 16. *Heorta cilla* (Dognin) ♂.
Hippia cilla Dognin, Ann. Soc. Ent. Belg., LII, 1908, p. 164. Chiquitos, Bolivia, March 1909, C. M., Acc. No. 4543 (Steinbach coll.).
 FIG. 17. *Heorta viridans* (Dognin) ♀.
Hippia viridans Dognin, Ann. Soc. Ent. Belg., LIII, 1909, p. 78. Puerto Suarez, Bolivia, November 1908, C. M., Acc. No. 3758 (Steinbach coll.).
 FIG. 18. *Dasylophia guarana* (Schaus) ♂.
Edemasia guarana Schaus, Proc. Zoöl. Soc. Lond., 1892, p. 331. Las Quiguas, Esteban Valley, N. Venezuela, March 1919, C. M., Acc. No. 5538 (Klages coll.).
 FIG. 19. *Malocampa punctata* (Stoll) small ♀.
Phalana punctata Stoll, in Cramer, Pap. Exot., IV, 1782, Pl. 307, fig. F. Puerto Suarez, Bolivia, December 1908, C. M., Acc. No. 3758 (Steinbach coll.).



South American Notodontidæ.

IV. A FOSSILBEARING SLAB OF SANDSTONE FROM THE
AGATE SPRING QUARRIES OF WESTERN NEBRASKA
EXHIBITED IN THE CARNEGIE MUSEUM.

BY O. A. PETERSON.

(PLATE V.)

Before the field-party, sent out from the Carnegie Museum in 1908, closed its work at the Agate Spring Fossil Quarries of Sioux County, Nebraska, it was decided to take up a section of the layer containing bones at Quarry No. 1. This section, which weighed when boxed nearly two tons, was sent in to the Carnegie Museum, and has recently been prepared and placed on exhibition in the Gallery of Mammalian Paleontology. The object of placing this section on exhibition is to permanently preserve a representation of the fossil-layer as it was when found. These quarries are not inexhaustible, and the day is not far distant when they will no longer yield fossil bones. A section showing the material in place, as it appeared to the collector while at work, will not only prove interesting to the casual visitor, but be instructive to the student.

This important field was first opened by a party from the Carnegie Museum in 1904. Quarry No. 1, from which the present section (See Plate V) was taken, was opened in 1905. An area of over 25 x 100 feet, or about 7 x 30 meters, was uncovered and blocks large and small were taken out and transported to the Museum from time to time. Since 1908 other parties have excavated equal, if not greater, areas, and have taken out an equal or greater amount of fossil remains.

As may be seen from a close inspection of Plate V, the bones literally formed a solid pavement. The skeletons were usually more or less disarticulated. One sees, for instance, an articulated neck of *Diceratherium cooki* with the lower jaws in their natural position, while the cranium is removed. A pelvis of the same species, with the right ilium broken and the sacrum slightly disturbed, but still lying within the pelvic cavity, may be seen. A short distance from this is a series of posterior dorsals and three lumbar nearly artic-

ulated. This series is thrust in between two layers of disarticulated bones, one above and one below. Whether these three layers represent three independent deposits separated in time, or one grand catastrophe, it is difficult to judge. The rounded edges and greater wear shown by the bones near the bottom of the layer may indicate longer exposure. The bone-bearing stratum in the quarries, as observed by the writer during his work, attained a thickness of from three to twenty inches (8 to 50 cm.). Some of the material, especially towards the bottom of the layer, appears worn and rounded

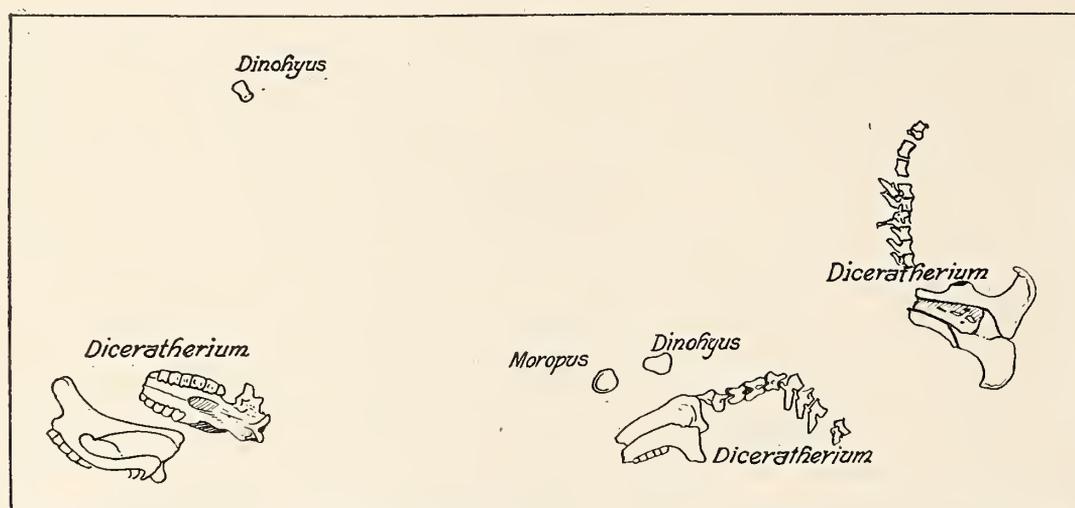
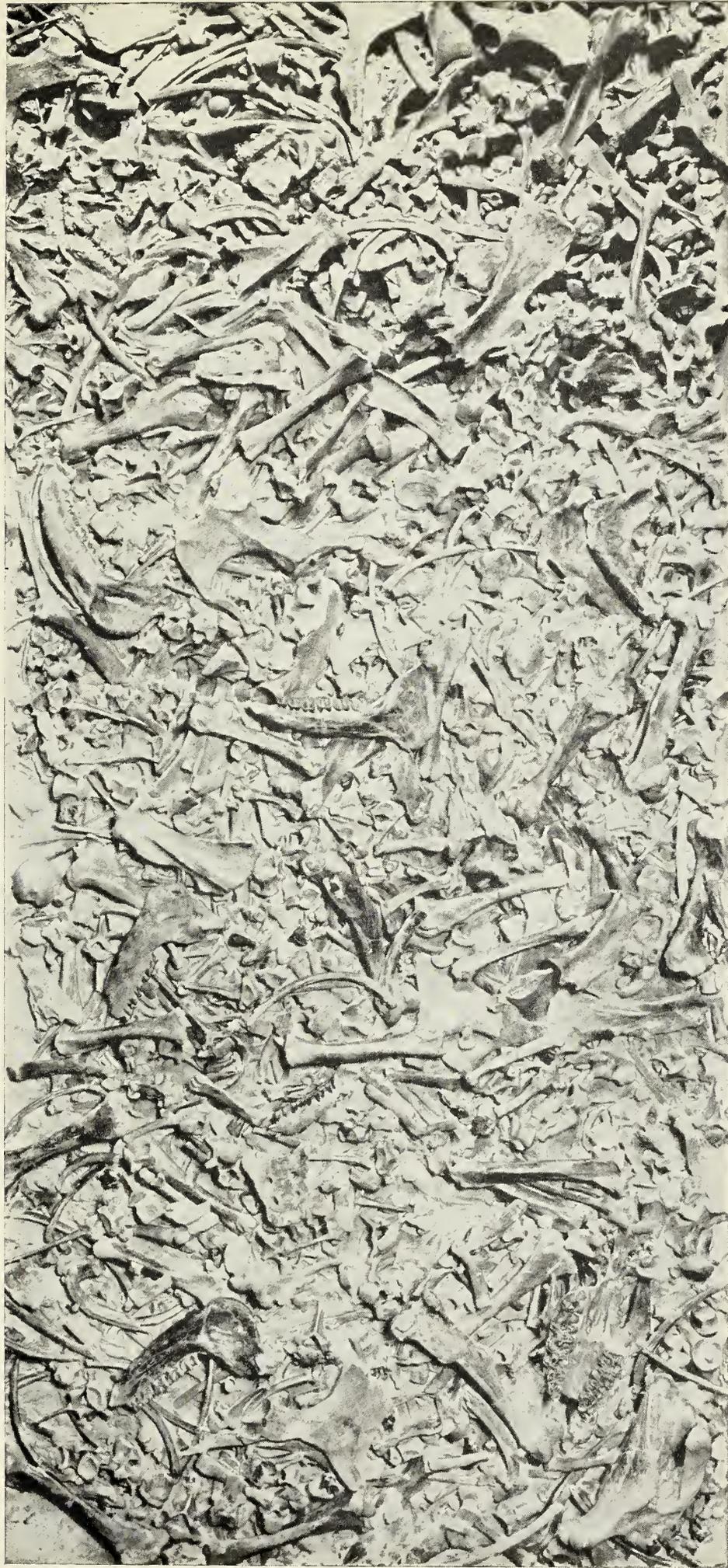


FIG. 1. Diagram showing the location of some of the more important specimens contained in the slab represented on Plate V.

by the elements, while the greater portion—especially where the layer was thickest—is unworn, and in one case a skeleton was found in a nearly perfectly articulated position. During the early work done in these quarries it very soon became evident to the writer that the thinner the bone-layer the more imperfect and disarticulated were the bones. The thicker bone-layer was therefore selected for excavation, because the bones, though sometimes crushed, were usually unworn and more portions of skeletons partially articulated were more frequently found. The lithological condition and the color of these heavier layers also differ from what is to be seen in the thinner portions. In the latter the sand was usually quite pure and the color of the bones often dark blue; while in the former, or the heavier portions, the sediment contained less sand, more lime, is lighter in color, and the fossils are usually much lighter both in weight and color, the color being usually a cream-yellow.



Slab showing a thick deposit of bones as they occurred in the Agate Spring Fossil Quarry discovered and opened for the Carnegie Museum in Sioux County, Nebraska, by Mr. O. A. Paterson, in 1904.

The shallow portions of the bone-layer of these quarries have the appearance of the sediments of swifter flowing channels, while the heavier beds would represent deeper or more sluggish movement of the stream.¹

CARNEGIE MUSEUM,

September 7, 1922.

¹ See diagram of one of the Agate Spring Fossil Quarries in *Memoirs Carnegie Museum*, Vol. IV, 1909, p. 75.

V. THE HYOID ARCH OF THE MIOCENE CAMEL STENOMYLUS.

BY O. A. PETERSON.

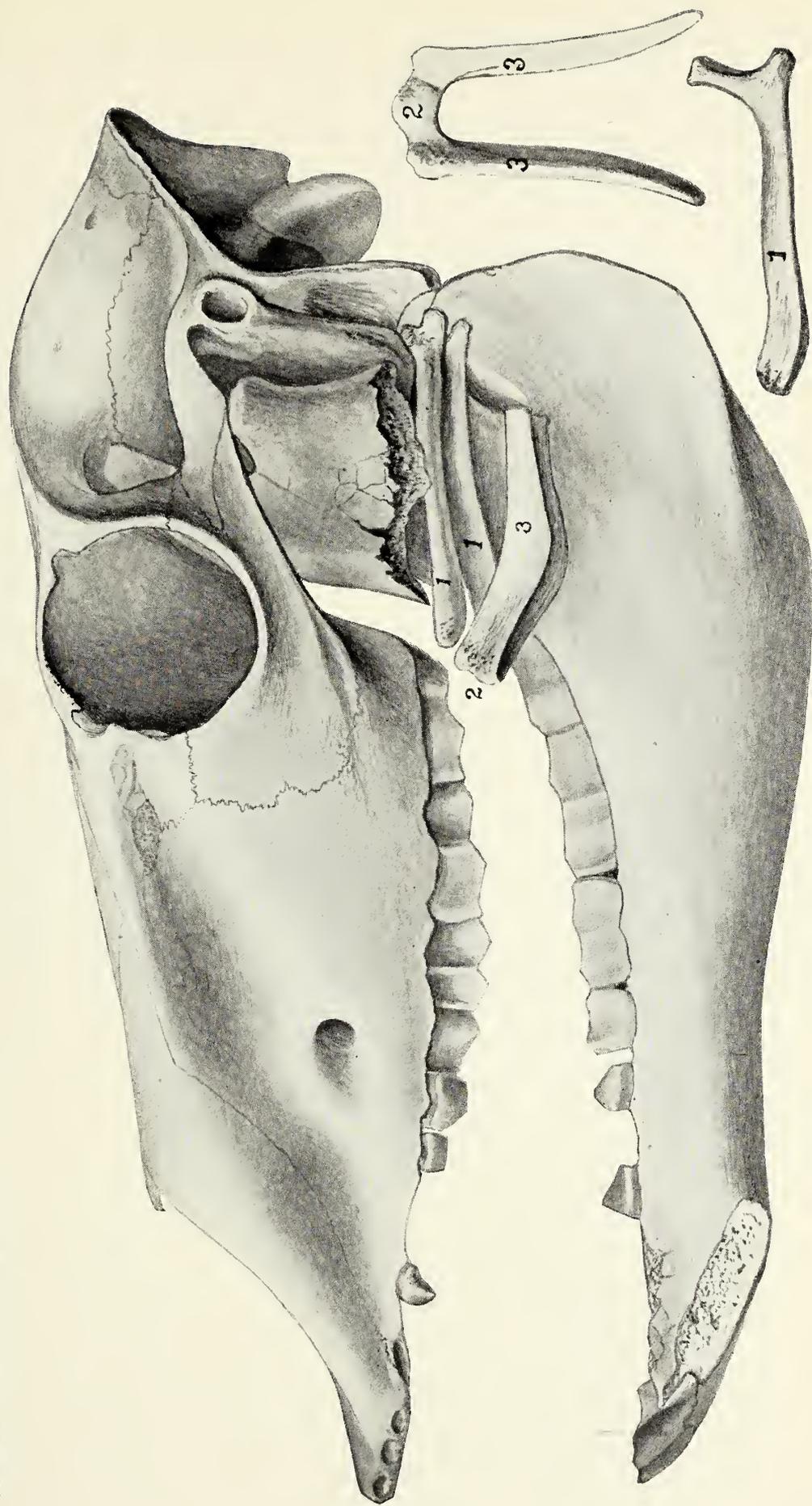
(PLATE VI.)

Until quite recently only stray hyoid bones have been found with the remains of *Stenomylus* obtained by the Carnegie Museum from the Stenomylus Quarry of Sioux County, Nebraska, opened by Professor F. B. Loomis and thoroughly explored by the writer. The work of patiently extracting a number of skeletons from the matrix, carried on intermittently by Mr. Serafino Agostini during recent years, reveals the skull and anterior cervicals of an individual, No. 11,015, with the greater portion of the hyoid arch in position. Herewith is submitted a brief description of these elements, hitherto unknown, in order to supplement the more or less complete account of this well known Miocene Camel, which has been brought to the knowledge of students by the labors of Professor F. B. Loomis and the writer.¹

The tympanohyal is deeply set in the postero-external portion of the auditory bulla and is well surrounded by the mastoid and paroccipital portions of the temporal bone. The stylohyal is, as usual, rib-like and attenuate. In shape and proportions this bone is not unlike that in the Huanaco (*Lama huanachus* Molina), the inferior tubercle, or angle of the proximal end, being less developed than in the recent species. The shaft is long and is expanded distally to receive the cartilaginous connection with the epihyal. The latter bone, and the

¹ Loomis, F. B., *Osteology and Affinities of the Genus Stenomylus*. *Amer. Jour. Sci.*, Vol. XXIX, April, 1910, pp. 217-223, text-figures.

Peterson, O. A., *Stenomylus gracilis* gen. et sp. nov. ANNALS CARNEGIE MUSEUM, Vol. IV, 1906, pp. 41-44, plate XII and text-figure. *Description of the Type Specimen of Stenomylus gracilis Peterson l. c.*, Vol. IV, pp. 286-300, text-figures. *A Mounted Skeleton of Stenomylus hitchcocki, the Stenomylus Quarry, and Remarks upon the Affinities of the Genus, l. c.*, Vol. VII, May, 1911, pp. 267-273, plates XXXVII-XLIV and text-figures. *A Group of Stenomylins Recently Prepared and Exhibited in the Carnegie Museum, l. c.*, Vol. VIII, 1912, pp. 366-369, pls. XXI-XXII, text-figure.



Stenomylus hitchcocki Loomis. 1, Stylohyal; 2, Basihyal; 3, Thyrohyal. (C. M. No. 11,015, slightly reduced from natural size.)

ceratohyal are not preserved. The basihyal has relatively a slightly greater transverse diameter than in *Lama*. The body is of trihedral outline and differs from that bone in the llama by the much less developed anterior appendix for the muscular tissue of the tongue. On the lateral superoanterior angles are slight eminences with a delicate rugose surface, which serves for the attachment of the ceratohyals. The thyrohyal is solidly coössified with the basihyal. Its shaft is also trihedral, but with a rather sharp apex directed downward, so that the inferior border of the shaft is quite sharp. Toward the posterior end the shaft gradually becomes more rounded and also slenderer. The extreme distal end is apparently somewhat injured, but the junction with the chondrohyal was very little, if at all, enlarged.

CARNEGIE MUSEUM,

October, 1922.

VI. RESTORATION OF MERYCHYUS ELEGANS SUBSP.
MINIMUS PETERSON.

BY O. A. PETERSON.

(PLATES VII-VIII.)

The material upon which this subspecies was based has recently been completely extracted from the matrix. It is found that enough has been obtained to set up an articulated skeleton composed of parts of a number of different individuals. No. 3,397 is used as the base, because it contains more parts of the skeleton than any of the others referred to this subspecies. This specimen is only a very little

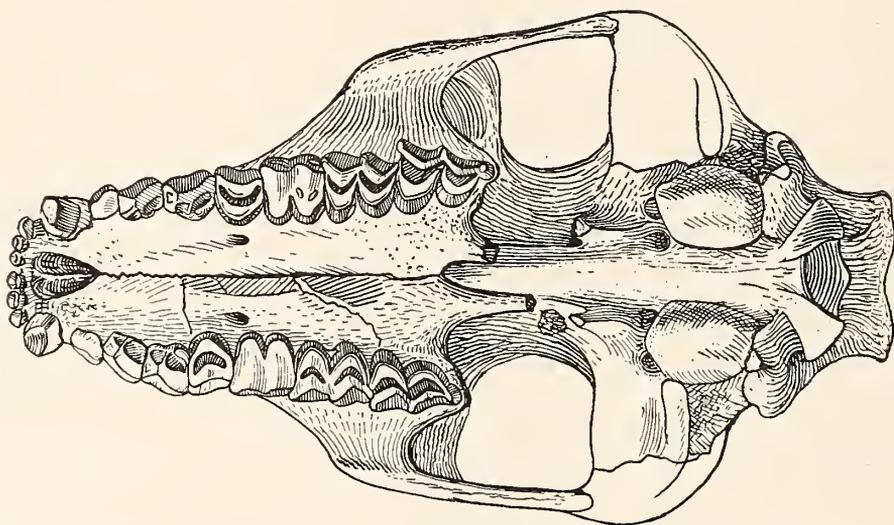


FIG. 1. Palatal view of Skull of *M. minimus* Peterson, type, C. M. No. 1466.
 $\frac{1}{2}$ nat. size.

smaller than the type and the only noteworthy difference between the skulls of the two specimens is the fact that in the type the distance between the canine and the first upper premolar is slightly greater than in No. 3,397. The latter specimen consists of the skull, jaws, and the vertebral column to, and including, the seventh dorsal, with some



FIG. 2. Lower dentition of *M. minimus* Peterson, type. $\frac{1}{2}$ nat. size.

of the ribs attached. The fore and hind limbs are also associated with this specimen. The skull and lower jaws of the articulated skeleton is the type specimen of *Merychys minimus*¹ No. 1,466.

SKULL.

The principal differences between the subspecies *Merychys minimus* Peterson, and *M. leptorhynchus* Cope, are the shorter sagittal crest of the former, the more posterior location of the infraorbital foramen, the shorter symphysis of the lower jaw, and the slightly shallower ramus. These differences may disappear upon further study, should more abundant material of *M. leptorhynchus* be found. *M. elegans* Leidy is larger and appears to have longer and narrower upper and lower third molars, a specialization which probably represents a later horizon. On the other hand it is altogether possible that with a large series of individuals of the latter species, the array of subspecies, namely *Merychys arenarum*, *M. leptorhynchus* Cope, and *M. minimus* Peterson, may ultimately be referred to *Merychys elegans* Leidy. *Merychys medius* Leidy and *M. harrisonensis* Peterson are of considerably larger size than the above mentioned species, while *M. major* Leidy most likely belongs to a different genus. *Merychys parigonus* Cope from the Deep River formation of Montana may possibly also pertain to a different genus. (See Cope, Scott, and Douglass.)

VERTEBRAL COLUMN AND THORAX.

The vertebral formula of *Merychys minimus* appears to be as follows: cervicals seven; dorsals fourteen;² lumbar six; sacrals from five to seven; caudals five (+?).

The centra of the anterior dorsals are depressed and broad, as usual, and the arches are heavy, while further back in the series they are higher and narrower and the neural arches lighter. The last three dorsal vertebrae are provided with lumbar-like *postzygapophyses* as in *Phenacocalus*, but the last dorsal does not have the transverse process developed to the same degree as in the latter genus. There are

¹ ANNALS OF THE CARNEGIE MUSEUM, Vol. IV, 1907, pp. 67-68.

² The number of dorsals is thought to be correct, inasmuch as the animal had the same number of lumbar as *Phenacocalus* and *Promerycocharus*. (See ANNALS CARNEGIE MUSEUM, Vol. IV, 1907, pp. 29 and 21; *Ibid.*, Vol. IX, 1914, p. 166.)

no distinct intervertebral foramina of the dorsals as in *Promerycochærus*. The neural spines of the dorsal vertebræ are nearly all restored in the articulated skeleton. This is especially true of the anterior region. (See Pl. VIII.)

The centra of the anterior lumbar vertebræ are sharper ventrally, and consequently present a more nearly triangular outline in cross-section than in *Merycoidodon*, and in this respect are more nearly similar to those of *Phenacocælus* or *Promerycochærus*. The posterior face of the last lumbar has an enlarged rugose surface, which, however, did not abut against the anterior face of the pleurapophysis of the first sacral by a distinct facet, but indicates a strong cartilaginous connection.

The pleurapophyses of the two anterior sacral vertebræ support the ilia, as is usual in other genera of the family; but in the present specimen the neural spines are more distinctly separated than in *Promerycochærus*. The sacrum is longer than in *Merycoidodon*, due to the additional posterior vertebræ, but in the specimen used in the articulated skeleton (No. 1439) the sacrum is not as greatly produced backward as in *Promerycochærus*.

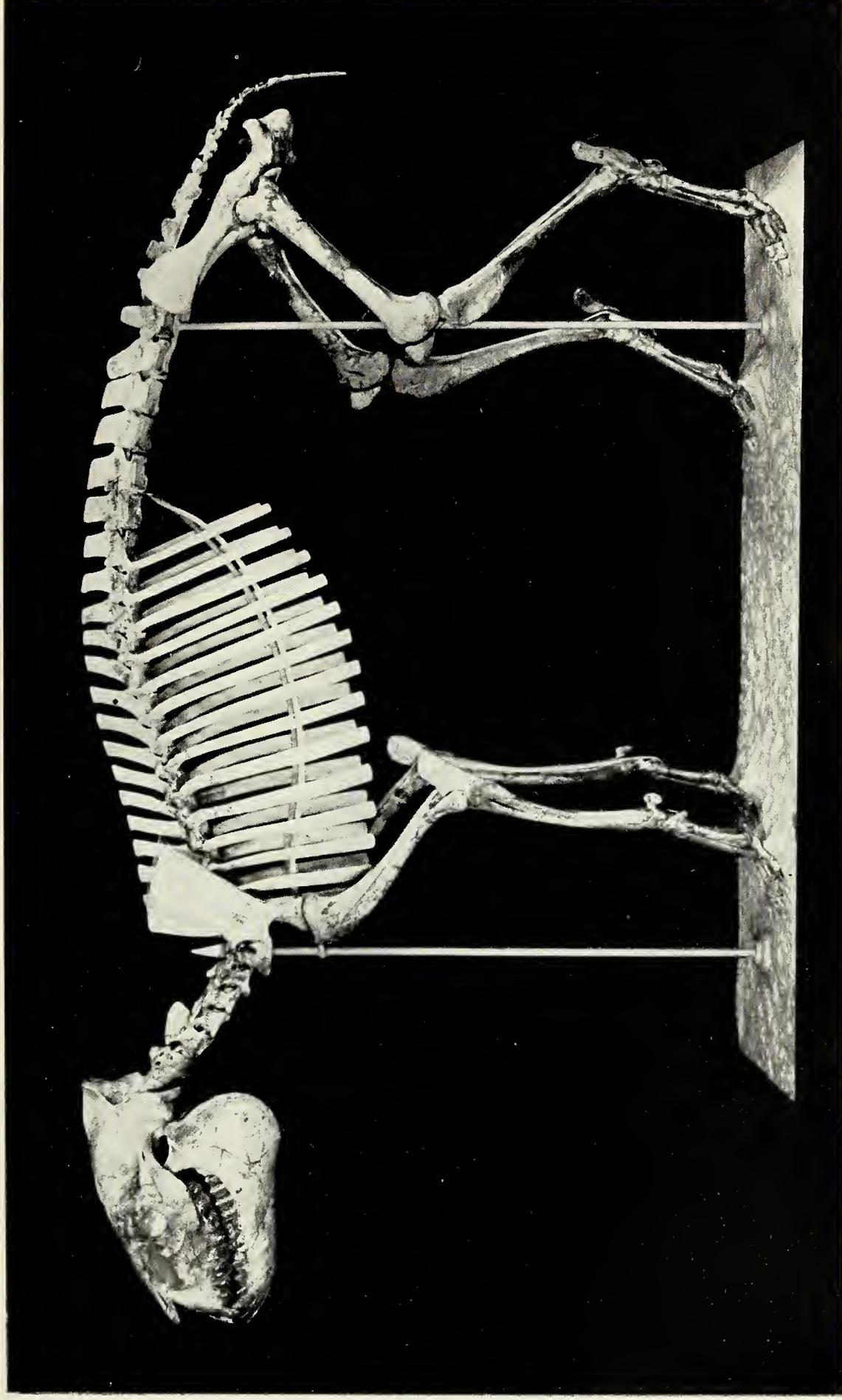
The tail was apparently quite short, as is suggested by the lack of the enlarged and convex anterior surfaces of the centra of the proximal caudals usually found in long-tailed animals.

The anterior ribs are robust, flattened, and indicate a thorax of normal proportions. The posterior ribs shown in Plate VIII have all been restored. The sternum is not represented in the material at hand.

LIMBS.

Scapula.—The general outlines of the scapula are more nearly like those of *Leptauchenia* or *Phenacocælus*. The bone as a whole is shorter than in the latter genus, but the acromion process is less developed, and the coracoid border of the blade is more suddenly expanded. There is no metacromion process, as in *Merycoidodon* or *Promerycochærus*, and in this respect the present genus again suggests *Phenacocælus* or *Leptauchenia*.

Humerus.—The humerus is quite similar to that of *Phenacocælus* in its general proportions. The supinator ridge and the internal epicondyle are smaller, otherwise the differences are only of very minor importance.



Restored skeleton of *Merychys minimus* Peterson (composite of C. M. Nos. 565, 1331, 1439, 1462, 1466, 1525, 3397).

Radius and Ulna.—The radius and ulna are very different from those of *Merycoidodon* and *Phenacocælus*; in fact they differ from most of the Oreodonts by the reduction in the thickness of the ulnar shaft and the broadening of the shaft of the radius. These bones are

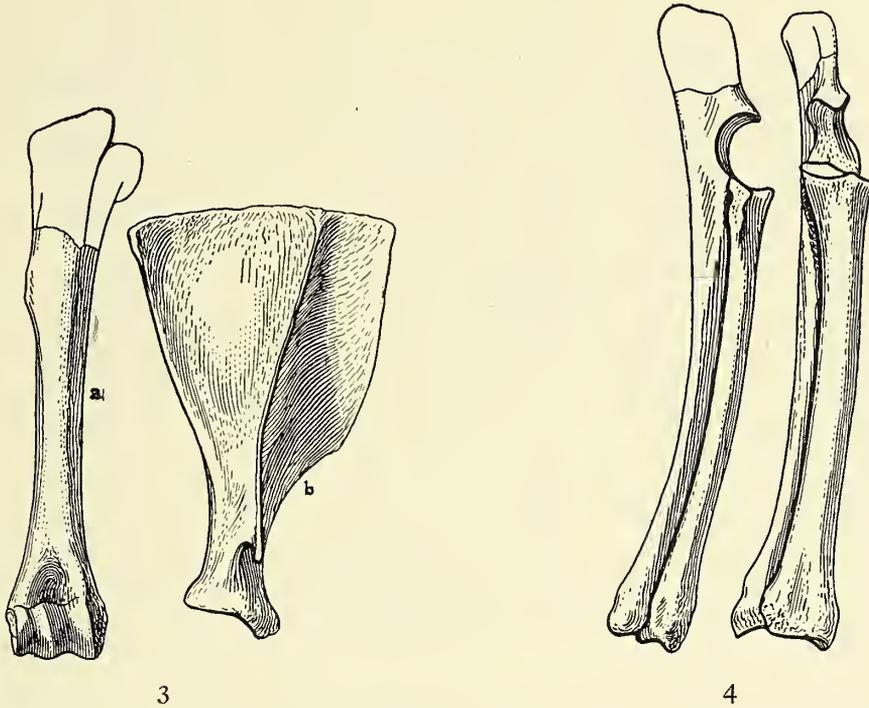


FIG. 3. *a*, humerus; *b*, scapula of *M. minimus* (C. M. No. 1439); $\frac{1}{2}$ nat. size.

FIG. 4. Radius and ulna of *M. minimus* Peterson (C. M. No. 3397); $\frac{1}{2}$ nat. size.

proportionally longer than in *Phenacocælus*, *Merycoidodon*, *Promerycochærus*, and many other forms. The proximal and distal articulations are, however, typically oreodont in their general character.

Manus.—The forefoot is high and narrow, when compared with most other oreodonts. The lunar, magnum, and in particular the trapezoid are strongly reduced in transverse diameter, while vertically the lunar is considerably increased; in fact the entire carpus appears to be more specialized in the direction of other cursorial forms. The lateral digits are, however, very little, if at all, reduced, when compared with those of *Merycoidodon*. The phalanges are of the typical broad and flat oreodont type.

Pelvis.—The pelvis is proportionally shorter than in *Merycoidodon* and the point of the ilium is possibly less developed than in this genus and in *Phenacocælus*; but its transverse diameter is fully equal to that in these genera. The pelvic cavity appears to be broad, but

not deep. The acetabulum is deep, and the heavy anterior border has a slight backward curve, in order to more completely lock the head of the femur. There is a well developed ischial tuberosity. The obtura-

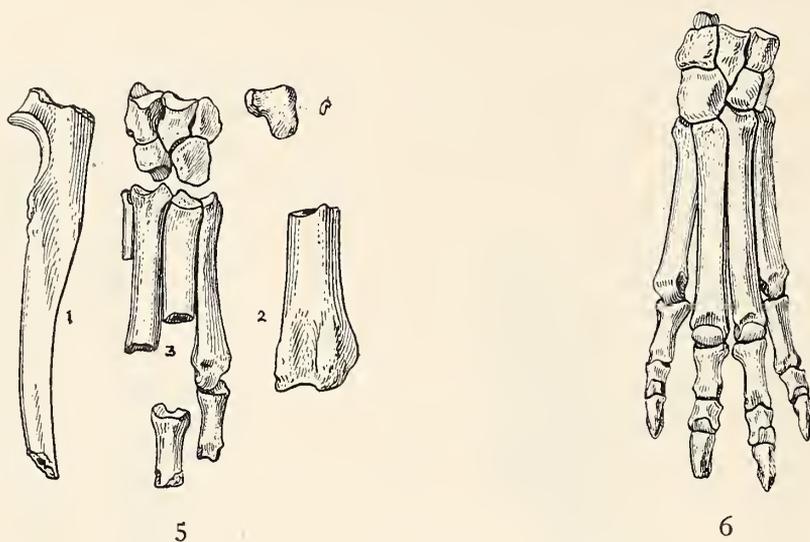


FIG. 5. *M. minimus* type (C. M. No. 1466); 1, fragment of ulna; 2, do. of radius; 3, do. of manus *P.* pisiform; $\frac{1}{2}$ nat. size.

FIG. 6. Manus of *M. minimus* (C. M. No. 3397); $\frac{1}{2}$ nat. size.

tor foramen is oblong and of large size, while the pubic symphysis is quite solidly coössified. The two ossa pubis form a broad bony surface, which terminates posteriorly in a v-shaped emargination.

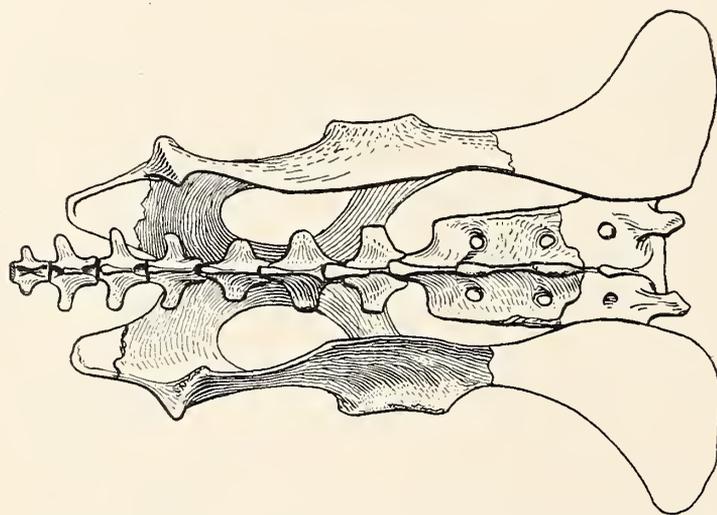


Fig. 7. Pelvis of *M. minimus* (C. M. No. 1439); $\frac{1}{2}$ nat. size.

Femur.—The femur is relatively slightly longer and slenderer than in *Merycododon*; the lesser trochanter is more directly posterior on the shaft; the fibular border of the shaft is sharper, and terminates dis-

tally in a more prominently developed external supracondylar ridge; the supracondylar fossa is unusually large and its anterior border apparently separates the supracondylar ridge from the external tuberosities of the distal end. (See fig. 8 and plate VIII.)

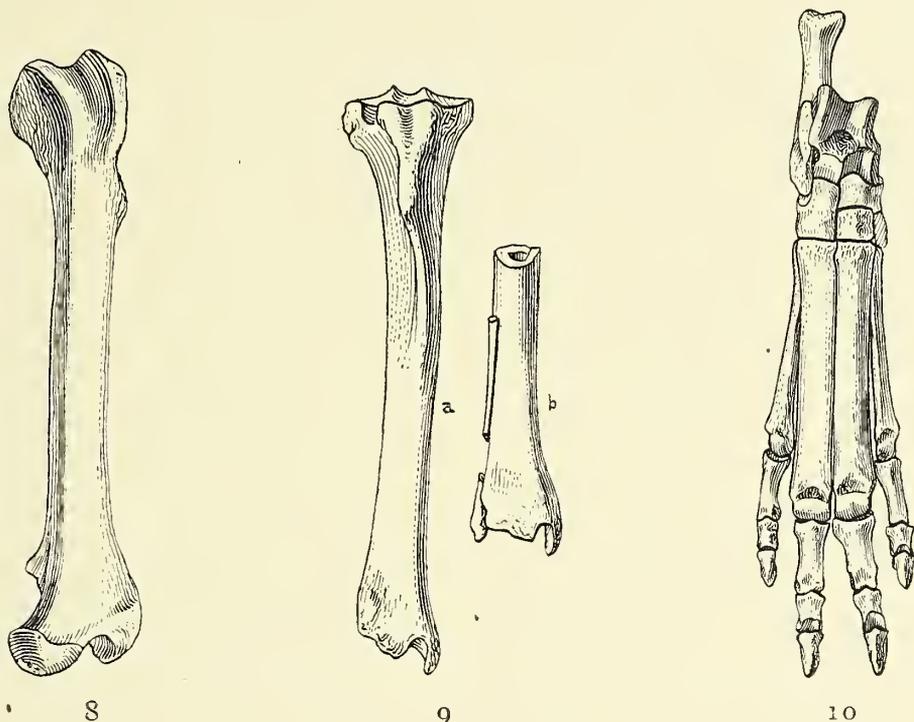


FIG. 8. Antero-tibial view of femur of *M. minimus* (C. M. No. 1439); $\frac{1}{2}$ nat. size.

FIG. 9. *a*, tibia of *M. minimus* (C. M. No. 1439); *b*, fragment of distal end of tibia with fragments of fibula (C. M. No. 1403). $\frac{1}{2}$ nat. size.

FIG. 10. Hind foot of *M. minimus* (C. M. No. 1439); $\frac{1}{2}$ nat. size.

The Patella.—The upper portion of the patella is relatively thick antero-posteriorly, but tapers rapidly towards the lower end. The trochlear articulations are of equal size and are separated by a prominent ridge.

The Tibia and Fibula.—The tibia is relatively slightly longer than in *Merycoidodon* and considerably longer and slenderer than in *Phenacocælus*. The most characteristic feature of this bone is the short, though stout, cnemial crest; thus differing markedly from most of the oreodonts and again suggesting that it was more fleet-footed. The fibula is not very well represented, but enough is preserved to indicate that it is much reduced in thickness when compared with *Merycoidodon*, *Phenacocælus*, and other genera. In No. 1403 a portion of the shaft of the fibula is connected by matrix to the shaft of

the tibia, and thus conclusively shows that the shaft, though slender, was complete (See fig. 9, b).

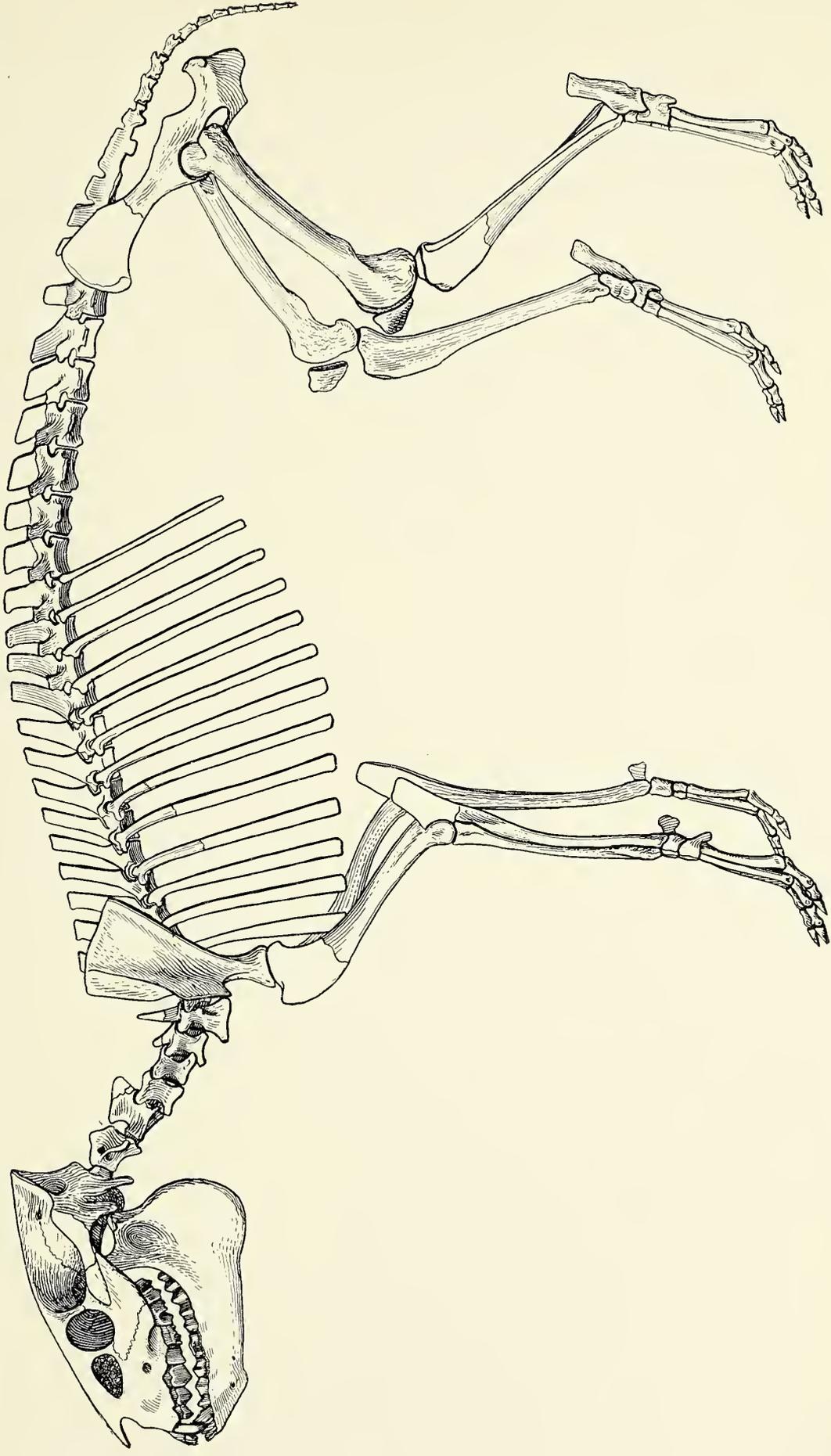
Pes.—The hind foot of *Merychys minimus* is as much specialized in the direction of a cursorial habit as the forefoot. The tuber of the calcaneum is shortened. The tarsus and metatarsus are actually or very nearly the same length as those in the skeleton of *Merycoidodon culbertsoni* exhibited in the Carnegie Museum, while the transverse diameters of the shafts, especially of Mt. III and IV, are only very little more than half as great as in *M. culbertsoni*. In their general proportions the lateral digits are, however, not much reduced, not as much as one might expect, judging from the change in the tibia and other features of the limb. The phalanges of metatarsals II and V function very nearly, if not identically, as those in *Merycoidodon*. The phalanges are on the whole possibly somewhat reduced in length.

THE ARTICULATED SKELETON.

The most striking feature of the articulated skeleton of *Merychys minimus* is its relatively high stature in comparison with its small size and the general reduction of its caudal region, when compared with *Merycoidodon*. The tail in the different genera of this family found in the later Tertiary, so far as we now know, seems to be much reduced, especially when such genera as *Protorcodon* and *Agriochærus* are considered. In the present genus it is very evident that the limbs were specialized in the direction of a cursorial habit. The thorax is also well proportioned in size, while the head is perhaps somewhat large for an animal which possibly inhabited open country. The robustness of the upper and lower jaws and their large teeth indicate the power of masticating coarse vegetation. They did not require the incisors specially adapted to cropping grasses seen in other contemporary *Artiodactyla*. Tall grasses and shrubbery in close vicinity to streams perhaps furnished their pabulum.

MEASUREMENTS.

Length of skeleton from upper incisors to tip of tail measured along curves of the vertebral column, approximately.....	800 mm.
Length of skeleton measured in a straight line from upper incisor to end of ischium.....	680 mm.
Greatest length of skull.....	160 mm.
Length of skull from incisors to occipital condyle.....	145 mm.



Articulated skeleton of *Merychyus elegans*, subsp. *minimus* Peterson ($\frac{1}{4}$ natural size).

Length of the cervical region.....	98 mm.
Length of the dorsal region.....	228 mm.
Length of the lumbar region.....	128 mm.
Length of the sacrum.....	90 mm.
Length of the caudal region, approximately.....	98 mm.
Height of skeleton at first dorsal.....	350 mm.
Height of skeleton at fourteenth dorsal.....	385 mm.
Height of skeleton at anterior portion of pelvis.....	350 mm.
Height of skeleton at end of ischium.....	275 mm.
Transverse diameter of thorax at 7th rib.....	100 mm.
Transverse diameter at point of ilia.....	108 mm.
Transverse diameter at ischial tuberossities.....	58 mm.

CARNEGIE MUSEUM,

October, 1922.

VII. PROCLAMATION OF NEBUCHADNEZZAR, KING OF
BABYLON, INSCRIBED UPON A CYLINDER RECENTLY
ACQUIRED BY THE CARNEGIE MUSEUM.

BY W. J. HOLLAND.

(PLATE IX.)

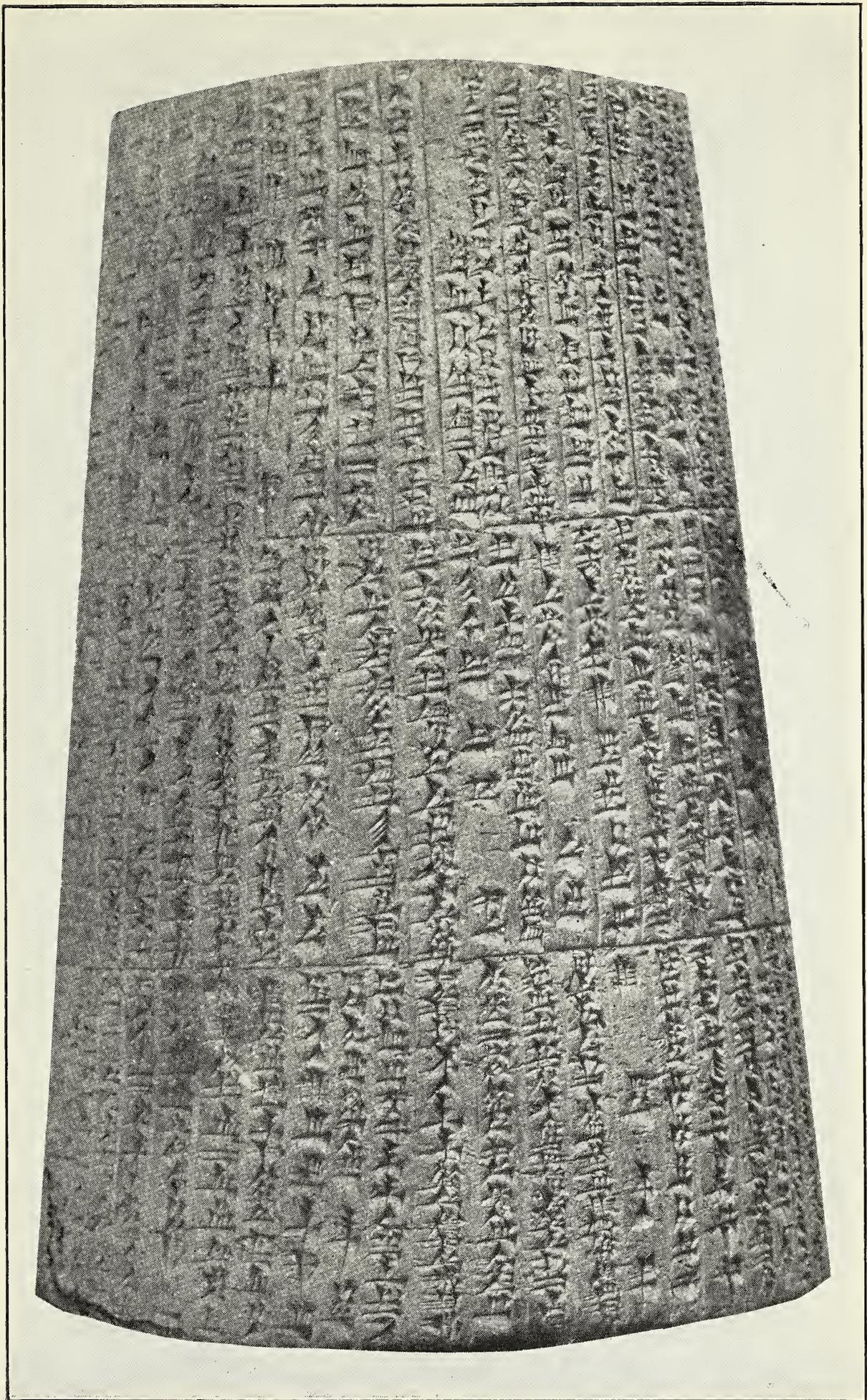
The Carnegie Museum about a year ago succeeded in obtaining through Mr. Edgar J. Banks a large cylinder inscribed upon which is a Proclamation of King Nebuchadnezzar who reigned in Babylon from 605 to 562 B.C. The cylinder was found by Arabs who were searching in a mound at Wana-Sadun, upon the site of the ancient city of Marad, a suburb of Babylon. It was buried in the wall of the temple of the local god according to the custom of the time. On Plate IX is given a figure of one side of the cylinder which is 226 mm. in height, 148 mm. in width at the base, and 106 mm. in width at the top. A translation of the cylinder has been supplied by Mr. Banks and is herewith given. Its concluding paragraph breathes the spirit of one of the imprecatory psalms.

TRANSLATION.

“I am Nebuchadnezzar, King of Babylon, the great, the mighty, the favorite of Marduk, the powerful prince, the beloved of Nabu, the ruler who knows not weariness, the protector of the temples Esagil and Ezida, who is obedient to Nabu and Marduk, his lords, who does their bidding; the wise lord, the darling and the joy of the heart of the great gods, the first-born son of Nabopolassar, King of Babylon.

“When Marduk, the great lord, made me the rightful son to rule the land, to be the shepherd of his people, to care for the city, to rebuild the temples, he bestowed on me mighty power.

“Tremblingly I was obedient to Marduk, my lord. I completed Imgur-Bel and Nimitti-Bel, the great walls of Babylon, the mighty city, the city of his exalted power. At the entrance of the great gates I erected strong bulls of bronze and terrible serpents standing erect.



Babylonian Cylinder Containing a Lengthy Proclamation by King Nebuchadnezzar.

“ My father did that which no previous king had done with mortar and bricks, he built the two moat-walls about the city, and, I, with mortar and bricks, built a third great moat-wall, and joined it and united it closely with the moat-walls of my father. I laid its foundation deep to the water-level; I reared its summit mountain-high. I constructed a moat-wall of burned bricks about the west wall of Babylon.

“ My father built the moat-wall of the Arachtu canal securely with mortar and bricks. He built well the quays along the opposite shore of the Euphrates, but he did not finish all his work, but I, his first-born son, the joy of his heart, built the moat-wall of the Arachtu with mortar and bricks, and joining them together with those of my father, made them very solid.

“ Esagil, the wonderful temple, the Palace of Heaven and Earth; Ekua, the temple of Marduk, the lord of the gods, Kahilisug, the great dwelling place of Zarpanit; Ezida, the temple of the King of the Gods of Heaven and Earth, I overlaid with shining gold and made bright like the day.

“ Ezida, the favorite temple, the beloved of Marduk, I restored in Borsippa. With gold and jewels I gave it the beauty of paradise. I overlaid with gold its great beams of cedar, and arranged them by threes to cover Emachtila, the shrine of Nabu.

“ I rebuilt and made lofty Emach, the temple of Ninharsag in the center of Babylon, and Ekikiini, a temple of Ninlilana, near the wall of Babylon, a thing which no king before me had ever done.

“ To the west of Babylon, at a great distance from the outer wall I constructed an enclosing wall 4,000 cubits in length about the city. I dug its moat to the water-level. I walled up its sides with mortar and burned bricks, and I united it securely with the moat-walls of my father. Along its edge I built a great wall of mortar and bricks mountain-high.

“ I rebuilt Tabisupurshu, the wall of Borsippa (Birs). To strengthen it I built the walls of its moat about the city with mortar and burned bricks. In Borsippa I rebuilt the temple of Turlilen, the god who breaks the weapons of my foes. Ebarra, the temple of Shamash in Sippar; Edurgina, temple of Sharsavi in Bas; Eidianu, temple of Anu in Dilbat; Eanna, temple of Ishtar in Erech; Ebarra, temple of

Shamash in Larsa; Egishshirgal, temple of Sin in Ur, the sacred temples of the great gods, I rebuilt and completed.

“The support of Esagil and Ezida, the rebuilding of Babylon and Borsippa, which I caused to be more magnificent than before, I accomplished according to divine instructions. All my noble deeds in regard to the support of the sacred temples of the great gods, which I performed better than the kings, my fathers, I wrote upon a stone tablet and recorded for future days.

“May the wise men after me read of all my works which I have written upon a tablet. May they comprehend the glory of the gods. The building of the cities of the gods and goddesses which Marduk, the great lord, set me to do, and kept urging my heart to undertake, with fear and without rest, I accomplished.

“At that time, for Ninharrak, my beloved mistress, who guards my life and makes my dreams good, I dug up and beheld the ancient foundation of Eharsagil, her temple in Babylon, which fell to ruins in ancient days, and which no previous king had rebuilt. But the construction of the temple was not suitable for Ninharrak. I endeavored eagerly to strengthen the wall of that temple, and with mortar and burned bricks to build a temple worthy of Ninharrak.

“On the day when it is customary to ask the gods concerning the future, Raman and Shamash gave me the fixed oracular response to make three burned bricks sixteen fingerbreadths in size, and to make an image of burned clay as a charm against disease. And so I made three bricks of sixteen fingerbreadths in size, and an image of burned clay as a charm to drive away disease, and I placed it at the base of the foundation. With mortar and burned bricks I erected the temple mountain-high.

“O Ninharrak, majestic mistress, when with joy thou dost enter thy house Eharsagil, the house of thy pleasure, may words in my favor be ever on thy lips. Increase my days and make long my years. Decree for me a long life and an abundance of posterity. Give peace to my soul. Make my body strong. Protect me and make my visions clear. O, in the presence of Marduk, lord of heaven and earth, command the destruction of my foes and the ruin of the land of my enemies.

“O Lugal-Marrada, my lord, hero, look favorably upon the work of my hands. Grant as a gift a life of distant days and an abundance

of posterity, security to the throne, and a long reign. Smite the evil-minded; break their weapons, and devastate all the lands of my enemies. Slay all of them. May thy fearful weapons, which spare not the foe, stretch forth and be sharp for the defeat of my enemies. O, may they ever be at my side. Intercede for me with Marduk, lord of heaven and of earth, and make my deeds appear acceptable."

VIII. A NEW SPECIES OF GALEATUS FROM NEW MEXICO (HEMIPTERA-TINGITIDÆ).

BY DR. G. HORVATH.

The genus *Galeatus* of Curtis is represented in the United States hitherto by a single known species, *Galeatus peckhami* (Ashmead). This insect was described by W. H. Ashmead (*Entomologico Americana*, III, 1887, p. 156) under the name *Sphærocysta peckhami* from Wisconsin. It has since been found in New England (Massachusetts, New Hampshire), New York, Michigan, and Canada (Manitoba). I am indebted to Dr. Carl J. Drake for a fine set of specimens taken by him in August, 1920, at Cranberry Lake in the Adirondack Mountains, New York.

Uhler listed this species in 1904 (*Proc. U. S. Nat. Mus.*, XXVII, p. 362) from Las Vegas, New Mexico. He was greatly surprised by such an unexpected find of a northern species in the south and gave the following explanation of its occurrence in New Mexico: "The dispersion of such feeble insects as this must have called for physical atmospheric activities of immensely wide range to settle this insect in spots thousands of miles apart. The swift winds blowing in summer from the region of southwest Texas might readily be a factor in transporting weak insects."

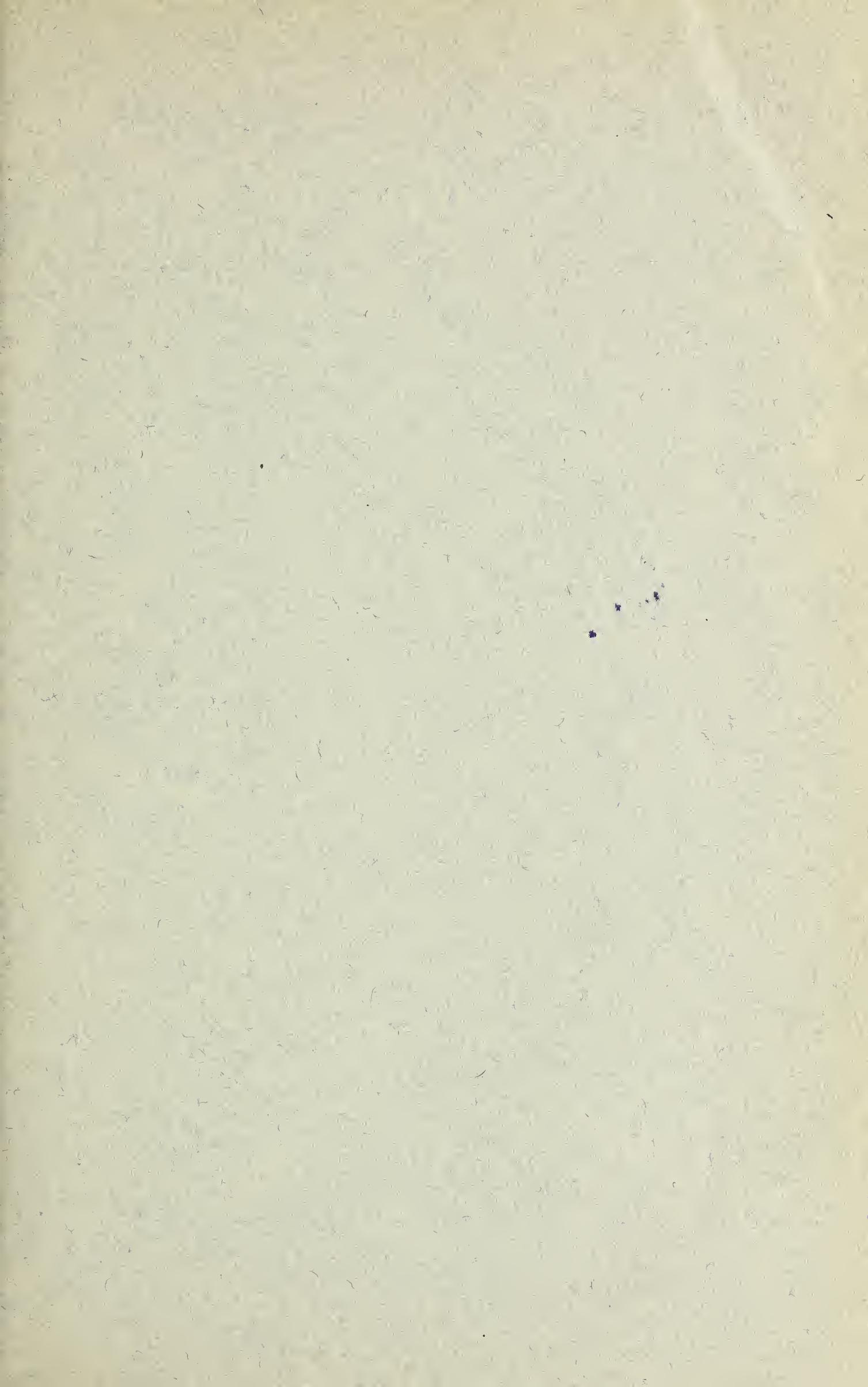
This theoretical explanation is, however, not necessary in the foregoing case. Many years ago I obtained this specimen of *Galeatus peckhami* taken by Mr. H. S. Barber at Las Vegas, New Mexico, August 3, from the late Mr. O. Heidemann of the United States National Museum. I have compared the New Mexican insect with specimens of the true *G. peckhami* collected by Dr. Drake in the north. This comparison has convinced me that the New Mexican insect is not identical with the true *G. peckhami*, but represents a very distinct and new species, which I wish to dedicate here to the memory of the late P. R. Uhler.

Galeatus uhleri n. sp.

Corpore obscure fusco, glabro, nitidulo; pronoto et elytris hyalinis; spinis capitis longis, apicem hujus superantibus, nigris; bucculis al-

bidis, uniseriatim areolatis; articulis duobus basalibus antennarum, fusco-testaceis, articulo primo articulo secundo triple longiore (articuli reliqui desunt); rostro fusco-testaceo, fere usque ad apicem sulci mesosternalis extenso; pronoto pallide venoso, membranis marginalibus latis, extus fortiter rotundatis, antice apicem capitis subsuperantibus, areolis quatuor magnis triangularibus (et præterea basi antice areola parva supplementaria) instructis, vesicula antica parva, dimidium basale capitis tegente, carinis lateralibus conchatis, a supero visis retrorsum divergentibus, a latere visis ellipticis et antrosum oblique ascendentibus, nigro-reticulatis et nigro-umbratis, basi autem pallide venosi et haud umbratis, vesicula mediana postica alte elevata, carinis lateralibus conchatis paullo humiliore, retrorsum sensim arcuato-declivi, areola ejus apicali nigro-umbrata et venis nigris terminata; elytris completis, abdomine multo longioribus et latioribus, nigro-venosis, tantum venis longitudinalibus spatium laterale utrinque terminantibus venaque marginali membranæ costæ pallidis, venulis transversis fere omnibus obsoletissime fusco-adumbratis, membrana costæ basi angusta, dein subito ampliata et areolis magnis, transversis, quadrangularibus instructa, vesicula discoidali parum elevata, humili; maculis pectoris ad coxas, pedibus, limbo apicali ventris segmento-que genitali maris fusco-testaceis; tarsis apice nigris. ♂ long. corp. 2.5, cum elytris 3.72 mill.

Type, a male, collected by Mr. H. S. Barber, Las Vegas, New Mexico, in my collection. Very closely allied to *G. peckhami* Ashm., but differs from it by the smaller size, the inflated posterior portion of the pronotum being less abruptly declivous posteriorly; all transverse veins of the elytra black and bordered by a very feeble obsolete shade, and the discal vesicle of the elytra less elevated. Body beneath dark brown with some spots on the pectus, the tip of the last ventral segment and the male genital segment dull testaceous, not black as in *G. peckhami*. The structure of the antennæ also seems different. The antennæ of my type are mutilated and have only the two basal segments, the first of which is three times as long as the second, while in *G. peckhami* the first antennal joint is twice the length of the second.



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Publications of the Carnegie Museum

Serial No. 118

P4P6842

ANNALS
OF THE
CARNEGIE MUSEUM

VOL. XV. Nos. 2 and 3

July, 1924



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PUBLICATIONS OF THE CARNEGIE MUSEUM SERIAL NO. 118

ANNALS

OF THE

CARNEGIE MUSEUM

VOL. XV. Nos. 2 and 3

W. J. HOLLAND, *Editor*

PUBLISHED BY THE AUTHORITY OF THE
BOARD OF TRUSTEES OF THE CARNEGIE INSTITUTE

APRIL, 1924

CARNEGIE INSTITUTE PRESS

ANNALS

OF THE

CARNEGIE MUSEUM

VOLUME XV, NOS. 2-3

EDITORIAL NOTES

The twenty-seventh celebration of Founder's Day occurred at the Carnegie Institute on April 23, 1923. In the absence of Colonel Samuel Harden Church, the President of the Board of Trustees, Honorable John D. Shafer, the Vice-President, presided. The principal addresses were made by Honorable David Aiken Reed, the junior United States Senator from Pennsylvania, and by Mr. Augustus Thomas, the well known dramatic critic and playwright. The address by Senator Reed revealed a sympathetic attitude on his part toward modern scientific research, and especially toward the doctrine of evolution, which is now generally accepted by all well informed people. His remarks were enthusiastically applauded by the distinguished company who were present, among them representatives of the clergy of almost every denomination in the land. *Evolution* is the twentieth century equivalent of the word "creation." It involves no negation either of the Divine presence or the Divine power. Nor does it involve any derogation from the splendor of the Divine grace, as that is set forth in the teachings of Jesus of Nazareth. It is only those who do not understand the meaning of the term, and be it said in all kindness, those who misinterpret the teachings of Holy Writ, who have recently indulged in the effort to bring about a recrudescence of the controversies of half a century ago. No scientific man on the globe believes to-day, and no scientific man in the past has believed, or taught, that the human race has ascended from any existing race of simians. But even were such an ascent

demonstrable, it would not subtract from the glory of manhood as it exists to-day. Though corporeally sprung from the dust, man has been made "but little lower than the angels," and capable of thinking the thoughts of God after Him. The writer of these lines, for half a century a clergyman, as well as a student of science, has never realized that there is any conflict between true religion and true science, although he is fully aware that there have been, and probably will be, many wordy wars between sciolists and religionists upon this and other subjects. The squabbling of "half-baked" scientific students and of dull-witted bigots will go on for many a year, while angels weep and hell chuckles. Speaking of "evolution" and the efforts being made to forbid the teaching of the doctrine that man came into being in the same way in which the Divine Father has brought into being all his other creatures, perhaps the wittiest remark which has come under the eye of the writer is that made by William Beebe in the article entitled "My Jungle Table," which appeared in the recent July number of the *Atlantic Monthly*. After alluding to the struggle made by our forefathers at the time of the American Revolution, and their efforts to gain freedom, he slyly remarks, "We are now considering passing a law to keep monkeys in their proper place." That in reality is the essence of the legislation advocated in certain quarters. "*Quem ad finem?*"

Speaking of monkeys, it is worthy of remark that the Carnegie Museum possesses a very large, though as yet necessarily incomplete, collection of these interesting animals. Our collection has mostly been derived from the forests of Central and South America, although a number of the apes and lemurs of the Eastern Hemisphere are also represented. Among the lemurs there is a fine cast of the skeleton of one of the large extinct forms from Madagascar, received as a gift from the Imperial Museum in Vienna many years ago. This should be mounted in the near future. The first specimen representing the larger anthropoids is a fine skin and skeleton of a gorilla, acquired by the writer many years ago from his friend, the late Dr. Albert C. Good, the noted African missionary. At the time the specimen was received the Carnegie Museum had no existence; it still lay in the land of dreams. A taxidermist in New York was commissioned to mount the skin in a life-like attitude, holding a

silver card-receiver in the extended right hand. It was the intention to place the animal thus posed near the front door of the entrance-hall of the residence, for the astonishment and amusement of visitors. The taxidermist, like many of his craft, was somewhat dilatory, and put off his task year after year. Meanwhile the Carnegie Museum came into being in a small way, and the specimen, finally mounted without the silver card-receiver, was turned over to the infant Museum, together with the skeleton, which long before had been mounted by the firm of Ward in Rochester, New York. This skeleton possesses peculiar interest, and a brief account of it appears elsewhere in this number of the ANNALS.

Dr. Thomas S. Arbuthnot has donated to the Museum mounted specimens of Fannin's Sheep, Stone's Sheep, a caribou, a caribou head, and a superb head of a moose. All of these animals were shot by Dr. Arbuthnot in the Cassiar Mountains, British Columbia, about fifty miles from the Alaskan border, north of the fifty-eighth parallel. This collection, which was secured in the fall of 1922, has been splendidly mounted at the expense of Dr. Arbuthnot, so the specimens have arrived at the Museum ready for exhibition.

During the month of June we have received two car-loads of fossils in the rock, totaling 120,000 pounds, from the National Dinosaur Monument in Utah. This collection represents all specimens removed from this famous quarry since the year 1918.

The Carnegie Museum has now turned the quarry over to the United States National Museum, and a field-party from that institution is carrying on the work there during this summer.

An expedition from the Museum will start for James Bay, Ontario, in the early part of August. The purpose of this expedition is to collect shore-birds and also to secure specimens of the Blue Goose, which we hope to use in a group of these beautiful creatures.

This expedition is made possible by the generosity of Mr. John B. Semple of Sewickley, who has donated half the expenses of the trip. Mr. Semple will accompany the party, which will be known as "The John B. Semple James Bay Expedition." The other mem-

bers, representing the Museum, will be Mr. W. E. Clyde Todd and Mr. George M. Sutton of the Section of Ornithology.

We had the great pleasure of entertaining for a few days Professor Emmanuel de Margerie, Madame de Margerie, his wife, and their charming daughter, on the occasion of their visit to Pittsburgh in the early part of the month of June.

Professor de Margerie is at the head of the Geological Survey of Alsace and Lorraine. He is one of the most famous and capable geologists of Europe. Having served as exchange professor, lecturing at Harvard, Yale, Columbia, and the University of Pennsylvania during the winter of 1922-1923, he decided to make a rapid journey across the continent before returning to his home. His first stay after leaving Washington was with us in Pittsburgh. Writing from St. Louis, while on his westward way, he expresses himself as carrying away indelible memories of the hospitality he received in Pittsburgh, as well as lasting impressions of the great work being done in the Sections of Geology and Paleontology in the Carnegie Museum.

Professor Henry Fairfield Osborn did us the honor of spending Decoration Day at the Museum as the guest of the Director, Mr. Douglas Stewart. The forenoon was spent in viewing some of our more recent acquisitions. After luncheon at the Pittsburgh Golf Club, where Dr. Osborn met most of the members of the Museum Committee, an hour or more was spent in viewing the moving picture, which has in recent months been prepared by Mr. Arthur S. Coggeshall, showing the work of collecting fossils in the West, particularly at the quarry opened by the Carnegie Museum, and subsequently set apart by President Wilson as the "National Dinosaur Monument."

Speaking of the "National Dinosaur Monument," it is perhaps becoming to state that the Carnegie Museum has been so fortunate as to be able to act as "pathfinder" in a number of the more important paleontological researches of the last two and one-half decades. The opening of the wonderful fossil-bearing deposits near Agate Springs in Nebraska, and the discovery of the great Jurassic deposits in Utah, are only two of the many accomplishments of the force employed by the Museum during recent years.

Another distinguished visitor to the Museum has been General Henri Joseph Eugène Gouraud, who came to the Museum on the afternoon of July 10, following in the footsteps of many of his distinguished countrymen. He seemed to enjoy his visit.

Dr. I. P. Tolmachoff, during the later spring joined a party from the University of Pittsburgh in making a geological tour, which carried them through the mountains of Pennsylvania, the Catskills, and the Adirondacks. On the return trip they visited many of the more famous localities of central and western New York, including Niagara. The party experienced at times no little discomfort on account of rain and snow. They were equipped to "camp out," and did this at many localities. The Professor, who is well known for his explorations in northeastern Siberia and in other localities in central and southern Asia, met the self-imposed hardships of the journey in most cheerful mood. He is not a fair-weather student and is prepared to "endure hardness as a good soldier" of science.

The Editor has in hand a considerable number of papers, some of them long ago prepared, and the illustrations for which have been made, which it is hoped may see the light both in these ANNALS and the MEMOIRS during the coming fiscal year, which began July 1, 1923.

CARNEGIE MUSEUM,

July 11, 1923.

IX. DESCRIPTION OF THE TYPE OF UINTASAURUS DOUGLASSI HOLLAND

BY W. J. HOLLAND

(PLATES X—XIV)

Among the fossil remains obtained in the quarry in Uinta County, Utah, which was discovered and opened by Mr. Earl Douglass while making researches on behalf of the Carnegie Museum in the year 1908-1909, and then subsequently in the year 1915 set apart by presidential proclamation as "The National Dinosaur Monument," there is considerable material representing a large sauropod dinosaur, which appears to belong to an undescribed genus. In my *Annual Report* as Director of the Carnegie Museum for the year 1919, p. 38, I stated that I had given to this animal the name *Uintasaurus douglassi* in honor of its discoverer.

While there is in our possession a large amount of material which in my opinion is probably referable to this same genus and species, much of it has not been extricated from the matrix, and that portion, which has been worked out, is at the present time so situated that its careful study and description is difficult. Under these circumstances it seems best to publish the description of the specimen, which was originally designated by me in the *Catalog of Vertebrate Fossils of the Carnegie Museum* as the type of the genus and species, without waiting until a more complete monographic paper upon the subject can be written. The specimen was contained in the original package numbered by Mr. Douglass as Box CCLXIII (263) designated in the list sent in by him from the field as "Block No. 150 M." The field notes made by Mr. Douglass suggested that the block contained "two vertebræ." As the specimen had been only partially uncovered and was found not very far from certain cervicals of very great length, it was supposed by Mr. Douglass that this block contained two similar vertebræ. When, however, the task of extricating the bones was completed, it was found that the block contained five comparatively short vertebræ, but with enormously long cervical

ribs. The specimen was carefully freed from the matrix by Mr. Louis S. Coggeshall and mounted by him. It bears the Carnegie Museum Acc. No. 5873 and the Div. No. 11069, (*Carnegie Museum Catalog of Vertebrate Fossils*).

CERVICAL VERTEBRÆ¹

The cervical vertebræ vary in number in the genera of the Sauro-poda, as recent studies show. They have been definitely found to be fifteen in the genus *Diplodocus* and in the genus *Apatosaurus*, perfect series of the cervicals of which, articulated at the time of discovery, are preserved in the Carnegie Museum. On the assumption that in the case of the genus, with which we are dealing in the present paper, the vertebral formula did not differ from that of the above genera, the cervicals in the type specimen of *Uintasaurus douglassi* would be, without doubt, the eleventh, twelfth, thirteenth, fourteenth, and fifteenth. One of my assistants in the paleontological laboratory suggested to me at one time that the posterior vertebra of the series under discussion might possibly be regarded as the first dorsal. I was at first inclined to coincide with this view, but a more careful study of the specimen has led me to conclude that the determination just given is most likely to be correct. Nevertheless, although convinced of the correctness of the relative position assigned to these bones in the series, I have, in the light of quite recent discoveries

¹ Osborn and Mook in their paper upon *Camarasaurus*, etc. (*Memoirs A. M. N. H.*, New Series, Vol. III, Part III, pp. 290, *et seq.*), in discussing the cervical vertebræ of *Camarasaurus*, contained in the Cope Collection, now a part of the collections of the American Museum of Natural History, estimate the number of cervicals in *Camarasaurus* as having been thirteen. The material at their command is admitted by them to be manifestly defective, and their conclusion to be only an approximation. Their statement on p. 291 that "Apatosaurus is known to have thirteen cervicals, including the atlas and axis" is one which must be corrected. *Apatosaurus*, like *Diplodocus*, is positively known by the writer and his fellow-students to have had fifteen cervical vertebræ, including the atlas and axis. In the mounted specimen of *A. louisæ* Holland in the Carnegie Museum, the cervical vertebræ were found regularly articulated in order from the first to the last and they number fifteen. The restoration of *Camarasaurus* effected by Osborn and Mook is believed by the writer to be doubtfully correct. Whether the number of the cervicals in *Camarasaurus* was the same as in the genera *Diplodocus* and *Apatosaurus*, in which it is definitely known that the cervicals were fifteen in number is a question yet to be decided.

refrained from giving them numerical position in the cervical series. The recent uncovering of a closely allied form at the Carnegie Museum having only twelve cervicals makes it prudent to suspend judgment.

The five vertebræ which form the type of *Uintasaurus douglassi* are articulated. The last two are bent to the right, thus on the left side more or less exposing their anterior extremities to view, and enabling quite accurate measurements to be made of the length and height of their anterior articulating extremities, as well as of the entire length of the centra (See Pl. XIII). The ends of the second and third vertebræ of the series are so closely articulated that similar measurements in their case are only approximations, but, as given, reasonably exact. The first three vertebræ are very nearly perfect on their right sides, and also on their left sides, save that in the foremost of the series on the left side the tubercular process of the rib and the tip of the transverse process have been lost, making the lateral arch therefore incomplete, and the ends of the shafts of the two anterior ribs have been broken off. The last two vertebræ are more or less imperfect on both sides, the lateral arches being incomplete in the foremost of the two and wholly wanting in the last. Nevertheless, enough remains in both cases to enable us to closely approximate their outlines and characteristic features in life. (See Plates X-XIII).

The most remarkable feature of the cervicals we are considering is the very great backward prolongation of the cervical ribs, which reaches its greatest extent in the foremost of the series which we are engaged in studying. This feature will be made clearer in the more detailed description and the figures which follow. In addition there are other structural features which widely separate these vertebræ from the corresponding bones in other genera of the Sauropoda which have been described. The centra are strongly opisthocœlous, comparatively short, with broad flattened inferior surfaces, and have a markedly transverse oval contour in cross-section. The latter feature may have been in this particular specimen somewhat accentuated by vertical crushing, but, making all allowance for the crushing which is apparent, an oval outline with the longer axis of the oval horizontally transverse to the main axis of the vertebral series must be accepted as one of the characteristics of these vertebræ.

The pleural cavities of the centra ("pleurocels" of Osborn and Mook) are relatively long, and vertically narrow in the two front vertebræ, but rapidly diminish in size as we proceed from the first to the last vertebra of the series. The prezygapophyses extend well beyond and overhang the anterior extremities of the centra; the postzygapophyses extend very slightly, or not at all, backward beyond a vertical rising from the posterior margin of the cups of the centra. The arch formed by the cervical ribs through their lateral articulations is very large and rounded, not high and narrow; it is formed below by the capitular process of the rib, which in the first three vertebræ before us is expanded into a wide, flattened plate with a deep saucer-shaped, or pocket-shaped depression on its upper surface

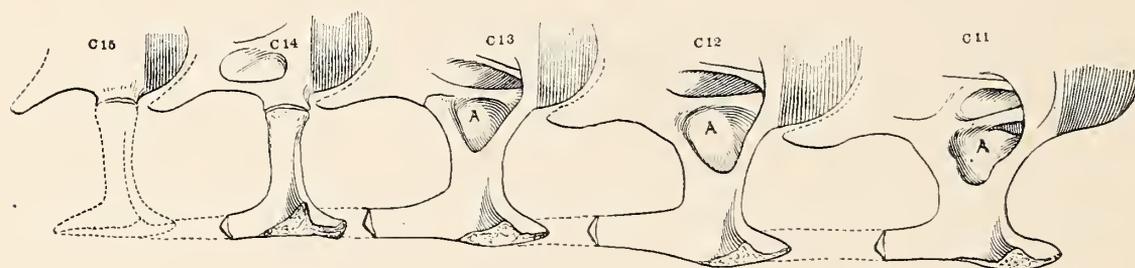


Fig. 1. View from above, showing outline of the capitular processes of the cervical ribs and the pocket-shaped depressions at A. The tubercular processes are removed to permit a full view. (*Greatly reduced in size*).

before the point where it articulates with the lower margin of the centrum, and by the tubercular process, which is modified so as to form a lengthy ascending, and outwardly curved bone, articulating at its upper extremity with the transverse process. The capitular process in relation to the centrum extends outwardly and strongly downwardly and the lateral arch in its lower portion lies below the level of the ventral surface of the centrum. The transverse process may be described as being formed by the union of an outwardly flaring lamina of bone (the "infrapostdiapophysial lamina" of Osborn and Mook) springing from the upper margin of the centrum, just before the cup, running forward and outward and met a little behind the neck of the ball by a similar but much shorter lamina (the "infraprediapophysial lamina" of Osborn and Mook) running slightly backwardly and abruptly outwardly. At their line of contact, the laminae fuse and project downward forming a thin, perpendicular, beam-like support, the transverse process, which bears on its upper

surface the zygapophysial plate (the "horizontal lamina" of Osborn and Mook). At its outer extremity the transverse process anchyloses with the tubercular process of the rib. The zygapophysial plates, one on either side, viewed laterally are somewhat saddle-shaped; viewed from above they present in rough outline the form of an oblique parallelogram. Of this parallelogram the anterior corner, which is nearest the axis of the vertebra, bears the articulating prezygapophysial surface, looking upward; the anterior outer angle enters into the composition of the upper part of the transverse process; the outer posterior angle bears the articulating postzygapophysial surface, looking downward; and the posterior inner angle enters into the composition of the upwardly extended surface of the dorsal process, which rises at this point, being connected with the postzygapophysial surface by an elevated ridge which runs along the inner margin of the zygapophysial plate, gradually thickening inwardly and melting into the dorsal process. The dorsal processes are arranged in pairs, or, upon the hypothesis that there is normally but one spine, this spine may be said to be broadly bifid at its extremity. Inwardly at their bases the dorsal processes fuse with and enter into the composition of the flattened plates of bone, which, supported on either side by the pedicles, constitute the floor of the great longitudinal nuchal valley and the roof of the neural canal. Both the prezygapophyses and the postzygapophyses find support and reinforcement from below by strong columnar pedicles, that of the prezygapophysis extending forward and outward and being thicker and more massive at its distal extremity than at its point of origin on the centrum near the neck of the ball; the pedicle supporting the postzygapophysis being relatively short vertically, but wide anteroposteriorly, extending forward along the side of the neural canal, into the composition of the outer wall of which it seems to enter. At the point, where the anterior pedicle arises from the upper surface of the centrum near the neck of the ball, there also arise inwardly on each side thin laminae of bone, which, extending inwardly and upwardly and meeting on the median line, form the lateral and superior walls of the neural canal in the anterior portion of the vertebra. Between these laminae and those forming the floor of the overlying median nuchal channel, there is, as seen from in front, a triangular vacuity, bounded outwardly by the anterior pedicle, which supports the prezygapophysis. How far back this vacuity extends it is impossible at present to say,

as it has not been deeply explored for fear of injuring the specimen. The neural canal is suboval in outline, but, as there has undoubtedly been some crushing, its ovality in life undoubtedly was less than is shown by the material under examination.

For comparison I introduce at this point figures of lateral views of the fifth predorsal cervical vertebræ of *Apatosaurus*, *Diplodocus*, *Uintasaurus*, and *Haplacanthasaurus*, as well as of the hypothetical outline of the same bone in *Camarasaurus* as given by Osborn and Mook (*Memoirs A. M. N. H.*, Vol. III, Part III, Pl. LXVII). An examination of these outline-drawings will serve to bring more clearly into view the differences which exist between the corresponding vertebræ in these genera than can be done by merely verbal description.

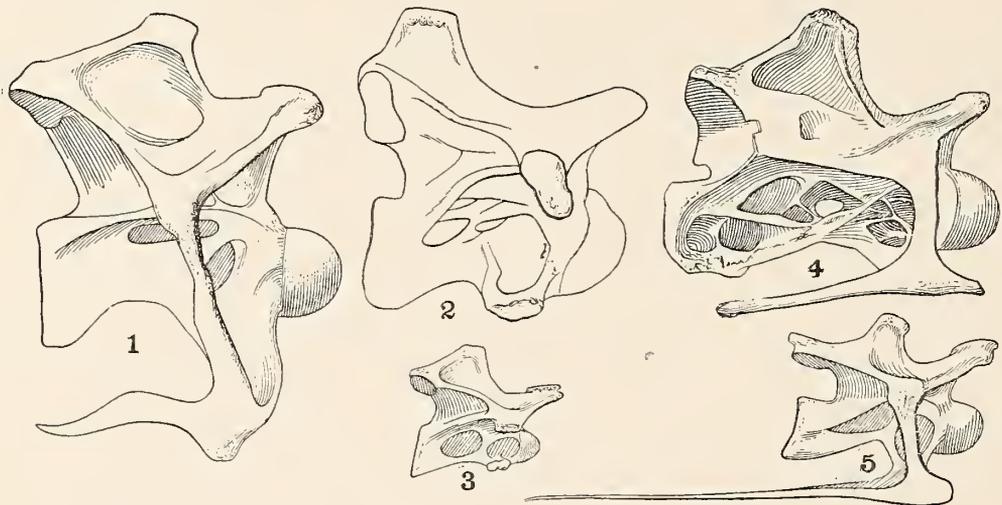


Fig. 2. No. 1, fifth predorsal vertebra of *Apatosaurus louisæ* Holland, outline of right side from an as yet unpublished drawing; No. 2, Do., *Camarasaurus supremus* Cope, adapted from Osborn and Mook, Mem. A. M. N. H., new ser., Vol. III, Part III, Pl. LXVII; No. 3, Do., *Haplacanthasaurus utterbacki* Hatcher, Mem. Carn. Mus., Vol. II, Pl. II; No. 4, Do., *Diplodocus carnegiei* Hatcher, Mem. Carn. Mus., Vol. I, Pl. IV; No. 5, Do., *Uintasaurus douglassi* Holland. (All figures one-fortieth natural size).

After the foregoing general description of the cervicals I proceed to a somewhat more detailed account of each of them, accompanied in each case by a table of measurements.

Fifth Predorsal Vertebra.—The centrum is more or less oval in cross-section. The ball is wide transversely, somewhat flattened dorsally, and more regularly curved ventrally. (See Fig. 3, No. 2.) The cup is deep, with the margin of its lower lip produced further backward than the margin of the upper lip. The pleurocentral

cavities are deep, longer than high, extending anteroposteriorly for about six-tenths of the total length of the centrum. These cavities are divided about the middle by a longitudinal lamina, extending backward and upward at an acute angle with the axis of the centrum. Below this median septum there is a shorter septum originating lower down back of the inner wall of the ball and extending backward and downward and vanishing into the lower edge of the

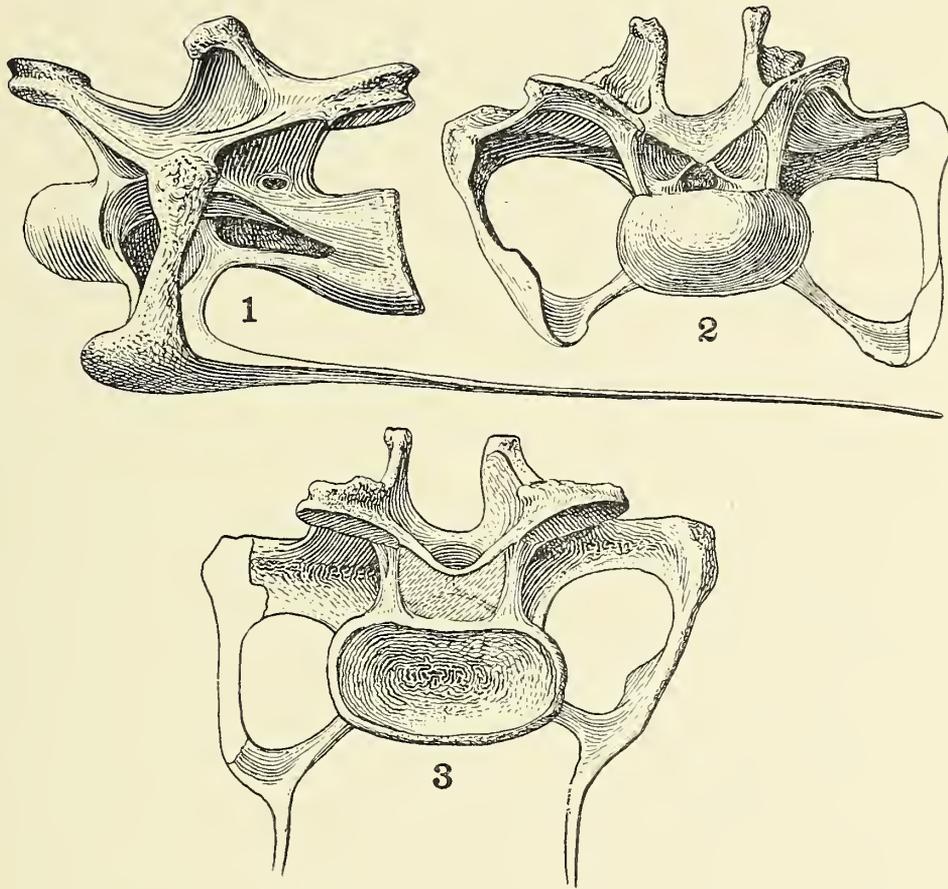


Fig. 3. Fifth predorsal vertebra of *Uintasaurus douglassi* Holland. 1, lateral view; 2, anterior view; 3, posterior view. One-tenth natural size. *Type*. C. M. Cat. Vert. Foss. No. 11069. (Fig. 1 does not exactly represent the pleuro-cellular laminae, W. J. H.)

centrum, where its outer margin enters into the composition of the inner border of the saucer-shaped depression lying on the upper surface of the capitular process of the rib where it unites with the centrum. The zygapophysial plates on their outer margins before the transverse process are gently curved outwardly as is shown by the moiety preserved on the right side, which has not been injured; between the transverse process and the postzygapophysial articulation the plate is deeply excavated, or inwardly curved, as is shown by

the moiety of the left side, which has not been so much injured as the corresponding part of the bone on the right side. On this latter side the bone at this particular point has been badly crumpled and disfigured by pressure. The spinous processes are somewhat lower than those of the following vertebra and at their extremities have been somewhat restored, and in consequence their height, as given in the following table of measurements, is only an approximation, but nevertheless very nearly correct. The anterior margin of the bases of the dorsal processes are continued forward as an elevated ridge upon the upper surface of the zygapophysial plate toward the prezygapophysis, before quite reaching which this ridge disappears, dying out upon the anterior surface of the plate. This ridge posteriorly unites with the corresponding elevation of the opposite side on the median line forming a raised bar of bone which subtends the space between the two dorsal processes over the roof of the neural canal, thus strengthening the latter. In other respects the body of the vertebra corresponds with the general description, which has already been given.

The most remarkable feature of this vertebra is revealed in the cervical ribs. That of the right side is complete and perfect in every particular; that of the left side has been broken, not much more than the anterior half of its shaft having been preserved. At the anterior extremity the cervical rib is thin and relatively broad, curving slightly upward on the inner and outer edge. There is a short anterior rounded projection beyond the capitular and tubercular processes. This anterior projection on its upper surface is dished or excavated, this excavated surface being separated from the remainder of the shaft by a low, sharply defined ridge, which is an inward extension of the sharpish ridge which runs along the inner side of the tubercular process. The capitular portion of the rib is a broad flat plate which widens as it approaches its line of articulation with the lower margin of the centrum and encloses between its gradually upturned and thickened margins, as it nears the centrum, a quite deep saucer-shaped depression with an outer pocket-like cavity. This saucer-shaped depression passes into and merges with the pleurocentral cavity, being slightly separated from the latter by the bony ridge, which marks the backward prolongation of the lowermost short bony septum, which arises near the base of the neck of the ball. The tubercular process of the rib, which is immediately opposite to the capitular process, is modified

so as to form a long outwardly curving rod of bone, flattish or slightly rounded on its outer surface, inwardly quite sharply ridged (triangular in cross-section). It extends upward, outward, and then inward, and finally coössifies with the outer extremity of the transverse process. The shaft is very long, running backward from the region of its articulating processes to beyond the middle of the centrum of the third, or antepenultimate, vertebra of the series; curved, or slightly trough-like on its upper side near its anterior extremity behind the origin of the articulating processes, and bending downward near its posterior extremity.

MEASUREMENTS

Distance from neck of ball to margin of cup at the middle of the centrum.	280 mm.
Length of centrum over all.	365 mm.
Length of ball of centrum.	85 mm.
Greatest transverse diameter of ball at neck.	185 mm.
Greatest vertical diameter of ball at middle.	105 mm.
Height of vertebra from base of centrum to top of dorsal processes.	250 mm.
Width between extremities of transverse processes.	445 mm.
Width between outer margins of prezygapophyses.	285 mm.
Width between outer margins of postzygapophyses.	295 mm.
Anteroposterior diameter of pleurocentral cavity.	190 mm.
Greatest vertical height of pleurocentral cavity.	95 mm.
Greatest depth of pleurocentral cavity (approximate).	45 mm.
Height of dorsal processes above median symphysis.	90 mm.
Anteroposterior diameter of dorsal processes at their tips.	50 mm.
Anteroposterior diameter of dorsal processes at base (approximate).	110 mm.
Length of articulating surfaces of prezygapophyses.	50 mm.
Width of articulating surfaces of prezygapophyses.	100 mm.
Length of articulating surfaces of postzygapophyses.	50 mm.
Width of articulating surfaces of postzygapophyses.	70 mm.
Length of shaft of cervical rib over all.	770 mm.
Width of shaft of cervical rib just behind origin of processes.	50 mm.
Width of shaft of cervical rib at posterior extremity.	8 mm.
Length of capitular process from middle of shaft to centrum.	105 mm.
Width of capitular process at its middle (narrowest point).	75 mm.
Length of tubercular process of rib from middle of shaft to union with transverse process (measured on the inner curve).	130 mm.
Width of tubercular process about middle (narrowest point).	30 mm.
Diameter of neural canal (approximate, crushed down).	35 mm.

Fourth Predorsal Vertebra.—The general contour and arrangement of the various elements in this member of the vertebral series is quite analogous to that in the preceding vertebra, making allow-

ance for such modifications as result from diminution in length and increase in height and width. The cervical ribs are preserved on both sides, that on the right side being apparently quite perfect, that on the left side being considerably shorter than its fellow of the opposite side. Whether the diminution in the length of the left rib is due to natural causes and is occasioned by asymmetrical growth, or whether it is due to the fact that some interstitial fragments were lost at the time the specimen was taken up in the quarry, is not clear.

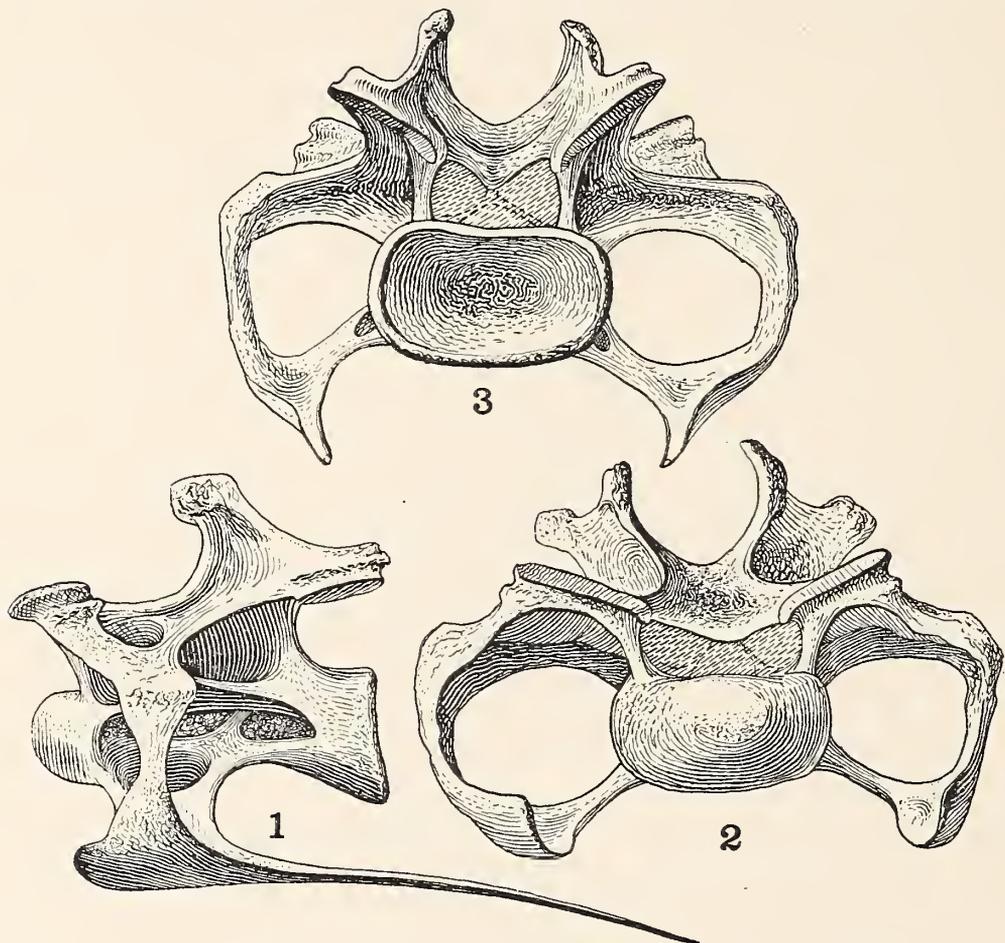


Fig. 4. Fourth predorsal vertebra of *Uintasaurus douglassi* Holland, 1, lateral view; 2, anterior view; 3, posterior view. One-tenth natural size. C. M. Cat. No. 11069.

The shaft of the rib is very slender, and on the left side had been more or less comminuted before being received at the laboratory. The preparator has very skillfully cemented the fragments together, but there is a suggestion that he may not have had all the fragments at hand when he made the restoration, and that in consequence this long and very slender bone may be a little shorter in the specimen than it was in life. The zygapophysial plate has its anterior margin from the prezygapophysis to the transverse process somewhat more

strongly rounded than is the case in the preceding vertebra, and the margin between the transverse process and the postzygapophysis more deeply excavated. The ridges running forward and backward from the base of each spinous process are higher and the dorsal process also projects outwardly more than in the preceding vertebra, resulting in the formation of a deep, triangular, inwardly pointed, lateral, pocket-shaped cavity at the base of the spinous process. This structure appears in the succeeding vertebræ, gradually increasing in depth, as we trace it backward. It is brought into view on Plate XII.

MEASUREMENTS²

Distance from the neck of the ball to the margin of the cup at middle of the centrum.	250 mm.
Length of centrum over all (approximate).	300 mm.
Length of ball of centrum (approximate).	50 mm.
Greatest transverse diameter of ball (approximate).	195 mm.
Greatest vertical diameter of ball (approximate).	110 mm.
Height of vertebra from base of centrum to top of dorsal processes.	270 mm.
Width between extremities of transverse processes.	465 mm.
Width between outer margins of prezygapophyses.	315 mm.
Width between outer margins of postzygapophyses.	320 mm.
Anteroposterior diameter of pleurocentral cavity (right side).	180 mm.
Greatest vertical diameter of ditto (right side, best preserved).	90 mm.
Depth of pleurocentral cavity (approximate).	40 mm.
Height of dorsal processes in front above median symphysis.	140 mm.
Anteroposterior diameter of dorsal processes at tips.	70 mm.
Anteroposterior diameter of dorsal processes at base.	130 mm.
Length of articulating surfaces of prezygapophyses.	50 mm.
Width of articulating surfaces of prezygapophyses.	70 mm.
Length of articulating surfaces of postzygapophyses.	60 mm.
Width of articulating surfaces of postzygapophyses.	120 mm.
Length of shaft of cervical rib over all (right side, best preserved).	560 mm.
Width of shaft of cervical rib just behind origin of processes.	60 mm.
Width of shaft of cervical rib at posterior extremity.	8 mm.
Length of capitular process from middle of shaft to centrum.	140 mm.
Width of capitular process at middle, where narrowest.	75 mm.
Length of tubercular process from middle of shaft to union with transverse process, measured on the inner curve.	140 mm.
Width of tubercular process, anteroposteriorly, about middle, (narrowest part)	30 mm.
Diameter of neural canal (invisible).

Third Predorsal Vertebra.—This vertebra differs from the one immediately anterior to it by being greatly reduced in length, accom-

²This and the following vertebra being articulated, it has not been possible to give the exact length of the ball or the depth of the cup into which it enters.

panied by a corresponding increase in width and height. The lateral arch is much enlarged, while the shaft of the cervical rib is greatly reduced in length. The zygapophysial plate becomes narrower antero-posteriorly and longer laterally, while retaining its saddle-shaped contour when viewed from the side. The spinous processes increase in

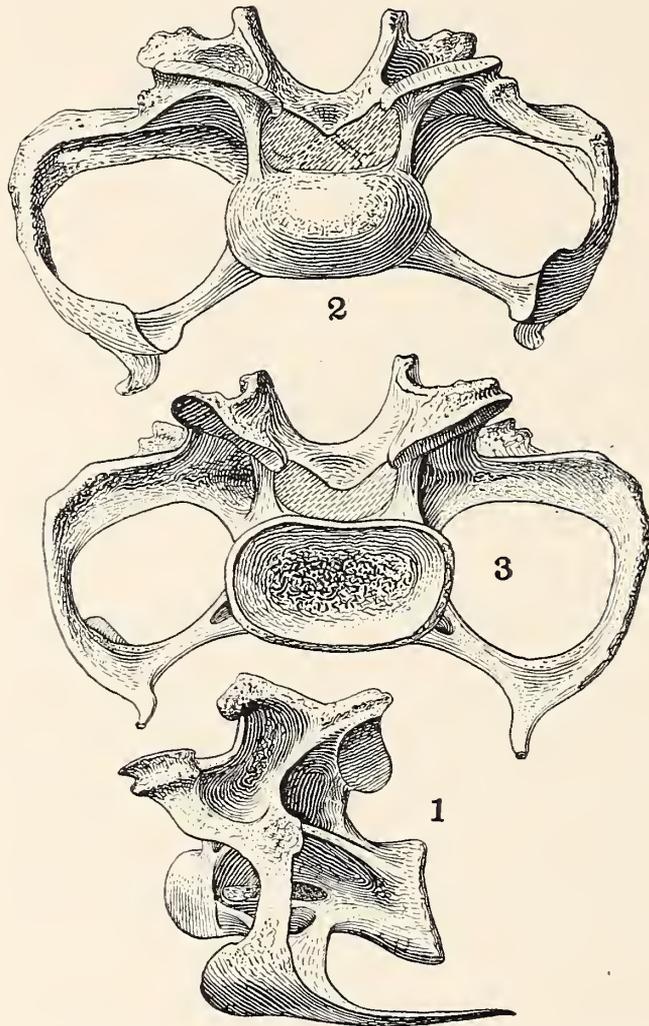


Fig. 5. Third predorsal vertebra of *Uintasaurus douglassi* Holland. 1, lateral view; 2, anterior view; 3, posterior view. One-tenth natural size. C. M. Cat. No. 11069.

height and are connected from their bases with the pre- and postzygapophyses by ridges like those on the two preceding vertebræ, which however, are much higher and fuse above with the margins of the articulating surfaces of the pre- and postzygapophyses, the posterior ridge being the higher and above bending forward somewhat, so as to overhang the deep lateral pit at the base of the dorsal process. This ridge lies at a less acute angle with the axial line of the vertebræ than the corresponding ridge on the preceding vertebræ. The tubercular and capitular processes of the cervical rib in this vertebra are

longer than in the preceding vertebræ. The deep saucer-shaped cavity on the upper side of the inner end of the capitular process is not so wide as in the preceding vertebræ, but deeper. It may be mentioned here that this peculiar structure disappears in the next two succeeding vertebræ, and that this is the last of the series of cervicals in which it comes into view. In Figure 1 there is represented in outline the arrangement of the depressions found on the upper surface of the capitular processes of the cervical ribs viewed from above. It is noticeable that there is no evidence of a distinct parapophysis on the centrum of the three anterior vertebræ of the series of cervicals before us. In the two posterior vertebræ the parapophyses are distinctly revealed. Complete coössification has taken place between the heads of the widely expanded capitular processes and the lower margin of the centrum in the three anterior vertebræ.

MEASUREMENTS

Distance from neck of ball to margin of cup.	220 mm.
Length of centrum over all (approximate).	260 mm.
Length of ball of centrum (approximate).	40 mm.
Greatest transverse diameter of ball.	225 mm.
Greatest vertical diameter of ball.	120 mm.
Extreme depth of cup (approximate).	30 mm.
Height of vertebra from base of centrum to top of dorsal processes.	280 mm.
Width between extremities of transverse processes.	600 mm.
Width between outer margins of prezygapophyses.	335 mm.
Width between outer margins of postzygapophyses.	345 mm.
Length of pleurocentral cavity.	160 mm.
Greatest vertical height of pleurocentral cavity.	85 mm.
Greatest depth of pleurocentral cavity (approximate).	25 mm.
Height of dorsal processes above median depression between them.	170 mm.
Anteroposterior diameter of dorsal processes at their tips.	60 mm.
Anteroposterior diameter of dorsal processes at base (approximate).	145 mm.
Length of articulating surfaces of prezygapophyses.	60 mm.
Width of articulating surfaces of prezygapophyses.	120 mm.
Length of articulating surfaces of postzygapophyses.	75 mm.
Width of articulating surfaces of postzygapophyses.	145 mm.
Length of shaft of cervical rib, over all.	335 mm.
Width of shaft of cervical rib just behind origin of processes.	80 mm.
Width of shaft of cervical rib at posterior extremity.	15 mm.
Length of capitular process from middle of shaft to centrum.	195 mm.
Width of capitular process at its middle.	70 mm.
Length of tubercular process from middle of shaft to union with the transverse process (measured on the inner curve).	185 mm.
Width of tubercular process about its middle (anteroposteriorly).	35 mm.
Diameter of neural canal (invisible).

Second Predorsal Vertebra.—The progressive shortening in length and gradual increase in width and height, which is characteristic of the preceding vertebræ, as we trace them backward in the series, also reveal themselves in this vertebra. Unfortunately the vertebra is not as well preserved as those which precede it. The transverse process of the left side has been broken off at its extremity, but fortunately that of the right side remains, so that it is possible by means of it to ascertain the distance between the two extremities. All which remains of the cervical ribs is a considerable portion of that of the right side, consisting of the anterior protruding extremity of the shaft, the capitular process, which is well preserved, and a short part of the shaft following the origin of the processes. The tubercular process, which must have been quite long, is missing. The capitular process is relatively thicker and not as wide as that of the rib of the preceding vertebra. It is trihedral in cross-section, approximately flat on its lower surface; on its upper surface revealing no trace whatever of the saucer-shaped cavity or depression which is so characteristic a feature in the ribs of the preceding vertebræ, and having nearer its anterior than its posterior border above an elevated ridge which is a continuation on the upper surface on the capitulum of the sharp inner ridge which extends along the inner surface of the tubercular process in the rib of the preceding vertebra, where, however, this inner ridge is not so highly developed as it is in this rib. The end of the shaft, where it is broken off behind, shows the cross-section to be triangular. It is plainly evident at this point that a considerable portion of the posterior end of the shaft is missing. The facets for the reception of the capitular process (the parapophyses) on both sides of the centrum are preserved in good condition and appear as very short processes, situated just behind the neck of the ball, below the pleurocentral cavity. The pleurocentral cavity is greatly reduced in size in this vertebra. The zygapophysial plate is considerably narrower than in the preceding vertebra, its posterior outer margin between the transverse process and the postzygapophysis deeply excavated, and the ridges connecting the dorsal processes and the pre- and postzygapophyses higher relatively than in the preceding vertebra and standing in relation to the axial line of the vertebra at

a greater angle. The cavity on the upper surface at the base of the dorsal processes, formed by these and the adjacent overhanging ridges, is deep and cone-shaped, pointing inwardly and downwardly toward the median line or axis of the vertebra.

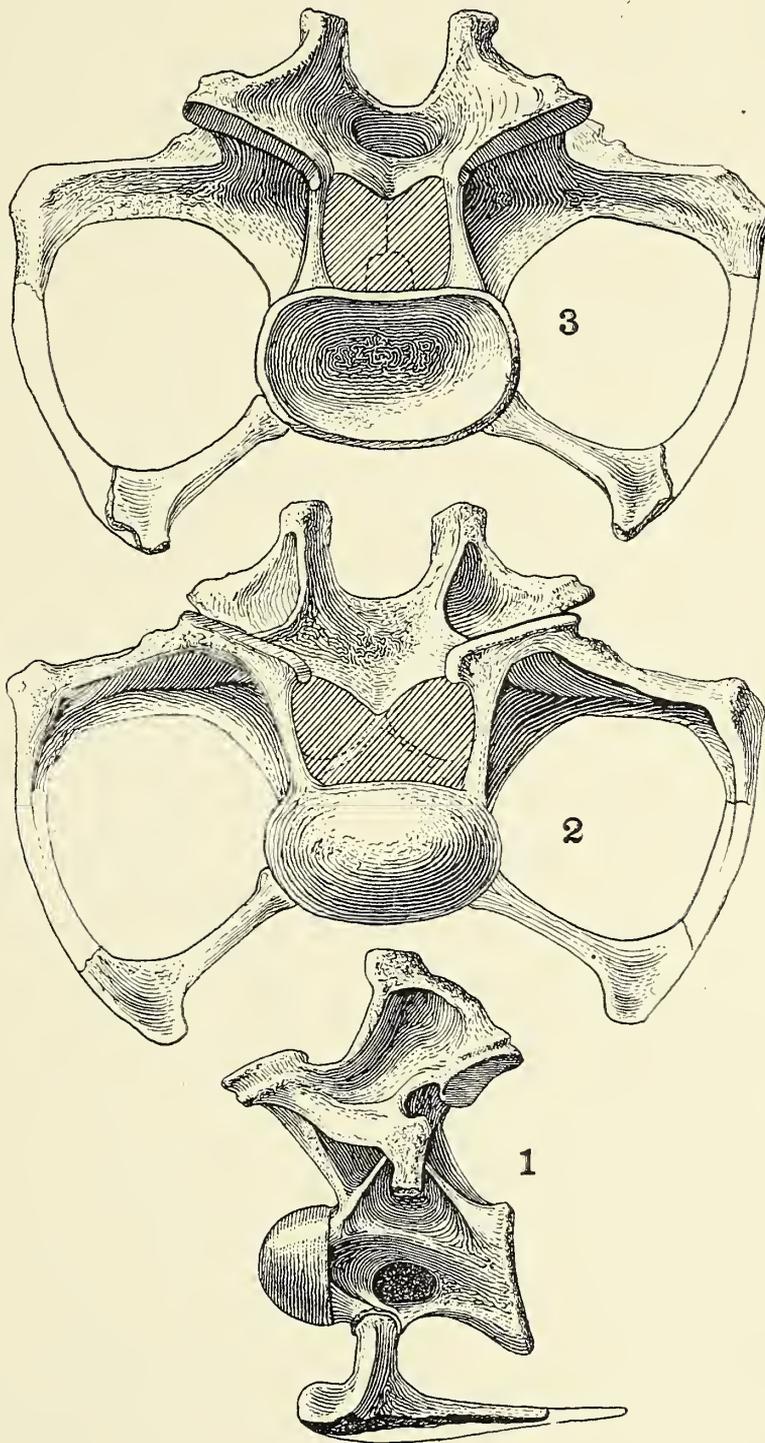


Fig. 6. Second predorsal vertebra of *Uintasaurus douglassi* Holland. 1, lateral view; 2, anterior view; 3, posterior view. One-tenth natural size. C. M. Cat. No. 11069.

MEASUREMENTS

Distance from neck of ball to margin of cup at middle.	185 mm.
Length of centrum over all (approximate).	265 mm.
Length of ball of centrum (exposed to view on left side).	80 mm.
Greatest transverse diameter of ball.	210 mm.
Greatest vertical diameter of ball.	130 mm.
Height of vertebra from base of centrum to tips of dorsal processes.	335 mm.
Width between extremities of transverse processes ³	670 mm.
Width between outer margins of prezygapophyses.	335 mm.
Width between outer margins of postzygapophyses.	400 mm.
Length of pleurocentral cavity.	112 mm.
Greatest vertical diameter of pleurocentral cavity, left side.	37 mm.
Greatest vertical diameter of pleurocentral cavity, right side.	77 mm.
Greatest depth of pleurocentral cavity (approximate).	35 mm.
Height of dorsal processes from median depression between them.	175 mm.
Anteroposterior diameters of dorsal processes at tips.	55 mm.
Anteroposterior diameter of dorsal processes at base (approximate).	125 mm.
Length of articulating surfaces of prezygapophyses.	75 mm.
Width of articulating surfaces of postzygapophyses.	120 mm.
Length of articulating surfaces of postzygapophyses.	104 mm.
Width of articulating surfaces of postzygapophyses.	140 mm.
Length of shaft of cervical rib (approximate) ⁴	250 mm.
Width of shaft of cervical rib just behind origin of processes.	50 mm.
Width of shaft of cervical rib at posterior extremity.
Length of shaft of capitular process from middle of shaft to centrum.	160 mm.
Width of capitular process at its middle.	50 mm.

First Predorsal Vertebra.—As has already been stated, the question has been raised whether the vertebra we are now studying should not be regarded as the first dorsal. Without having made a close study of the material, I was at first inclined to regard this suggestion as being plausible, but upon a closer and more minute investigation, coupled with a careful comparison with the cervicals and anterior dorsals of other genera, of which we possess complete and well articulated vertebral columns, I have found myself forced to abandon the view suggested to me and momentarily accepted by me in conversa-

³Ascertained by taking twice the distance from the median line to the end of the transverse process of the right side, which is preserved entire.

⁴The length of that portion of the shaft which is in our possession is 184 mm. It is evident that a considerable portion of the posterior end of the shaft is missing, probably as much as 70 mm. in length, if not more. Adding this to the length of the fragment, we ascertain that it must have fallen, like the shafts of the preceding vertebræ, under the capitular process of the succeeding vertebra.

tion. I am satisfied that to accept the vertebra, which we are now studying, as being the first dorsal would be to admit too violent a change in the structure of the vertebral column at this point, involving insuperable mechanical difficulties which are contrary to nature. The first dorsal vertebra is accepted as being the foremost of those which bear dorsal ribs. Upon the supposition that the vertebra before us is the first dorsal, and in life bore a dorsal rib, it follows from what we know of the articulation, the length of the centrum and the cervical rib of the preceding vertebra, which has been hereinbefore described, that the extremity of the shaft of this rib, short as it is, would in life have fallen under the capitular process of the first dorsal rib, thus locking the cervical series of ribs into the dorsal series. Such a condition does not exist in the genera *Diplodocus* and *Apatosaurus*, as is demonstrable, nor does it exist in any other genera of the Dinosauria, so far as I know. In both of the genera mentioned the last cervical rib has its shaft greatly reduced: in *Apatosaurus* it is only a slight posterior projection, a mere knob-like boss; in *Diplodocus* it is extremely short, only projecting backward a few inches. In both genera there is a wide interval between the posterior extremity of the shaft of the last cervical and the capitular process of the first dorsal. This would not be the case if we interpret the vertebra, which is the last of the series before us, as a dorsal, as has been pointed out. Such an arrangement would deprive the vertebral column at this point of all mobility, and though, owing to the singularly great extension backward of the cervical ribs in *Uintasaurus*, the neck of the animal must have been very highly immobile, I am inclined to think that, following the analogies of other genera, it is far more natural to assume that this vertebra is the last of the cervical series rather than the first of the dorsals; that its rib, which in the specimen before us is unfortunately missing, was, as in the other genera of the Sauropoda, provided with a very short shaft, and that between the posterior extremity of this and the first dorsal there was a gap, which admitted of at least some motion of the cervical series of vertebræ where they unite with the succeeding dorsals. Of course there is a possibility of error in this view, but until we obtain a complete series of cervicals interlocking with the succeeding dorsals, I am inclined to prefer it, as most in consonance with what we know of the homologous parts in the other Sauropoda.

The vertebra is shorter anteroposteriorly than its predecessor, and the ball, exposed to view on the left side, and the cup, in full view behind, are both very broadly oval, the transverse diameter greatly exceeding the vertical diameter. Although the extremities of the transverse processes on both sides are lost, it is evident that no increase in width at this point is taking place, although the width between the

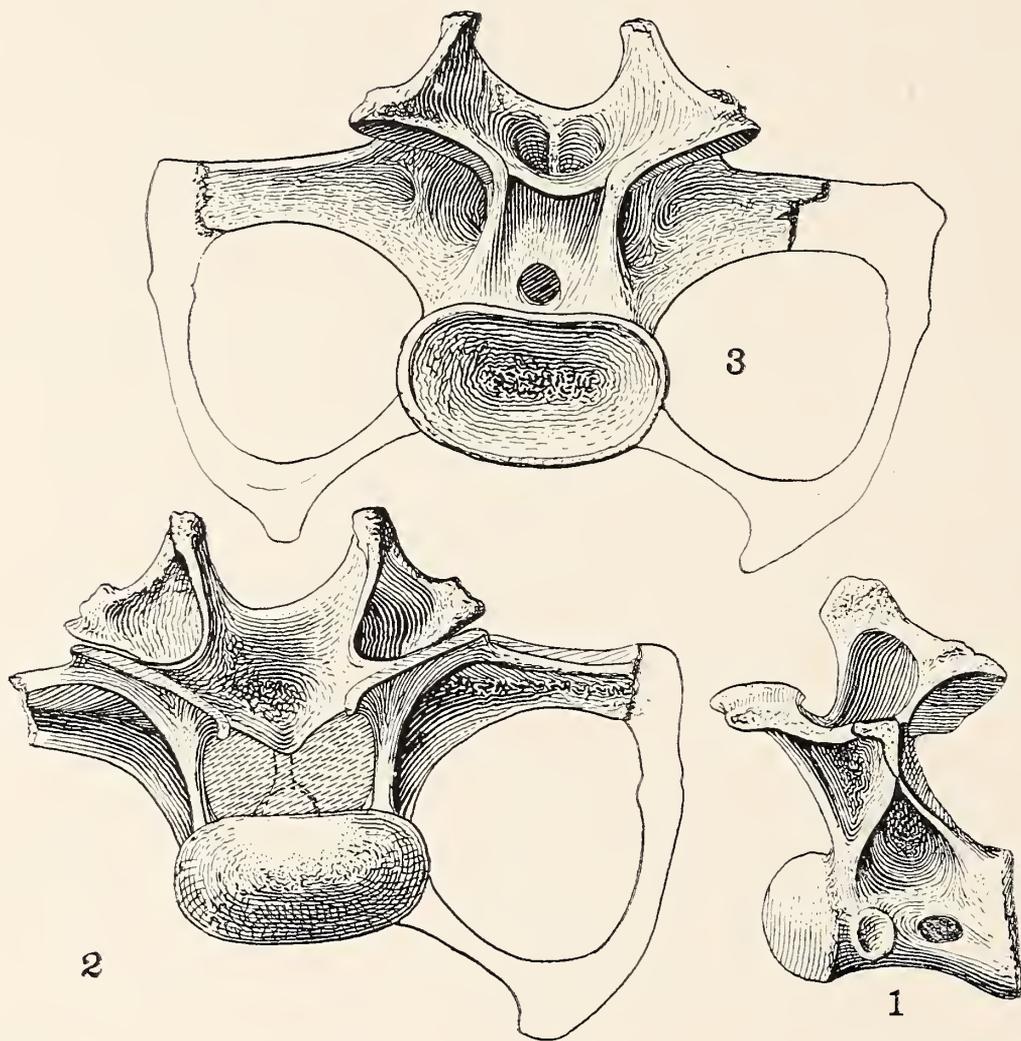


Fig. 7. First predorsal vertebra of *Uintasaurus douglassi* Holland. 1, lateral view of left side; 2, anterior view; 3, posterior view. One-tenth natural size. C. M. Cat. No. 11069.

outer margins of the pre- and postzygapophyses is greater than in the next antecedent vertebra, and the height from the base of the centrum to the tips of the dorsal processes is also greater. The zygapophysial plate is narrower anteroposteriorly, and deeply incised or excavated between the transverse process and the postzygapophysis on its external border. The pleurocentral cavities on this vertebra

appear to have become almost obsolete. On the right side the pleurocentral cavity appears as a small oval pocket, filled with matrix. However, the centrum on this side has been so much repaired and filled in with plaster that little can be positively made out as to its lateral structure save its length. On the left side the centrum has sustained very little injury and is not much repaired. On this side the pleurocentral vacuity is merely a small pit just behind the facet for the capitular attachment of the rib. This opening is not analogous in its location to that shown on the opposite side, the latter having a position more to the rear of the centrum. It is proper to call attention at this point to the fact that in both *Diplodocus* and *Apatosaurus* pleurocentral vacuities of considerable size occur on both the last cervical and the first dorsal vertebræ.

MEASUREMENTS

Distance from neck of ball to margin of cup at middle.	155 mm.
Length of centrum over all.	250 mm.
Length of ball of centrum.	95 mm.
Greatest transverse diameter of ball.	240 mm.
Greatest vertical diameter of ball.	125 mm.
Extreme width of cup.	230 mm.
Extreme height of cup.	130 mm.
Extreme depth of cup (approximate, filled with matrix).	80 mm.
Height of vertebra from base to top of dorsal processes.	340 mm.
Width between extremities of transverse processes (approximate).	600 mm.
Width between outer margins of prezygapophyses.	400 mm.
Width between outer margins of postzygapophyses.	370 mm.
Length of pleurocentral cavity (right side, approximate).	30 mm.
Vertical height of ditto (right side, approximate).	25 mm.
Greatest depth of pleurocentral cavity (approximate).	15 mm.
Height of dorsal processes above median depression between them.	190 mm.
Anteroposterior diameter of dorsal processes at tips.	60 mm.
Anteroposterior diameter of dorsal processes at base (approximate).	135 mm.
Length of articulating surfaces of prezygapophyses.	104 mm.
Width of articulating surfaces of prezygapophyses.	140 mm.
Length of articulating surfaces of postzygapophyses.	70 mm.
Width of articulating surfaces of postzygapophyses.	120 mm.
Diameter of neural canal (approximate, crushed and occluded by matrix).	35 mm.

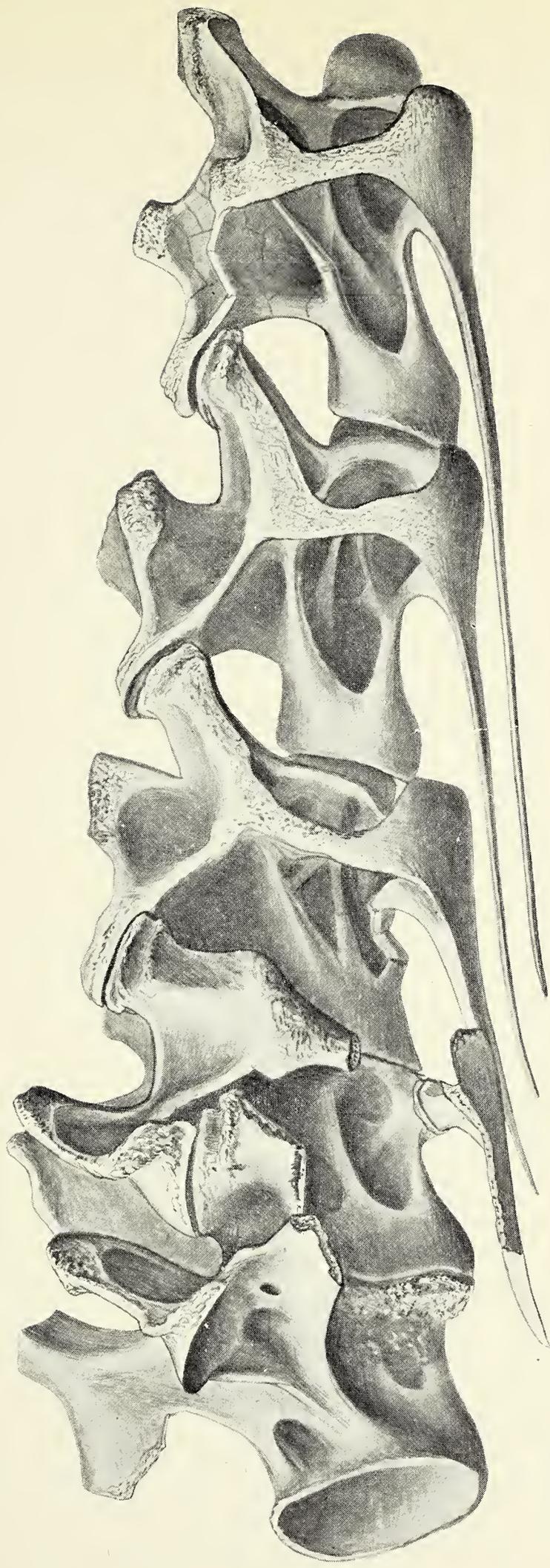
The entire length of the series of vertebræ as articulated in the specimen, is 1350 mm., measured from the end of the ball of the first vertebra to the margin of the cup of the last. On the hypothesis that these are the last five vertebræ of the cervical series, we may

conclude in a general and approximate fashion that this reptile had a neck about twelve feet in length. It was relatively shorter than in *Diplodocus*, and also in *Apatosaurus*. In comparison with these reptiles it was not only shorter, but wider and flatter. It was also much less mobile, owing to the enormous length of the cervical ribs which, in the case of the anterior vertebræ which we have been studying, overlap not only the whole of the next succeeding vertebra, but the greater part of the one following that.

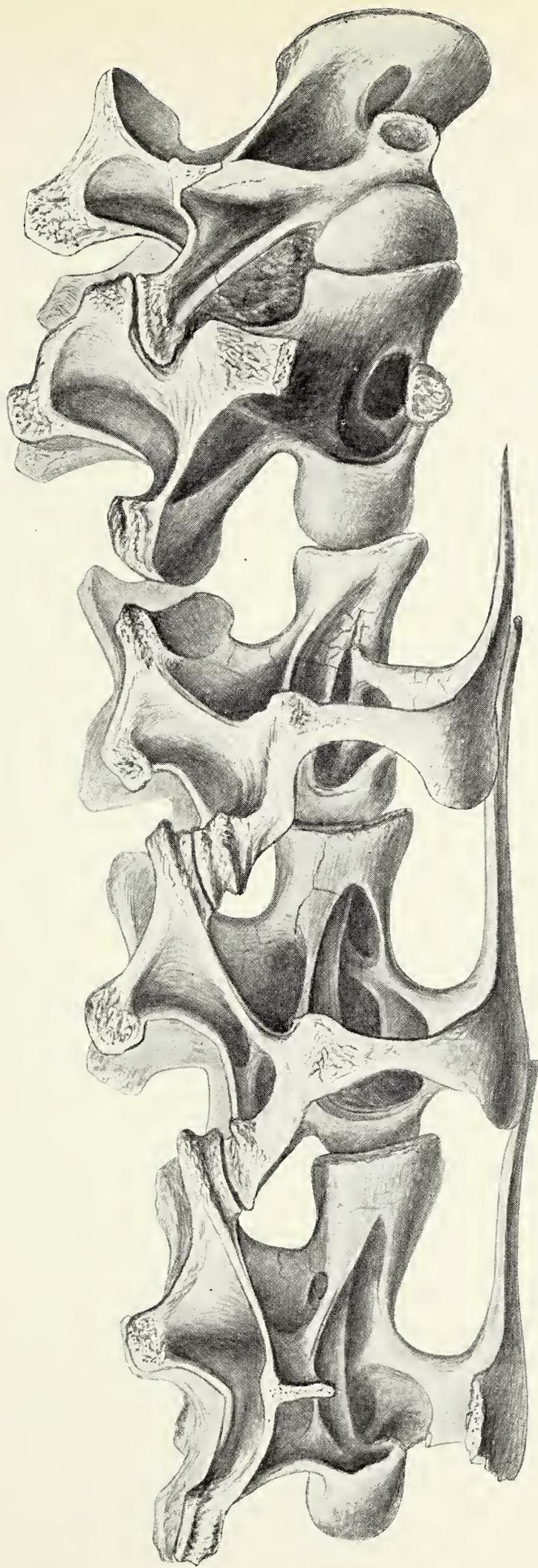
It is probable that the barrel of the reptile was also somewhat broader in proportion to its height than was the case in the other genera with which comparison has been made in this article. It had little resemblance, so far as can be determined, to *Haplacanthosaurus* and its allies, with which a comparison has been instituted. All the features shown by the vertebræ which have so far been prepared for study, show it to be widely distinct from any other genus of the Sauropoda which has hitherto been described. It is proper at this point to state that, if my surmise as to the association with these cervicals of other remains at our command is hereafter verified, *Uintasaurus*, while having a relatively short neck, had an enormously long tail.

CARNEGIE MUSEUM,

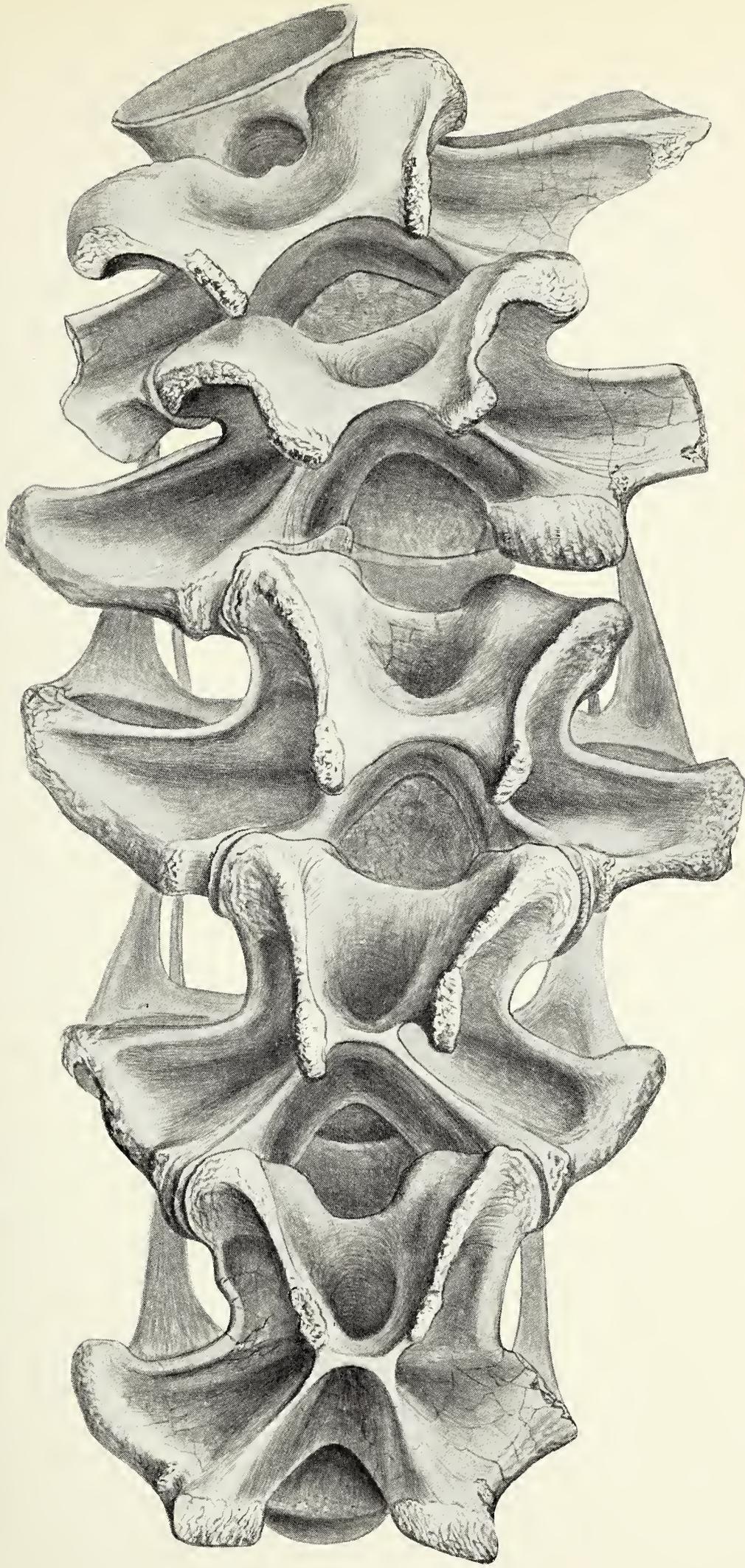
July 11, 1923.



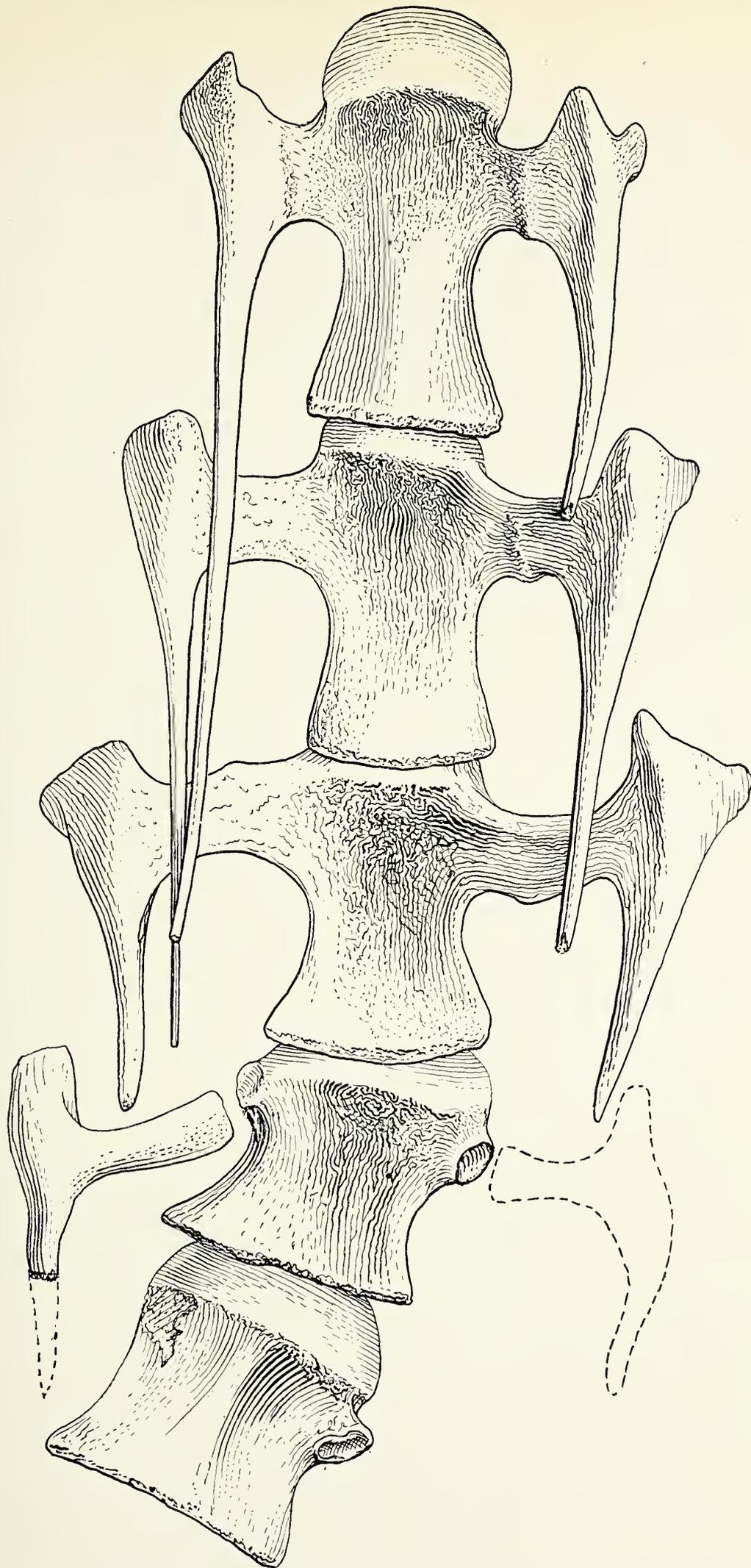
View of right side of posterior cervicals of *Uintasaurus douglassi* Holland. One-seventh nat. size.



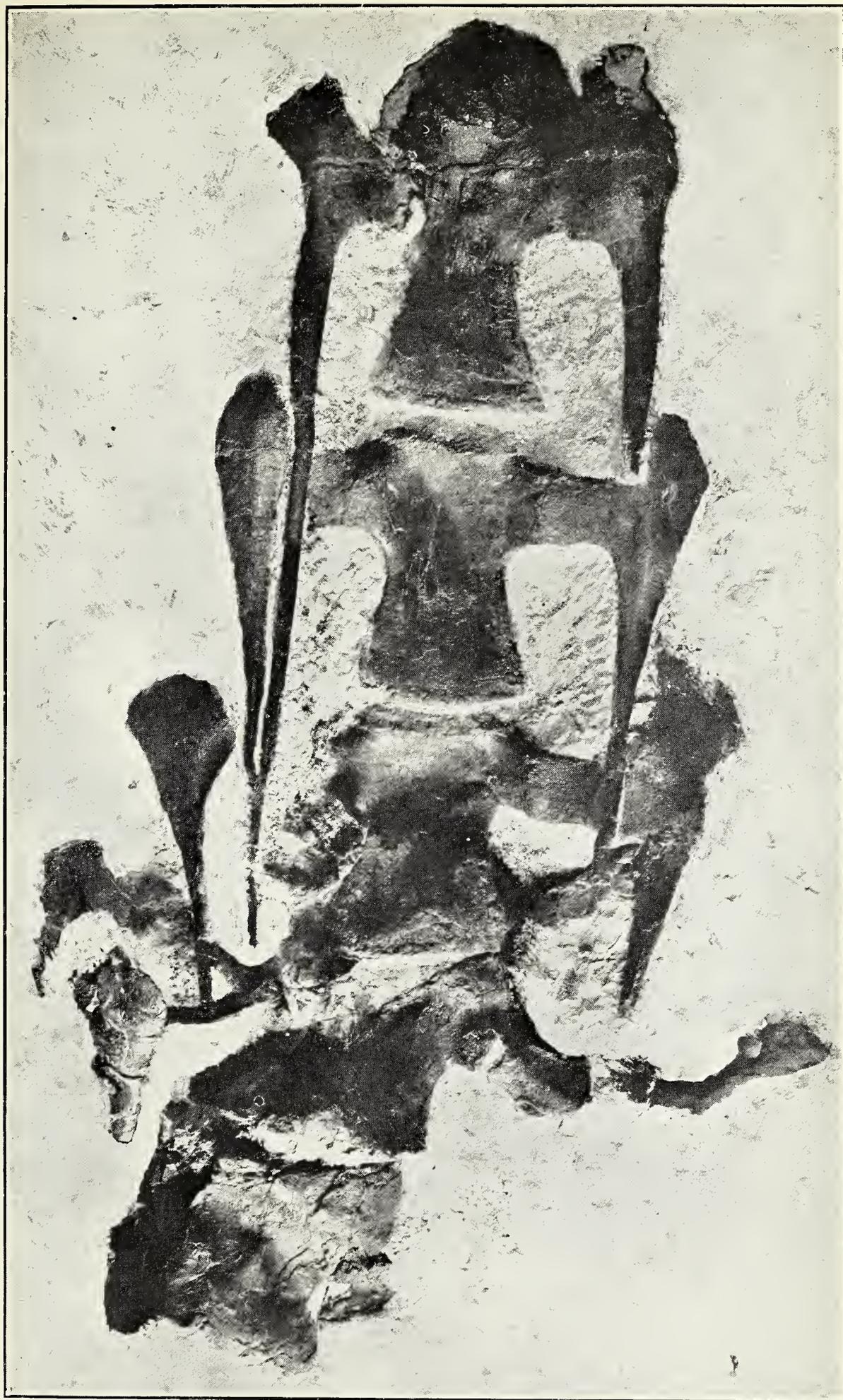
View of left side of posterior cervicals of *Uintasaurus douglassi* Holland. One-seventh nat. size.



Dorsal view of posterior cervicals of *Uintasaurus douglassi* Holland. One-seventh nat. size.



Drawing of ventral surface of cervicals of *Uintasaurus douglassi* Holland.
One-seventh nat. size.



Photograph of ventral surface of posterior cervicals of *Uintasaurus douglassi* Holland, when first uncovered. (Greatly reduced.)

X. THE CARANGOID FISHES OF JAPAN.¹

BY YŌJIRŌ WAKIYA.

(PLATES XV—XXXVIII)

INTRODUCTION.

In this paper the writer has undertaken to describe all the species of the carangoid fishes found in the waters of Japan, including Korea, the Bonin Islands, the Ryūkyū Islands, and Formosa. In order to this the specimens in the institutions hereinafter named have been studied. Only one species, *Ulua richardsoni* Jordan and Snyder, has failed to come under the eye of the writer, but its occurrence in the waters of Japan may be confidently asserted upon the authority of the authors of the species.

The collections which have been examined are the following:

1. The collection in the Marine Zoölogical Laboratory, College of Agriculture, Tōkyō Imperial University. It comprises specimens

¹This paper was submitted by the author for publication at the suggestion of Dr. David Starr Jordan with the understanding that the Carnegie Museum in consideration of undertaking its publication should receive all the types of the new species therein described as well as specimens of all the other species therein mentioned. With this condition the author has substantially complied. The only exceptions are the following:

Of *Trachurus argenteus* Wakiya, we received a paratype, but no figure; of *Caranx schlegeli* Wakiya we received the figured specimen, but not the type; of *Caranx tanakai* Wakiya we received a paratype and a figure of the type; of *Trachynotus cuvieri* Wakiya we received no specimen and no figure. Almost all the other species in the list were received; either the types, or figured and described specimens, with the exception of *Ulua richardsoni* Jordan and Snyder, the type of which is in the Carnegie Museum, No. 413, C. M. Cat. of Fishes.

As originally submitted, the manuscript required revision to make it accord in form with other papers published by the Carnegie Museum. Dr. David Starr Jordan read it in a preliminary way, and partially revised it, inserting a number of notes and then turned it over to the undersigned for final revision. Mr. Wakiya must be sincerely congratulated upon his knowledge of the English language and, while he will recognize that numerous minor changes in idiom have been made, yet in substance the article as published is identical in language with the manuscript, as handed over by him.

W. J. HOLLAND.

mostly collected in the following localities: the bays of Aomori, Miyako, Sendai, and Tōkyō, and their vicinities; the coasts of Kii, Akita, and Echigo; the bays of Toyama, Uwajima, Amakusa, and Nagasaki; the coasts of Korea, including both sides, *i.e.*, on the Yellow Sea and the Japan Sea; and the seas surrounding the Bonin Islands, the Ryūkyū Islands, and the coasts of Formosa.

2. The collection in the Imperial Museum at Ueno, Tōkyō, which consists of specimens from different parts of Japan proper, the Bonin and the Ryūkyū Islands.

3. A part of the collection in Suisan-Kōsyūjo (The Imperial Fishery Institute) at Fukagawa, Tōkyō, containing specimens obtained from Formosa.

Of these collections it may be noted that the third contains the greater part of the types studied by Jordan and Evermann, when identifying the species of the carangoid fishes of Formosa, as well as those fishes enumerated by Seno in his "Report of the Fisheries in Formosa," so that the writer has been enabled to identify the specimens treated by these authors, many of which were either insufficiently described, or merely listed.

A careful examination of the specimens in the above named collections has revealed to the writer that most of the species in them were already known to science, only twelve proving to be new, while fifty-nine per cent. had already been referred to as belonging to Japan by many previous authors, such as Temminck and Schlegel, Bleeker, Günther, Steindachner and Döderlein, Jordan and his collaborators, Snyder, Seno, Smith and Pope, and Franz. It is, however, especially to be noted that the majority (about eighty-three per cent.) of the carangoid fishes occurring in Japanese waters are the species described by earlier authors, such as Linnæus, Forskål, Bloch and Schneider, Quoy and Gaimard, Cuvier and Valenciennes, Temminck and Schlegel, and Bleeker, previous to Günther's publication of his great work "A Catalogue of the Fishes in the British Museum." In the latter work some of the species are merely referred to, or are even omitted, while most of them are confused with others, from which according to the present terminology of the species they should be separated. These unfortunate conditions were either left unnoticed by later authors, or the species so treated by Günther were even described by some authors as new, without any closer examination of the literature of the subject. Accordingly it has been deemed

necessary that all of the species of carangoid fishes thus far known from Japanese waters should be submitted to a closer examination in order to verify their specific status. Therefore the writer proposes without exception to describe all of the forms of this group known in Japan, and to give their discriminative characters as clearly and as concisely as possible, so as to facilitate their comparison either with the descriptions or with the figures given by previous authors, and thus to throw some light upon the fauna of this group in Japan.

Before going further, the writer wishes to express his hearty thanks to all those who have helped him in various ways. He is under especial obligation to Prof. Chiyomatsu Ishikawa not only for his supervision and suggestions, but for his great sympathy shown toward the writer throughout the whole course of his study.

In this connection, the writer cannot close these introductory remarks without expressing his deep indebtedness to Dr. David Starr Jordan, in view of the fact that the author not only acquired his elementary knowledge of ichthyology from the study of various papers and books of Dr. Jordan, but also for the kindness of the latter in sending him some copies of the literature in his library, which have been of the utmost importance in the present studies, and which were not accessible in Japan. The writer also expresses his gratitude for the encouragement of the work shown the writer by Dr. Jordan in a private letter addressed by him to Professor Ishikawa.

Yōjirō Wakiya.

The Fifth High School,
Kumamoto, Japan,
February, 1922.

PISCES.

Superorder **TELEOSTEI**, Müller.

Order PERCOMORPHI Cope.

Family CARANGIDÆ Günther (*partim*).

Head more or less compressed. Premaxillaries mostly protractile. Teeth small, conical in shape, but dentition various. Gills 4; a slit behind the last; pseudobranchiæ present; branchiostegals 7. Lateral line single, more or less curved anteriorly. Dorsals 2; the spinous composed of five to eight spines, which are rather weak; anal generally preceded by two spines free from the fin; caudal deeply forked; pectorals narrow; ventrals thoracic, I. 5. Pyloric cæca usually numerous; air-bladder present. Vertebræ 10 + 14 or 15.

The fishes of this group are widely distributed throughout the seas of the temperate and tropical regions, especially abounding in warmer waters. Fourteen genera and seventy-four species of the family are with certainty known from Japan, although a closer examination may reveal others.

They are divided into four subfamilies as follows:

- a. Lateral line armed with scutes. *Caranginae*.
- aa. Lateral line not armed with scutes.
 - b. Body covered with small, cycloid scales; premaxillary protractile.
 - c. Body much compressed; anal fin equal to soft dorsal fin; both much longer than abdomen. *Trachynotinae*.²
 - cc. Body not so much compressed; anal fin much shorter than soft dorsal, not longer than abdomen. *Seriolinae*.
 - bb. Scales rudimentary, transformed into small lanceolate or linear dermal products, imbedded in the skin; posterior rays of soft dorsal and anal semidetached, forming several finlets; premaxillaries not protractile. *Scomberoidinae*.

²From *Trachinotus* Lacépède, corrected by later authors to *Trachynotus*. D. S. JORDAN.

Subfamily CARANGINÆ.

Body oblong, ovate or rhombic in shape, either strongly compressed or scarcely so; premaxillary protractile. Dentition various. Gill-rakers normal in shape, but sometimes transformed to long feather-like filaments. Body covered with small cycloid scales. Curvature of lateral line comparatively strong in most species; scutes developed on lateral line much larger than the scales covering the body, and usually keeled and ending behind in spines. Spinous dorsal generally composed of eight spines, usually connected by membrane. Soft dorsal nearly equal to anal, with two detached spines; anal longer than abdomen. Pectorals long and falcate; ventrals usually not longer than head.

Fifty-seven species of this subfamily are represented in Japan. These belong to seven genera, which are distinguished as follows:

- a. Scutes present along whole length of lateral line. *Trachurus*.
- aa. Scutes not present along whole length of lateral line.
 - b. One or several finlets behind soft dorsal and anal.
 - c. Several finlets behind soft dorsal and anal. *Megalaspis*.
 - cc. One finlet behind soft dorsal and anal. *Decapterus*.
 - bb. No finlets behind soft dorsal and anal.
 - d. Shoulder-girdle not crossed with a furrow at its junction with isthmus.
 - e. Spines of spinous dorsal eight or seven, connected with membrane; none of anterior rays of soft dorsal and anal so long as length of body.
 - f. Abdomen without a deep median groove, into which ventrals are wholly received; ventral usually much shorter than head.
 - g. Gill-rakers of moderate length and of normal shape. *Caranx*.
 - gg. Gill-rakers extremely long, and feather-like in shape. *Ulua*.
 - ff. Abdomen with a deep median groove, into which the ventrals are wholly received; ventral long, equal to head in length. *Atropus*.
 - ee. Spines of spinous dorsal smaller in number, free, rudimentary; anterior rays of soft dorsal and anal not shorter than length of body. *Alectis*.

Genus TRACHURUS Rafinesque.

Body a little compressed, elongate, oblong in shape. Head pointed, compressed. Jaws, vomer, palatines, and tongue with very fine teeth. Posterior adipose eyelid very well developed. Breast scaly. Lateral line broadly curved. Scutes about as high as diameter of eye, present along whole length of lateral line. No finlets behind soft dorsal and anal.

Three species of this genus are known from Japan.

- a.* Head longer than depth; highest scutes on curved portion of lateral line not higher than those on straight portion; scutes seventy to seventy-two.
- b.* Eye longer than snout; highest scutes on curved portion of lateral line lower than those on straight portion; body in life dark blue above. *japonicus*.
- bb.* Eye equal to snout, or nearly so; highest scutes on curved portion of lateral line equal to those on straight portion; in life body greenish above. *argenteus*, sp. nov.
- aa.* Head equal to depth; highest scutes on curved portion of lateral line somewhat higher than those on straight portion; scutes seventy-five or seventy-six; eye shorter than snout; in life body greenish blue above. *declivis*.

1. *Trachurus japonicus* (Temminck and Schlegel).

(*Kuroje*)

Caranx trachurus japonicus Temminck and Schlegel, 1844, p. 109, pl. 59, fig. 1.

Selar japonicus Bleeker, Vehr. Bat. Gen., XXVI, Ichth. van Jap., 1857, pl. 8, fig. 1.

Trachurus trachurus Günther, (*partim*), Cat. Fish. Brit. Mus., II, 1860, p. 419.

D. VIII-I, 31 to 33; A. II-I, 27 to 29; scutes 69 to 72 (35 or 36 + 34 to 36).

Head 3.7 in length of body (4.5 in total length); depth 4.03 (4.88); pectoral 3.17; eye 4.29 in head; snout 3.17.

Head longer than depth of body. Snout pointed, longer than eye, which is rather shorter than interorbital space; lower jaw longer than upper; maxillaries scarcely reaching anterior border of pupil. Teeth very fine; those on upper jaw imperceptible in old specimens. Lateral line becoming straight below eighth soft dorsal ray, which is at anterior quarter of fin; curved portion rather longer than straight portion, 1.1 to 1.2 times of latter. Highest scutes on curved portion of

lateral line lower than those on straight portion. Pectorals rather longer than head.

Color in formalin dark brown above, lighter below; dorsals and anal brownish; anterior part of soft dorsal white; anal and paired fins lighter; opercular spot black, distinct. Dark blue above in life.

The above description is founded upon a specimen from Uwajima, Shikoku, measuring 270 mm. in the length of the body. The proportions of the eye and of the snout in the head vary in accordance with the size of the specimens as follows:

Length of body	Eye in head	Snout in head
300 mm.	4.52 times	3.16 times
290 mm.	4.44 "	3.18 "
70 mm.	4.29 "	3.17 "
158 mm.	3.82 "	3.20 "
139 mm.	3.90 "	3.25 "
135 mm.	3.80 "	3.23 "
134 mm.	3.54 "	3.30 "

The specimens dealt with here exactly agree with the original description and the figure of this species given by Temminck and Schlegel.

The present species, as well as all other Japanese species of *Trachurus*, closely resembles *T. trachurus*, but the latter differs from all of them in having 77 (40 + 37) scutes, the eye equalling the snout in length, and contained four times in the head.

The fishes of this species approach the coast in autumn, whereas those of the other two Japanese species of *Trachurus* do so in summer. The fish is distinguished from the others in Tōkyō by the Japanese name "Kuroje," which means "black back."

Widely distributed along the coasts of Japan proper and of north-eastern Korea.

Localities:—Aomori; Miyako; Sendai Bay; Niigata; Tōkyō Bay; Kii; Uwajima; Amakusa; Fusan (Korea); Seisin (Korea).

Carnegie Museum, Cat. of Fishes, No. 7702, one specimen from Amakusa.

2. *Trachurus argenteus* Wakiya, sp. nov.

D. VIII-I, 31 to 33, A. II-I, 27 to 29; scutes 71 to 72 (35 or 36 + 34 to 36).

Head 3.77 in length of body, (4.47 in total length); depth 4.21 (5); pectoral 3.25; eye 3 in head; snout 3.35.

Head longer than depth of body. Snout rather pointed, equal to or slightly longer than eye, which is equal to interorbital space. Highest scutes on curved portion of lateral line equal to those on straight portion.

Color much lighter than that of *T. japonicus*, and body in life silvery, becoming greenish above. Otherwise similar to *T. japonicus*.

The above description is made from a specimen from Kii, measuring 215 mm. in length of body. The proportion of the eye and of the snout in the head varies in accordance with the size of the specimens as follows:

Length of body	Eye in head	Snout in head
215 mm.	3.80 times	3.35 times
205 mm.	3.92 "	3.43 "
152 mm.	3.70 "	3.25 "
159 mm.	3.48 "	3.52 "
154 mm.	3.66 "	3.52 "
150 mm.	3.33 "	3.33 "

This species closely resembles both *T. japonicus* and *T. declivis*, but is distinguishable from them in having the eye nearly equal to the snout, and the highest scutes on the curved portion of the lateral line equal to those on the straight portion.

The species is also common in Japan proper, but its distribution does not extend so far northward as that of *T. japonicus*, while it ranges to Formosa and southward.

Localities:—Tōkyō Bay; Kii; Uwajima; Amakusa; Ryūkyū; Formosa.

One specimen, Carnegie Museum, Cat. of Fishes, No. 7703, *cotype*, from Amakusa.

3. *Trachurus declivis* (Jenyns)

Caranx declivis Jenyns, Zööl. Beagle, Fishes, 1841, p. 68, pl. 14.

Trachurus trachurus Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 419.

Trachurus japonicus Seno, Report on Fishery Industry of Formosa, 1910, pl. IX, fig. 2.

D. VIII-I, 32 or 33; A. II-I, 28 or 29; scutes 75 or 76 (40 + 35 or 36).

Head 4 in length of body (4.8 in total length); depth 4 (4.8); pectoral 3.3; eye 4 in head; snout 3.22.

Head equal to depth of body, or nearly so. Snout rather pointed, longer than eye, which is nearly equal to interorbital space. Highest scutes on curved portion of lateral line somewhat higher than those on straight portion, 1.17 times of latter.

Color much lighter than that of *T. japonicus*, and in life greenish blue above. Otherwise similar to that species.

The above description is based upon a specimen from Uwajima, Carnegie Museum, Cat. of Fishes, No. 7704, measuring 240 mm. in the length of body.

Another specimen from Amakusa attaining 310 mm. in the length of body, has the head 4 in the body, the depth 4.2, the eye 4 in the head, the snout 3.12, and 75 scutes.

The specimens dealt with here agree well with the original description and the figure of this species given by Jenyns.

The species differs from the other two Japanese species of the genus in having the depth of the body nearly equal to the length of the head, rather more numerous scutes, and the highest scutes on the curved portion of the lateral line higher than those on the straight portion. A specimen from Formosa, identified by Seno as *T. japonicus*, is certainly this species, since all the peculiarities shown in the figure given by the same author exactly correspond with those of the present species.

The species is widely distributed throughout the warmer seas of the Pacific, and is rather common in the waters of the southern coasts of Japan proper.

Localities:—Uwajima; Amakusa; Formosa.

Genus MEGALASPIS Bleeker.

Body a little compressed, elongate, oblong in shape. Head pointed, compressed. Jaws, vomer, palatines, and tongue toothed. Anterior and posterior adipose eyelids very well developed. Breast naked. Curved portion of lateral line very short. Scutes very well developed, very high, but not present along whole length of lateral line. Several finlets behind soft dorsal and anal.

Only one species is known in this genus.

4. *Megalaspis cordyla* (Linnæus)

(PL. XV, fig. 1.)

Scomber cordyla Linnæus, Syst. Nat., 1758, I., p. 483.

Megalaspis cordyla Seno, Report on Fishery Industry of Formosa, 1910, pl. 7, fig. 1.

D. VIII-I, 10-IX or IX; A. II-I, 10-VI; scutes 50.

Head 3.9 in length of body (4.43 in total length); depth 3.9 (4.45); pectoral 3.28; eye 3.7 in head; snout 3.7.

Body not lower than length of head. Snout pointed, equal to eye;

maxillaries extending to centre of eye; lower jaw longer than upper. Anterior and posterior adipose eyelids somewhat extending beyond borders of pupil toward its centre. Teeth on upper jaw in a very narrow band; those on lower in a single series; vomer, palatines, and tongue with minute teeth. Lateral line shortly and strongly arched, becoming straight below middle of pectoral; curved portion four times in straight portion. Scutes very high, present along whole length of straight portion of lateral line; highest scutes 1.6 times of eye. Pectorals very long, about 1.2 times of head.

Color in formalin dark brown above, lighter below: fins brownish, except anal, which is pale; top of soft dorsal and posterior margin of caudal blackish; opercular spot black, distinct.

The above description is taken from a specimen from Formosa, Carnegie Museum Cat. of Fishes, No. 7705, measuring 215 mm. in the length of the body.

The species is widely distributed throughout the Indian Ocean, and the tropical seas of the Pacific. It is known to occasionally occur along the southernmost coasts of Japan proper.

Localities:—Nagasaki; Formosa.

GENUS DECAPTERUS Bleeker.

Body more or less compressed, elongate, fusiform or subcylindrical in shape. Head pointed, less compressed. Teeth fine; dentition various. Adipose eyelids well developed. Shoulder-girdle crossed with a shallow furrow at its junction with isthmus. Lateral line a little curved; scutes present on straight portion of lateral line. A finlet behind soft dorsal and anal.

Six species of this genus are known from Japan.

- a. Teeth on tongue obsolete, wholly absent, or present as a mere small patch; twenty-four to twenty-six soft anal rays; fins tinged with red in life. *russelli*.
- aa. Teeth on tongue in a band; soft anal rays twenty-six or more; fins not tinged with red in life.
- b. Vomer without a median longitudinal strip of teeth.
- c. Depth not more than 5.5 in length of body; upper jaw not toothed; maxillaries reaching midway between nostril and front border of eye; opercular membrane finely serrated. . . . *macrosoma*.

- cc. Depth not less than 5.3 in length of body; upper jaw toothed; maxillaries reaching to front border of eye; opercular membrane not serrated. *muroadsi*.
- bb. Vomer with a median longitudinal strip of teeth.
- d. Depth less than 5 in length of body; pectorals equal to head without snout; scutes present on posterior two-thirds of straight portion of lateral line; highest scutes not higher than half of eye. *lajang*.
- dd. Depth more than five times in length of body; pectorals much longer than head without snout; scutes present along whole length of straight portion of lateral line; highest scute higher than half of eye.
- e. Pectorals equal to head; thirty-five or thirty-six scutes; highest scute equal to eye; top of soft dorsal white. *maruadsi*.
- ee. Pectorals a little shorter than head; thirty-eight scutes; highest scutes three-fourths of eye; top of soft dorsal not white. *dayi*, sp. nov.

5. *Decapterus russelli* (Rüppell)

(PL. XV, fig. 2)

(*Oaka*; *Akamuro*)

Caranx russelli Rüppell, Atl. Fisch., 1828, p. 99.

Caranx kurra, Cuvier and Valenciennes, Vol. IX, 1830, p. 44 (based on Russell's figure of *Kurra-Wodagawah*).

Decapterus kurra Bleeker, Verh. Bat. Gen., XXIV, Makr., 1852, p. 50.

Caranx kurra Günther, Cat. Fish. Brit. Mus., Vol. II, 1860, p. 429.

D. VIII-I, 30 to 32-I; A. II-I, 24 to 26-I; scutes 45.

Head 3.5 in length of body (4 in total length); depth 4.95 (5.52); pectoral 5; eye 5 in head; snout 3.

Body scarcely compressed. Snout much longer than eye, 1.66 times of it; interorbital space wider than eye, 1.25 times of it. Maxillaries scarcely reaching front border of eye; lower jaw slightly longer than upper. Teeth on each jaw in a single series; but on the upper only several at anterior end; those on vomer in two small patches at anterior end, and in a longitudinal median strip; palatines toothed; teeth on tongue obsolescent, either wholly absent, or forming a very small patch near posterior end. Posterior margin of subopercle distinctly

concave, descending obliquely forward; opercular membrane finely and sharply serrate, but only partially and indistinctly so in younger specimens. Lateral line slightly arched, becoming straight below the fourteenth soft dorsal ray, which is at middle of fin; curved portion longer than straight portion, 1.45 times of latter. Scutes distinct along nearly whole length of straight portion of lateral line; highest scutes slightly higher than half of eye. Pectorals short, equal to head without snout.

Color in formalin brown above, light below; dorsals, caudal, and pectorals brownish; anal and ventrals light; opercular spot black, distinct. In life body blue above, with a diffuse yellow longitudinal band, silvery below; snout, back, and all fins tinged with red, but caudal fin margined with yellow.

The above description is based upon a specimen from Kii, measuring 287 mm. in length of body. The proportions of the depth of the body in its length and of the eye in the head vary in accordance with the size of the specimens as follows:

Length of body	Depth in length of body	Depth in total length	Eye in head
393 mm.	4.80 times	5.40 times	5.20 times
295 mm.	4.91 times	5.53 times	5.12 times
287 mm.	4.95 times	5.52 times	4.95 times
286 mm.	4.84 times	5.50 times	4.92 times
250 mm.	4.87 times	5.58 times	4.85 times
227 mm.	5.40 times	6.20 times	4.60 times
195 mm.	5.57 times	6.30 times	4.50 times

All the specimens thus far examined exactly agree with the original description of this species given by Rüppell, as well as with that of *Caranx kurra* given by Cuvier and Valenciennes.

The specific name *russelli* is given by Rüppell to a specimen which he considered to be identical with that figured by Russell as *Kurra-Wodagawah*. The former author has so fully enumerated some of the discriminative characters of his species that by merely following him we are enabled to distinguish it easily from all other species of *Decapterus*; but, unfortunately for us, he has not mentioned any of the characters represented in Russell's figure, except the presence of the finlets and the number of the anal rays. It is perhaps the latter fact which led Cuvier and Valenciennes to consider the fish drawn by Russell as a new species, and to propose the specific name *kurra*; assigning to it the characters which may be drawn from the same figure, such as the presence of the finlets, the number of the anal

rays and of the scutes, the point where the lateral line begins to become straight, and the color of the caudal fin. Later authors without making closer study of the identification made by Rüppell of his fish with that figure, have come to use these two specific names *russelli* and *kurra* as synonymous with each other; and at least four species, quite different from one another, have been reported by authors under either one or the other of these names. Thus, Bleeker and Günther have respectively described as *kurra* (= *russelli*) a form, which well agrees with the description given by Rüppell of his species; while Day, using the same specific name, has described and figured another form, the characteristics of which are not identical with those enumerated by Rüppell. Afterwards Steindachner and Döderlein regarded *D. kiliche* (Cuvier and Valenciennes), *D. kurra* (Cuvier and Valenciennes), *D. maruadsi* (Temminck and Schlegel), and *D. kurroides* Bleeker, as synonyms of *D. russelli*. The writer is inclined to believe Rüppell was right when he considered his specimen as identical with the "Kurra-Wodagawah" of Russell. This may be concluded from the fact that the specimens dealt with here exactly agree with the description by Cuvier and Valenciennes of *kurra*, they having twenty-four to twenty-six soft anal rays, forty-six scutes, the lateral line becoming straight below the middle of the soft dorsal, and the caudal fin margined with yellow; they exactly agree, moreover, in the possession of the toothless tongue and of the red fins, with the original descriptions of Rüppell of *russelli*. There is thus no doubt that these two specific names are synonymous, and the only question is which of the two names is to be used as the specific name for the present species. According to our present laws of nomenclature, the name *russelli* must be accepted, and *kurra* regarded as its synonym; for the former is earlier than the latter. *D. kurra* of Bleeker and of Günther which agrees with the original description of *D. russelli* is certainly the present species. Both the species identified by Day with *D. kurra*, and *D. maruadsi*, which bears a close resemblance to the species of Day, cannot be the present species; for, as the writer will explain in the descriptions of those species, they contradict not only the original description of *D. russelli* in the color of all the fins and the dentition on the tongue, but also that of *D. kurra* in the number of the anal rays and of the scutes. *D. kurroides*, agreeing with *D. kiliche* in the number of the anal rays and of the scutes, seems to be a synonym of the latter species, as Steindachner and Döderlein were inclined to

think. At any rate, these two species manifestly differ from the present species in having thirty scutes, and the lateral line becoming straight below the anterior third of the soft dorsal.

This fish is known in Tōkyō by the name of "Oaka," which means "red caudal," and in Kii by "Akamuro" which means "red Decapterus."

The species is widely distributed throughout the Indian Ocean and the warm seas of the Pacific.

Localities.—Tōkyō Bay; Kii; Uwajima; Ryūkyū.

One specimen, Carnegie Museum Cat. of Fishes, No. 7706, from Tōkyō Bay.

6. *Decapterus muroadsi* (Temminck and Schlegel).

(PL. XVI, fig. 1.)

Caranx muroadsi Temminck and Schlegel, 1844, p. 108, pl. 58, fig. 1.—Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 427.

Decapterus muroadsi Bleeker, Verh. Bat. Gen. XXVI, Ichth. van Japan, 1857, p. 101.

Decapterus sanctæ-helenæ Steindachner and Döderlein, (*non* Cuvier and Valenciennes), Vol. III, 1884, p. 37, pl. IV, fig. 1.

D. VIII-I, 31 to 33-I; A. II-I, 26 to 28-I; scutes 33.

Head 4 in length of body (4.57 in total length); depth 4.7 (5.38); pectoral 4.7; eye 5.23 in head; snout 3.

Body scarcely compressed; snout much longer than eye, 1.75 times of it; interorbital space wider than eye, 1.56 times of it; lower jaw a little longer than upper; maxillaries scarcely reaching front border of eye. Teeth on each jaw in a single series, but those of upper only on anterior end; vomer with a transverse strip of teeth confined to anterior end; palatines toothed; a band of teeth on middle of posterior half of tongue. Posterior margin of subopercle concave, descending forward a little; opercular membrane not serrated. Lateral line slightly arched, becoming straight below twelfth soft dorsal ray; curved portion longer than straight portion, 1.3 times of latter. Scutes distinct along posterior five-sevenths of straight portion of lateral line; highest scutes equal to half of eye. Pectorals a little longer than head without snout.

Color in formalin dark bluish brown above, light below; spinous dorsal brown; soft dorsal gray, broadly edged with brown; caudal and pectorals gray; anal and ventrals light; opercular spot black, distinct. In life body deep blue above, silvery below; a broad reddish brown band, which turns yellow after death, running from tip of snout to base of upper lobe of caudal; top of soft dorsal, lower lobe of caudal, basal part of anal, and paired fins faintly washed with purple.

The above description is founded upon a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7707, measuring 280 mm. in the length of body. The proportions of the depth in the length of body, and of the eye in the head vary in accordance with the size of the specimens as follows:

Length of body	Depth in length of body	Depth in total length	Eye in head
335 mm.	4.50 times	5.23 times	5.40 times
280 mm.	4.70 times	5.33 times	5.25 times
223 mm.	5.00 times	5.80 times	5.00 times
160 mm.	5.13 times	5.90 times	4.50 times
152 mm.	5.20 times	6.00 times	4.33 times

The specimens dealt with here quite agree with the original description and the figure of this species given by Temminck and Schlegel.

Steindachner and Döderlein have regarded this species as a synonym of *D. sanctæ-helenæ* (Cuvier and Valenciennes). However, as the latter according to its original description has the head five times in the total length, the depth 5, the pectoral 6, the eye 4 in the head, thirty-five dorsal rays, thirty anal rays, and the lateral line marked with a series of black spots, it differs so much from the present species that this must be distinct from the Atlantic species, and the identification of this species with *D. sanctæ-helenæ* must be considered as an error.

This fish is known in Tōkyō by the Japanese name "Akaje" which means "red back."

The species is common along the warmer coasts of Japan proper, but it is not yet known from the south beyond that region.

Localities:—Tōkyō Bay; Kii; Kagoshima; Uwajima; Hamada.

7. *Decapterus macrosoma* Bleeker.

(PL. XVI, fig. 2.)

Decapterus macrosoma Bleeker, Nat. Tydschr. Nederl. Ind., I, 1851, p. 358.

Decapterus muroadsi Jordan and Evermann, (*non* Temminck and Schlegel), Proc. U. S.

Nat. Mus., Vol. XXV, 1902, p. 337.—Seno, (*non* Temminck and Schlegel)

Report on Fishery Industry of Formosa, 1910, p. 117.

D. VIII-I, 32 to 35-I; A. II-I, 28 to 30-I; scutes 27.

Head 3.8 in length of body (4.35 in total length); depth 5.5 (6.4); pectoral 5.55; eye 5 in head; snout 3.

Body very low, scarcely compressed. Snout much longer than eye, 1.66 times of it; interorbital space slightly wider than eye. Maxillaries reaching below a point midway between posterior nostril and front border of eye; lower jaw scarcely longer than upper. Teeth feeble; none on upper jaw; a few teeth in a single series only on anterior part of lower jaw; vomer with a transverse strip of teeth confined to its anterior end; palatines not toothed; a narrow band of teeth on the middle of posterior part of tongue. Posterior margin of subopercle somewhat concave, descending slightly forward; opercular membrane finely and bluntly serrated along whole free margin, but only partially so in young. Lateral line scarcely arched, becoming straight below thirteenth soft dorsal ray; curved portion longer than straight portion, 1.3 times of latter. Scutes distinct along posterior half of straight portion of lateral line; highest scutes two-fifths of eye. Pectorals slightly longer than head with snout.

Color in formalin dark bluish brown above, light below; dorsals and caudal brownish; distal half of soft dorsal darker; anal and paired fins light; opercular spot black, very distinct.

The above description is founded upon a specimen from the Bonin Islands, measuring 248 mm. in the length of body. The largest specimen which the writer has examined attains 350 mm. in the length of body. The proportion of the depth of the body in the length varies greatly in accordance with the size of the specimens: for example the depth of specimens measuring about 200 mm. in the length of body is 6.7 to 7 in the total length, whereas it is 6.4 in the above described specimen, which is 248 mm. in length of body, as stated. The species is represented in the Carnegie Museum by No. 7708, measuring 214 mm. to base of caudal, from the Bonin Islands.

All the specimens thus far observed agree well with the original description of this species by Bleeker, except for the number of scutes, which according to his count number sixty as against our twenty-seven. If, however, we sum up all the scales on the straight portion of the lateral line, the total number comes to sixty, keeping count of about thirty-three enlarged scales on the anterior half, and about twenty-seven bony scales bearing a spine on the posterior half. The writer, assuming that the statement made by Bleeker of the number of scutes is not correct, is inclined to give the present specific name to those specimens which accord with the description given above. Examination of a specimen from Formosa now preserved in the museum of Suisan Kōsyūjo, and which has been identified both by Jordan and Evermann and by Seno with *D. muroadsi*, reveals to the writer that it is not that species, but is in reality *D. macrosoma*.

The species is distributed throughout the tropical seas of the Pacific, occurring on the southernmost coasts of Japan proper.

Localities:—Ito and Oshima (Izu); Yaku (Satsuma); Bonin Islands; Ryūkyū; Formosa.³

8. *Decapterus lajang* Bleeker.

(PL. XVII, fig. 1.)

(*Muroaji*)

Decapterus lajang Bleeker, Ternate, V, 1855, p. 302.

Caranx muroadsi Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 427.

D. VIII-I, 34 or 35-I; A. II-I, 28 to 30-I; scutes 28.

Head 4 in length of body, (4.5 in total length); depth 5.33 (6); pectoral 6; eye 4.72 in head; snout 3.

Body a little compressed. Snout rather longer than eye; inter-orbital space equal to eye; lower jaw scarcely longer than upper; maxillaries extending to front border of eye; their posterior end rather concave, and inferiorly produced backward. Teeth on upper jaw imperceptible; those on lower in a single series; vomerine teeth in a transverse strip at anterior end, and in a longitudinal strip on middle; those of tongue in a median longitudinal band; palatines also toothed. Posterior margin of subopercle straight, descending obliquely forward; opercular membrane not serrated. Lateral line scarcely arched, becoming straight below fifteenth soft dorsal ray; curved portion longer than straight portion, 1.36 times of latter. Scutes distinct on posterior two-thirds of straight portion of lateral line; highest scutes about half of eye. Pectorals much shorter than head, equal to head without snout.

Color in formalin dark bluish brown above, light below; dorsals and caudal brown; anal and ventrals light; pectorals gray; opercular spot black, distinct. In life, body greenish blue above, silvery below; no longitudinal band.

The above description is based upon a specimen from Kii, measuring 204 mm. in length of body. The species is represented in the Carnegie Museum by No. 7709, which measures 260 mm. to base of caudal.

This species is distinct from all other species of *Decapterus* in having the maxillaries concave at the posterior end and produced backward inferiorly. Together with *D. macrosoma*, it bears a great resemblance to *D. sanctæ-helenæ* in having thirty-four or thirty-five dorsal soft rays, and twenty-eight to thirty soft anal rays, but both differ from

³A specimen from Kagoshima is referred to this species by Jordan. D. S. JORDAN.

the Atlantic species in having a longer head, a lower body, and shorter pectorals, and in the absence of a series of black spots on the lateral line.

This fish, which is generally known in Japan by the name "Muroaji," is often mistaken for *D. muroadsi*. It is, however, readily to be distinguished from the latter by the dentition on the vomer and the coloration in life, not to speak of the shape of the maxillary.

It seems to be distributed throughout the tropical seas of the Pacific, and is common in the waters of the warmer parts of Japan proper.

Localities:—Tōkyō Bay; Kii; Uwajima; Kagoshima; Bonin Islands.

9. *Decapterus maruadsi* (Temminck and Schlegel).

(PL. XVII, fig. 2.)

(*Aoaji*)

Caranx maruadsi Temminck and Schlegel, 1848, p. 109, pl. 158, fig. 2.—Günther, Cat. Fish. Brit. Mus., Vol. II, 1860, p. 428.

Decapterus maruadsi Bleeker, Verh. Bat. Gen., XXVI, Japan, 1857, p. 100.

Decapterus russelli Steindachner and Döderlein, (*non* Rüppell), Vol. III, 1884, pl. IV, fig. 2.

D. VIII-I, 32 to 33-I; A. II-I, 28 or 29-I; scutes 35 or 36.

Head 4 in length of body (4.6 in total length); depth 4.33 (5); pectoral 4; eye 4.4 in head, snout 2.6.

Body a little compressed. Snout much longer than eye, 1.7 times of it; interorbital space rather wider than eye, 1.2 times of it. Maxillaries scarcely reaching front border of eye; lower jaw a little longer than upper. Teeth on jaws in a single series; vomerine teeth in a transverse strip on anterior end, and in a longitudinal strip on middle; palatines toothed; a band of teeth on middle of tongue. Posterior margin of subopercle nearly straight, descending obliquely forward; opercular membrane not serrated. Lateral line somewhat strongly arched, becoming straight below fourteenth soft dorsal ray, which is nearly at middle of fin; curved portion longer than straight portion, 1.4 times of latter. Scutes well developed, present along whole length of straight portion of lateral line; highest scutes equal to eye, 4.5 in depth of body. Pectorals as long as head.

Color in formalin brownish; spinous dorsal brown; soft dorsal gray, with a broad darker margin and a white top; caudal and pectorals gray; anal and ventrals light; opercular spot black, distinct, encroaching on shoulder. In life body greenish above, silvery below; fins faintly tinged with yellow, but no parts of head, body, and fins tinged with red.

The above description is made from a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7710, measuring 247 mm. in the length of body.

The specimens dealt with here exactly agree with the original description and the figure of this species given by Temminck and Schlegel, except the proportion of the depth of the body in its length, which in this species greatly varies in accordance with the sex and the size as follows:

Length of body	Sex	Depth in length of body	Depth in total length
282 mm.	♂	4.00 times	4.64 times
247 mm.	♀	4.33 times	5.00 times
243 mm.	♀	4.50 times	5.27 times
220 mm.	♂	4.15 times	4.70 times
200 mm.	♂	4.20 times	4.80 times
200 mm.	♀	4.70 times	5.50 times
180 mm.	♂	4.17 times	4.83 times
176 mm.	♀	4.63 times	5.40 times
175 mm.	?	4.26 times	4.88 times
160 mm.	?	4.70 times	5.50 times

Thus the length, compared with the depth in the case of older male specimens, quite agrees with the figure of this species by Temminck and Schlegel, while that of younger female specimens corresponds exactly with the description by Günther, as well as with the figure by Steindachner and Döderlein of their *D. russelli* (= *D. maruadsi*).

This species can easily be distinguished from all other Japanese species of *Decapterus* by having longer pectorals, higher scutes, and the soft dorsal with a white top; and especially from *D. russelli*, which has been regarded by Steindachner and Döderlein and some other authors as synonymous with this species, by having a higher and more compressed body, the tongue with teeth in a band, the opercular membrane not serrated, rather more numerous anal rays, and the fins yellow in life, besides the other characters mentioned above.

This fish is known in Japan by the name "Aoaji" which means "blue Decapterus."

Though the species is common in the waters off the southern coasts of Japan proper, it is uncertain whether it occurs in any other regions.⁴

Localities:—Tōkyō Bay; Kii; Uwajima; Hamada.

⁴Specimens from Hawaii are referred to this species by J. T. Nichols. D. S. JORDAN.

10. *Decapterus dayi* Wakiya, sp. nov.

(PL. XVIII, fig. 1.)

Caranx kurra Day, (*non* Cuvier and Valenciennes), Fish. India, 1867, p. 214, pl. XLVIII, fig. 5.

Decapterus macrosoma Jordan and Evermann (*non* Bleeker), Proc. U. S. Nat. Mus., Vol. XXV, 1902, p. 337.

Decapterus maruadsi Seno (*non* Temminck and Schlegel), Report on Fishery Industry of Formosa, 1910, pl. 8, fig. 3.

D. VIII-I, 32-I; A. II-I, 26 to 28-I; scutes 38.

Head 3.6 in length of body (4.2 in total length); depth 4.37 (5.1); pectoral 4; eye 3.5 in head; snout 3.3.

Body comparatively strongly compressed; thickness not more than half of head and of depth. Snout equal to, or slightly longer than, eye, which is equal to interorbital space. Lateral line somewhat strongly arched, becoming straight below twelfth soft dorsal ray, which is at anterior two-fifths of fin; curved portion a little longer than straight portion, 1.18 times of latter. Highest scutes less than eye, three-fourths of it, 5 in depth of body. Pectorals rather shorter than head, equal to distance between anterior nostril and posterior end of opercle. Top of soft dorsal not white. Otherwise similar to *D. maruadsi*.

The above description is made from the type, a specimen from Formosa, Carnegie Museum Cat. of Fishes, No. 7711, measuring 140 mm. in length of body. The number of the soft dorsal rays varies from twenty-six to twenty-eight, but is mostly twenty-seven.

The present species is surely that described and figured by Day as *kurra* (= *russelli*) from India, for, as may be known from the description given above, the specimens dealt with here quite agree with the figure by the same author. However, not only does the present species differ in the same respects from *D. russelli* as *D. maruadsi* does from the latter, but it also disagrees with the original description of *D. kurra*, Cuvier and Valenciennes, which is a synonym of *D. russelli*, in having fewer than forty-six scutes and in having the lateral line become straight at a point a little more forward than below the middle of the soft dorsal. A specimen from Formosa now preserved in the museum of Suisan-Kōsyūjo has been identified by Jordan and Richardson as *D. macrosoma*, and figured by Seno as *D. maruadsi*. However, examination of the specimen revealed to the writer that it is neither *D. macrosoma* nor *D. maruadsi*, but the present species, as can be learnt manifestly from the figure of the fish given by Seno.

Localities:—The species is widely distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from Japan proper, but occurs in Formosan waters.

SELAR⁵ Bleeker.

(Trachurops Gill)

Body more or less compressed, rather elongated, oblong in shape. Head rather pointed, compressed. Jaws, vomer, palatines, and tongue toothed. Adipose eyelids very well developed. Shoulder-girdle crossed with a deep furrow at its junction with isthmus. Breast scaly. Lateral line broadly curved. Scutes present along whole length of straight portion of lateral line. No finlets behind soft dorsal and anal.

Three species of this genus are known from Japan.

- a. Thickness of body half of depth; teeth on upper jaw in a narrow band.
 - b. Eye rather shorter than snout, and equal to interorbital space. *mauritanus*.
 - bb. Eye equal to snout or nearly so, and longer than interorbital space. *macrophthalmus*.
- aa. Thickness of body 1.5 in depth; teeth on upper jaw in a single series; eye shorter than snout, and equal to interorbital space. *torvus*.

11. *Selar mauritanus* (Quoy and Gaimard).

(PL. XVIII, fig. 2.)

Caranx mauritanus Quoy and Gaimard, Voy. Uranie, Zool., 1824, p. 359.—Cuvier and Valenciennes, (*partim*), Vol. IX, 1833, p. 60.

Caranx crumenophthalmus Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 431.

Caranx torvus Steindachner and Döderlein (*non* Jenyns), Vol. IV, 1884, p. 16.

Trachurops crumenophthalmus Seno, (*non* Bloch), Report on Fishery Industry of Formosa, 1910, p. 118, pl. VI, fig. 1.—Jordan, Tanaka, and Snyder, (*partim*), Cat. Fish. Japan, 1913, p. 128.

D. VIII-I, 26; A. II-I, 23; scutes 36.

Head 3.25 in length of body (4 in total length); depth 3.54 (4.31); pectoral 3.54; eye 3.58 in head; snout 3.3.

Body much compressed, its thickness twice in the depth. Eye rather shorter than snout, equal to interorbital space. Lower jaw rather longer than upper; maxillaries extending to front border of

⁵As restricted by Jordan and Gilbert, 1882, *Caranx boöps* being taken as type. D. S. JORDAN.

pupil. Teeth of upper jaw in an exceedingly narrow band; those on lower jaw in a single series. Lateral line slightly curved, becoming straight below twelfth soft dorsal ray, which is a little before middle of fin; curved portion longer than straight portion, 1.45 times of latter. Scutes present along whole length of straight portion of lateral line, but a few anterior ones not bearing a spine; highest scutes equal to half of eye.

Color in formalin brown above, light below; spinous dorsal brown; soft dorsal, anal, and caudal, brownish; soft dorsal with darker margin; anal edged with white; pectorals gray; ventrals pale; opercular spot very faint, indistinct.

The above description is based upon a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7712, measuring 177 mm. in length of body. The proportions of the depth of the body to its length, and of the eye in the head vary in accordance with the size of the specimens; for example, in the specimens measuring 80 to 100 mm. in length of body, the depth is 5 in the total length, and the eye 3 in the head.

Among the specimens dealt with here, younger ones quite agree with the description of the type given by Cuvier and Valenciennes.

This species resembles *S. crumenophthalmus*, especially in the shape of the body, but it is distinct from the Atlantic species in having a smaller eye, longer pectorals, the teeth of the upper jaw in a band, and a very faintly marked opercular spot. A specimen from Formosa identified by Seno with *T. crumenophthalmus* is certainly this species, as is plainly to be seen from the figure given by that author. Specimens from Tōkyō Bay merely listed by Steindachner and Döderlein as *Caranx torvus* must be this species, since this is the only species of *Selar* (*Trachurops*) known from that locality.

The species is widely distributed throughout the Indian Ocean and the warm seas of the Pacific. It is common along the warmer coasts of Japan proper.

Localities:—Tōkyō Bay; Kii; Uwajima; Fusan (Korea); Ryūkyū; Formosa.

12. *Selar macrophthalmus* (Rüppell).

(PL. XVIII, fig. 3.)

Caranx macrophthalmus Rüppell, Atl. Fische, 1828, p. 97, pl. 25, fig. 4.

Caranx mauritanus Cuvier and Valenciennes, (*partim*), Vol. IX, 1933, p. 60.

Caranx crumenophthalmus Günther, (*partim*), Cat. Fish. Brit. Mus., 1860, Vol. II, p. 431.

Trachurops torva Jordan and Evermann, (*non* Jenyns), Proc. U. S. Nat. Mus., Vol. XXV, 1902, p. 337.—Seno, (*non* Jenyns), Report on Fishery Industry of Formosa, 1910, p. 118.

Trachurops crumenophthalma Jordan and Richards (*non* Bloch), Mem. Carnegie Mus., Vol. IV, 1909, p. 178.

D. VIII-I, 26; A. II-I, 22; scutes 34.

Head 3.13 in length of body (3.7 in total length); depth 3.24 (3.82); pectoral 3.4; eye 3.25 in head; snout 3.25.

Body comparatively high, much compressed; its thickness half of depth. Eye very large, equal to snout or nearly so, and longer than interorbital space. Maxillaries extending to front border of pupil. Lower jaw rather longer than upper. Teeth on upper jaw in a very narrow band; those on lower in a single series. Lateral line scarcely curved, becoming straight below twelfth soft dorsal ray, which is at middle of fin; curved portion longer than straight portion, 1.66 times of latter. Scutes present along whole length of straight portion of lateral line, but a few anterior scutes not bearing a spine; highest scute much lower than half of eye, 2.8 in it.

Coloration like that of *S. mauritanus*.

The above description is derived from a specimen from the Bonin Islands, Carnegie Museum Cat. of Fishes, No. 7713, measuring 175 mm. in length of body. In this species, the eye is very large, its diameter being only a little shorter than the snout, even in a full grown specimen; for example, a specimen from the Bonin Islands, measuring 256 mm. in length of body has the eye, which is 3.35 in the head, 1.13 in the snout, and 1.2 times of the interorbital space.

All the specimens thus far observed quite agree with the original description and the figure of this species given by Rüppell.

The present species is distinguished from all other species of *Selar* by having a higher body, a larger eye, and lower scutes. It corresponds with *S. crumenophthalmus* in having the eye not shorter than the snout, but differs from the Atlantic species in addition to the above mentioned characters in having the upper jaw with teeth in a band, longer pectorals, and an indistinct opercular spot.

Examination of a specimen from Formosa, now preserved in the Museum of Suisan-Kōsyūjo, and which has been identified by Jordan and Evermann and by Seno with *T. torva*, and by Jordan and Richardson with *T. crumenophthalmus*, reveals to the writer that it is neither of these, but the present species.

The fish is widely distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is also rarely found along the southernmost coasts of Japan proper.

Localities:—Kagoshima; Nagasaki; Ryūkyū; Bonin Islands; Formosa.

13. *Selar torvus* (Jenyns).

(PL. XIX, fig. 1.)

Caranx torvus Jenyns, Zoöl. Beagle, Fish., 1841, p. 69, pl. 15.—Günther, Cat. Fish. Brit. Mus., Vol. II, 1860, p. 431.

D. VIII-I, 25 to 27; A. II-I, 22; scutes 38.

Head 3.14 in length of body (3.88 in total length); depth 3.89 (4.64); pectoral 3.82; eye 3.7 in head; snout 3.5.

Body slightly compressed, its thickness 1.45 in depth. Eyes rather shorter than snout, equal to interorbital space. Lower jaw rather longer than upper; maxillaries extending to front border of pupil. Teeth on jaws in a single series. Lateral line scarcely curved, becoming straight below eighth soft ray of dorsal, which is at anterior third of fin; curved portion rather longer than straight portion, 1.12 times of latter. Scutes present along whole length of straight portion of lateral line, but a few anterior ones without a spine; highest scutes lower than half of eye, 2.2 in it.

Coloration like that of *S. mauritanus*.

The above description is made from a specimen from the Bonin Islands, Carnegie Museum Cat. of Fishes, No. 7714, measuring 218 mm. in length of body.

This species differs from all other species of *Selar* in having a lower and less compressed body, rather more numerous scutes, and a more shortly curved lateral line.

The species seems to be widely distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is also not rare on the southernmost coasts of Japan proper.

Localities:—Uwajima; Bonin Islands.

Genus *CARANX*⁶ Lacépède.

Body compressed, oblong or ovate in shape; back either much, or only a little, elevated. Head compressed; occipital portion usually trenchant. Dentition various. Adipose eyelids either tolerably well, or not developed. Gill-rakers mostly normal. Breast scaly or naked; cheek scaly; top of preopercle, and upper part of opercle usually

⁶It is as yet an unsettled question what species is the proper type of the genus *Caranx*. Common convenience points to *Caranx carangus-hippos* Linnæus. Rafinesque, the first reviser of the group, left the name for a group of which *Caranx ruber* has been made the logotype. Cuvier and Valenciennes made the first formal selection of a type and settled upon *Caranx trachurus*. Gill gives reasons for the selection of *Caranx speciosus* as the genotype. Pending a settlement, we may follow authors who give precedence to *Caranx carangus*, the male of which is the type of the genus *Tricopterus* Rafinesque. D. S. JORDAN.

scaled. Scutes not very high, only present on straight portion of lateral line. No finlets behind soft dorsal and anal. Ventral usually much shorter than head.

This genus has close relationship with *Selar* (*Trachurops*), *Atropus*, *Ulua*, and *Alectis*. It is distinct, however, from the first in having the normal shoulder-girdle; from the second in having the abdomen without a median groove into which the ventrals are wholly received; and from the last in having the anterior rays of the soft dorsal and of the anal much shorter than the length of the body, and the spinous dorsal connected with a membrane.

The genus is very rich in the number of species, thirty-eight being known from the waters of the warmer parts of Japan, but very rare in the north beyond the peninsula of Kinkazan on the eastern and of Noto on the western coast.

The separation of the genus into several genera, as is done by some authors, Rafinesque, Cuvier and Valenciennes, Bleeker, and Jordan and Snyder, on the ground of the prolongation of the first soft dorsal ray, on the difference of the dentition, or the shape of the gill-rakers, is in the opinion of the writer not proper, since all the genera thus proposed by these authors agree in all their essential characters, the only differences being sought in one or the other of such characters as have been just mentioned. It will be noted, however, that the dentition, which is generally regarded as one of the most important generic characters, is liable to vary to such an extent in a group furnished with such feeble teeth as the *Carangidæ*, that it is not safe to look upon it as determinative. The length of the rays of the soft dorsal is also subjected to variations which are often seen even in one and the same species. For these reasons the writer has regarded the different genera separated by the above authors from *Caranx*, merely as subgenera.

The subgenera of *Caranx* known from Japan are distinguished as follows:

- a. Both jaws toothed.
 - b. Teeth on both jaws in villiform bands.
 - c. Breast scaly. *Carangoides*.
 - cc. Breast naked. *Citula*.
 - bb. Teeth in lower jaw in a single series or two.
 - d. Teeth on upper jaw in a narrow band with an outer series of stronger ones; those on lower in a single series intermingled with larger ones; vomer, palatines, and tongue toothed. *Caranx*.

- dd.* Teeth on upper jaw in a single series or two, or in a narrow band.
- e.* Tongue toothed; breast scaly; scutes normal.
- f.* Snout not much longer than eye; adipose eyelid well developed; scutes present along whole length of straight portion of lateral line. *Atule*.
- ff.* Snout much longer than eye; adipose eyelid not developed; scutes not present along whole length of straight portion of lateral line. *Longirostrum*, nom. nov.
- ee.* Vomer, palatines, and tongue not toothed; breast naked; keel on scutes produced, plate-like, ending in a spine anteriorly. . . *Uraspis*.
- aa.* Upper jaw not toothed.
- g.* Lower jaw, vomer, palatines, and tongue toothed. *Selaroides*.
- gg.* No teeth in adult.
- h.* Gill-rakers normal in shape; breast scaly. *Gnathanodon*.
- hh.* Gill-rakers feather-like in shape; breast broadly naked. *Ulua*.

Subgenus CARANGOIDES Bleeker.

Body oblong. Teeth on jaws in villiform bands; vomer, palatines, and tongue toothed. Adipose eyelid rudimentary. Breast scaly. Top of soft dorsal and of anal not prominent; no ray of fins produced into a filament.

This subgenus corresponds to a part of *Carangoides* Bleeker, who took *Carangoides plagiotænia* as the type of his genus. He, confining his attention only to the peculiar dentition of his type, was led to include in his genus, *Carangoides*, some other forms of the *Caranginæ*, which are quite different from *Caranx*, such as *Atropus*, *Alectis*, etc. The present subgenus, being defined as above, must be separated from all the other subgenera in *Caranx* or other genera in the *Caranginæ*.

Only two species of this subgenus are known from Japan.

- a.* Lower jaw prominently projecting; tips of soft dorsal and anal acute; scutes present only on posterior part of straight portion of lateral line. . . *ferdau*.

- aa. Lower jaw slightly longer than upper; tips of soft dorsal and anal not acute; scutes present along whole length of lateral line. *equula*.

14. **Caranx (Carangoides) ferdau** (Forskål).

(PL. XIX, fig. 2.)

Scomber ferdau Forskål, 1775, p. 55.

Caranx ferdau Rüppell, Atl. Fische, 1828, p. 99, pl. 25, fig. 6.—Günther, Cat. Fish. Brit. Mus., Vol. II, 1860, p. 439.

D. VIII-I, 23; A. II-I, 19; scutes 14.

Head 3.69 in length of body (4.33 in total length); depth 2.7 (3.11); pectoral 2.63; eye 4.2 in head; snout 2.68.

Body rather low; nape rather elevated, and thence descending rather rapidly and almost straight to tip of snout. Snout pointed, much longer than eye; lower jaw strongly projecting; maxillary extending beyond front border of eye. Teeth on each jaw minute, arranged in a very narrow band on side. Lateral line slightly arched, becoming straight below fourteenth soft dorsal ray; curved portion much longer than straight portion, two times of latter. Scutes small in size, less in number, only distinct on posterior third of straight portion of lateral line. Caudal peduncle with nine scutes. All parts of gill-cover scaled, only leaving naked area along free margins of interopercle and subopercle. Soft dorsal and anal pointed anteriorly; height of former 3.32 in base of fin, one-third of depth of body, equal to spinous dorsal. Pectoral much longer than head, 1.35 times of it; ventral 2.6 in head.

Color in formalin dark brown, with five large blackish transverse spots; fins gray; soft dorsal and anal with an interrupted blackish band along middle; membrane of ventral blackish; axils brown.

The above description is based upon a specimen from Ryūkyū, Carnegie Museum, Cat. of Fishes, No. 7715, measuring 240 mm. in length of body.

The specimen dealt with here exactly agrees with the description and the figure of this species given by Rüppell, though the number of soft dorsal and anal rays in his specimen are somewhat smaller than that counted by Forskål.

The species is distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from Japan proper.⁷

Locality:—Ryūkyū.

⁷The species called by this name, and occurring in Hawaii, has been described by Nichols as *Carangoides jordani*. It has the lower jaw scarcely projecting, the dorsal rays 29 to 30, anal 25 to 27. D. S. JORDAN.

15. *Caranx* (*Carangoides*) *equula* Temminck and Schlegel.

(PL. XIX, fig. 3.)

Caranx equula Temminck and Schlegel, 1844, p. 111, pl. 60, fig. 1.—Günther, Cat. Fish. Brit. Mus., Vol. II, 1860, p. 438.

Carangoides equula Bleeker, Verh. Batav. Gen., XXVI, Ichthy. van Japan, 1857, p. 102.

D. VIII-I, 25; A. II-I, 23; scutes 28.

Head 3.16 in length of body (3.7 in total length); depth 2.18 (2.55); pectoral 2.56; eye 4 in head; snout 2.8.

Body rather high; profiles rather strongly and almost equally curved. Snout rather longer than eye; maxillary extending beyond front border of pupil; jaws equal, but in full grown specimens lower maxillary slightly shorter than upper. Lateral line a little arched, becoming straight below fifteenth soft dorsal ray; curved portion much longer than straight portion, 1.8 times of latter. Scutes rather small, but well armed, present along whole length of straight portion of lateral line. Caudal peduncle with seven scutes. Breast scaly; all parts of gill-cover largely scaled, except preopercle, only the top of which is scaly. Soft dorsal and anal not pointed; height of former 3.4 in base of fin, 2.44 in head, 3.6 in depth of body, almost equal to height of spinous dorsal. Pectoral longer than head, 1.23 times of it; ventral 2.28 in head.

Color in formalin brownish above, lighter below; spinous dorsal brownish; soft dorsal and anal gray, with a submarginal blackish band, which runs along, leaving a narrow white margin; caudal gray, edged with blackish posteriorly; pectoral light; ventral grayish, becoming darker toward middle; opercular spot blackish, distinct. Body crossed with six dark bands in immature stage.

The above description is founded upon a specimen from Tōkyō Bay, Carnegie Museum Cat. of Fishes, No. 7716, measuring 195 mm. in length of body.

All the specimens thus far examined agree well with the original description and the figure of this species given by Temminck and Schlegel.

This is one of the commonest species of *Caranx* in Japan and extends northward as far as Noto and Kinkwazan, but is also reported by Bleeker to occur at Batavia.

Localities.—Tōkyō Bay; Kii; Uwajima; Hamada; Tosa; Satsuma; and Formosa.

Subgenus CITULA Cuvier.

Body ovate or oblong. Soft dorsal and anal falcate anteriorly; first soft dorsal ray produced into a long filament, or not. Breast broadly naked. Otherwise similar to *Carangoides*.

The writer places in this subgenus those species of *Caranx* which agree in the dentition and in the squamation of the breast with *Caranx armatus*, the type of *Citula* Cuvier. Thus restricted, the present subgenus corresponds with those species of Bleeker's *Carangoides*, in which the ventrals are decidedly shorter than the head, the breast broadly naked, and the spinous dorsal well developed.

Thirteen species of this subgenus are known from Japan, as follows:

- a. First ray of soft dorsal produced into a long filament.
- b. Scutes more or less weakly armed, not distinct on anterior part of straight portion of lateral line.
- c. First ray of anal much shorter than that of soft dorsal.
- d. Anterior nostril nearly equal to posterior; first soft dorsal ray not longer than base of fin; ventral black.
- e. First anal ray black; ventral half of pectoral.....*armatus*.
- ee. First anal ray pale; ventral two-thirds of pectoral.....*schlegeli*, nom. nov.
- dd. Anterior nostril much smaller than posterior; first soft dorsal ray longer than base of fin; ventral pale, rather shorter than half of pectoral.....*plumbeus*.
- cc. First soft anal ray nearly as long as first dorsal ray.
 - f. Soft dorsal rays, 20 or 21; soft anal rays, 17.....*ciliaris*.
 - ff. Soft dorsal rays, 22 or 23; soft anal rays, 19.....*uii*, sp. nov.
- bb. Scutes well armed, present along whole length of straight portion of lateral line; teeth rather coarse.
 - g. Scutes thirty-five or more; caudal peduncle with six scutes.

- h.* Depth not higher than 2.5 in length of body; opercular spot present. *oblongus*.
- hh.* Depth higher than 2.5 in length of body; opercular spot absent.
- i.* Scutes forty; pectoral equal to head; anal with a black longitudinal band; ventrals distally blackish. *deani*.
- ii.* Scutes thirty-five; pectoral 1.3 times of head; anal and ventral immaculate. *tanakai*, sp. nov.
- gg.* Scutes twenty-five; caudal peduncle with four scutes. *dinema*.
- aa.* First ray of soft dorsal not produced into a long filament.
- j.* Soft dorsal rays not more numerous than twenty-two; anal rays not more than eighteen; breast broadly naked; free anal spines persistent.
- k.* Soft dorsal rays twenty-one or twenty-two; anal rays eighteen; dorsal profile of head curved; snout not much longer than eye.
- l.* Anterior lobe of dorsal higher than that of anal. *malabaricus*.
- ll.* Anterior lobe of soft dorsal lower than that of anal. *cæruleopinnatus*.
- kk.* Soft dorsal rays twenty-one; anal rays sixteen; dorsal profile of head nearly straight; snout much longer than eye. *chrysophrys*.
- jj.* Soft dorsal rays thirty-one; anal rays twenty-six; breast naked inferiorly; free anal spines apparently not visible. *hemigymnostethus*.

16. *Caranx* (*Citula*) *armatus* (Forskål).

(PL. XX, fig. 1.)

Sciæna armatus Forskål, 1775, p. 53.*Caranx armatus* Cuvier and Valenciennes, Vol. IX, 1833, p. 127.—Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 453.—Seno, Report on Fishery Industry of Formosa, 1910, p. 118, pl. VII, fig. 3.

D. VIII-I, 21; A. II-I, 17; scutes 20.

Head 3.43 in length of body (4.24 in total length); depth 1.91 (2.34); pectoral 3.1; eye 4.29; snout 3.32.

Body high, ovate; nape elevated; dorsal profile rapidly curving down from occipital to tip of snout. Snout obtuse, a little longer than eye; maxillary extending to front border of pupil; lower jaw equal to upper. Teeth on jaws fine. Posterior nostril not larger than anterior. Lateral line moderately arched, becoming straight below thirteenth soft dorsal ray; curved portion longer than straight portion, 1.42 times of latter. Scutes few in number, small in size, rather weakly armed, present on posterior two-thirds of straight portion of lateral line. Caudal peduncle with eight scutes. Naked area of breast very broad, extending superiorly to base of pectoral, and posteriorly behind base of ventral. First soft dorsal ray produced into a long filament; its length 1.09 in base of fins, 1.44 times of head, 2.44 in length of body, 1.28 in depth; first soft anal ray scarcely produced, nearly half of base of fin, shorter than head, 1.33 in it. Ventral half of pectoral 1.5 both in head and in distance between its insertion and origin of soft anal.

Color in formalin brownish above, light below, crossed with six darker bands, which are especially distinct in immature specimens and lost with age; spinous dorsal brown; soft dorsal gray, with blackish first ray and narrow brown edge; caudal gray, washed with black posteriorly; anal grayish, with blackish first ray; pectoral light; ventral black; opercular spot black, distinct; axils blackish.

The above description is made from a specimen from Formosa measuring 128 mm. in the length of the body.

The specimen dealt with here exactly agrees with the description of this species given by Cuvier and Valenciennes.

The species is distributed throughout the Indian Ocean and the tropical seas of the Pacific; it is not, however, as yet certainly known from Japan proper.

Locality:—Formosa.⁸

⁸No specimen of this species was received from Mr. Wakiya. It is represented in the Carnegie Museum by a specimen from Ceylon, collected and determined by D. S. Jordan. (C. M. Cat. Fishes, No. 8067.) W. J. HOLLAND.

17. *Caranx (Citula) schlegeli* Wakiya, **nom. nov.**

(PL. XX, fig. 2.)

Caranx ciliaris Cuvier and Valenciennes, (*non* Rüppell), Vol. IX, 1853, p. 129 (based on Russell's figure of *Tchawil-Parah*).—Temminck and Schlegel, 1844, p. 112.

Caranx armatus Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 453.

D. VIII-I, 21; A. II-I, 17; scutes 20.

Head 3.25 (3.9); depth 1.88 (2.25); pectoral 3.3; eye 3.25.

Shape like that of *C. armatus*. Snout equal to eye; maxillary extending to front border of pupil; lower jaw equal to upper. Teeth on jaws exceedingly fine. Posterior nostril not much larger than anterior. Lateral line moderately arched, becoming straight below twelfth soft dorsal ray; curved portion longer than straight portion, 1.37 times of latter. Scutes small, few in number, rather weakly armed, present only on posterior two-thirds of straight portion of lateral line. Caudal peduncle with eight scutes. Breast as broadly naked as in *C. armatus*. First ray of soft dorsal produced into a long filament, 1.2 in base of fin, 1.26 times of head, 2.6 in length of body, 1.36 in depth of body; first soft anal ray scarcely produced, equal to head and to half of base of fin. Ventral two-thirds of pectoral 1.44 in head, 1.28 in distance between its insertion and origin of soft anal.

Color in formalin similar to *C. armatus*, but anal with no black rays.

The above description is taken from a specimen from Nagasaki, 102 mm. in length. The species is represented in the Carnegie Museum by No. 7717, the figured specimen, measuring 77 mm. in length of body.

The present species is nothing more than *Caranx ciliaris* Cuvier and Valenciennes, for the specimen dealt with here agrees well with the original description. However, the writer, recognizing that this specific name is preoccupied by Rüppell, proposes the new name as a substitute for *ciliaris* C. and V.

This species closely resembles both *Caranx armatus*, and *C. plumbeus*, but differs from them in having a shorter pectoral and a rather shorter first soft dorsal ray; and especially differs from the former in having finer teeth on the jaws and a pale first anal ray, and from the latter in having the posterior nostril not much larger than the anterior, and in having the ventral black. A specimen from Nagasaki described by Temminck and Schlegel as *C. ciliaris* is certainly this species, as may be learned from the description given by the authors.

The species is distributed throughout the Indian Ocean and the warm seas of the Pacific. It is occasionally known from the southern coasts of Japan proper.

Localities:—Uwajima; Nagasaki; Formosa.

18. *Caranx* (*Citula*) *plumbeus* (Quoy and Gaimard).

(Pl. XX, fig. 3.)

Citula plumbea Quoy and Gaimard, Voy. Uranie, Zool., 1824, p. 361. Form without filamentous middle rays in soft dorsal and in anal.

Olistus malabaricus Cuvier and Valenciennes, Vol. IX, 1833, p. 137, pl. 251. Form with filamentous middle rays in soft dorsal and in anal.

Caranx armatus Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 543.

Caranx plumbeus Jordan and Seale, Bull. U. S. Bur. Fisheries, Vol. XXV, 1906, p. 233, fig. 28. Form with filamentous middle rays in soft dorsal and in anal.

D. VIII-I, 21; A. II-I, 17; scutes 25.

Head 3.55 in length of body (4.34 in total length); depth 2 (2.41); pectoral 2.82; eye 3.68 in head; snout 2.9.

Body high, ovate; nape rather less elevated; dorsal profile evenly and strongly curving down from origin of spinous dorsal to tip of snout. Snout obtuse, rather longer than eye; maxillary extending to front border of pupil; lower jaw equal to upper. Teeth on jaws very fine. Posterior nostril much larger than anterior. Lateral line moderately arched, becoming straight below twelfth soft dorsal ray; curved portion longer than straight portion, 1.45 times of latter. Scutes small, rather few in number, tolerably well armed, present on posterior three-fourths of straight portion of lateral line; caudal peduncle with eight scutes. Breast as broadly naked as in *C. armatus*. First dorsal ray produced into a long filament, 1.2 times of base of fin, 1.7 times of head, half of length of body, equal to depth of body; first anal ray slightly prolonged into a filament, which is slightly shorter than head, and 1.46 in base of fin. Ventral shorter than pectoral, 2.4 in it, 1.9 both in head and in distance between its insertion and origin of anal.

Color in formalin similar to that of *C. armatus*, but anal with no blackish rays, ventral pale, and cross-bands on side of body lighter than those of *C. armatus*.

The above description is derived from a specimen from Kii, Carnegie Museum, Cat. of Fishes, No. 7718, measuring 144 mm. in length of body.

All the specimens thus far examined are probably females, and quite agree with the original description of this species, given by Quoy and Gaimard. *Olistus malabaricus* Cuvier and Valenciennes seems to the writer to be the male of the present species, as recognized by Jordan and Seale, since the two accord exactly with each other in detail, the difference between them being found only in the proportional length of the middle rays of the soft dorsal and of the anal.

The form of this species without filamentous middle rays in soft dorsal and in anal closely resembles both *C. armatus* and *C. schlegeli*, but these three differ from one another as follows:

	<i>C. armatus</i>	<i>C. schlegeli</i>	<i>C. plumbeus</i>
Pectoral in body length. . .	3.10 times	3.30 times	2.82 times
Ventral in pectoral.	2.00 times	1.50 times	2.37 times
Length of first ray of soft dorsal in reference to its base.	1.09 times base of fin	1.2 times base of fin	1.2 times base of fin
Anterior nostril.	equal to posterior	nearly equal to posterior	much smaller than posterior
Teeth on jaws.	fine	very fine	very fine
Color of first anal ray.	blackish	pale	pale
Color of ventral.	black	black	pale

The species is widely distributed throughout the Indian Ocean, and the warmer seas of the Pacific. It is rather common in the warmer parts of Japan proper.

Localities:—Kii; Ryūkyū; Formosa.

19. *Caranx (Citula) ciliaris* (Rüppell).

(PL. XXI.)

Citula ciliaris Rüppell, Atl. Fisch., 1828, p. 102, pl. 25, fig. 8. Form with filamentous middle rays in soft dorsal.

Caranx cirrhosus Cuvier and Valenciennes, (after Ehrenberg) Vol. IX, 1833, p. 136. Form without filamentous middle rays in soft dorsal.

Olistus rüppelli Cuvier and Valenciennes, Vol. IX, 1833, p. 144. Form with filamentous middle rays in soft dorsal.

Caranx armatus Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 453.

?*Caranx rastrosus* Jordan and Snyder, Mem. Carnegie Mus., Vol. IV, No. 2, 1909, p. 37, pl. 51. Form with filamentous middle rays in soft dorsal. (The type is in the Carnegie Museum C. M. Cat. of Fishes, No. 411, Takao, Formosa, Sauter coll. w. J. H.)

D. VIII-I, 20 or 21; A. II-I, 17, scutes 17.

Head 3.66 in length of body (4.4 in total length); depth 2.13 (2.57); pectoral 2.65; eye 3.8 in head; snout 3.

Body rather high, ovate; nape greatly elevated; head strongly curved at occipital, and thence descending rather rapidly and almost straightly to tip of snout with a slight concavity in front of nostril. Snout obtuse, rather longer than eye; maxillary extending to front border of pupil; lower jaw rather longer than upper. Teeth on jaws rather fine. Lateral line moderately arched, becoming straight below twelfth soft dorsal ray, which is at middle of fin; curved portion longer than straight portion, 1.3 times of latter. Scutes few in number, rather small in size, tolerably well armed, only present on posterior half of straight portion of lateral line. Caudal peduncle

with eight scutes. Breast as broadly naked as in *C. armatus*. Opercle scaled, with only a narrow naked area along free margin. Spines of spinous dorsal apparently seven, the first one being very small. First soft ray of dorsal, and of anal prolonged into a long filament; former longer than base of fin, 1.75 times of head, 2.22 in length of body; latter rather shorter than former, rather longer than base of fin, 1.43 times of head. Middle rays of soft dorsal not produced in female specimens, but in male filamentous and produced. Ventral 2.8 in pectoral, equal to half of head, 1.9 in distance between its insertion and origin of anal; caudal lobe 3.3 in length of body.

Color in formalin uniformly brownish; spinous dorsal blackish; soft dorsal light, with first ray and narrow edge, black; anal light, with first ray blackish; caudal gray, edged with blackish behind; paired fins light, but ventral tipped with blackish; opercular spot black, distinct; axils blackish.

The above description is made from a specimen from Formosa, measuring 220 mm. in length of body. It has been identified by Jordan and Evermann as *C. armatus*, and is now preserved in the museum of Suisan-Kōsyūjo.

The measurements of the specimens examined by the writer are as follows:

Length of body.....	220 mm.	185 mm.	140 mm.	95 mm.
Head in length of body....	3.66 times	3.40 times	3.40 times	3.45 times
Depth in length of body...	2.13 times	2.00 times	1.96 times	1.94 times
Eye in head.....	3.75 times	3.70 times	3.58 times	3.50 times
Pectoral in length of body.	2.62 times	2.57 times	2.50 times	2.60 times
Ventral in pectoral.....	2.80 times	2.67 times	2.40 times	2.35 times
Number of soft dorsal rays	21	20	20	19
Number of gill-rakers on lower limb.....	...	22	22	23
Longest raker in head.....	...	6.2
Middle rays of soft dorsal.	not produced

The present species is certainly *Caranx cirrhosus* Cuvier and Valenciennes, for the specimens dealt with quite accord with the original description. The species also agrees exactly with the original description by Rüppell of *Citula ciliaris*, and with that of *Caranx rastrosus* by Jordan and Evermann, except that the middle rays of the soft dorsal are not filamentous. The writer is inclined in this case to consider such a difference as one of the sexual characters, and therefore the three as synonymous. The specific name of the present species should accordingly be *ciliaris* Rüppell, it having priority. The form without filamentous middle rays in the soft dorsal closely resembles the three species *C. armatus*, *C. schlegeli*, and *C. plumbeus*.

It may, however, be easily distinguished from all of them by having the first ray of the anal as long as that of the soft dorsal, and the nape much more elevated. It is differentiated from the two former by having a longer pectoral and a shorter ventral; and from the last by having the anterior nostril equal in size to the posterior.

The species is distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from Japan proper.

Localities:—Ryūkyū; Formosa.

One specimen, Carnegie Museum, Cat. of Fishes, No. 7719, from Formosa, 195 mm. to base of caudal.

20. *Caranx (Citula) uii*, Wakiya, sp. nov.

(Pl. XXII, fig. 1.)

D. VIII-I, 23; A. II-I, 19; scutes 20.

Head 3.12 in length of body (3.9 in total length); depth 1.78 (2.23); pectoral 2.55; eye 4.44 in head; snout 2.66.

Body very high, shape like that of *Caranx ciliaris*, but nape less elevated. Snout obtuse, much longer than eye, 1.67 times of it; maxillary extending to front border of eye; lower jaw a little longer than upper. Teeth on jaws very fine. Lateral line moderately arched, becoming straight below sixteenth soft dorsal ray, which is at posterior third of fin; curved portion much longer than straight portion, twice the latter. Scutes small in size, few in number, weakly armed, present on posterior two-thirds of straight portion of lateral line. Breast as broadly naked as in *C. armatus*. First soft rays of dorsal and of anal almost equally prolonged; former a little longer than base of fin, 1.45 times of head, about half length of body, 1.25 in depth. Ventral one-third of pectoral, 2.5 in head, 1.82 in distance between its insertion and origin of anal.

Color in formalin brownish, light below; spinous dorsal gray; other fins light, but first soft dorsal ray blackish; opercular spot blackish; axils brown.

The above description is derived from the type, a specimen from Kii, Carnegie Museum, Cat. of Fishes, No. 7720, measuring 125 mm. in length of body. The Carnegie Museum has also received a paratype, taken at Kii, C. M. No. 7720b, measuring 105 mm. to base of caudal.

The species approaches nearer to the form *C. ciliaris* (Rüppell), which has not the produced middle rays in the soft dorsal, than any other species of the subgenus *Citula*, but differs in having the snout

much longer than the eye, and the more numerous soft rays in the dorsal and in the anal.

It is known from the waters of the warmer parts of Japan proper.

Localities:—Kii; Nagasaki; Ryūkyū.

The species is named after Mr. N. Ui, teacher of natural history in the Girls High School at Tanabe, who has supplied the writer with numerous specimens of carangoid fishes from the Province of Kii.

21. *Caranx (Citula) oblongus* (Cuvier and Valenciennes).

(PL. XXII, fig. 2.)

Caranx oblongus Cuvier and Valenciennes, Vol. IX, 1833, p. 132.—Günther (*partim*), form with forty scutes, Cat. Fish. Brit. Mus., Vol. II, 1860, p. 452.

D. VIII-I, 21; A. II-I, 18 or 19; scutes 40.

Head 3.6 in length of body (4.6 in total length); depth 2.73 (3.45); pectoral 2.6; eye 4.66 in head; snout 3.3.

Body oblong; nape much less elevated; dorsal profile evenly and gently curving down from origin of dorsal to tip of snout; ventral profile ascending forwards from origin of anal somewhat rapidly and nearly straight. Snout rather pointed, longer than eye, 1.4 times of it; maxillary scarcely reaching centre of eye; lower jaw rather longer than upper. Teeth on jaws rather coarse. Lateral line moderately arched, becoming straight below seventh soft dorsal ray; curved portion a little shorter than straight portion. Scutes numerous, well armed, present along whole length of straight portion of lateral line; caudal peduncle with six scutes. Naked area of breast rather narrow, extending scarcely to base of pectoral superiorly, and beyond base of ventral posteriorly. First soft ray of dorsal and of anal much prolonged; former twice length of head, 1.6 in length of body, 1.6 times of depth, passing beyond middle of caudal when depressed; latter a little longer than head, 3.3 in length of body, but shorter than both depth of body and base of fin. Pectoral much longer than head, 1.4 times of it.

Color in formalin uniformly brownish; dorsals and caudal gray; soft dorsal edged with brown; upper lobe of caudal darker than lower; anal and paired fins pale; opercular spot brown, distinct.

The above description is made from a specimen from Formosa, measuring 200 mm. in length of body. The proportion of the depth in the length varies somewhat largely in accordance with the size of the specimens; for example, a specimen measuring 170 mm. in length of body has the depth 2.5 in the length of body and the eye equal to the snout.

The specimens dealt with here agree with the original description of this species given by Cuvier and Valenciennes.

The species is distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from Japan proper.

Localities:—Ryūkyū; Formosa.

One specimen, Carnegie Museum, Cat. of Fishes, No. 7721, from Ryūkyū.

22. *Caranx (Citula) deani* Jordan and Seale.

(PL. XXII, fig. 3.)

Caranx deani Jordan and Seale, Proc. U. S. Nat. Mus., Vol. XXVIII, 1905, p. 776, fig. 2.

D. VIII-I, 22; A. II-I, 18; scutes 43.

Head 3.17 in length of body (4.08 in total length); depth 2.31 (3); pectoral 3.17; eye 3.57; snout 3.57.

Shape like that of *C. oblongus*, but nape rather more elevated, snout equal to eye; maxillary extending to front border of pupil. Teeth on both jaws rather stronger than those in allied species. Lateral line moderately arched, becoming straight below eighth soft dorsal ray; curved portion slightly shorter than straight portion. Scutes very numerous, well armed, present on whole length of straight portion of lateral line. Caudal peduncle with six scutes. Naked area of breast rather narrow, extending to base of pectoral superiorly, and to base of ventral posteriorly. First soft rays of dorsal and anal somewhat prolonged; both not more than length of their own bases; former 1.2 times of head, 2.5 in length of body, a little shorter than depth of body; latter a little longer than head, 3 in length of body, much shorter than depth of body. Pectoral short, equal to head.

Color in formalin brownish above, lighter below; spinous dorsal brown; soft dorsal and anal gray, each with a blackish submarginal band; caudal gray, becoming darker posteriorly; paired fins light, but ventral distally blackish; no opercular spot.

The above description is drawn from a specimen from Ryūkyū, Carnegie Museum Cat. of Fishes, No. 7722, measuring 111 mm. in length of body.

The specimen dealt with here quite agrees with the original description and the figure by Jordan and Seale of this species from the Philippines.

Though this species closely resembles *Caranx oblongus*, it distinctly differs from the latter species in having coarser teeth, a shorter pectoral, no opercular spot, the ventral washed with black distally, and the anal with a blackish submarginal band.

This species seems to be distributed throughout the warm seas of the Pacific Ocean.

Localities:—Nagasaki; Ryūkyū.

23. *Caranx (Citula) tanakai* Wakiya sp. nov.

(PL. XXIII, fig. 1.)

Caranx oblongus Günther (*partim*), form with 36 scutes, Cat. Fish. Brit. Mus., Vol. II, 1860, p. 452.

D. VIII-I, 21; A. II-I, 18 or 19; scutes 36.

Head 3.37 in length of body (4.25 in total length); depth 2.33 (3); pectoral 2.56; eye 4.62 in head; snout 3.08.

Shape like that of *C. oblongus*. Snout rather pointed, longer than eye, 1.5 times of it; maxillary reaching front border of pupil; lower jaw rather longer than upper. Lateral line moderately arched, becoming straight below ninth soft dorsal ray; curved portion slightly longer than straight portion. Scutes rather numerous, well armed, present along whole length of straight portion of lateral line; caudal peduncle with six scutes. Breast naked as in *C. deani*. First soft dorsal ray much prolonged, equal to base of fin, 2.5 in length of body, equal to depth of body; first ray of anal scarcely produced, a little shorter than base of fin, 3.5 in length of body, much shorter than depth of body. Pectoral much longer than head, 1.3 of it.

Color in formalin brownish above, light below; upper lobe of caudal darker than lower, anal and paired fins pale; diffuse dark blotch present on opercle; opercular spot absent.

The above description is made from a specimen from Kii, measuring 197 mm. in the body length.

The species closely resembles *C. oblongus* and *C. deani*, but is decidedly distinct from either of those species, as will be seen from the following table:

	<i>C. oblongus</i>	<i>C. deani</i>	<i>C. tanakai</i>
Soft dorsal rays.	21	22	21
Scutes.	40	43	36
Depth in length of body.	2.60 times	2.30 times	2.33 times
Pectoral.	much longer than head	equal to head	much longer than head
Arch of lateral line.	a little shorter than straight portion	slightly shorter than straight portion	slightly longer than straight portion
Anal.	without blackish longitudinal band	with blackish longitudinal band	without blackish longitudinal band
Ventral.	pale	blackish distally	pale
Opercular spot.	present	absent	absent.

The species seems to be distributed throughout the warmer parts of the Pacific Ocean. It is rather common in the waters of the warmer parts of Japan.⁹

Localities:—Kii; Ryūkyū.

The species is named after Prof. Tanaka of the Tōkyō Imperial University.

24. *Caranx (Citula) dinema* Bleeker.

(PL. XXIII, fig. 2.)

Caranx dinema Bleeker, Makr., 1851, p. 367.

D. VIII-I, 18; A. II-I, 17; scutes 25.

Head 3.8 in length of body (4.26 in total length); depth 2.37 (3); eye 4.18 in head; snout 3.66.

Shape just like that of *Caranx deani*. Snout rather longer than eye; maxillary reaching centre of eye; lower jaw equal to upper. Teeth on jaws rather coarse. Lateral line moderately arched, becoming straight below eleventh soft dorsal ray; curved portion rather longer than straight portion, 1.16 times of latter. Scutes few in number, but large, well armed, present along whole length of straight portion of lateral line; caudal peduncle with four scutes. Breast naked as in *C. deani*. First soft ray of dorsal and of anal produced into a very long filament, former passing beyond base of caudal when depressed, 1.74 times of head, half of length of body, 1.2 times of depth; latter reaching base of caudal when depressed, 1.3 times of head, 2.65 in length of body, a little shorter than depth.

Color in formalin almost uniformly brownish; fins gray, except pectoral, which is pale; soft dorsal narrowly edged with brown; distal portion of ventral blackish; opercular spot distinct, brown.

The above description is drawn from a specimen from Ryūkyū, Carnegie Museum Cat. of Fishes, No. 7724, measuring 154 mm. in the length of body.

The species is distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from Japan proper.

Locality:—Ryūkyū.

25. *Caranx (Citula) malabaricus* Bloch and Schneider.

(PL. XXIII, fig. 3.)

Scomber malabaricus Bloch and Schneider, 1801, p. 31.

Caranx malabaricus Cuvier and Valenciennes, Vol. IX, 1833, p. 121.—Jordan and Evermann, Proc. U. S. Nat. Mus., Vol. XXV, 1903, p. 337.—Seno, Report on Fish Industry of Formosa, 1910, pl. VIII, fig. 1, p. 118. (*partim*) form with twenty-two rays in soft dorsal.

⁹One specimen, Carnegie Museum Cat. of Fishes, No. 7723, cotype from Kii.
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D. VIII-I, 22; A. II-I, 18; scutes 25.

Head 3.15 in length of body (3.86 in total length); depth 2.07 (2.5); pectoral 2.6; eye 4 in head; snout 2.5.

Body high; nape elevated; dorsal profile strongly and evenly curving down from origin of dorsal to top of snout, with a slight concavity anterior to nostrils. Snout obtuse, a little longer than eye; lower jaw rather longer than upper; maxillary somewhat extending beyond front border of eye. Preorbital above angle of mouth lower than diameter of eye, 1.24 in it. Lateral line moderately arched, becoming straight below fourteenth ray, which is behind middle of soft dorsal; curved portion longer than straight portion, twice of latter. Scutes small in size, weakly armed, distinct along four-fifths of straight portion of lateral line; caudal peduncle with nine scutes. Naked area of breast broad, extending above base of pectoral superiorly, and beyond ventral posteriorly. None of rays in soft dorsal and anal produced into filaments. Lobe of soft dorsal 1.7 in base of fin, a little higher than that of anal, about twice of spinous dorsal, 1.3 in head, half of depth of body; caudal lobe 3 in length of body. Pectoral 1.2 times in head; ventral 2.73 in head.

Color in formalin brownish; fins almost uniformly light; soft dorsal and caudal edged faintly with blackish; opercular spot black, but, being surrounded with a large blackish blotch on opercle, it is not distinct; axils black.

The above description is drawn from a specimen from Formosa, Carnegie Museum Cat. of Fishes, No. 7725a, measuring 170 mm. in length of body.

The species is a tropical *Caranx* commonly found in the Indian Ocean and the Pacific. It is not known from Japan proper.

Locality:—Formosa.

26. *Caranx (Citula) cæruleopinnatus* Rüppell.

(Pl. XXV, fig. 1.)

Caranx cæruleopinnatus Rüppell, Atl. Fische, 1828, p. 100. (*non* Cuvier and Valenciennes, which is *Caranx melampygus*.)

Caranx malabaricus Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 439.

Caranx armatus Jordan and Evermann, (*non* Forskål), Proc. U. S. Nat. Mus., Vol. XXV, 1903, p. 337.

Caranx formosanus Jordan and Snyder, Mem. Carnegie Mus., Vol. IV, 1910, No. 2, p. 38, pl. 52. (Type in Carnegie Mus. Cat. of Fishes, No. 412.)

D. VIII-I, 23; A. II-I, 18; scutes 20.

Head 3.07 in length of body (3.6 in total length); depth 1.91 (2.28); pectoral 3; eye 4 in head; snout 2.77.

Shape of body like that of *C. malabaricus*. Snout obtuse, a little longer than eye; lower jaw slightly longer than upper; maxillary extending somewhat beyond front border of eye; preorbital at angle of mouth lower than diameter of eye, 1.5 in it. Lateral line moderately arched, becoming straight below fifteenth soft dorsal ray, which is behind posterior third of fin; curved portion much longer than straight portion, 2.2 times of latter. Scutes small in size, rather few in number, weakly armed, distinct along whole length of straight portion of lateral line. Breast as broadly naked as in *C. malabaricus*. None of rays in soft dorsal and in anal produced into a filament. Lobe of soft dorsal lower than both half of base of fin, and lobe of anal, 1.57 times of spinous dorsal, 1.63 in head, 2.6 in depth of body. Caudal lobe 3.5 in length of body. Pectoral slightly longer than head; ventral 2.57 in head. Coloration just like that of *C. malabaricus*.

The above description is based upon a specimen from Uwajima, Carnegie Museum Cat. of Fishes, No. 7726, measuring 105 mm. in the length of body.

The species dealt with here quite agrees with the original description of this species given by Rüppell.

The species closely resembles *C. malabaricus*, but can be easily distinguished from that species by its having the soft dorsal lower than half both of the base of the fin and the lobe of the anal. Specimens from Formosa described and figured by Jordan and Snyder as *C. formosanus* would be this species, since the original description and the figure given by these authors quite agree with its distinctive characters.

The species seems to be widely distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is rarely known from the southernmost coasts of Japan proper.

Localities:—Uwajima; Formosa.

27. *Caranx (Citula) chrysophrys* Cuvier and Valenciennes.

(PL. XXIV, fig. 1.)

Caranx chrysophrys Cuvier and Valenciennes, Vol. IX, 1833, p. 77, pl. 247.

Caranx nigrescens Day, Fishes of India, 1867, p. 704, pl. I, fig. 6.

Caranx armatus Jordan and Evermann, (*non* Forskål), Proc. U. S. Nat. Mus., Vol. XXV, 1903, p. 338.

Caranx malabaricus Seno, (*partim*), (form with nineteen rays in soft dorsal), Report on Fishery Industry of Formosa, 1910, pl. VII, fig. 2.

D. VIII-I, 19 or 20; A. II-I, 16; scutes 25.

Head 3.18 in length of body (3.88 in total length); depth 2.04 (2.48); pectoral 2.4; eye 5.07 in head; snout 2.84.

Body high; nape less elevated. Dorsal profile curving down rather strongly and evenly from origin of soft dorsal to tip of snout. Snout much longer than eye, 1.75 times of latter; lower jaw slightly longer than upper; maxillary extending to front border of eye. Lateral line moderately arched, becoming straight below thirteenth soft dorsal ray, which is at posterior third of fin; curved portion much longer than straight portion, 1.84 times of latter. Scutes small, rather few in number, weakly armed, present along whole length of straight portion of lateral line. Breast as broadly naked as in *C. malabaricus*. No rays of soft dorsal and anal produced into a long filament; lobe of former 1.66 in base of fin, equal to that of latter, about two times of spinous dorsal, half of depth of body, 1.29 in head; caudal lobe 3.36 in length of body. Pectoral much longer than head, 1.3 times of it; ventral 2.7 in head.

Color in formalin dark brown above, lighter below; fins light; opercular spot brown, not distinct.

The above description is made from a specimen from Formosa, measuring 220 mm. in length of body.

The specimen now preserved in the museum of Suisan-Kōshūjo had been identified by Jordan and Evermann as *C. armatus*. There is no doubt, however, about the identity of the specimen with *C. chrysophrys* Cuvier and Valenciennes, for it agrees exactly with the original description of the species, whereas it manifestly contradicts that of *C. armatus* by Forskål.

The species resembles *C. malabaricus* and *C. cæruleopinnatus*, but differs from them in having the nape much less elevated, the snout much longer than eye; the pectoral much longer than head; and in the smaller number of the dorsal and anal rays. One of the specimens identified with *C. malabaricus* by Seno, which has nineteen soft dorsal rays and sixteen anal rays, is the present species, as can be learned from the figure given by the same author. The species proposed by Day as *C. nigrescens* seems to be also the present species, for the original description of the former species exactly agrees with that of the latter, except as to the dentition of the tongue.

The species is distributed throughout the Indian Ocean, and the tropical seas of the Pacific. It is not known from Japan proper.¹⁰

Locality:—Formosa.

¹⁰No specimens of this species were sent to the Carnegie Museum, and up to date it is not represented in our collections. W. J. HOLLAND.

28. *Caranx (Citula) hemigymnostethus* (Bleeker).

(PL. XXIV, fig. 2.)

Carangoides hemigymnostethus Bleeker, Makr., 1851, p. 364.*Caranx* sp. Seno. Report on Fishery Industry of Formosa, 1910, pl. VI, fig. 2.

D. VIII-I, 31; A. 9-I, 26; scutes 25.

Head 3.65 in length of body (4.5 in total length); depth 2.33 (2.86); pectoral 2.43; eye 3.9 in head; snout 3.1.

Body rather high; nape rather less elevated. Snout obtuse, longer than eye, 1.58 times of it; lower jaw nearly equal to upper; maxillary extending beyond front border of eye. Lateral line a little arched, becoming straight below twentieth soft dorsal ray; curved portion longer than straight portion, 1.5 times of latter. Scutes rather small in size, rather less in number, only present on posterior three-fourths of straight portion of lateral line, but moderately armed. Caudal peduncle with seven scutes. Breast only naked inferiorly. No rays in soft dorsal and anal produced. Lobe of soft dorsal 1.63 in base of fin, a little more than that of anal, 4.5 times of height of spinous dorsal, 1.63 in depth of body, 1.07 in head; caudal lobe 2.75 in length of body. Pectoral much longer than head, 1.5 times of it; ventral 2.18 in head. Free anal spines rudimentary, hidden under skin in adult.

Color in formalin brown; top of soft dorsal and of anal black, posterior margin of caudal edged with black; paired fins light; opercular spot black, distinct; axils brown.

The above description is drawn from a specimen from Ryūkyū, Carnegie Museum Cat. of Fishes, No. 7727, measuring 212 mm. in length of body.

The specimen dealt with here exactly agrees with the original description of this species given by Bleeker.

A specimen from Formosa figured by Seno as *Caranx* sp. must be this species, as is clearly shown by his figure.

The species is tropical, inhabiting the Indian Ocean and the Pacific, but is very rarely known from the warmer parts of Japan proper.

Localities.—Misaki; Ryūkyū; Formosa.

Subgenus *CARANX*.¹¹*(Tricropterus* Rafinesque).

Body oblong. Teeth on upper jaw in a narrow band, with an outer series of stronger teeth; those of lower in a single series, intermixed with larger ones. Lower jaw longer than upper. Posterior adipose eyelid developed. Breast scaly, or naked inferiorly, with a

¹¹As commonly restricted, the type being either *C. carangus* or *C. ruber*. D. S. JORDAN.

small patch of minute scales in front of ventrals. Scutes well armed, present along whole length of straight portion of lateral line. Anterior part of soft dorsal and of anal falcate; none of their rays produced into a filament.

This subgenus includes those species of *Caranx* which correspond in dentition with *C. hippos* Linnæus, the type (as *Caranx carangus*) of the genus *Tricropterus* of Rafinesque.

Eleven species of this subgenus are known from Japan. They are distinguished from one another as follows:

- a. Breast entirely scaled.
- b. Lobe of soft dorsal and of anal lower than length of head.
- c. Soft anal rays 16 or 17; snout not much longer than eye.
- d. Lateral line becoming straight below sixth soft dorsal ray; snout longer than eye; body distinctly crossed with six black bands in young stage. *sexfasciatus*.
- dd. Lateral line becoming straight below third soft dorsal ray.
- e. Scutes 33; soft dorsal rays 21. *xanthopygus*.
- ee. Scutes 30; soft dorsal rays 20.
- f. Pectoral longer than head; lateral line moderately curved; anal rays 16; soft dorsal without black; a small blackish spot above gill-opening. *lessoni*.
- ff. Pectoral equal to head; lateral line strongly curved; anal rays 17; soft dorsal with blackish top and edge; no spot above gill-opening. *oshimai*, sp. nov.
- cc. Soft anal rays 19; scutes 38; snout much longer than eye.
 - g. Lobe of soft dorsal and of anal rather low and rather less acute; former lower than half of its base. *bixanthop erus*.
 - gg. Lobe of soft dorsal and of anal high and comparatively acute; former lower than half of its base. *melampygus*.
- bb. Lobe of soft dorsal and of anal not lower than length of head; soft dorsal rays 22; anal rays 18; scutes 30; color blackish. *ishikawai*, sp. nov.

- aa.* Breast naked inferiorly, with a small patch of minute scales in front of ventrals.
- h.* Scutes 30; soft dorsal rays 18 to 20; anal rays 15 to 17.
 - i.* Pectoral longer than head; maxillary extending beyond centre of eye.
 - j.* Soft dorsal rays 20; anal rays 16 or 17; curved portion of lateral line nearly equal to straight portion; eye nearly equal to snout; maxillary extending beyond centre of eye; but not reaching posterior border of pupil; height of soft dorsal half of base of fin.....*ignobilis.*
 - jj.* Soft dorsal rays 18 or 19; anal rays 15 or 16; curved portion of lateral line shorter than straight portion; eye shorter than snout; maxillary extending beyond posterior border of pupil; height of soft dorsal more than half of base of fin.....*bucculentus.*
 - ii.* Pectoral equal to head; maxillary scarcely reaching centre of eye.....*jarra.*
 - hh.* Scutes 36; soft dorsal rays 21 to 23; anal rays 16 to 18.....*sansun.*

29. ***Caranx sexfasciatus*** Quoy and Gaimard.

(Pl. XXV, figs. 3 and 4.)

Caranx sexfasciatus Quoy and Gaimard, Voy. Uranie, Poiss., 1824, p. 358, pl. 65, f. 4.—Cuvier and Valenciennes, Vol. IX, 1833, p. 112.—Jordan and Evermann, Proc. U. S. Nat. Mus., Vol. XXV, 1903, p. 337.

Caranx forsteri Cuvier and Valenciennes, Vol. IX, 1833, p. 105.—Jordan and Richards, Mem. Carnegie Mus., Vol. IV, 1909, p. 179.

Caranx flavo-cæruleus Temminck and Schlegel, 1845, p. 110, pl. 59, fig. 2.

Caranx hippos Günther, (*non* Linnæus), Cat. Fish. Brit. Mus., Vol. II, 1866, p. 449.

D. VIII-I, 20 or 21; A. II-I, 16 or 17; scutes 30.

Head 3.3 in length of body (4 in total length); depth 2.72 (3.34); pectoral 3; eye 4.63 in head; snout 3.4.

Body oblong; nape rather elevated (more so in younger stages); dorsal profile gradually and almost evenly curved from tip of snout to origin of soft dorsal, and thence descending equally with ventral profile to posterior end of fin; ventral profile curving from tip of mandible to base of ventral, and thence descending to origin of anal very slowly and almost in a straight line. Snout rather pointed, longer than eye, 1.35 times of it; maxillary extending to, or beyond, posterior border of pupil. Lateral line rather strongly arched, becoming straight below sixth soft dorsal ray (fourth or fifth in younger stages); curved portion of lateral line shorter than straight portion, 1.35 in latter. Caudal peduncle with four scutes. Breast scaly. Lobe of soft dorsal 1.65 in head, and half both of depth of body and base of fin; pectoral a little longer than head.

Color in formalin brown above, lighter below; spinous dorsal brown; soft dorsal gray, with blackish top and margin; caudal gray, edged posteriorly with black; anal and paired fins light; no opercular spot; a small black spot present above gill-opening. In rather smaller specimens, body conspicuously marked with seven black cross bands; of which the first descends through eye from occipital.

The above description is based upon a specimen from Kii, Carnegie Museum, Cat. of Fishes, No. 7728, measuring 166 mm. in length of body. The proportions of the different parts of the body vary in accordance with the size of the specimens as follows:

Length of body.....	166 mm.	129 mm.	125 mm.	113 mm.	51 mm.
Head in total length...	4.00 times	4.05 times	4.10 times	3.97 times	3.64 times
Head in length of body.	3.30 times	3.30 times	3.30 times	3.30 times	3.00 times
Depth in total length...	3.34 times	3.30 times	3.32 times	3.14 times	3.10 times
Depth in length of body.	2.72 times	2.70 times	2.63 times	2.63 times	2.55 times
Depth at nape in length of body.....	3.04 times	2.93 times	2.90 times	2.82 times	2.68 times
Eye in head.....	4.63 times	4.33 times	4.31 times	4.25 times	3.4 times
Snout in head.....	3.40 times	3.54 times	3.57 times	3.77 times	3.77 times
Curved portion of lateral line in straight portion	1.35 times	1.45 times	1.48 times	1.50 times	1.57 times

In most cases, the number of the rays in the dorsal is 20, and the number in the anal 17, but some have 20 dorsal rays and 16 anal rays, while others have 21 dorsal rays and 17 anal rays, as in the specimen figured.

Among the specimens dealt with here, the older ones exactly agree with the original description of *Caranx forsteri*, given by Cuvier and Valenciennes, and with that of *Caranx flavo-cæruleus* and its figure given by Temminck and Schlegel, while, on the other hand, the younger ones quite accord with the description of the type of *Caranx*

sexfasciatus Quoy and Gaimard, given by Cuvier and Valenciennes. These younger specimens are not only marked with black bands in the way peculiar to *C. sexfasciatus*, but when compared with the older ones, as may be seen from the above table, also have the body rather higher, the nape rather more elevated, and the lateral line curving rather more anteriorly. These facts justify the writer, in accordance with the rules of priority to apply to the present species the specific name of Quoy and Gaimard. Günther has united with this species such forms as *C. flavo-cæruleus*, *C. lessoni*, *C. personi*, etc., and regarded them as a single species synonymous with his *C. hippos*, which is not that of Linnæus, but *C. latus* of Agassiz. As stated above, the writer holds with Günther in uniting the present species with *C. forsteri* and *C. flavo-cæruleus*, but it is not justifiable to unite it with *C. latus* Agassiz, from which it differs in the number of the soft dorsal rays, the number of the scutes, the proportion of the depth of the body in its length, and the position of the arch of the lateral line, *C. latus* having twenty-two soft dorsal rays, thirty-five scutes, the depth 3 in the total length, the lobe of the soft dorsal 3 in the depth, and the lateral line becoming straight below the third soft dorsal ray. It is also distinct from *C. lessoni*, as will be explained under the description of that species. Specimens hitherto reported from Japan proper as *C. hippos* by some authors, such as Steindachner and Döderlein, Franz, etc., appear also to be this species.

The species is widely distributed throughout the Indian Ocean and the warm seas of the Pacific. It is also one of the commonest species of *Caranx* in the warmer parts of Japan proper.

Localities:—Tōkyō Bay; Kii; Uwajima; Ryūkyū; Bonin Islands; Formosa.

30. *Caranx xanthopygus* Cuvier and Valenciennes.

(PL. XXIV, fig. 3.)

Caranx xanthopygus Cuvier and Valenciennes, Vol. IX, 1833, p. 109.

? *Caranx rhabdotus* Jenkins, Bull. U. S. Fish Comm., Vol. XXII, 1903, p. 444, fig. 16.

D. VIII-I, 21 or 22; A. II-I, 17 or 18; scutes 34.

Head 3.25 in length of body (4 in total length); depth 2.66 (3.4); pectoral 3; eye 3.7 in head; snout 3.82.

Shape of body like that of *Caranx sexfasciatus*, but nape rather more elevated, and dorsal profile of head descending rather more rapidly from occipital to tip of snout. Snout rather obtuse, equal to, or slightly longer, than eye (only a little so, even in full grown

specimens); maxillary extending to posterior border of pupil. Teeth on both jaws much stronger and more unequal than in *Caranx sexfasciatus*. Lateral line strongly arched, becoming straight below third soft dorsal ray; curved portion shorter than straight portion, 1.5 in latter. Caudal peduncle with four scutes. Breast scaly. Lobe of soft dorsal equal to half both of base of fin and of depth of body, 1.5 in head; pectoral a little longer than head.

Color in formalin brown above, lighter below, very faintly banded in young stages; spinous dorsal brown; soft dorsal gray, its top and edge washed with black; caudal gray, edged with blackish posteriorly, its upper lobe darker than the lower; anal and paired fins light; opercular spot absent; a small black spot above gill-opening. In life, dorsals and upper lobe of caudal greenish yellow; other fins yellow.

The above description is founded upon a specimen from Ryūkyū, Carnegie Museum Cat. of Fishes, No. 7729, measuring 160 mm. in length of body. The proportions of the depth in the length, and of the eye and of the snout in the head vary as follows:

Length of body	220 mm.	185 mm.	160 mm.	129 mm.
Depth at middle in length of body	2.84 times	2.72 times	2.66 times	2.63 times
Depth at nape in length of body	2.82 times	2.93 times	2.96 times	2.80 times
Eye in head	4.28 times	4.00 times	3.70 times	3.63 times
Snout in head	3.58 times	3.60 times	3.82 times	4.00 times

In most cases the number of soft dorsal rays is twenty-one, and that of anal rays seventeen, but two out of thirty individuals observed by the writer have twenty-two dorsal rays and seventeen anal rays, while one has twenty dorsal rays and eighteen anal rays.

The specimens examined agree with the original description of the type of this species by Cuvier and Valenciennes, the only difference being that in all the specimens observed by the writer, the brown spots on the back and sides, which the author mentions as occurring in the type, are wanting, just as they are wanting in their cotype.

The present species closely resembles *C. sem* Cuvier and Valenciennes, only differing from this in the number of the soft dorsal rays, which is nineteen in *C. sem*. It also comes near to *C. sexfasciatus*, from which it can be distinguished by having the eye decidedly larger in relation to the snout, and the lateral line curving more in front and more strongly. A specimen from Hawaii, described and figured by Jenkins as a new species under the name *C. rhabdotus*, and which is

considered by most American ichthyologists as a synonym of *C. sexfasciatus*, much resembles the present species,¹² since as may be known from the figure given by the same author, it has the eye almost as large as the snout and the lateral line curving more anteriorly and more strongly than in *C. sexfasciatus*. On the other hand, specimens described by Bleeker as *C. xanthopygus* do not belong to the present species, as, according to his description, the breast should be naked.

The species is distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is occasionally known from the southernmost coasts of Japan proper.

Localities:—Tosa; Ryūkyū; Formosa.

31. *Caranx lessoni* Cuvier and Valenciennes.

(PL. XXV, fig. 2.)

Caranx lessoni Cuvier and Valenciennes, Vol. IX, 1833, p. 113.

Caranx hippos Günther (*non* Linnæus), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 449.

D. VIII-I, 20; A. II-I, 16; scutes 30.

Head 3.28 in length of body (4 in total length); depth 2.56 (3.12); pectoral 3.06; eye 3.9 in head; snout 3.3.

Shape of body like that of *C. sexfasciatus*. Snout rather pointed, a little longer than eye; maxillary somewhat extending beyond posterior border of pupil. Teeth on jaw rather stronger and more unequal than those of *C. sexfasciatus*. Lateral line rather strongly arched, becoming straight below third soft dorsal ray; curved portion shorter than straight portion, 1.45 in latter. Caudal peduncle with four scutes. Breast scaly. Lobe of soft dorsal 2.1 in base of fin, 1.72 in head, 2.2 in depth of body; pectoral rather longer than head.

Color in formalin brownish; dorsal and caudal light; anal and paired fins pale; opercular spot absent; a small brown spot above gill-opening. In life all fins yellow.

The above description is based upon a specimen from Formosa, Carnegie Museum Cat. of Fishes, No. 7730, measuring 140 mm. in length of body.

The specimen dealt with here quite agrees with the original description of this species given by Cuvier and Valenciennes.

The species closely resembles *C. sexfasciatus*, but differs from it in having a rather higher body, a rather larger eye, rather stronger

¹²The dark bands are, however, more persistent, and the species invades fresh waters. D. S. JORDAN.

teeth on jaws, the lateral line becoming straight below the third dorsal ray, the soft dorsal and the caudal nearly clear of black, and the body not crossed with dark bands even in the youngest stages. A form described by Bleeker as *C. lessoni* does not belong to the present species, since, according to his description, the breast should be naked.

The species is distributed throughout the Indian Ocean, and the tropical seas of the Pacific. It is not known from Japan proper.

Locality:—Formosa.

32. *Caranx oshimai* Wakiya, sp. nov.

(PL. XXVII, fig. 1.)

Caranx jarra Cuvier and Valenciennes, Vol. IX, 1833, p. 109, (*partim*).

D. VIII-I, 20; A. II-I, 17; scutes 31.

Head 3.32 in length of body (4 in total length); depth 2.5 (3); pectoral 3.32; eye 4.11 in head; snout 3.36.

Shape of body like that of *Caranx sexfasciatus*, but body rather higher at middle and rather less elevated at nape, and outline of belly more strongly curved. Snout rather pointed, a little longer than eye, 1.22 times of it; maxillary extending to posterior border of pupil. Teeth on jaws as strong as those of *C. sexfasciatus*, but more unequal. Lateral line strongly arched, becoming straight below third soft dorsal ray; curved portion shorter than straight portion, 1.57 in latter. Caudal peduncle with four scutes. Breast scaly. Lobe of soft dorsal slightly lower than half of base of fin, 1.6 in head, 2.27 in depth of body; pectoral equal to head.

Color in formalin brownish, becoming very slightly darker toward back; spinous dorsal gray, with blackish spines; soft dorsal light, with blackish top and margin; caudal light, becoming slightly darker distally; paired fins pale; opercle quite clear of black.

The above description is based upon the type, a specimen from Formosa, Carnegie Museum Cat. of Fishes, No. 7731, measuring 123 mm. in length of body.

The specimen dealt with here is identical with that hesitatingly named *C. jarra* by Cuvier and Valenciennes. Cuvier and Valenciennes based their species upon Russell's figure of "Yarradenree-Parah." The description given by Cuvier and Valenciennes and the specimen before the writer distinctly differ from Russell's figure in the number of rays in the soft dorsal and the anal, and in the color of the fins.

The species resembles *C. sexfasciatus* and *C. lessoni*, but is distinct from both in having a rather less elevated nape, a more ventricose belly, a more strongly curved lateral line, a shorter pectoral, and no dark spot above the gill-opening. From *C. sexfasciatus* it differs decidedly in having the teeth on the jaws rather more unequal, a rather larger eye, the lateral line more curved anteriorly, and the body not crossed with dark bands even in the young stages. From *C. lessoni* it differs in having weaker teeth on the jaws and the soft dorsal tipped and edged with blackish.

The species is distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from Japan proper.

Locality:—Formosa.

The species is named after Dr. M. Oshima of the Central Research Institute of Formosa.

33. *Caranx bixanthopterus* Rüppell.

(PL. XXVII, fig. 2.)

Caranx bixanthopterus Rüppell, N. W. Fishes, 1835, p. 49, pl. 14, fig. 2.

Caranx latus Jenkins (*non* Agassiz), Bull. U. S. Fish. Comm., Vol. XXII, 1903, p. 444.

Caranx forsteri Jordan and Evermann (*non* Cuvier and Valenciennes), Bull. U. S. Fish. Comm., Vol. XXIII, 1905, p. 191.

D. VIII-I, 23; A. II-I, 19; scutes 38.

Head 3.34 in length of body (4.05 in total length); depth 2.5 (3.04); pectoral 3; eye 5 in head; snout 2.9.

Shape like that of *Caranx sexfasciatus*, but nape less elevated, and outline between origin of soft dorsal and tip of snout more evenly curving, so that it forms a quite regular arc of a circle. Snout pointed, much longer than eye, nearly 1.75 times of it; maxillary scarcely reaching centre of eye. Teeth on jaws finer than those of *C. sexfasciatus*. Width of interorbital space rather more than diameter of eye. Lateral line rather strongly curved, becoming straight below fifth soft dorsal ray; curved portion shorter than straight portion, 1.4 in latter. A few anterior scutes much smaller than others. Caudal peduncle with five scutes. Breast scaly. Lobe of soft dorsal 2.16 in base of fin, 1.55 in head, 2.2 in depth of body; pectoral longer than head, 1.2 times of it.

Color in formalin brown above, lighter below; spinous dorsal brown; soft dorsal and anal gray, with blackish tip and edge; caudal brown, edged with blackish; paired fins light; opercular spot absent; no black spot above gill-opening.

The above description is founded upon a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7732, measuring 135 mm. in length of body.

All the specimens so far examined quite agree with the original description and the figure of this species given by Rüppell.

The species distinctly differs from all other Japanese forms, having the breast scaly; besides it has a longer snout, much more numerous scutes and anal rays, and the anal tipped with black. However, the species agrees so closely with *C. stellatus* (*melampygus* of authors, not of Cuvier and Valenciennes) in the above mentioned characters, that Jordan and Evermann in their great work on "The Fishes of North and Middle America," have treated *C. bixanthopterus* as a synonym of the latter, which none the less differs from the former in having the soft dorsal and the anal with much higher and acuter lobes, the interorbital space rather less than the diameter of the eye, brown spots scattered over the body, and a small, but distinct, opercular spot.

Specimens from Hawaii identified by Fowler, Snyder, and Jenkins with *C. latus* and described by Jordan and Evermann as *C. forsteri*, should belong to this species, for, according to the description of the last named authors, their specimen has the head 3.3 in the length of body, the depth 2.5, the eye 5.5 in the head, the snout 3.5, the produced portion of the anal as dark as that of the soft dorsal, 23 soft dorsal rays, 19 anal rays, and 36 scutes. These facts also lead the writer to believe that *C. latus* reported by Jordan and Snyder from Tōkyō Bay, and *C. forsteri* hitherto reported from Japan by most American ichthyologists, except Jordan and Richardson (who give *C. sexfasciatus*, as it has been identified by Jordan and Evermann) also would probably be this species.¹³

The species seems to be distributed as widely as *Caranx sexfasciatus*, but it is rather rare in the seas of Japan proper. It is one of the chief food-fishes of the South Seas. Known generally as *Ulua*.

Localities:—Kii; Uwajima; Nagasaki; Bonin Islands; Ryūkyū.

¹³Mr. Wakiya is no doubt correct in this statement. It is also probable that the original *Caranx forsteri* is not this species, as it has twenty dorsal and sixteen anal rays, as in *C. sexfasciatus* and *C. heberi*. *Caranx bixanthopterus* may be the oldest name for this species, but the original account of *C. melampygus* fits it better than it does the species usually called by that name. D. S. JORDAN.

34. *Caranx melampygyus* Cuvier and Valenciennes.

Caranx melampygyus Cuvier and Valenciennes, Vol. IX, 1833, p. 116.—Günther, Cat. Fish. Brit. Mus., Vol. II, 1860, p. 400.

D. VIII-I, 23; A. II-I, 19; scutes 38.

Head 3.33 in length of body (4.07 in total length); depth 2.68 (3.28); pectoral 2.81; eye 4.9 in head; snout 2.7.

Nape elevated; dorsal profile descending rapidly from occipital to tip of snout, nearly straight. Snout pointed, much longer than eye, 1.8 times of the same, maxillary scarcely reaching center of eye. Width of interorbital space much more than eye, 1.5 times of the same. Lateral line moderately curved, becoming straight below sixth soft dorsal ray, which is at anterior fifth; curved portion rather shorter than straight portion, 1.23 in latter. A few anterior scutes much smaller than others. Caudal peduncle with five scutes. Breast scaly. Lobes of soft dorsal and anal high and acute; former 1.71 in base of fin and in depth of body, 1.38 in head.

Color in formalin almost uniformly dark brown, not spotted with black; all vertical fins blackish; anal becoming darker distally, so that the first ray and tips of fins become black; paired fins light.

The above description is based upon a specimen from Ryūkyū, Carnegie Museum Cat. of Fishes, No. 7733, measuring 180 mm. in length of body.

The specimen dealt with here exactly agrees with the original description of this species given by Cuvier and Valenciennes.

The present species well accords with *C. xanthopterus* and with *C. stellatus* (= *melampygyus* of authors, not of Cuvier and Valenciennes) in the formulæ of the soft dorsal and of the anal rays, the number of scutes, the proportion of the eye in the snout, and in having a black tip to the anal. However, it can be distinguished from the former in having the lobe of the soft dorsal and the anal much higher and acuter, the nape much more elevated, the interorbital space broader, compared with the eye, and a darker body. From *C. stellatus* it may be discriminated by its having the interorbital space narrower, the maxillaries extending beyond the front border of the pupil, and the body not spotted with black.

The species is distributed throughout the tropical seas of the Pacific, and the Indian Ocean. It is not known from Japan proper.

Locality.—Ryūkyū.

35. *Caranx ishikawai* Wakiya sp. nov.

(PL. XXVI.)

D. VIII-I, 22; A. II-I, 18; scutes 30.

Head 3.6 in length of body (4.33 in total length); depth 2.3 (3.22); pectoral 2.38 (3.33); eye 5 in head; snout 3.

Body high, elevated at nape, dorsal profile of head descending rapidly and nearly straight, with a concavity above anterior nostril. Snout obtuse, longer than eye; maxillary extending somewhat beyond front border of pupil. Lateral line strongly arched, becoming straight below third soft ray; curved portion shorter than straight portion, 1.5 in latter. Caudal peduncle with four scutes. Breast scaly. All parts of gill-cover scaled, leaving a tolerably broad naked area along the free margin of interopercle and subopercle. Falcated portion of dorsal and of anal very high; former about one diameter of eye longer than length of head, and latter about equal to head. Pectoral long, 1.3 times of head, but 3.33 in total length of body. Caudal lobe 4.2 in total length.

Color in formalin uniformly blackish brown.

The above description is based upon the type, a specimen from the Bonin Islands, Carnegie Museum Cat. of Fishes, No. 7734, measuring 323 mm. in the length of body.

The species is one of the largest of the genus in Japan, one specimen at hand attaining 405 mm. in length of body.

It closely resembles *C. lugubris* Poey, but is distinct from this in having a higher body, much higher dorsal and anal lobes, and rather shorter pectoral and caudal lobes. A specimen from Formosa which is described by Jordan and Evermann as "a small specimen from Kotosho resembling *Carangus jarra* (Cuvier and Valenciennes). D. VIII-I, 23; scales about 30; no spots," would probably be a young example of this species.

It is not known from Japan proper.

Localities:—Bonin Islands; Formosa.

The species is named after Prof. Chiyomatsu Ishikawa.

36. *Caranx ignobilis* (Forskål).

(PL. XXVII, fig. 3.)

Scomber ignobilis, Forskål, 1775, p. 55.*Caranx hippoides* Jenkins, Bull. U. S. Fish. Comm., Vol. XXII, 1903, p. 443.

D. VIII-I, 20; A. II-I, 16 or 17; scutes 30.

Head 3.21 in length of body (3.88 in total length); depth 2.21 (2.67); pectoral 2.8; eye 3.5 in head; snout 3.15.

Body high; nape elevated; height of head equal to its length. Snout obtuse, only a little longer than eye; maxillary extending somewhat beyond centre of eye. Teeth on jaws strong and unequal. Lateral line moderately arched, becoming straight below seventh soft dorsal ray; curved portion somewhat wavy, nearly equal to straight portion, 1.12 in latter. Caudal peduncle with four scutes. Breast naked below, with a small patch of minute scales in front of ventrals. Lobe of soft dorsal half of base of fin, 1.65 in head, 2.3 in depth of body; pectoral a little longer than head, 1.15 times of it.

Color in formalin brownish above, lighter below; fins light, except spinous dorsal, which is brown; top and edge of soft dorsal blackish, and upper lobe of caudal slightly darker than lower; opercular spot indistinct; no spot above gill-opening.

The above description is made from a specimen from Nagasaki, measuring 106 mm. in length of body. The figured specimen, Carnegie Museum Cat. of Fishes, No. 7735, measures 147 mm. to caudal.

The proportions of the parts of the body vary in accordance with the size of the specimens as follows:

Length of body.....	142 mm.	106 mm.	79 mm.
Eye in head.....	3.90 times	3.68 times	3.37 times
Snout in head.....	3.30 times	3.33 times	3.50 times
Curved portion of lateral line in straight portion.....	1.12 times	1.16 times	1.15 times
Height of soft dorsal in base.....	2.03 times	2.00 times	2.00 times

The specimens dealt with here fully agree with the original description of this species given by Forskål, and well agree with that given by Jenkins of *C. hippoides*, which is considered by Jordan and other American ichthyologists as being a synonym for the present species. It ought to be remembered, however, that the specimen described by Jenkins evidently differs from that represented on our plate in the size of the eye in comparison with the snout, the position of the point at which the lateral line bends, and in the extension of the maxillary. These may be matters of age.

The species also closely resembles *Caranx hippos* of the Atlantic, but differs from it in having a rather higher body, a rather longer head, a larger eye, a longer pectoral, and no distinct opercular spot.

The species is distributed throughout the Indian Ocean and the warm seas of the Pacific. It is also known from the southern coasts of Japan proper.

Localities:—Nagasaki; Uwajima; Ryūkyū; Formosa.

37. *Caranx bucculentus* Alleyne and Macleay.

(PL. XXVII, figs. 4 and 5.)

Caranx bucculentus Alleyne and Macleay, Proc. Linn. Soc. N. S. Wales, Vol. I, 1876, p. 326, pl. XI, fig. 1.

D. VIII-I, 18 or 19; A. II-I, 15 or 16; scutes 30.

Head 3 in length of body (3.96 in total length); depth 2.28 (2.83); pectoral 2.8; eye 4.72 in head; snout 2.88.

Shape of body like that of *C. ignobilis*, but nape more elevated. Snout obtuse, longer than eye, 1.63 times in it; maxillary extending beyond posterior border of pupil. Teeth on jaws rather weaker and less unequal than in *C. ignobilis*. Lateral line strongly arched, becoming straight below fifth soft dorsal ray; curved portion shorter than straight portion, 1.3 in latter. Caudal peduncle with four scutes. Breast naked below, with a small patch of minute scales in front of ventrals. Lobe of soft dorsal 1.71 in base of fin, 1.5 in head, 2.12 in depth of body. Pectoral rather longer than head, 1.07 times of it.

Color in formalin brownish above, light below; spinous dorsal brown; soft dorsal gray, with blackish first ray and edge; caudal gray, its upper caudal lobe darker than lower; anal and paired fins light; opercular spot absent; no spot above gill-opening.

The above description is drawn from a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7736, measuring 170 mm. in length of body.

The measurements of another specimen from Formosa, 130 mm. in length of body, are as follows: eye 4.1 in head; snout 3.03; curved portion of lateral line 1.37 in straight portion; height of soft dorsal 1.8 in base of fin.

The specimens thus far examined quite agree with the original description of this species given by Alleyne and Macleay, except that the lateral line becomes straight below the fifth soft dorsal ray, instead of the fifth dorsal spine, as stated by the authors. However, since any form having such an abruptly curved lateral line never occurs in the genus *Caranx*, the writer has identified them with Alleyne and Macleay's species on the assumption that their statement about the lateral line is not correct.

They also well agree with the figure of *C. hippoides* given by Jenkins.

The present species closely resembles *C. ignobilis*, but differs from it in having rather less numerous dorsal and anal rays, a smaller

eye, a rather more strongly and shorter curved lateral line, and a higher soft dorsal. Specimens identified by Bleeker with *C. sem* would be the present species.

The species seems to be widely distributed throughout the Indian Ocean and the warm seas of the Pacific. It occurs rather commonly in the warmer seas of Japan proper.

Localities:—Tōkyō Bay; Kii; Formosa.

38. *Caranx jarra* Cuvier and Valenciennes.

(PL. XXIX, fig. 2.)

Caranx jarra Cuvier and Valenciennes, Vol. IX, 1833, p. 109 (based on Russell's figure of Yarradanree-Parah).

D. VIII-I, 19 or 20; A. II-I, 16; scutes 30.

Head 3 in length of body (3.6 in total length); depth 2.45 (3); pectoral 3; eye 4 in head; snout 3.2.

Shape of body like that of *C. ignobilis*. Snout rather obtuse, longer than eye, 1.25 times in it; maxillary scarcely extending to center of eye. Teeth on jaws as strong and unequal as those of *C. ignobilis*. Lateral line moderately arched, becoming straight below the sixth soft dorsal ray; curved portion running somewhat wavy, only a little shorter than straight portion, 1.2 in it. Caudal peduncle with four scutes. Breast narrowly naked below, with a small patch of minute scales in front of ventrals. Lobe of soft dorsal 2 in base of fin, 1.76 in head, 2.47 in depth of body; pectoral equal to head.

Color like that of *C. ignobilis*.

The above description is drawn from a specimen from the Bonin Islands, Carnegie Museum Cat. of Fishes, No. 7737, measuring 100 mm. in length of body.

All the specimens thus far examined fully accord with Russell's figure of "Yarradanree-Parah," upon which Cuvier and Valenciennes founded *C. jarra*, while they differ from a specimen doubtfully identified by these authors with the same figure of Russell, in having the breast naked inferiorly, and the soft dorsal not blackish at the tip and the edge. They also differ from the specimens identified respectively by Bleeker and by Günther with this species in having a shorter pectoral, rather less numerous dorsal and anal rays, and much less numerous scutes, and a rather higher body. On the other hand, this species closely resembles *C. ignobilis* and *C. hippoides*, but differs from them in having the maxillary scarcely reaching the

centre of the eye, and the pectoral not longer than the head, and differs especially from the former in having a smaller eye, and from the latter in having a lower soft dorsal. Specimens identified by Bleeker with *C. lessoni* would probably be this species.

The species is distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from Japan proper.

Locality:—Bonin Islands.

39. *Caranx sansun* (Forskål).

(PL. XXVIII, figs. 1 and 2.)

Scomber sansun Forskål, 1775, p. 55.

Caranx jarra Bleeker, (*non* Cuvier and Valenciennes) Verh. Bat. Gen. XXIV, Makr., 1852, p. 58.—Günther (*non* Cuvier and Valenciennes) Cat. Fish. Brit. Mus., Vol. II, 1860, p. 446.—Jordan and Evermann (*non* Cuvier and Valenciennes), Proc. U. S. Nat. Mus., Vol. XXV, 1903, p. 337.

D. VIII-I, 21 to 23; A. II-I, 16 to 18; scutes 36.

Head 3.61 in length of body (4.3 in total length); depth 2.8 (3.5); pectoral 2.86; eye 5 in head; snout 3.25.

Nape much less elevated than usual; head lower than its length, and profile not greatly curved. Snout obtuse, longer than eye, 1.54 times of it; maxillary scarcely extending to centre of eye. Lateral line moderately arched, becoming straight below fifth dorsal ray; curved portion somewhat wavy, shorter than straight portion, 1.3 in latter. Caudal peduncle with four scutes. Breast only naked at bottom, with a small patch of minute scales in front of ventrals. Lobe of soft dorsal 1.55 in base of fin, 1.2 in head, 1.5 in depth of body. Pectoral much longer than head, 1.26 times of it.

Color in formalin brown above, lighter below; dorsals and caudal gray; top and edge of soft dorsal blackish; caudal edged with blackish posteriorly, its upper lobe darker than lower, anal and paired fins light; opercular spot indistinct; no spot above gill-opening; axils brownish.

The above description is made from a specimen from Ryūkyū, Carnegie Museum Cat. of Fishes, No. 7738, measuring 224 mm. in length of body.

The number of soft anal rays varies from sixteen to eighteen.

The specimens dealt with here are identical with those described by Bleeker and others as *C. jarra*, and, in having the breast naked with a patch of minute scales in front of the ventrals, bear a close resemblance to all the species allied to *C. ignobilis*, such as *C. hippos*, *C. jarra*, and *C. bucculentus*. However, they differ distinctly from

all these species in having the pectoral much longer than the head, the soft dorsal much higher than half of the base of the fin, the depth of body as low as 3 in the length, the soft dorsal rays as numerous as 21 to 23, and the scutes as numerous as 36. On the other hand, the present specimens quite agree with the original description of *C. sansun* given by Forskål, which, as he states, closely approaches *C. ignobilis*, only differing from it in having twenty-two dorsal rays and sixteen anal rays, whereas the specimens hitherto identified with *C. sansun* by various authors do not accord with the original description in the number of the soft dorsal rays. In consequence the writer is inclined to apply the specific name given by Forskål to the specimens which accord with the description above given by that writer. A specimen from Formosa, identified by Jordan and Evermann and by Jordan and Richardson with *C. jarra*, certainly belongs to this species; as can be known from the note given by the former authors. Both the specimens described by Bleeker as *C. jarra* and as *C. xanthopygus* also belong to the present species, the former having twenty-two dorsal rays, and the latter twenty-one.

The species is widely distributed throughout the Indian Ocean and the warm seas of the Pacific, but it is rather rare in the waters of Japan proper.

Localities:—Ryūkyū; Kumamoto; Uwajima; Formosa.

Subgenus ATULE Jordan and Jordan.

Body oblong. Teeth on both jaws usually in a single series, but those on upper in a narrow band in some species; vomer, palatines, and tongue toothed. Snout not much longer than eye; maxillary extending to, or beyond, front border of eye; lower jaw not shorter than upper. Adipose eyelid well developed. Breast scaly. Scutes well armed, present along whole length of straight portion of lateral line. Anterior parts of soft dorsal, and of anal not falcate; none of their rays produced into a filament.

As defined above, this subgenus, which corresponds with a part of the genus *Selar*,¹⁴ can be distinguished from all other subgenera of *Caranx*. Bleeker includes in *Selar* such genera as *Trachurus* and *Trachurops*, which have the same dentition as that of *Selar*. *Trachurus*, however, differs manifestly from all the species of *Caranx* by the great development of the scutes, *Selar* (*Trachurops*) by the possession of a deeply furrowed shoulder-girdle.

Four species of this subgenus are known from Japan. They are distinguished from one another as follows:

¹⁴But the type of *Selar*, as fixed by Jordan and Gilbert, is a species of *Trachurops*.
D. S. JORDAN.

- a. Teeth on upper jaw in a single series; fifty or more scutes.
 - b. Lateral line becoming straight below third soft dorsal ray; maxillary scarcely reaching front border of pupil; fifty-eight scutes. *djeddaba*.
 - bb. Lateral line becoming straight below origin of soft dorsal; maxillary extending beyond front border of pupil; fifty scutes. *malam*.
- aa. Teeth on upper jaw in a narrow band.
 - c. Depth 3.33 in body length; pectoral 3; forty-five scutes. *affinis*.
 - cc. Depth 2.5 in body length; pectoral 3.5; thirty-six scutes. *miyakamii*.

40. **Caranx (Atule) djeddaba** (Forskål).

(PL. XXIX, fig. 1.)

Scomber djeddaba Forskål, 1775, p. 56.

Caranx djeddaba Seno, Report on Fishery Industry of Formosa, 1910, pl. IX, fig. 1.

D. VIII-1, 24; A. II-1, 22; scutes 58.

Head 3.95 in length of body (4.75 in total length); depth 3.1 (3.72); pectoral 4.16; eye 4 in head; snout 4.

Body rather low; profiles evenly and equally curved. Snout obtuse, equal to eye; maxillary scarcely reaching front border of pupil; lower jaw slightly longer than upper. Posterior adipose eyelid broad, extending to posterior border of pupil. Lateral line strongly arched, becoming straight below third soft dorsal ray; curved portion much shorter than straight portion, twice in latter. Scutes very numerous, distinct along whole length of straight portion of lateral line. Caudal peduncle with six scutes.

Color in formalin brown above, light below; spinous dorsal blackish; soft dorsal gray, edged with blackish; caudal gray; paired fins light; opercular spot black, distinct; free margin of branchiostegal membrane black.

The above description is drawn from a specimen from Ryūkyū, measuring 158 mm. in length of body.

The specimens examined quite agree with the original description of this species given by Förskål.

The species is widely distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from Japan proper.

Localities:—Ryūkyū; Formosa.

One specimen, Carnegie Museum Cat. of Fishes, No. 7739, from Formosa.

41. **Caranx (Atule) malam** (Bleeker).

(PL. XXIX, fig. 3.)

Selar malam Bleeker, Fishes of Java, III, 1851, p. 362.

D. VIII-I, 23; A. II-I, 20; scutes 50.

Head 3.86 in length of body (4.72 in total length); depth 2.8 (3.42); pectoral 3.73; eye 3.5 in head; snout 3.5.

Profiles evenly and equally curved. Snout equal to eye; lower jaw slightly longer than upper; maxillary extending beyond front border of pupil. Posterior adipose eyelid broad, extending to posterior border of pupil. Lateral line strongly arched, becoming straight below first soft dorsal ray; curved portion much shorter than straight portion, 2.28 in latter. Scutes very numerous, distinct along whole length of straight portion of lateral line. Caudal peduncle with six scutes.

Color in formalin brownish above, light below; spinous dorsal blackish; soft dorsal and anal gray, edged with blackish; caudal gray; paired fins pale; opercular spot black, distinct.

The above description is drawn from a specimen from Formosa, Carnegie Museum Cat. of Fishes, No. 7740, measuring 112 mm. in length of body.

The specimen exactly agrees with the original description of this species given by Bleeker.

The species seems to be distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from Japan proper.

Locality:—Formosa.42. **Caranx (Atule) affinis** Rüppell.

(PL. XXX, fig. 1.)

Caranx affinis Rüppell, N. W. Fisch, 1828, p. 49, pl. 14, fig. 1.

D. VIII-I, 24; A. II-I, 21; scutes 45.

Head 3.5 in length of body (4.1 in total length); depth 3.36 (3.95); pectoral 3.05; eye 5 in head; snout 3.6.

Profiles equally and evenly curving toward both ends. Snout rather pointed, longer than eye. Lower jaw longer than upper; maxillary extending to front border of eye. Anterior and posterior adipose eyelids well developed, extending to pupil. Teeth minute, those on upper jaw in a very narrow band. Lateral line moderately curved, becoming straight below ninth soft dorsal ray, which is at anterior third of fin; curved portion equal to straight portion. Scutes

numerous, well armed, present along whole length of straight portion of lateral line. Caudal peduncle with six scutes. Pectoral long, extending to origin of soft anal.

Color in formalin brownish above, light below; opercular spot black, very distinct.

The above description is founded upon a specimen from Formosa, Carnegie Museum Cat. of Fishes, No. 7741, 244 mm. in length of body.

The specimen dealt with here exactly agrees with the original description and the figure of this species given by Rüppell.

The species is widely distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from the waters of Japan proper.¹⁵

Localities:—Formosa; Ryūkyū.

43. *Caranx (Atule) miyakamii* Wakiya, sp. nov.

(PL. XXIX, fig. 4.)

D. VIII-I, 25; A. II-I, 20; scutes 36.

Head 3.84 in length of body (4.68 in total length); depth 2.53 (3.08); pectoral 3.5; eye 3.78 in head; snout 3.87.

Ventral profile more strongly curved than dorsal profile. Snout obtuse, equal to eye; maxillary extending to front border of pupil; lower jaw rather longer than upper. Posterior adipose eyelid broad, extending to posterior border of pupil, anterior eyelid also well developed. Teeth on upper jaw arranged in a narrow band. Lateral line rather strongly arched, becoming straight below fifth soft dorsal ray; curved portion shorter than straight, 1.34 in latter. Scutes distinct along whole length of straight portion of lateral line. Caudal peduncle with six scutes. Pectoral rather short, not extending to origin of anal. Cheek narrowly scaled; all parts of gill-cover naked.

Color in formalin brownish above, light below; dorsals, anal, and caudal grayish; soft dorsal and anal edged with brown; caudal becoming darker posteriorly; paired fins pale; opercular spot black, distinct, encroaching on shoulder.

The above description is made from the type, a specimen from Formosa, Carnegie Museum Cat. of Fishes, No. 7742, measuring 119 mm. in length of body.

This species closely resembles *C. kalla* (Bleeker) in the shape of the

¹⁵The closely allied form found in Hawaii and Samoa is somewhat different, and has been named *Atule lundini*. D. S. JORDAN.

body, in the number of soft rays in the soft dorsal and of the anal, and in the coloration; but quite differs from it in having the teeth on the upper jaw in a band, not in a single series, and in having thirty-six scutes instead of forty-two. In the dentition, the species corresponds with *C. affinis*, but differs from this latter species in having a higher body, less numerous scutes, a more strongly curved lateral line and a shorter pectoral.

The species is named after Mr. K. Miyakami of the Formosan Government, who has helped the writer in collecting the carangoid fishes of Formosa.

Locality:—Formosa.

Subgenus LONGIROSTRUM¹⁶ Wakiya, **nom. nov.**

Body oblong, teeth on each jaw arranged in a single series; vomer, palatines, and tongue toothed, but vomerine teeth lost with age. Snout much longer than eye; maxillary not reaching eye; lower jaw not longer than upper. Adipose eyelid rudimentary. Breast scaly. Lateral line broadly arched. Scutes not present along whole length of straight portion of lateral line. Anterior parts of soft dorsal and of anal not falcate; none of their rays produced into a filament.

It corresponds with the subgenus *Atule* in the dentition, but differs from the same in having the snout much longer than the eye, the adipose eyelid quite rudimentary, and the scutes not developing in the anterior part of the straight portion of the lateral line.

Three species of the subgenus are known from Japan.

- a. Scutes more than twenty-five; opercular spot black, distinct; teeth on jaw rather strong.
- b. Scutes thirty; pectoral shorter than depth of body; soft dorsal rays twenty-six or twenty-seven.....*platessa*.
- bb. Scutes twenty-six; pectoral shorter than depth of body; soft dorsal rays twenty-four or twenty-five.....*delicatissimum*.
- aa. Scutes about twenty; opercular spot obscure; teeth on jaws exceedingly fine; pectoral much shorter than depth of body; soft dorsal rays twenty-six.....*mertensi*.

¹⁶The writer proposes this name as a substitute for *Selenia*, preoccupied in the Coleoptera.

44. **Caranx (Longirostrum) platessa** (Cuvier and Valenciennes).

Caranx platessa Cuvier and Valenciennes, Vol. IX, 1833, p. 84.

D. VIII-I, 26 or 27; A. II-I, 22 or 23; scutes 30.

Head 3.33 in length of body (3.9 in total length); depth 2.85 (3.35); pectoral 2.8; eye 6.8 in head; snout 2.47.

Nape elevated; dorsal profile of head almost straight, descending rather rapidly from occipital to tip of snout, showing a slight concavity above nostrils. Snout pointed, very much longer than eye, 2.9 in it; maxillary not reaching eye; lower jaw included. Teeth on jaws rather strong; vomer not toothed in full grown specimens. Lateral line becoming straight below fifteenth soft dorsal ray, which is at middle of soft dorsal; curved portion longer than straight portion, 1.6 times of latter. Scutes rather well armed, present on posterior four-fifths of straight portion of lateral line. Caudal peduncle with seven scutes. All parts of gill-cover scaled, only leaving a broad naked area on margin of interopercle. Pectoral equal to depth of body.

Color in formalin brown above, light below; opercular spot black, very distinct.

The above description is drawn from a specimen from Nagasaki, Carnegie Museum Cat. of Fishes, No. 7743, measuring 400 mm. in length of body.

The specimen examined agrees well with the original description of this species given by Cuvier and Valenciennes.

It is widely distributed throughout the Indian Ocean and the tropical seas of the Pacific, and is rarely known from the southern coasts of Japan proper.

Localities:—Nagasaki; Bonin Islands.

45. **Caranx (Longirostrum) delicatissimus** (Döderlein).

(Pl. XXVIII, fig. 3.)

Caranx delicatissimus Döderlein, Vol. III, 1884, p. 16.

D. VIII-I, 24 or 25; A. II-I, 21 or 22; scutes 26.

Head 3.25 in length of body (3.85 in total length); depth 2.86 (3.35); pectoral 3.25; eye 5.63 in head; snout 2.58.

Shape of body like that of *C. platessa*, but nape less elevated, and dorsal profile almost evenly curving from origin of soft dorsal to tip of snout. Snout pointed, very much longer than eye, 2.18 of it; maxillary not reaching front border of eye, its posterior end falling in front of eye at a distance equal to one-fourth of diameter of eye. Lower jaw rather included. Adipose eyelid rudimentary. Teeth on

jaws rather strong; vomer not toothed in adult. Lateral line becoming straight below thirteenth soft dorsal ray, which is before middle of fin; curved portion longer than straight portion, 1.5 times of latter. Scutes rather well armed, present along posterior three-fourths of straight portion of lateral line. Caudal peduncle with six scutes. All parts of gill-cover scaly, except preopercle, but free margin of interopercle and subopercle naked. Pectoral shorter than depth of body.

Color in formalin brown above, light below; opercular spot black, very distinct.

The above description is drawn from a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7744, measuring 200 mm. in the length of body. Among the specimens examined by the writer, those not reaching 130 mm. in length of body have a toothed vomer.

The specimens examined quite agree with the original description of this species given by Döderlein, except in the number of anal rays, which is given by that author as eleven. However, since no form having the anal composed of such a small number of rays ever occurs in *Caranx*, the writer makes his identification with Döderlein's species on the assumption that the statement of Döderlein as to the number of the anal rays is not correct.

The present species closely resembles *C. platessa*, but differs from it in the dorsal profile of the head, the length of the pectoral, the squamation of the gill-cover, the position of the point where the lateral line bends, and the number of scutes, and, although slightly, by that of the rays in the soft dorsal.

The species is known only from Japan proper.

Localities:—Miyako; Tōkyō Bay; Kii.

46. *Caranx (Longirostrum) mertensi* Cuvier and Valenciennes.

Caranx mertensi Cuvier and Valenciennes, Vol. IX, 1833, p. 64.

Caranx leptolepis Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 440.

D. VIII-I, 26; A. II-I, 22; scutes 20.

Head 3 in length of body (3.58 in total length); depth 3.2 (3.82); pectoral 4.23; eye 4.8 in head; snout 3.

Body rather low; nape not greatly elevated. Profiles evenly and equally curved. Snout rather pointed, much longer than eye, 1.6 times in it; maxillary scarcely reaching front border of eye; lower jaw somewhat included. Teeth on jaws exceedingly fine. Lateral line becoming straight below thirteenth soft dorsal ray, which is at

middle of fin; curved portion slightly longer than straight portion, 1.14 times of it. Scutes not very numerous, small in size, rather weakly armed, and present along posterior half of straight portion of lateral line. Caudal peduncle with six scutes. All parts of gill-cover partially scaled. Pectoral much shorter than depth of body.

Color in formalin brownish above, light below; all fins light; opercular spot very obscure.

The above description is based upon a specimen from Ryūkyū, Carnegie Museum Cat. of Fishes, No. 7745, measuring 72 mm. in length of body.

The specimen dealt with here perfectly agrees with the original description of this species given by Cuvier and Valenciennes.

The species is distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from Japan proper.

Locality:—Ryūkyū.

Subgenus URASPIS* Bleeker.

Teeth on both jaws in a single or two series; vomer, palatines, and tongue not toothed. Palate and tongue covered with thick membrane. Adipose eyelid rudimentary. Scutes very well armed, present along whole length of straight portion of lateral line; keel on scutes produced, plate-like, armed with a spine in front. Breast rather broadly naked. Soft dorsal and anal not falcate; no rays produced.

This subgenus corresponds to the genus *Uraspis* of Bleeker, who selected *Uraspis carangoides* as the genotype. Three species are known from Japan.

- a. Teeth on both jaws in a single series; ventral shorter than head; body not marked with transverse darker bands.
- b. Body lower than 2.5 in its length; maxillary not reaching pupil; gill-rakers 1.72 in eye; lateral line a little curved; ventral 1.65 in head; color brown. *helvola*.
- bb. Body higher than 2.5 in its length; maxillary reaching pupil; gill-rakers 2.17 in eye; lateral line moderately curved; ventral 1.45 in head; color blackish brown. *microptera*.
- aa. Teeth on both jaws in two series; ventral equal to head; body crossed with six darker bands. . . . *uraspis*.

* *Uraspis* being a feminine noun, the specific qualifying adjective must be feminine as shown in the key given below. W. J. HOLLAND.

47. *Caranx (Uraspis) helvolus* (Forster).

(Pl. XXVIII, fig. 4.)

Scomber helvolus Forster, Descr. Anim., 1775, p. 415.*Caranx helvolus* Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 443.

—Snyder, Bull. U. S. Fish. Comm., XXII, 1904, p. 524.—Jordan and Evermann, Bull. U. S. Fish. Comm., XXIII, 1905, pl. 32.

D. VI-I, 27; A. O-I, 21; scutes 37.

Head 3.52 in body length (4.11 in total length); depth 2.55 (3); pectoral 3.33; eye 4.58 in head; snout 2.95.

Profiles strongly and almost equally curved. Snout obtuse, longer than eye; maxillary extending to front border of eye; lower jaw longer than upper. Teeth on each jaw rather strong, arranged in a single series. Number of gill-rakers thirteen on lower limb of arch of gill; longest one 1.72 in eye. Lateral line slightly curved, becoming straight below twelfth soft dorsal ray, which is at anterior third of fin; height of arch 8.5 in its width; curved portion a little shorter than straight portion, 1.2 in latter. Caudal peduncle with five scutes. Spinous dorsal low, 2.6 in soft dorsal, which is 1.82 in head. Free anal spines hidden under skin in adult. Pectoral rather longer than head; ventral 1.65 in head and in distance between its insertion and origin of anal.

Color in life uniformly brownish.

The above description is derived from a specimen from Uwajima, Carnegie Museum Cat. of Fishes, No. 7746, measuring 250 mm. in length of body.

The specimen dealt with here quite agrees with the description and the figure by Snyder of a specimen from Hawaii, which the same author had identified with *C. helvolus*.

The species is widely distributed throughout the warmer seas of the Pacific, occurring on the southern coasts of Japan proper.

Localities:—Uwajima; Formosa.48. *Caranx (Uraspis) micropterus* Rüppell.

(Pl. XXX, fig. 2.)

Caranx micropterus Rüppell, N. W. Fische., 1835, p. 46, pl. 13, fig. 1.

D. VIII-I, 29; A. I-I, 22; scutes 36.

Head 3.44 in length of body (4.1 in total length); depth 2.36 (2.8); pectoral 3.5; eye 4.7 in head; snout 3.

Shape of body like that of *C. helvolus*, but nape rather more elevated. Snout obtuse, longer than eye; maxillary extending to front border of pupil; lower jaw rather longer than upper. Teeth

on each jaw rather strong, arranged in a single series. Number of gill-rakers thirteen on lower limb of arch of gill; longest one 2.17 in eye. Lateral line moderately arched, becoming straight below thirteenth soft dorsal ray, which is at anterior two-fifths of fin; height of arch 6 in its width, curved portion a little longer than straight portion, 1.15 times of latter. Caudal peduncle with five scutes. Spinous dorsal low, 2.37 in soft dorsal, which is 1.6 in head; first and last spines very short. Free anal spines small, tip of second only visible. Pectoral slightly shorter than head; ventral 1.45 in head, 1.38 in distance between its insertion and origin of anal.

Color in life uniformly dark brown, with somewhat silvery lustre.

The above description is made from a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7747, measuring 210 mm. in the length of body.

The specimen dealt with here quite agrees with the original description and the figure of this species given by Rüppell.

The present species closely resembles *Caranx helvolus*, but differs from it in having a rather higher body, the maxillary reaching the pupil, shorter gill-rakers, a more strongly curved lateral line, a longer ventral, and much darker coloration.

The species is distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is also known from the southern coasts of Japan proper.

Localities:—Kii; Ryūkyū.

49. *Caranx* (*Uraspis*) *uraspis* Günther.

(PL. XXXI, fig. 1.)

Uraspis carangoides Bleeker, Amboina, VI, 1855, p. 418. (Name preoccupied in *Caranx*).

Caranx uraspis Günther, Cat. Fish. Brit. Mus., Vol. II, 1860, p. 444.

D. VIII-I, 28; A. O-I, 21; scutes 33.

Head 3.30 in length of body (3.84 in total length); depth 2.35 (2.74); pectoral 3.47; eye 4.16 in head; snout 3.25.

Shape of body like that of *C. micropterus*. Snout obtuse, longer than eye; maxillary scarcely reaching centre of eye, lower jaw rather longer than upper. Teeth on each jaw in two series. Lateral line moderately arched, becoming straight below thirteenth soft dorsal ray; curved portion a little longer than straight portion, 1.13 times of latter. Caudal peduncle with five scutes. Spinous dorsal low, 2.35 in soft dorsal, which is 1.58 in head; first and last spines very short. Free anal spines rudimentary, hidden under skin in adult. Pectoral a little shorter than head. Ventral equal to head and extending to anal, longer than that of any species in *Caranx*.

Color in formalin brownish, crossed with six dark vertical bands; spinous dorsal blackish; soft dorsal and anal with a white top, intruding into the dark bands, which cross the body; ventral black; opercular spot indistinct.

The above description is based upon a specimen from Nagasaki, Carnegie Museum Cat. of Fishes, No. 7748, measuring 172 mm. in length of body.

The specimen dealt with here quite agrees with the original description of this species given by Bleeker.

This species distinctly differs from *C. helvolus* and *C. micropterus* in having the teeth on the jaws arranged in two series, the ventral as long as the head, and the body crossed with six dark bands.

The species is distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is also known from the southernmost part of Japan proper.

Localities:—Nagasaki; Ryūkyū.

Subgenus SELAROIDES Bleeker.

Teeth on lower jaw in a single series; those on tongue rudimentary; upper jaw, vomer, and palatines not toothed. Scutes weakly armed. Otherwise similar to *Selar*.

This subgenus corresponds to *Selaroides* of Bleeker, who took *Caranx leptolepis* Cuvier and Valenciennes as the type of his genus.

Only one species of this subgenus is known.

50. *Caranx* (*Selaroides*) *leptolepis* (Cuvier and Valenciennes).

(Pl. XXXI, fig. 2.)

Caranx leptolepis Cuvier and Valenciennes, Vol. IX, 1833, p. 63.—Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 440.—Jordan and Evermann, Proc. U. S. Nat. Mus., Vol. XXV, 1903, p. 337.

D. VIII-I, 25; A. II-I, 20; scutes 30.

Head 3.71 in length of body (4.5 in total length); depth 3.5 (4.2); pectoral 3.6; eye 3.45 in head; snout 3.45.

Body low; profiles gradually and equally curved. Snout rather pointed, equal to eye; maxillary reaching front border of eye; lower jaw very slightly longer than upper. Teeth on lower jaw minute, in a single series; those on tongue rudimentary; upper jaw, vomer, and palatines not toothed. Anterior adipose eyelid somewhat developed; posterior eyelid broad, extending to posterior border of pupil. Lateral line scarcely curved, becoming straight below tenth soft dorsal ray;

curved portion longer than straight portion, 1.37 times of latter. Scutes small, scarcely armed, present along whole length of straight portion of lateral line. Caudal peduncle with eight scutes.

Color in formalin brownish; fins light; opercular spot black, very distinct, encroaching on shoulder.

The above description is taken from a specimen from Ryūkyū, Carnegie Museum Cat. of Fishes, No. 7749, measuring 141 mm. in length of body.

Two smaller specimens from Formosa have the body higher and the head rather longer as follows:

Length of body	124 mm.	111 mm.
Depth in total length	3.64 times	3.58 times
Head in total length	4.27 times	4.28 times

The specimens dealt with here quite agree with the original description of this species given by Cuvier and Valenciennes.

It is distributed throughout the Indian Ocean and the tropical seas of the Pacific. It is not known from Japan proper.

Localities:—Ryūkyū; Formosa.

Subgenus GNATHANODON Bleeker.

Teeth none. Otherwise similar to *Carangoides*.

This subgenus is represented by *C. speciosus*, which is regarded by Gill as the type of the genus *Caranx*, as has been discussed on p. 162.

Only one species of this subgenus is known.

Caranx (Gnathanodon) speciosus (Forskål).

(PL. XXXI, fig. 3.)

Scomber speciosus Forskål, 1775, p. 54.—Seno, Report on Fishery Industry of Formosa, 1910, pl. 7, fig. 3.

D. VIII-I, 19; A. II-I, 16; scutes 15.

Head 3 in length of body (3.72 in total length); depth 2.47 (3); pectoral 3.6; eye 3.62 in head; snout 2.76.

Body oblong; nape elevated; dorsal profile evenly and gradually curved from origin of dorsal to tip of snout. Snout longer than eye; maxillary extending to front border of eye; lower jaw slightly shorter than upper. Teeth none. Adipose eyelid rudimentary. Lateral line moderately arched, becoming straight below eighth soft dorsal ray; curved portion slightly longer than straight portion. Scutes few in number, small in size, weakly armed, present on posterior half of straight portion of lateral line. Breast scaly. Soft dorsal and anal somewhat pointed, but not falcate.

Color in formalin brownish, crossed with five brown vertical bars alternating with five narrower stripes; another bar running down through eye from nape.

The above description is based upon a specimen from Formosa, measuring 86 mm. in length of body.

This species is widely distributed throughout the Indian Ocean, and the tropical seas of the Pacific. It is not known from Japan proper.

Localities:—Formosa.¹⁷

Genus ULUA¹⁸ Jordan and Snyder.

Gill-rakers very numerous, exceedingly long, feather-like in shape. Otherwise similar to *Caranx*, especially to the subgenus *Citula*.

This genus agrees in many regards with the genus *Leioglossus* of Bleeker, but the dentition is different. It is inconceivable that Bleeker when examining the dentition, should have overlooked the extraordinary gill-rakers of *Ulua richardsoni*, which give the appearance of a mouth-full of feathers. It is the opinion of Dr. Jordan that *Ulua* should be regarded as a distinct genus, its characters being of first importance.

Only a single species of this genus is known.

52. *Ulua richardsoni* Jordan and Snyder.

Ulua richardsoni Jordan and Snyder, Mem. Carnegie Museum, Vol. IV, p. 39, pl. 53.

D. VIII-I, 20; A. II-I, 16; scutes about 20.

Head 3.5 in length of body (4 in total length); depth 2.33 (2.8); pectoral 2.3; eye 5.5 in head; snout 3.

Dorsal profile descending gently from origin of dorsal to occipital, thence rapidly to tip of snout. Snout pointed, much longer than eye; maxillary extending below centre of eye; lower jaw prominently longer than upper. No teeth. Gill-rakers numerous, 24 + 54, extremely

¹⁷No specimens of this species were sent to the Carnegie Museum. A. W. HENN.

¹⁸In the original manuscript the author sank the genus *Ulua* Jordan and Snyder in the genus *Leioglossus* Bleeker, with reference to *Leioglossus carangoides* Bleeker, Verh. Bat. Gen., Makr., 1851, p. 367. Dr. D. S. Jordan in revising the manuscript modified the generic characterisation, substituting what is given in the two paragraphs printed above, as well as making some slight changes in the account of the species, which Mr. Wakiya confesses that he has never seen. This explanation seems to the Editor to be one which should be given at this point. W. J. HOLLAND.

long, with small lateral setæ, giving them a distinctly feather-like appearance; length of longest one 3.5 in head. Lateral line strongly arched, becoming straight below twelfth dorsal ray, which is at middle of fin; curved portion slightly longer than straight portion. Scutes tolerably well armed, distinct, except a few anterior ones. Naked area of breast extending to axil of pectoral superiorly, and beyond ventral posteriorly. Soft dorsal and anal highly falcate. Caudal lobe 3.25 in length of body; ventral 2.66 in head.

Color in spirit bright silvery, somewhat dusky above; axils black; dorsals narrowly edged with dusky; caudal with dusky margin.

The type of the species is a specimen eighteen inches in length from Takao, Formosa, Carnegie Museum Cat. of Fishes, No. 413. A cotype from the same locality has the soft dorsal decidedly filamentous, the tip extending backward to the middle of the caudal.

No specimen of this species has come under the inspection of the writer. The above description is based upon the original description and the figure given by Jordan and Snyder.

Locality:—Formosa.

Genus ATROPUS Cuvier.

Body strongly compressed, ovate in shape. Top of head, nape, and isthmus trenchant. Abdomen with a deep median groove, into which ventrals are wholly received, when depressed. Teeth on each jaw in a villiform band; vomer, palatines, and tongue toothed. Adipose eyelid rudimentary. Lateral line strongly curved. Scutes present only on straight portion of lateral line. No finlet behind soft dorsal and anal. Ventral not shorter than head.

Only one species of this genus is known.

53. *Atropus atropus* (Bloch and Schneider).

(PL. XXXII, figs. 1-3.)

Brama atropus Bloch and Schneider, 1801, p. 98, pl. 23.

Caranx nigripes Cuvier and Valenciennes, Vol. IX, 1833, p. 122.

Caranx atropus Günther, Cat. Fish. Brit. Mus., Vol. II, 1860, p. 450.

D. VIII-I, 22; A. II-I, 18; scutes 35.

Head 3.96 in length of body (4.77 in total length); depth 2 (2.43); pectoral 2.6; eye 3.18 in head; snout 3.6.

Body high; nape elevated. Dorsal profile strongly curved at occipital. Snout very obtuse, shorter than eye; maxillary extending beyond front border of pupil; lower jaw longer than upper. Lateral line strongly arched, becoming straight below fourth soft dorsal ray; curved portion shorter than straight portion, 1.67 in latter. Scutes

present along whole length of straight portion of lateral line, but rather weakly armed. Caudal peduncle with five scutes. Cheek with partially imbedded scales; all parts of gill-cover naked, except tops of opercle and preopercle. Naked area of breast extending to pectoral superiorly, and beyond ventrals posteriorly. Several rays of soft dorsal filaments, somewhat produced in male, and slightly so in female, but in young specimens middle rays not filamentous. Pectoral longer than head, 1.5 times of it; ventral equal to head.

Color in formalin brown above, lighter below; spinous dorsal brown; soft dorsal gray, with blackish top and edge; caudal gray; anal and pectoral pale; ventral deep black, with white outer margin; opercular spot indistinct; branchiostegal membrane black.

The above description is derived from a male specimen from Formosa, Carnegie Museum Cat. of Fishes, No. 7750, measuring 214 mm. in length of body.

The older specimens dealt with here quite agree with the original description and figure of this species given by Bloch and Schneider, while a small specimen measuring 124 mm. in length of body, exactly coincides with the original description of *Caranx nigripes* given by Cuvier and Valenciennes.

The species is distributed throughout the Indian Ocean and the tropical areas of the Pacific. It is not known from Japan proper.

Locality:—Formosa.

Genus ALECTIS¹⁹⁻²⁰ Rafinesque.

Body very strongly compressed, subrhomboidal in shape. Top and inferior part of head, nape, and breast trenchant. Teeth on each jaw in a villiform band; vomer, palatines, and tongue toothed. Adipose eyelid rudimentary. Lateral line strongly curved. Scutes present only on straight portion of lateral line, small in size, few in number, and rather weakly armed. Scales minute and imbedded, body apparently naked. Spinous dorsal composed of not numerous, free, rudimentary spines, which disappear with age; anterior rays of soft dorsal and of anal produced into very long filaments. No finlets behind soft dorsal and anal.

¹⁹The differences due to age in this genus are extraordinary, and the value of some of the species here accepted may be questioned. D. S. JORDAN.

²⁰The differences due to age are, as remarked by Dr. Jordan, very great in this genus, especially in the ventrals. It is, however, to be noted that these are proportional to the individuals of the same size among the different species, so that it is possible to distinguish them from each other. Y. WAKIYA.

Five species of this genus are known from Japan.

- a. Depth of preorbital not higher than diameter of eye.
 - b. Depth of body almost equal to its length; width of opercle rather broader than half of its length.....*ciliaris*.
 - bb. Depth of body lower than its length; width of opercle not broader than half of its length.
 - c. Eye longer than snout; preorbital measuring half of eye; interorbital space narrower than diameter of eye.....*indicus*.
 - cc. Eye not longer than snout; preorbital measuring two-thirds of eye; interorbital space equal to diameter of eye.
 - d. Ventral extending far beyond origin of anal; pectoral longer than head.....*temmincki*.
 - dd. Ventral not reaching origin of anal; pectoral equal to head.....*breviventralis*.
- aa. Depth of preorbital much higher than diameter of eye.....*major*.

54. *Alectis ciliaris* (Bloch).

(Pl. XXXII, fig. 4.)

Zeus ciliaris Bloch, Ichthyol., VI, 1788, p. 27, pl. 191.

Caranx ciliaris Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 454.

D. V-I, 19; A. II-I, 16; scutes 12.

Head 2.96 in length of body (3.65 in total length); depth 1.07 (1.29); pectoral 2.7; eye 2.84 in head; snout 3.6.

Depth of body nearly equal to its length. Dorsal profile descending rapidly and in a straight line from origin of soft dorsal to nape, thence, after making a slight curvature at occipital, subvertically to tip of snout; ventral profile ascending straight and slowly from origin of anal to base of ventral, thence rapidly to tip of mandible with a slight concavity. Snout very obtuse, shorter than eye, 1.25 in it; interorbital space narrower than diameter of eye; maxillary extending beyond front border of eye; lower jaw longer than upper. Width of opercle slightly more than half of its length; depth of preorbital equal to half of eye. Lateral line strongly arched, becoming straight below eleventh soft dorsal ray, which is at middle of fin; curved portion slightly longer than straight portion. Scutes few in number, weakly armed, distinct only on posterior half of straight portion of lateral line. Caudal peduncle with five scutes. Anterior seven rays of soft

dorsal and five of anal exceedingly produced, their first rays much longer than twice the length of the body. Pectoral rather longer than head, not very greatly pointed; ventral very long, half of the length of body, extending to base of ninth or tenth anal ray.

Color in formalin brownish, crossed with six blackish subvertical bands; prolonged rays of dorsal and anal becoming black distally; a large black blotch present on soft dorsal, extending between first and seventh soft rays; another black blotch on anal, extending between first and fifth rays; opercular spot black, but not distinct, it being situated on a diffuse blackish blotch on opercle; pectoral pale; ventral deep black.

The foregoing description is drawn from a specimen from the Bonin Islands, Carnegie Museum Cat. of Fishes, No. 7751, measuring 78 mm. in length of body.

The specimens examined exactly agree with the figure of this species given by Bloch.

It may be distinguished from all other species of *Alectis* by the possession of a less curved head and a much longer ventral.

The species is widely distributed throughout the Indian Ocean and the tropical seas of the Pacific, but is rare in Japan proper.

Localities:—Misaki, Bonin Islands.

55. *Alectic indicus* (Cuvier and Valenciennes).

Blepharis indicus Cuvier and Valenciennes, Vol. IX, 1833, p. 154.

Blepharis fasciatus Rüppell, Atl. Fische, 1828, p. 129, pl. 33, fig. 2 (*non* Richardson).

Caranx ciliaris Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 454.

D. V-I, 19; A. II-I, 16; scutes 17.

Head 2.9 in length of body (3.5 in total length); depth 1.23 (1.52); pectoral 2.5; eye 2.54 in head; snout 3.47.

Depth of body lower than its length. Dorsal profile descending straight and rather rapidly from origin of soft dorsal to nape, thence, making an arc of a circle, to snout, which descends subvertically. Snout exceedingly obtuse, shorter than eye; interorbital space narrower than diameter of eye; maxillary extending beyond front border of eye; lower jaw longer than upper. Width of opercle 2.33 in its length; depth of preorbital equal to half of eye. Lateral line strongly arched, becoming straight below eleventh soft dorsal ray, which is at middle of fin; curved portion slightly shorter than straight portion. Scutes weakly armed, but comparatively numerous, distinct on posterior three-fifths of straight portion of lateral line. Caudal peduncle with five scutes. Anterior soft rays of dorsal and anal

prolonged, just like those of *Alectis ciliaris*. Pectoral long, much more pointed than that of *Alectis ciliaris*; ventral 4.3 in length of body, just reaching to origin of anal.

Color just like that of *Alectis ciliaris*, except that the ventral is much lighter.

The foregoing description is based upon a specimen from the Bonin Islands, measuring 90 mm. in the length of the body.

The specimen here dealt with agrees exactly with the figure and description of this species given by Rüppell, and also with the description of *Blepharis indicus* given by Cuvier and Valenciennes.

Though the species resembles *A. ciliaris* so closely that it has been regarded by Günther and many other ichthyologists as a synonym of the latter, it not only differs from that species in having a less elevated body, a more strongly curved head, and a much more pointed pectoral, as remarked by Cuvier and Valenciennes, but also in having a rather larger eye, a much narrower opercle, and a shorter and lighter ventral.

The species is as widely distributed as *A. ciliaris*, but is not known from Japan proper.²¹⁻²²

Locality:—Bonin Islands.

56. *Alectis temmincki* Wakiya, sp. nov.

Blepharis indicus Temminck and Schlegel (*non* Cuvier and Valenciennes), 1844, p. 113, pl. 60, fig. 2.

Caranx ciliaris Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 454.

D. V-I, 19; A. II-I, 16; scutes 15.

Head 3 in length of body (3.6 in total length); depth 1.29 (1.54); pectoral 2.45; eye 3.07 in head; snout 3.1.

Depth of body rather lower than its length. Dorsal profile descending almost straight and rather rapidly from origin of soft dorsal to nape, thence making a slight curvature to tip of snout. Snout obtuse, equal to eye, or slightly shorter than eye; interorbital space equal to eye; maxillary extending beyond front border of eye; lower jaw longer than upper. Width of opercle 2.33 in its length; depth of preorbital two-thirds of eye. Lateral line strongly arched, becoming straight below twelfth soft dorsal ray, which is a little behind middle of fin; curved portion almost equal to straight portion, 107 of it.

²¹No specimen of this species was received from Mr. Wakiya by the Carnegie Museum. A. W. HENN.

²²It is possibly the adult form of *A. ciliaris*. D. S. JORDAN.

Scutes weakly armed, distinct along posterior half of lateral line. Caudal peduncle with five scutes. Anterior rays of soft dorsal and of anal produced just like those of *A. ciliaris*. Pectoral longer than head, more pointed than that of *A. ciliaris*; ventral 2.3 in length of body, extending to fifth or sixth anal ray.

Color in formalin like that of *A. ciliaris*, but ventral much lighter.

The foregoing description is based upon the type, a specimen from the Bonin Islands, Carnegie Museum Cat. of Fishes, No. 7752, measuring 120 mm. in the length of body.

The specimen here dealt with is identical with that from Nagasaki described and figured by Temminck and Schlegel as *Blepharis indicus* Cuvier and Valenciennes, from which species it differs in having a longer ventral, a smaller eye, and a higher preorbital in comparison with the eye.²³ It is also distinct from *A. ciliaris* in having a lower body, a more strongly curved head, and a narrower opercle.

The species is rather common in the warmer waters of Japan proper.

Localities:—Tosa; Nagasaki; Bonin Islands.

57. *Alectis breviventralis* Wakiya, sp. nov.

(PL. XXXIII)

D. V-I, 19; A. II-I, 16; scutes 12.

Head 3 in length of body (3.6 in total length); depth 1.35 (1.63); pectoral 3; eye 3.38 in head; snout 3.

Depth of body lower than length of body. Dorsal profile descending straight and rather slowly from origin of soft dorsal to nape, thence to tip of snout, making an arc of a circle. Snout obtuse, rather longer than eye; interorbital space equal to eye; maxillary extending to front border of eye; lower jaw longer than upper. Width of opercle half of its length; depth of preorbital about two-thirds of eye. Lateral line strongly arched, becoming straight below eleventh soft dorsal ray, which is at middle of fin; curved portion rather longer than straight portion, 1.15 in latter. Scutes few in number, weakly armed, distinct only on posterior half of straight portion of lateral line. Caudal peduncle with five scutes. Anterior rays of soft dorsal and of anal produced just like those of *A. ciliaris*. Pectoral equal to head, much more pointed than that of *A. ciliaris*; ventral comparatively short, 4 in length of body, 1.5 in distance between its insertion and origin of anal.

Color in formalin just like that of *A. ciliaris*, but ventral much lighter.

The foregoing description is based upon the type, a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7753, measuring 116 mm. in length of body.

²³It may, however, be the young of that species. D. S. JORDAN.

The proportions of the different parts of the body vary in accordance with the size of the specimens as follows:

Length of body.	83 mm.	83 mm.	90 mm.	104 mm.	116 mm.	127 mm.	130 mm.
Head in length of							
body.	3.04 times	3.00 times	3.00 times	3.05 times	3.00 times	3.07 times	3.05 times
Depth in length							
of body.	1.20 times	1.22 times	1.20 times	1.30 times	1.35 times	1.33 times	1.33 times
Eye in head. . . .	3.05 times	3.11 times	3.06 times	3.23 times	3.00 times	2.93 times	2.80 times
Snout in head. .	3.05 times	3.11 times	3.15 times	3.10 times	3.00 times	2.93 times	2.80 times
Pectoral in							
length of body	2.90 times	3.07 times	2.90 times	2.90 times	3.00 times	2.90 times	2.85 times
Ventral in length							
of body.	3.45 times	3.60 times	4.00 times	4.33 times	4.72 times	4.80 times	4.98 times
Ventral in dis-							
tance between							
its insertion							
and origin of							
anal.	2.20 times	1.35 times	1.36 times	1.45 times	1.50 times	1.60 times	1.51 times

The present species can easily be distinguished from *A. ciliaris* and its allied species by the possession of a lower body, a smaller eye, a shorter pectoral, and a much shorter ventral.²⁴

The species is common in the warmer waters of Japan proper.

Localities:—Tōkyō Bay; Kii; Uwajima; Ryūkyū; Formosa; Bonin Islands.

58. *Alectis major* (Cuvier and Valenciennes).

(PL. XXXIV, fig. 1.)

Gallichthys major Cuvier and Valenciennes, Vol. IX, 1833, p. 168, pl. 254.

Caranx gallus Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 455.

Alectis ciliaris Jordan and Evermann, (*non* Bloch) Proc. U. S. Nat. Mus., XIV, 1903, p. 338.—Seno (*non* Bloch) Report on Fishery Industry of Formosa, 1910, p. 119.

Alectis major Jordan and Richardson, Mem. Carnegie Museum, Vol. IV, 1909, p. 180.

D. VI-I, 19; A. II-I, 16; scutes 8.

Head 2.75 in length of body (3.51 in total length); depth 1.33 (1.66); pectoral 2.55; eye 4 in head; snout 2.25.

Dorsal profile descending straightly and rather rapidly from origin of soft dorsal to nape; thence very rapidly to tip of snout, making a

²⁴This fin, however, rapidly grows shorter with age in this group. D. S. JORDAN.

strong angle at occipital; ventral profile ascending nearly straight and rather rapidly from origin of anal to tip of mandible. Snout obtuse, but much longer than eye, about twice of it; maxillary scarcely reaching below anterior nostril; opercle 1.6 in its length; depth of preorbital much deeper than diameter of eye, 1.7 of it. Lateral line strongly arched, becoming straight below tenth soft dorsal ray, which is at middle of fin. Scutes not very numerous, weakly armed, distinct only on posterior half of straight portion of lateral line. Caudal peduncle with five scutes. Anterior nine dorsal rays and three anal rays produced into long filaments; first dorsal ray rather longer than length of body. Pectoral rather longer than head; outer three rays of ventral produced into long filaments, its first ray reaching caudal.

Color in formalin uniformly brownish, with no traces of darker cross-bands on body; anterior portions of soft dorsal and anal gray, with produced rays deep black and without black blotches; ventral distally deep black.

The foregoing description is based upon a specimen from Formosa, Carnegie Museum Cat. of Fishes, No. 7754, measuring 130 mm. in length of body.

The specimen here dealt with quite agrees with the original description and figure of this species given by Cuvier and Valenciennes. On examining a specimen from Formosa identified by Jordan and Evermann with *A. ciliaris*, and which is now preserved in the Museum of Suisan-Kōsyūjo, the writer has found that it is certainly this species, as has already been indicated by Jordan and Richardson.

The species is distributed through the Indian Ocean, and the tropical seas of the Pacific, but it is not known from Japan proper.

Locality:—Formosa.

Subfamily TRACHYNOTINÆ.

Body much compressed, oblong in shape, much elevated at middle. Head trenchant at top. Premaxillary protractile. Teeth present on jaws, vomer, and palatines, but in some species becoming lost with age. Gill-rakers normal in shape. Scales small, cycloid. Lateral line scarcely curved, not armed with scutes, not developed into a keel on each side of caudal peduncle. Spinous dorsal composed of a few, short, free spines. Soft dorsal and anal highly falcate anteriorly; anal equal to soft dorsal, much longer than abdomen. Pectoral short, not pointed; ventral also short.

Only a single genus is known in this subfamily.

Genus TRACHYNOTUS Lacépède.

The generic characters are the same as those of the subfamily.

Four species of this genus are known from Japan, two of which are new to science.

- a. Lower jaw not longer than upper; anterior nostril much smaller than posterior, scales very small.
- b. Caudal lobe 3.5 in total length; lobe of soft dorsal and of anal not longer than their own bases.
 - c. Head 4.5 in length of body; pectoral 6; ventral 10; soft dorsal rays 24; soft anal rays 23. *bailloni*.
 - cc. Head 3.5 in length of body; pectoral 5.3; ventral 8; soft dorsal rays 22 or 23; soft anal rays 22. *cuvieri*, sp. nov.
 - bb. Caudal lobe 3 in length of body; lobe of soft dorsal and of anal longer than their own bases. *quadripunctatus*.
- aa. Lower jaw longer than upper; anterior nostril as large as posterior; scales rather large. *jordani*, sp. nov.

59. *Trachynotus bailloni* (Lacépède).

Cæsiomorus bailloni Lacépède, 1802, p. 93, pl. 3, fig. 1.

Trachynotus bailloni Cuvier and Valenciennes, (*partim*), Vol. III, 1831, p. 431.—Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 484.—Seno, Report on Fishery Industry of Formosa, 1910, p. 119, pl. 5, upper figure.

D. VI-I, 24; A. II-I, 23.

Head 4.44 in length of body (5.8 in total length); depth 2.3 (3.07); pectoral 6.1; ventral 10; eye 4.3 in head; snout 4.

Snout obtuse, rather longer than eye. Maxillary extending to front border of pupil; lower jaw slightly shorter than upper. Anterior nostril smaller than half of posterior, midway between tip of snout and front border of eye. Jaws, vomer, and palatines toothed. Scales small. Top of soft dorsal a little less than length of its base; that of anal nearly equal to its base. Caudal lobe 3.5 in total length.

Color in formalin brown above, lighter below; four small black spots on lateral line; the first below origin of spinous dorsal; the second below fifth spine; the third below sixth ray of soft dorsal; and the fourth below the sixteenth ray; the anterior two spots being rather larger than pupil, twice the size of the two posterior spots. The three anterior rays of soft dorsal and of anal black; outer rays of caudal blackish.

The foregoing description is based upon a specimen from Formosa, measuring 190 mm. in length of body.²⁵

²⁵No specimen of this species was sent to the Carnegie Museum. A. W. HENN.

The specimen dealt with here quite agrees with the description and figure of this species given by Lacépède.

The species is widely distributed throughout the Indian Ocean and the tropical portions of the Pacific. It is not known from Japan proper.

Locality:—Formosa.

60. *Trachynotus cuvieri* Wakiya, *sp. nov.*

Trachynotus bailloni Cuvier and Valenciennes (*partim*), Vol. VIII, 1831, p. 431.

D. VI-I, 22; A. I-I, 22.

Head 3.7 in length of body (5 in total length); depth 2.4 (3.2); pectoral 5.33; ventral 8; eye 4.5 in head; snout 3.5.

Snout longer than eye, its tip subvertical. Maxillary extending to point below center of eye. Top of soft dorsal 1.4 in its base; that of anal 1.3 in its base. Caudal lobe 3.65 in total length. Four small black spots on lateral line of which the second and third are rather larger than the other two, but only one-half diameter of pupil. Otherwise similar to *T. bailloni*.

The foregoing description is based upon a specimen from Misaki, measuring 120 mm. in length of body.²⁶

The specimen dealt with here is identical with that from the Indian Ocean, which was described by Cuvier and Valenciennes as *T. bailloni* Lacépède, but differs from it in having a much longer head, a blunter snout, the pectoral and the ventral longer, the soft dorsal and the anal rather lower, the dorsal rays somewhat less numerous, and the black spots on the side of the body smaller.

The species seems to be distributed throughout the Indian Ocean and the warm seas of the Pacific. It is only occasionally found along the warmer coasts of Japan proper.

Localities:—Misaki; Uwajima; Ryūkyū; Formosa.

61. *Trachynotus quadripunctatus* (Rüppell).

(PL. XXXIV, fig. 2.)

Cæsiomorus quadripunctatus Rüppell, Atl. Fische, 1828, p. 90, pl. 24, fig. 1.

Trachynotus bailloni Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 484.

D. VI-I, 23; A. II-I, 22 or 23.

Head 3.9 in length of body (5.36 in total length); depth 2.16 (3); pectoral 5.5; ventral 8.4; eye 4.55 in head; snout 3.9.

²⁶Neither the type nor any other specimen of this species was sent by Dr. Wakiya to the Carnegie Museum. A. W. HENN.

Snout rather obtuse, longer than eye. Maxillary extending a little beyond front border of pupil. Anterior nostril smaller than half of the posterior, rather nearer to eye than to tip of snout. Jaws, vomer, and palatines toothed. Scales minute. Anterior part of lateral line somewhat wavy. Top of soft dorsal equal to its base; that of anal a little longer than its base. Caudal lobe 3.1 in total length.

Color in formalin brown above, lighter below; two small black spots on lateral line; the first below the fifth spine of spinous dorsal, the second below the fifth soft dorsal ray; anterior rays of soft dorsal and anal and outer margins and tips of caudal black.

The foregoing description is derived from a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7755, measuring 160 mm. in length of body.

The specimen here dealt with quite agrees with the description and the figure of this species given by Rüppell. The species closely resembles both *T. bailloni* and *T. cuvieri*, but may be easily distinguished from both by its having the lobes of dorsal, anal, and caudal longer, and by its having smaller scales.

It is distributed throughout the Indian Ocean, and the tropical areas of the Pacific. It is rarely taken along the warmer coasts of Japan proper.

Localities:—Kii; Ryūkyū; Formosa.

62. *Trachinotus jordani* Wakiya, sp. nov.

(Pl. XXXV, fig. 1.)

D. V-I, 23; A. II-I, 22.

Head 4.12 in length of body (6.25 in total length); depth 2.53 (3.83); pectoral 5.6; ventral 15; eye 3.6 in head; snout 3.6.

Snout obtuse; maxillary extending to front border of pupil; lower jaw rather longer than upper. Anterior nostril as large as posterior, nearer to front border of eye than to tip of snout. Jaws, vomer, and palatines toothed. Scales rather large, partially imbedded. Lateral line slightly curved anteriorly. Top of soft dorsal 1.64 in its base; that of anal 1.47 in its base. Caudal lobe 3.33 in total length.

Color in formalin dark brown above, light below; four black spots on middle of side of body; the two anterior spots smaller than pupil, and located just above lateral line in front of spinous dorsal; the two posterior spots larger than pupil, located on the lateral line, one below the third spine of the spinous dorsal, the other below the fifth dorsal ray; dorsal, anal, and caudal blackish, margined with white; paired fins pale.

The foregoing description is drawn from the type, a specimen from the Bonin Islands, Carnegie Museum Cat. of Fishes, No. 7756,

measuring 297 mm. in the length of the body. The type is unique, being the only specimen which has so far come to hand.

The species is named after Dr. David Starr Jordan.

Locality:—Bonin Islands.

Subfamily SERIOLINÆ.

Body somewhat compressed, oblong in shape, not much elevated at middle, with abdomen rounded. Head pointed, scarcely, or but slightly compressed. Premaxillary protractile. Teeth in villiform bands, present on jaws, vomer, palatines, and tongue. Gill-rakers mostly normal in shape. Scales small, cycloid, partially imbedded. Lateral line slightly curved anteriorly, not armed with scutes, but mostly developing a keel on each side of the caudal peduncle. Spinous dorsal composed of several spines connected with membrane, or of short free spines; anal with detached spines much shorter than soft dorsal, not longer than abdomen. Generally no finlets behind soft dorsal and anal, but a single one in some species. Pectoral short, roundish, usually not longer than ventral.

Four genera of this subfamily are known from Japan.

- a.* No finlets behind soft dorsal and anal.
- b.* Spines of spinous dorsal connected with membrane.
- c.* Gill-rakers normal in shape. *Seriola*.
- cc.* Gill-rakers transformed into knob-like masses. . . *Seriolina*.
- bb.* Spines of spinous dorsal free. *Naucrates*.
- aa.* A finlet behind soft dorsal and anal. *Elagatis*.

Genus SERIOLA Cuvier.

Spinous dorsal composed of five to seven spines connected with membrane; no finlets behind soft dorsal and anal. Lateral line more or less developed into a keel on each side of caudal peduncle.

Four species of this genus are known from Japan.

- a.* Head not greatly curved; snout pointed; maxillary extending to front border of eye in adult; about two hundred scales; gill-rakers on lower limb twenty or more.
- b.* Spinous dorsal with six spines (seven in young); snout nearly equal to interorbital space; highest dorsal spine not higher than three times in highest soft dorsal ray; pectoral shorter than ventral; posterior end of maxillary with roundish upper corner. *aureovittata*.

- bb.* Spinous dorsal with five spines (six in young); snout rather longer than interorbital space; highest spine not lower than 2.5 in highest soft dorsal ray; pectoral not shorter than ventral; posterior end of maxillary with an acute upper corner. *quinqueradiata*.
- aa.* Maxillary nearly reaching center of eye in adult; about one hundred and fifty scales; gill-rakers upon lower limb about twenty.
- c.* Depth of body not lower than length of head; depth of caudal peduncle nearly equal to its length. *purpurascens*.
- cc.* Depth of body lower than length of head; depth of caudal peduncle not more than 1.43 in its length. *cristata*.

63. *Seriola aureovittata* Temminck and Schlegel.

(PL. XXXV, fig. 2.)

Seriola aureovittata Temminck and Schlegel, 1844, p. 115, pl. 62, fig. 1.

Seriola lalandi Günther (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 463.

D. VII (VI)-I, 34-36; A. II (O)-I, 20-22; scales about 200; vert. 25 (11+14).

Head 3.62 in length of body (4.44 in total length); depth 3.71 (4.45); eye 6 in head; snout 3; maxillary 2.55; pectoral 1.9; ventral 1.56.

Body rather strongly compressed; its thickness about twice in depth. Dorsal profile of head slightly curved. Snout subconical, much longer than eye, twice as long, and equal to interorbital space. Maxillary extending somewhat beyond front border of eye (to front border of eye in full-grown specimens, and to center of eye in youngest); its posterior end slightly convex, with roundish corners, its breadth 3 in length. Gill-rakers 8-20, anterior two or three on lower limb rudimentary, longest a little shorter than eye. Depth of caudal peduncle 1.33 in its length; keel on its side distinct. Spinous dorsal commencing at point equal to diameter of eye behind base of pectoral, with seven spines, but the last one very short, not clearly visible in specimens longer in the length of body than 400 mm.; third or fourth spines highest, rather shorter than eye, 6.5 in head, 3.2 in highest soft dorsal ray, which is 2 in head. Anal spines short, not clearly visible in full-grown specimens. Origin of soft anal below anterior two-fifths of soft dorsal. Ventral just behind base of pectoral, rather longer than latter, 2 in distance between its insertion and origin of anal. Caudal lobe rather longer than head. Pyloric cæca about two hundred in number, rather short and thick; longest ones about one-third of head.

Color in life steel-blue above, lead-white below; a distinct yellow longitudinal band running from snout to caudal peduncle; ventral yellow; other fins olivaceous, with yellowish margins.

The above description is drawn from a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7757, measuring 300 mm. in length of body.

The proportions of the parts of the body vary greatly in accordance with the size of the specimens as follows:

Length of body.....	615 mm.	535 mm.	454 mm.	300 mm.	290 mm.
Head in length of body...	3.80 times	3.80 times	3.69 times	3.62 times	3.62 times
Depth in length of body...	3.90 times	4.12 times	3.90 times	3.71 times	3.71 times
Eye in head.....	6.80 times	6.71 times	6.47 times	6.01 times	5.92 times
Eye in snout.....	2.54 times	2.50 times	2.31 times	2.02 times	2.00 times
Pectoral in head.....	2.00 times	2.00 times	2.05 times	1.90 times	1.90 times
Ventral in head.....	1.63 times	1.65 times	1.78 times	1.56 times	1.56 times
Ventral in distance between its insertion and origin of anal.....	2.25 times	2.22 times	2.23 times	1.94 times	1.94 times
Highest dorsal spine in head	7.50 times	7.00 times	7.23 times	6.50 times	6.40 times
Highest dorsal spine in soft dorsal.....	3.57 times	3.40 times	3.50 times	3.20 times	3.12 times
Soft dorsal in head.....	2.16 times	2.06 times	2.05 times	2.00 times	2.05 times

Although Günther has united this species with *S. lalandi*, under the assumption that Temminck and Schlegel's figure is not correct, the specimens here dealt with accord so exactly with the original description and the figure given by the authors of *S. aureovittata*, that Günther's view cannot be considered valid. It is true that this species bears some resemblance to *S. lalandi* in the shape of the body, the number of the rays of the soft dorsal and the anal, and the coloration, but that species of the Atlantic differs very distinctly from the present fish in having the maxillary broader and much more strongly curved at its posterior end, and extended to the center of the eye, the spinous dorsal as high as 2.3 in the soft dorsal, and the ventral inserted beneath the base of the pectoral. It is therefore not admissible to regard the two species as the same.

The species is distributed throughout the temperate seas of eastern Asia, but it is rare northward on the coasts of Japan beyond the Kinkazan Peninsula on the east, and the Tsugaru Strait on the west.

Localities:—Sendai Bay; Tōkyō Bay; Kii; Kumamoto; Gensan and Chemulpo (Korea); Port Arthur.

64. *Seriola quinqueradiata* Temminck and Schlegel.

(PL. XXXVI fig. 1.)

Seriola quinqueradiata Temminck and Schlegel, 1844, p. 115, pl. 62, fig. 2.—
Steindachner and Döderlein, Vol. III, 1884, p. 185.

Seriola lalandi Steindachner and Döderlein (*non* Cuvier and Valenciennes),
Vol. III, 1884, p. 185.

Seriola aureovittata Jordan, Tanaka, and Snyder, (*non* Temminck and Schlegel),
Cat. Fishes of Japan, 1913, p. 127, fig. 90.

D. VI (V)-I, 30-34; A. II-I, 17-20; scales about 200; vert. 24 (10+14).

Head 3.4 in length of body (4.1 in total length); depth 3.9 (4.6); eye 8.1 in head; snout 2.7; maxillary 2.52; pectoral 2.12; ventral 2.15.

Body a little compressed, its thickness about 1.5 in depth. Dorsal profile of head nearly straight. Snout pointed, conical, very much longer than eye, three times of it, and rather longer than interorbital space. Maxillary extending somewhat beyond front border of eye (scarcely to front of eye in full-grown specimens, and nearly to center of eye in younger); its posterior end straight, with acute upper corner and roundish lower corner, decidedly inclined backward; its breadth 3.1 in length. Preopercle descending backward rather more obliquely, and more strongly curved at angle than in all other species of *Seriola* from Japan. Gill-rakers 8 to 10-20 to 23; first or second anterior rakers on lower limb rudimentary; highest rakers equal to, or a little longer than eye, but slightly shorter in young specimens. Depth of caudal peduncle about 2 in its length; keel on its sides very distinct. Spinous dorsal commencing at a point nearly twice diameter of eye from behind base of pectoral; six spines, the last very short, not plainly visible in adults; second or third spine longer than eye, 6.8 in head, 2.53 in highest soft dorsal ray, which is 2.7 in head. Anal spines short, tip of second spine barely visible in full-grown specimens. Origin of soft anal below middle of soft dorsal. Ventral inserted below posterior part of base of pectoral, not longer than latter, 2.7 between its insertion and origin of soft anal. Caudal lobe rather shorter than head. Pyloric cæca slender, very numerous, varying from four hundred to five hundred; longest cæcum 1.5 in head.

Color in life like that of *S. aureovittata*, but yellow longitudinal band on side fainter and more diffuse, and vertical fins faintly tinged with yellow.

The foregoing description is drawn from a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7758, measuring 350 mm. in length of body.

The proportions of the parts of the body vary greatly in accordance with the size of the specimens as follows:

I.

Length of body	795 mm.	735 mm.	350 mm.	300 mm.	295 mm.
Head in the total length . .	4.18 times	3.98 times	4.08 times	4.11 times	4.00 times
Head in length of body . . .	3.53 times	3.50 times	3.40 times	3.43 times	3.31 times
Depth in total length	4.50 times	4.97 times	4.61 times	4.80 times	4.66 times
Depth in the length of body	3.78 times	4.23 times	4.02 times	3.91 times	3.93 times
Eye in head	9.00 times	8.48 times	8.10 times	8.00 times	8.00 times
Snout in head	2.74 times	2.65 times	2.78 times	2.80 times	2.80 times
Eye in snout	3.28 times	3.20 times	2.91 times	2.85 times	2.85 times
Pectoral in head	2.25 times	2.16 times	2.12 times	2.12 times	2.12 times
Ventral in head	2.47 times	2.30 times	2.12 times	2.12 times	2.07 times
Ventral in distance between its insertion and origin of anal	3.40 times	3.00 times	2.70 times	2.60 times	2.53 times
Third spine in soft dorsal . .	2.62 times	2.83 times	2.53 times	2.47 times	2.46 times
Soft dorsal in head	2.62 times	2.75 times	2.83 times	2.70 times	2.78 times
Third spine in head	7.76 times	8.00 times	6.80 times	6.40 times	6.83 times
Depth of caudal peduncle in its length	2.00 times	2.04 times	1.90 times	1.90 times	1.88 times

II.

Length of body	185 mm.	163 mm.	151 mm.	142 mm.	135 mm.
Head in total length	3.85 times	3.90 times	3.91 times	4.00 times	3.90 times
Head in length of body . . .	3.27 times	3.25 times	3.28 times	3.42 times	3.30 times
Depth in total length	5.10 times	5.00 times	4.90 times	4.60 times	4.90 times
Depth in length of body . .	4.34 times	4.18 times	4.08 times	3.84 times	4.05 times
Eye in head	6.50 times	6.25 times	6.13 times	6.07 times	5.12 times
Snout in head	2.83 times	2.77 times	2.87 times	2.83 times	2.95 times
Eye in snout	2.30 times	2.25 times	2.13 times	2.14 times	1.75 times
Pectoral in head	2.18 times	2.12 times	2.09 times	1.93 times	1.95 times
Ventral in head	2.06 times	2.08 times	2.09 times	1.93 times	1.95 times
Ventral in distance between its insertion and origin of anal	2.40 times	2.33 times	2.28 times	2.28 times	2.33 times
Third spine in soft dorsal . .	2.30 times	2.12 times	2.28 times	2.28 times	2.33 times
Soft dorsal in head	2.64 times	2.94 times	2.87 times	2.65 times	2.90 times
Third spine in head	6.55 times	6.25 times	6.57 times	6.70 times	6.80 times
Depth of caudal peduncle in its length	1.87 times	1.71 times	1.70 times	1.68 times	1.60 times

Among the specimens dealt with here those attaining about 500 mm. in length of body exactly agree with the description and the figure of this species given by Temminck and Schlegel, while those measuring from 150 mm. to 200 mm. accord with the description of Steindachner and Döderlein.

The species is distinct from all other species of *Seriola* from Japanese waters in having a less curved head; a longer and more pointed snout; a smaller eye; the maxillary with an acute upper corner at its posterior end and decidedly inclined backward; the preopercle obliquely descending backward and strongly curved at the angle; the gill-rakers not shorter than the eye; a slenderer caudal peduncle; the pectoral not shorter than the ventral; the soft dorsal as low as 2.8 in the head; and much more numerous and longer pyloric cæca. The species approaches nearer to *S. aureovittata* than any other, but it can easily be distinguished from the rest, not merely by the above mentioned peculiarities, but by the number of vertebræ, the proportion of the highest spine of the spinous dorsal to the highest soft dorsal ray, the length of the caudal lobe in comparison with the head, and the coloration in life.

Two small specimens from Japan, which have been identified by Steindachner with *S. lalandi*, according to the description given by that author, have six spines in the spinous dorsal, the head rather longer than 4 in the total length, the depth about 5, the eye 5 in the head, the snout 3, the ventral 2.6 in the distance between its insertion and the origin of the anal, and the maxillary extending to the center of the eye. I infer from these peculiarities that they are neither *S. lalandi* Cuvier and Valenciennes, nor *S. aureovittata* Temminck and Schlegel, but the young of the present species, measuring about 130 mm. in length of body. A specimen from Japan figured by Jordan, Tanaka, and Snyder as *aureovittata* must also belong to this species, since all the characters, which can be ascertained from their figure, exactly accord with the peculiarities of the present species.

The species ranges through the temperate seas of eastern Asia, like *S. aureovittata*, and it is found as far north as the southern coasts of Sakhalin, but it does not extend southward beyond the southernmost coast of Kyūshū.

Localities:—Aomori; Toyama; Miyako; Sendai Bay; Tōkyō Bay; Kii; Uwajima; Kagoshima; Kumamoto; Fusan; Genjan and Seishin (Korea).

65. *Seriola purpurascens* Temminck and Schlegel.

(PL. XXXVI, fig. 2.)

Seriola purpurascens Temminck and Schlegel, 1844, p. 113, pl. 61.*Seriola dumerili* Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 462.—Steindachner and Döderlein (*non* Risso), Vol. III, 1884, p. 186.

D. VII (VI)-I, 32 or 33; A. II-I, 19 to 22; scales 150; vert. 24 (10+14).

Head 3.3 in length of body (4 in total length); depth 3 (3.55); eye 5.7 in head; snout 2.65; maxillary 2.27; pectoral 2; ventral 1.8.

Body rather strongly compressed; its thickness twice in depth. Dorsal profile evenly and rather strongly curved from origin of dorsal to tip of snout. Depth of body not less than length of head. Snout obtuse, much longer than eye, 2.15 of it, and rather longer than interorbital space. Maxillary reaching center of eye; its posterior end broad and convex with rounded corners; its breadth 2.6 in length. Gill-rakers 4 to 6/12 to 15; anterior first or second rakers on lower limb rudimentary; longest ones 1.4 in eye. Depth of caudal peduncle nearly equal to its length (rather less than its length in adults); keel on each side rather distinct. Spinous dorsal commencing at point equal to half diameter of eye behind base of pectoral; with seven spines, but the last one very short, not plainly visible in full-grown specimens; third spine highest, rather longer than eye, 2.1 in highest soft dorsal ray, which is 22 in head. Anal spines short, not plainly visible in adult. Origin of soft anal only a little before middle of soft dorsal. Ventral below posterior part of base of pectoral, rather longer than latter, 2.2 in distance between its insertion and origin of soft anal. Caudal lobe rather shorter than head. Fifty to sixty pyloric cæca, the longest half of head.

Color in life purplish brown above, whitish below; a yellow longitudinal band from behind middle of upper jaw to base of caudal through eye; fins dark olivaceous, anal edged with white.

The above description is drawn from a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7759, measuring 285 mm. in length of body.

The measurement of another specimen from Nagasaki, which is 600 mm. in length, is as follows: head 3.46 in length of body; depth 3.4; eye 6.18 in head; snout 2.62; interorbital space 2.88; maxillary 2.45; pectoral 2.11; ventral 1.88; highest ray of soft dorsal 2.25; highest spine 4.52; depth of caudal peduncle 1.13 in its length.

The specimens examined closely agree with the original description and figure of this species given by Temminck and Schlegel.

The species closely resembles *S. dumerili*, but differs from it in the proportion of the maxillary in the head, the position of the origin of the spinous dorsal in reference to the base of the pectoral, and the coloration of the body; the species found in the Atlantic having the maxillary as long as 2.1 in the head, the spinous dorsal commencing above the base of the pectoral, and the body not tinged with purple. It attains six feet in length and one hundred pounds in weight.

The distribution of this species is similar to that of *S. aureovittata*, and it also extends along the coasts of the Yellow Sea.

Localities:—Tōkyō Bay; Kii; Uwajima; Kumamoto; Niigata; Toyama Bay.

66. *Seriola cristata* Döderlein.

(Pl. XXXVII, fig. 1.)

Seriola cristata Döderlein, Vol. III, 1884, p. 186.

Seriola dumerili Günther, (*non* Risso) Südsee Fische, Vol. V, 1876, p. 136, pl. 10, fig. a.

Seriola purpurascens Jordan and Evermann, (*non* Temminck and Schlegel), Bull. U. S. Fish. Commission, Vol XXIII, 1905, p. 183.

Seriola aureovittata Jordan, Tanaka, and Snyder (*partim*), Cat. Fishes of Japan, 1913, p. 127.

D. VI-I, 33; A. O-I, 21; scales about 150; vert. 24 (10+14).

Head 3.44 in length of body (4.1 in total length); depth 3.73 (4.45); eye 5.5 in head; snout 2.8; maxillary 2.32; pectoral 2; ventral 1.75.

Body a little compressed, its thickness about 1.5 in depth. Dorsal profile evenly and rather strongly curved from nape to tip of snout. Snout obtuse, longer than eye, twice its diameter, and a little longer than interorbital space. Maxillary extending to center of eye; its posterior end broad and convex, with rounded corners; its breadth 2.6 in length. Gill-rakers 6/15; anterior three on lower limb rudimentary; longest 1.46 in eye. Depth of caudal peduncle 1.43 in length; keel on the sides rather distinct. Spinous dorsal commencing at point equal to half of diameter of eye behind base of pectoral; spines six in number, the last one very short, only its tip being visible; third spine the highest, slightly longer than the eye, 4.76 in head, 2.05 in highest soft dorsal ray, which is 2.32 in head. Anal spines rudimentary; their tips not plainly visible. Origin of anal below anterior two-fifths of soft dorsal. Ventral inserted below just behind base of pectoral, rather longer than latter, 2 in distance between its insertion and origin of anal. Caudal lobe equal to head. Pyloric cæca forty in number; longest about half of head.

Color like that of *S. purpurascens*.

The above description is founded upon a specimen from Sagami Bay, Carnegie Museum Cat. of Fishes, No. 7760, measuring 344 mm. in length of body.

The specimen here dealt with agrees well with the original description of the species given by Döderlein.

The species closely resembles *S. purpurascens*, but differs from it in having the depth of the body decidedly lower than the length of the head; the eye comparatively large in comparison with the length of the body; the caudal peduncle as low as 1.4 in its length; the ventral inserted behind the base of the pectoral; and the caudal lobe equal to the head. Jordan, Tanaka, and Snyder have united this species with their *S. aureovittata*, which is not that of Temminck and Schlegel, but *S. quinqueradiata* of the latter. However, the present species undoubtedly differs from both *S. quinqueradiata* and *S. aureovittata* in the shape of the head, the extension of the maxillary, the number of the scales in the lateral line, the gill-rakers, and the pyloric cæca. Specimens from Hawaii described and figured by Günther as *S. dumerili* and described by Jordan and Evermann as *S. purpurascens* certainly belong to this species, as is known from the description and figure given by the former author, and from the description of the latter authors.

The species is distributed throughout the tropical and temperate zones of the Pacific. It is rather common upon the southernmost coasts of Japan proper.

Localities:—Sagami Bay; Amakusa; Ryūkyū.

SERIOLINA Wakiya, gen. nov.

Gill-rakers transformed into knob-like masses, otherwise like *Seriola*. The genus is proposed with *Seriola intermedia* Temminck and Schlegel as the genotype. Only a single species is known from Japan.

67. *Seriolina intermedia* (Temminck and Schlegel).

(PL. XXXVIII, fig. 1.)

Seriola intermedia Temminck and Schlegel, 1844, p. 116.

D. VII-I, 32; A. O-I, 16; scales about 150; vert. 24 (11+13).

Head 3.2 in length of body (4 in total length); depth 3.2 (4); eye 5 in head; snout 3.5; maxillary 2.04; pectoral 1.75; ventral 1.25.

Body moderately compressed; dorsal profile of head rather strongly curved. Snout obtuse, longer than eye, three-fourths of interorbital

space. Maxillary extending beyond posterior border of pupil; its posterior end quite convex, very narrow; its breadth 5 in length. Gill-rakers transformed into knob-like masses. Depth of caudal peduncle 1.4 in length; keel on the sides scarcely developed. Spinous dorsal commencing a little behind anterior end of the base of pectoral; with seven spines, the last two very short, only their tips being visible; third spine the highest, 4.9 in head, nearly equal to eye, 2.9 in highest soft dorsal ray, which is 1.75 in head. Anal spine hidden under skin. Origin of soft anal behind middle of soft dorsal. Ventral inserted below posterior part of base of pectoral, longer than latter, 1.6 in distance between its insertion and origin of anal. Twenty pyloric cæca, the longest 2.66 in head.

Color in formalin brownish, with six blackish cross-bands; the first running back to middle of side, and thence backward; the last one above lateral line on caudal peduncle. Head darker above; opercle with a blackish blotch; preopercle, interopercle, and subopercle narrowly edged with white; spinous dorsal blackish; soft dorsal brownish, intruded upon by third, fourth, and fifth dark bands on side of the body; distal parts of the three anterior soft dorsal rays white; caudal brown, its outer and posterior margins white; pectoral pale; ventral brownish, becoming black distally.

The foregoing description is drawn from a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7761, measuring 156 mm. in length of body. Another specimen from Nagasaki, with the body 245 mm. long, has the snout equal to the interorbital space, the eye 5.5 in the head, and the ventral 1.85 in the distance between its insertion and the origin of the anal.

The specimens here dealt with quite agree with the original description of this species given by Temminck and Schlegel.

S. nigrofasciata (Rüppell) is nearly related to this species, but differs from it in having the depth higher than the length of the head, the ventral equal to the head, and the maxillary not extending beyond the center of the eye.

This species seems to be widely distributed in the warm seas of Japan proper, but it is not common.

Localities:—Kii; Nagasaki; Ryūkyū.

Genus NAUCRATES Rafinesque.

Spinous dorsal composed of a few free, short spines; no finlets behind soft dorsal and anal. Lateral line developed into a large fleshy keel on each side of the caudal peduncle.

Only a single species of this genus is known from Japan.

68. *Naucrates indicus* Cuvier and Valenciennes.

(PL. XXXVIII, fig. 2.)

Naucrates indicus Cuvier and Valenciennes, Vol. IX, 1833, p. 326.*Naucrates ductor* Günther, (*partim*), Cat. Fish. Brit. Mus. Vol. II, 1860, p. 374.

D. V (IV)-I, 28; A. II (O)-I, 16 or 17.

Head 3.87 in length of body (4.65 in total length); depth 3.8 (4.54); eye 6.14 in head; snout 3.07; pectoral 1.75; ventral 1.56.

Body scarcely compressed, subcylindrical in shape. Snout rather obtuse, much longer than eye, twice its diameter; maxillary reaching front border of eye; lower jaw equal to upper. Opercle striated. Lateral line somewhat wavy and scarcely curved anteriorly. Spinous dorsal with four (five in young) spines, weak, very short, not connected with membrane; height of soft dorsal a little lower than half of head, 2.1 in it; that of anal 2.53. Free anal spines not plainly visible in adult. Origin of soft anal commencing a little before middle of soft dorsal. Ventral inserted just below posterior end of base of pectoral, rather longer than latter; caudal lobe 3.6 in length of body.

Color in formalin dark brown above, lighter below, crossed with six darker ventral bands; fins brownish, except pectoral, which is light; tip of caudal lobes white; uppermost rays of pectoral blackish.

The foregoing description is founded upon a specimen from Kii, measuring 335 mm. in the length of body. The figure on the plate is drawn from a specimen from the same locality, Carnegie Museum Cat. of Fishes, No. 7762, measuring 135 mm. in the length of body. The younger specimen has a much lower body, a larger eye, a shorter caudal lobe, and the maxillary extending a little farther backward. The darker bands crossing the sides of the body become indistinct with age.

The specimens here dealt with quite agree with the original description of this species given by Cuvier and Valenciennes.

The species closely resembles *N. ductor*, but differs from it in having a less compressed body, a smaller eye, a more curved snout, the ventrals rather longer than the pectoral, and the caudal with white tips. Specimens from Japan listed by Steindachner and Döderlein and by Jordan, Tanaka, and Snyder as *N. ductor* would be this species.

The fish seems to be widely distributed throughout the Indian Ocean and the warm areas of the Pacific. In Japan proper its distribution extends as far northward as the Tsuruga Strait.

Localities:—Miyako; Kii; Nagasaki; Ryūkyū.

Genus *ELAGATIS* Bennett.

Spinous dorsal composed of several spines connected with membrane; a finlet composed of two rays behind soft dorsal and anal. Lateral line not developing into a keel on each side of caudal peduncle.

Only a single species of this genus is known.

69. *Elagatis bipinnulata* (Quoy and Gaimard).

(PL. XXXVII, fig. 2.)

Seriola bipinnulata Quoy and Gaimard, Voyage Uranie, Zoöl., I, 1824, p. 363, pl. 61, fig. 3.

D. VI-I, 26-I; A. O (II)-I, 17-I; vert. 24 (10+14).

Head 3.66 in length of body (4.54 in total length); depth 4 (5); eye 5.84 in head; snout 3.15; pectoral 2.11; ventral 2.11.

Body a little compressed; shape fusiform; profiles equally turning from middle toward both ends rather rapidly and almost straight. Snout pointed, conical, about twice diameter of eye; maxillary not reaching front border of eye; lower jaw slightly longer than upper. Scales comparatively large. Lateral line slightly curving anteriorly. Spinous dorsal with six spines connected by membrane; highest spine 5.75 in head. Soft dorsal and anal pointed anteriorly; former 3 in head, latter 3.5. Free anal spines hidden under skin in adult. Pectoral equal to ventral; caudal lobes attenuated, upper lobe 1.3 times of head, somewhat longer than lower.

Color in formalin brown above, lighter below; spinous dorsal brown; ventral blackish; other fins gray; top of anal white; posterior margin of caudal darker. Body in life with two longitudinal blue bands; fins yellow, except dorsals.

The above description is based upon a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7763, measuring 278 mm. in length of body.

The species is widely distributed throughout all the warm seas of both hemispheres. It is found in the warm waters of Japan proper.

Localities:—Kii; Ryūkyū.

Subfamily SCOMBEROIDINÆ.

Body much compressed, oblong in shape, not much elevated at middle, head trenchant at top. Jaws equal; premaxillary not protractile, except in the very young. Teeth sharp, present on jaws, vomer, palatines, and tongue. Gill-rakers normal in shape. Scales rudimentary, transformed into linear dermal products imbedded in the skin. Lateral line slightly curving anteriorly, not armed with scutes, nor developed into a keel on each side of the caudal peduncle. Spinous

dorsal composed of a few, short, free spines; soft dorsal and anal not falcate anteriorly; anal equal to soft dorsal, much longer than abdomen; posterior rays of dorsal and anal semi-detached, forming finlets. Pectoral short, not pointed; ventrals also short, depressible in a deep median groove on abdomen.

Three genera compose this family, but only one of them is known from Japan.

Genus *SCOMBEROIDES* Lacépède.

Maxillary with supplemental bone; teeth subequal; spines of spinous dorsal seven in number.

Five species of this genus are known from Japanese waters.

- a. Maxillary not extending beyond posterior border of eye.
- b. Scales linear, pointed at both ends; teeth of upper jaw in a single series on side.
- c. Sides of body with a series of darker spots.
 - d. Head equal to depth of body; curved portion of lateral line making an obtuse angle over middle of pectoral. *sancti-petri*.
 - dd. Head shorter than depth of body; curved portion of lateral line not making an angle over middle of pectoral. *moadetta*.
 - cc. Side of body without a series of darker spots. *formosanus*.
 - bb. Scales lanceolate, rounded behind; teeth of upper jaw in a narrow band; no spots on side of body. *orientalis*.
- aa. Maxillary extending far beyond posterior border of eye. *lysan*.

70. *Scomberoides sancti-petri* (Cuvier and Valenciennes).

Chorinemus sancti-petri Cuvier and Valenciennes, Vol. VIII, 1831, p. 38.—
Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 473.

D. VII-I, 21; A. II-I, 19.

Head 4.82 in length of body (5.73 in total length); depth 4.7 (5.6); eye 5.6 in head; snout 3.36; pectoral 2; ventral 2.

Snout pointed, much longer than eye. Maxillary widened posteriorly, extending to posterior border of pupil. Teeth of upper jaw in a band on front and in a single series on sides; those of lower in two series on sides, of which the outer ones are somewhat finer than the inner, and bending a little forward. Scales linear, pointed at both ends. Lateral line somewhat wavy, its curved portion making

an obtuse angle above middle of pectoral. First spine of spinous dorsal two-thirds of second spine. Ventral short, 1.88 in distance between its insertion and origin of anal.

Color in formalin brownish above, light below; a series of ten blackish spots on sides of body, of which the anterior ones are set rather closely on the curved portion of the lateral line, and the remaining rather distantly above the straight portion; greatest diameter of largest spot equal to that of eye; dorsal and caudal gray; anal and paired fins light; top of soft dorsal and of anal blackish.

The above description is based upon a specimen from Ryūkyū, Carnegie Museum Cat. of Fishes, No. 7764, measuring 400 mm. in length of body.

The specimen here dealt with agrees with quite closely with the original description of this species.

S. sancti-petri is widely distributed throughout the Indian Ocean and the tropical areas of the Pacific. It is not known from Japan proper.

Localities:—Ryūkyū; Formosa.

71. *Scomberoides moadetta* (Cuvier and Valenciennes).

(Pl. XXXVII, fig. 3.)

Chorinemus moadetta Cuvier and Valenciennes, Vol. VIII, 1831, p. 382.

Chorinemus sancti-petri Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 473.

Scomberoides moadetta Seno, Report on Fishery Industry of Formosa, 1910, p. 119.

D. VII-I, 21; A. II-I, 19.

Head 4.86 in length of body (5.75 in total length); depth 4.23 (5); eye 5.3 in head; snout 3.53; pectoral 2; ventral 2.2.

Snout pointed, much longer than eye. Maxillary rather widened posteriorly, extending to center of eye. Teeth of upper jaw in a narrow band on front, and in a single series on sides; those of lower in two series on sides, of which the outer ones are finer than the inner. Scales linear, pointed at both ends. Lateral line not wavy, and curved portion not making an angle above middle of pectoral. First spine of spinous dorsal two-thirds of second spine. Ventral short, 2.26 in distance between its base and origin of anal.

Color in formalin brown above, lighter below; a series of ten blackish oblong spots above lateral line; greatest diameter of largest spot somewhat more than that of pupil; dorsal and caudal gray; top of soft dorsal black; anal and paired fins pale.

The foregoing description is drawn from a specimen from Formosa, measuring 285 mm. in the length of body.

The specimens examined quite agree with the original description of this species by Cuvier and Valenciennes.²⁷

The species closely resembles *S. sancti-petri*, but differs from it in having the head shorter than the depth of the body, and the curved portion of the lateral line not making an angle above the middle of the pectoral, and in having much smaller spots on the curved portion of the lateral line, and the anal not tipped with black.

The species is widely distributed throughout the Indian Ocean and the tropical areas of the Pacific. It is not known from Japan proper.

Locality:—Formosa.

72. *Scomberoides formosanus* Wakiya, sp. nov.

(PL. XXXVIII, fig. 3.)

Scomberoides orientalis Jordan and Evermann, (*non* Temminck and Schlegel), Proc. U. S. Nat. Mus., Vol. XXV., 1903, p. 336.

Scomberoides tol Jordan and Richardson, (*non* Cuvier and Valenciennes), Memoirs Carnegie Museum, Vol. IV, 1909, p. 178.

D. VII-I, 20; A. II-I, 18.

Head 4.8 in length of body (5.6 in total length); depth 4 (4.6); eye 4.3 in head; snout 3.5; pectoral 1.75; ventral 2.

Snout pointed, longer than eye. Maxillary extending to posterior border of pupil. Teeth on upper jaw in a single series rather widely spread; those of lower jaw in two series, the inner ones of which are somewhat curved inwardly. Scales linear, pointed at both ends. Curved portion of lateral line wavy, making an obtuse angle above middle of pectoral. First dorsal spine a little shorter than half of second spine. Ventral short, 1.7 in distance between its base and origin of anal, its tip falling far forward from anus.

Color in formalin brown above, light below; no black spots on body and fins. The above description is that of the type, a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7765, measuring 130 mm. in length of body.

The species resembles both *S. sancti-petri* and *S. moadetta* in the shape of the scales, but differs from them in having no black spots on the body and the fins, rather less numerous rays in the soft dorsal and the anal, and a narrower maxillary. A specimen from Formosa, identified by Jordan and Evermann as *S. orientalis*, and which afterwards was named *S. tol* by Jordan and Richardson, has, according to the note given by Jordan and Evermann, the depth of the body equal

²⁷No specimen of this species was sent by Dr. Wakiya to the Carnegie Museum.
A. W. HENN.

to only one-fourth of its length, and thus it distinctly differs from *S. orientalis* in which the depth of the body is much greater, being one-third of its length. Moreover, the maxillary of their specimen reaches to the posterior border of the pupil, whereas that of *S. tol* reaches only the anterior margin of the eye. Besides other differences, these two factors alone make it possible that their specimen does not represent either *S. orientalis* T. and S., or *S. tol* C. and V. As, however, the present species is the only one in which the peculiarities attributed by Jordan and Evermann to their *S. orientalis* (*S. tol*) occur, the writer may with all probability regard the form dealt with by Jordan and Evermann and by Jordan and Richardson as being identical with the present species.²⁸

The species is distributed throughout the warm waters of the Japanese Empire, but it is rare in Japan proper.

Localities:—Kii; Formosa.

73. *Scomberoides orientalis* (Temminck and Schlegel).

(Pl. XXXVIII, fig. 4.)

Chorinemus orientalis Temminck and Schlegel, 1844, p. 106, pl. 57, fig. 1 (*poor*).

D. VII-I, 20; A. II-I, 18.

Head 4.33 in length of body (5.3 in total length); depth 3.5 (4.33); eye 4 in head; snout 3.6; pectoral 1.6; ventral 1.83.

Snout rather pointed, rather longer than eye. Maxillary extending to posterior border of eye, but scarcely to posterior of pupil in young stages. Teeth on upper jaw in a narrow band; those of lower in two series, of which the outer ones are set very close, and bend horizontally outward. Scales lanceolate, rounded posteriorly. Curved portion of lateral line somewhat wavy, making an obtuse angle above middle of pectoral. First dorsal spine very small, much shorter than half of second, about one-fifth diameter of eye. Ventral extending just to anus, 1.35 in distance between its base and origin of anal.

Color in formalin brown above, light below; dorsals gray; top of soft dorsal black; lobes of caudal blackish; anal and paired fins pale.

The foregoing description is based upon a specimen from Kii, Carnegie Museum Cat. of Fishes, No. 7766, measuring 125 mm. in the length of the body.

²⁸The inadequate description of early writers together with the large variations due to age, render identifications of species in this group difficult and uncertain. D. S. JORDAN.

The specimens examined agree well with the original description of the species given by Temminck and Schlegel, and are so closely allied to *S. mauritanus* Cuvier and Valenciennes that it is difficult to point out the differences between them, except by comparison of the dentition of the two species. Among the distinctive characters of *S. mauritanus* attention may be called to the shortness of the two anterior dorsal spines and the extension of the hind end of the maxillary to the posterior border of the eye. The figure which accompanies the description of Temminck and Schlegel, however, shows a relatively long first dorsal spine equalling the diameter of the eye, and the maxillary scarcely reaching the posterior border of the pupil, characters which thus differ from those of *S. mauritanus*. Temminck and Schlegel state that the species they describe is the only one occurring rather commonly in the seas of the warmer parts of Japan. As, however, no fish with such a long first dorsal spine and such a short maxillary as their figure shows has ever been observed by the writer (although forms coinciding with the description they give, excepting the last mentioned characters, are somewhat common) it is perhaps allowable to infer that some error was made in the figure given by these authors. Assuming this, the present species may be looked upon as nothing more than *S. orientalis* Temminck and Schlegel.

The species is distributed throughout the warmer seas of Japan and abounds especially in the Bonin Islands, Ryūkyū, and Formosa.

Localities:—Kii; Uwajima; Nagasaki; Bonin Islands; Ryūkyū; Formosa.

74. *Scomberoides lysan* (Forskål).

Scomber lysan Forskål, 1775, No. 67, pl. 54.

Lychia lysan Rüppell, Atlant. Fische, 1828, p. 91.

Chorinemus lysan Günther, (*partim*), Cat. Fish. Brit. Mus., Vol. II, 1860, p. 471.

D. VIII-I, 20; A. II-I, 18.

Head 4.6 in length of body (5.53 in total length); depth 3.15 (3.8); eye 5.35 in head; snout 4.7; pectoral 1.53; ventral 1.78.

Snout obtuse, equal to eye, or nearly so. Maxillary very long, 1.8 in head, much widened posteriorly, extending far beyond posterior border of eye. Teeth of upper jaw in a band on front, and in a single series at sides; those of lower jaw in a band on front, with two pairs of distinct canines at tip of mandible, and in two series on sides, of which the outer are stronger than the inner, and bending a little forward. Scales lanceolate, those on lower half of body not quite

imbedded. Curved portion of lateral line making two obtuse angles; one above middle of pectoral, the other over the tip of the same fin. First dorsal spine short, one-third of second, which is a little shorter than half of eye. Ventral comparatively long, extending far beyond anus.

Color in formalin brownish; a series of eight large round darker spots present above lateral line; size of largest spots equal to diameter of eye; all fins pale, except posterior margin of caudal, which is darker.

The foregoing description is based upon a specimen from Formosa, Carnegie Museum Cat. of Fishes, No. 7768, measuring 345 mm. in length of body.

The specimen here dealt with accords well with the figure of this species given by Forskål, and quite well with the descriptions given by Rüppell and by Günther. The species closely resembles *S. commersonianus* (Lacépède), but differs in having a shorter head, a longer maxillary, and a series of blackish spots on the body. *S. commersonianus* has the head 5 in total length, the maxillary not extending beyond posterior border of eye, and is without a series of dark spots upon the body.

The species is widely distributed throughout the Indian Ocean and the tropical areas of the Pacific. It is not known from Japan proper.

Locality:—Formosa.

OBSERVATIONS.

It will, I think, be granted that the foregoing pages contain a review of almost all of the carangoid fishes which up to the present time are known to exist in the waters of the Japanese Empire. It should, however, be observed that, beside the seventy-four species hereinbefore listed, there are two species of the group, which are stated to occur in Japan, which I have omitted. The first was reported by Jordan and Snyder under the name *Trachynotus ovatus*, from Formosa, also listed by Jordan, Tanaka, and Snyder as occurring in the southern seas of Japan; the second species was reported by Jordan and Richardson under the name *T. russelli* from Formosa. Since both of these species are identified by certain ichthyologists with other species of the genus *Trachynotus*, and as Dr. Jordan and his collaborators merely listed them, the writer at present hesitates to include them among the carangoid fishes of Japan.

Of the seventy-four species, listed in the foregoing pages as occurring in Japanese waters, fifty-eight, or over seventy-seven per cent. are common also to the Indo-Pacific Region, excluding the coastal waters of western America. Six species, so far as is now known, are confined to the immediate region of Japan proper and the waters of the northern parts of eastern continental Asia, while ten species are found in the subtropical seas of Japan, but have not as yet been reported from the seas southward. Only one species, *Elagatis bipinnulata*, is also found in the Atlantic; none of the species are found in the Mediterranean; and probably none of them occur along the western coasts of America. Of the fifty-eight species common to Japanese waters and the Indo-Pacific region nineteen also occur in the Red Sea, where in all twenty-six species of carangoid fishes are known to exist; sixteen species about Hawaii, where twenty-five Carangoids are found; twenty-two about Samoa, where forty-eight species of Carangoids have been collected.

Of the sixteen species, which are as yet only known from Japanese waters, eight belong to types found in comparatively warm seas, and are rare about Japan proper and the subtropical waters of its southern extremity and the islands to the south. This fact goes to prove that the center of distribution of these forms lies to the south of Japan. When the carangoid fishes of the Indo-Pacific Region are more thoroughly investigated, species common to that region and the seas of Japan may probably be found to be more numerous, and those peculiar to Japanese waters may be found to be fewer in number, than we at present suppose. Taking all the circumstances into consideration the carangoid fishes of Japan must be regarded as forming a part of the Indo-Pacific fauna.

The fishes reported upon in the foregoing paper may be classified in groups according to their habitat, as follows:

- a. Sixty-seven species found in the Subtropical District, which comprises the Bonin Islands, Ryūkyū, and Formosa.
- b. Forty-five species found in the seas of Southern Japan proper, *i.e.*, from Nagasaki Bay around the southern coast of Kyūsyū as far north as the Bay of Tōkyō.
- c. Ten species found in the seas of Northern Japan proper, *i.e.*, from Nagasaki Bay northward in the Sea of Japan to the Strait of Tsugaru, and thence southward along the eastern coast as far as the Bay of Tōkyō.

d. Two species found in the Subarctic District of Japan, *i.e.*, Hokkaidō, Sakhalin, and the Kuriles.

e. Five species found in the Korean District.

If we now consider these districts somewhat more closely, we find in the first, or Subtropical District (a), a confirmation of the opinion we have expressed that the carangoid fishes of Japan form a part of the Indo-Pacific fauna. Not only are the species more numerous in this district but also all the genera occurring in it are found throughout the Indo-Pacific Region. Of the sixty-seven species of the *Carangidæ* occurring in the district fifty-eight, or eighty-six per cent., also occur in the Indo-Pacific area. The majority of the remaining eight species are likely with future exploration to be found to occur in the Indo-Pacific also.

In the second district covering the seas of southern Japan proper (b), which fairly corresponds with "The Japanese District" of Günther, the carangoid fauna shows some difference from that of the Subtropical District (a). In this district we have *Trachurus japonicus*, *Decapterus muroadsi*, *D. maruadsi*, *Caranx delicatissimus*, *Seriola quinqueradiata*, *S. aureovittata*, and *S. purpurascens*, which are peculiar to the waters of Japan proper and the opposite shores of the Asiatic Continent. Furthermore, the number of the species in the genera *Decapterus*, *Caranx*, *Scomberoides*, and *Trachynotus* is here greatly reduced. The genus *Atropus* with its single species wholly disappears, and the entire number of species only amounts to about three-fourths that of the Subtropical District. Nevertheless all of the genera of the family in this district and sixty-two per cent. of the species found here are common to the Indo-Pacific Region. This fact manifestly shows that the carangoid fishes of this district are a part of the Indo-Pacific fauna.

In the third district, the seas of northern Japan proper (c), five genera, *Selar*, *Alectis*, *Elagatis*, *Megalaspis*, and *Scomberoides*, as well as almost all of the Indo-Pacific species of the genera *Trachurus*, *Decapterus*, and *Caranx* disappear. The number of species occurring in this district is very small, the only two species which range northward beyond the Strait of Tsugaru, being *Trachurus japonicus* and *Seriola quinqueradiata*. In the distribution of the carangoid fishes in this district it is especially noteworthy that the number of species becomes considerably smaller along the eastern or Pacific coast than on the western or Japan Sea coast as we proceed northward. This

phenomenon is not restricted only to the *Carangidæ*, but the same is true of all tropical and subtropical fishes. In the opinion of the writer the reason for this fact is that on the Pacific side of Japan the warm current, the "Kurosiwo," or "Black Stream," runs close inshore as far as the Bay of Tōkyō, whence it trends outwardly into the Pacific Ocean, and runs eastwardly, while its counter-current, the "Oyasiwo," brings the cold water down from Bering Straits, reaching the Inube promontory at the northern entrance of the Bay of Tōkyō. This prevents the distribution of fishes of a tropical type from spreading to the north of the Bay of Tōkyō. On the contrary in the Japan Sea the cold current from the Sea of Okhotsk, the Liman Current, runs close inshore along the Asiatic mainland, and does not prevent the flow of the warm from the south, which, although much feebler than the Black Stream, pours uninterruptedly along the western coasts of Japan proper northwards, until it mixes with the cold water along the western coasts of the Hokkaidō.

In the fourth, or Subarctic District, (d), two species of the *Carangidæ*, *Trachurus japonicus* and *Seriola quinqueradiata* are known from the northwestern coast of the Hokkaidō (Yeso), and the latter only from the southernmost extremity of Sakhalin. No other carangoid fishes occur in this district.

In the Korean District, (e), only a few species are known from the coasts of the Japan and Yellow Seas. In the Japan Sea this is perhaps owing to the low temperature of the water, produced by the inshore flow of the cold current from the north; and in the Yellow Sea owing to the muddy water, unsuited to the life of carangoid fishes. At the southernmost extremity of the Korean District, where no thorough search for carangoid fishes has as yet been made, it is possible that more species may turn up as the result of future investigations. The marine conditions at this point more closely resemble those at Nagasaki and vicinity on the opposite side of the Yellow Sea.

Now let us take up the question of the barriers which separate the fauna of the Indo-Pacific from tropical and subtropical regions of the Atlantic Ocean. Günther believed in the occurrence of a much greater number of identical genera and even of identical species in the Mediterranean and the waters of southern Japan proper, his "Japanese District," than we do. He therefore asserts that "The Mediterranean and Japanese seas were in direct and open communication with each other within the period of the existence of the present

Teleostean fauna." According to this view continuous communication must have existed between the Mediterranean and those parts of the Pacific surrounding Japan. It has been suggested that this communication may have been by a passage where now is located the Isthmus of Suez. Ortmann and others are inclined to think that such a line of communication did not exist where the Isthmus of Suez now is, but further north, probably through some part of Siberia. It is alleged that such a communication must have existed during the Eocene. Great changes have occurred both in the crust and the climate of the earth since that time and the fish fauna of the Mediterranean of the Eocene and the fish fauna of the Mediterranean of today surely differ. A connection at the time of the Eocene, if such a connection really existed, fails entirely to explain the similarity, or rather dissimilarity, which exists between the two faunæ at the present time. Jordan and Evermann, after stating that the number of the genera common to Japanese waters and the Mediterranean is not much greater than the number common to Japan and the West Indies or the Pacific coasts of North America and Mexico, or Japan and Australia, go on to mention the existence of several autochthonous genera existing separately in both seas. They attribute the similarities between the widely separated faunæ to like conditions, rather than to direct communication between them. Furthermore they (or perhaps Dr. Jordan alone, as in the discussion in this part of their work the nominative "I" is used instead of "we") state, that, since the fauna of the Red Sea is essentially Indian in respect to the genera, it is much the same as that of southern Japan. But the Mediterranean fauna is the same as that of the warm Atlantic, and the number of genera common to the Red Sea and the Mediterranean is very small. The facts known as to the distribution of fishes in these two bodies of water do not therefore go to prove the recent submergence of the Isthmus of Suez. Even if, as shown on recognized geological maps, such a submergence took place in Pliocene and Postpliocene times, the resultant channel must have been shallow and muddy, and the salinity of the water, judging from the flow of the Nile, must have been very low. Only fishes living in brackish water could have migrated through the passage. Even if we admit the former existence of such a shallow channel, the influence of the Isthmus of Suez as a barrier separating the faunæ of the Mediterranean and the Indian Ocean must have been very great.

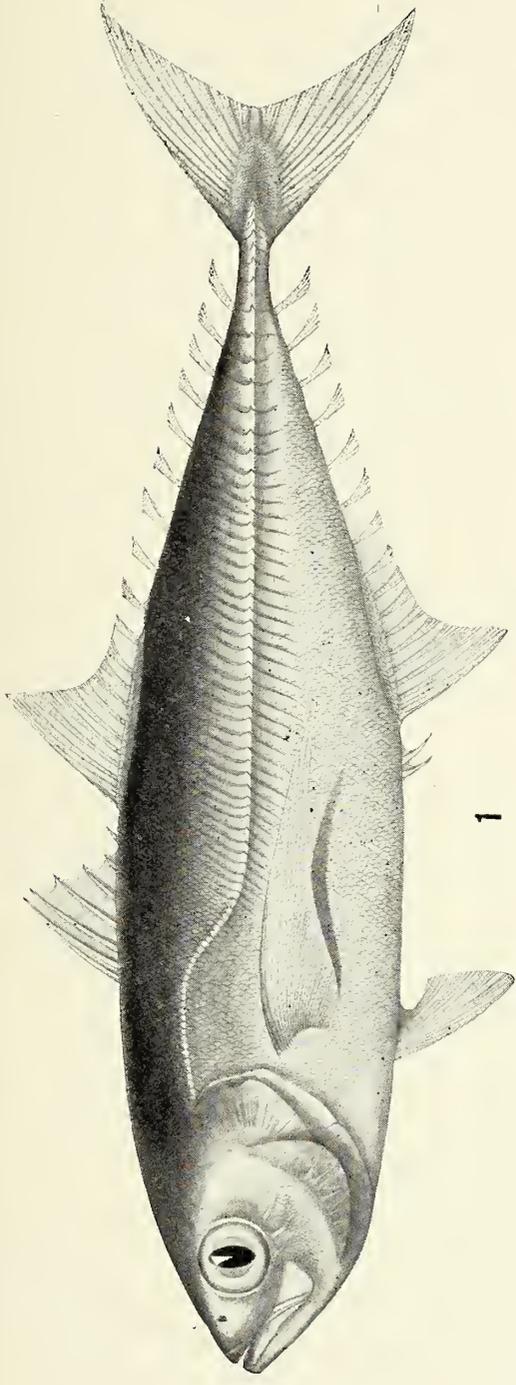
The study given by the writer to the species of carangoid fishes forming the fauna of Japan, of the Red Sea, and of the Mediterranean, leads him to agree with the conclusions of Jordan and Evermann. Of the forty-five species of carangoid fishes ascribed to the waters of southern Japan proper, nine are also found in the Red Sea, eleven in Hawaii, and ten around Samoa, while not a single one of these species is found in the Mediterranean. This fact alone proves the untenability of the hypothesis of an open and direct communication between the waters of Japan and those of the Mediterranean in recent geologic time. Moreover, out of twenty-five species known to occur in the Red Sea, nineteen, or seventy-three per cent., are common to Japan, and nine, or thirty-five per cent., are common even to southern Japan proper, while not a single one of these species occurs in the Mediterranean. These facts can only be explained upon the assumption that the barrier formed by the Isthmus of Suez checked the intermingling of the fishes, at least of the carangoid fishes, of the Red Sea and the Mediterranean, during the evolution of the faunæ of these two seas. The ten Atlantic species of carangoid fishes, which have been reported by some previous authors as also occurring in the Indo-Pacific Region, therein including Japan, such as *Trachurus trachurus*, *Decapterus sanctæ-helenæ*, *Selar crumenophthalmus*, *Caranx hippos*, *C. latus*, *C. lugubris*, *Seriola lalandi*, *S. dumerili*, *Naucrates ductor*, and *Elagatis bipinnulata*, with the single exception of the last-mentioned species do not exist in Japanese waters. The same remark applies to other carangoids reported from other areas of the Indo-Pacific region, so far as it is possible to reach conclusions from the literature. The fewness of the forms of *Carangidæ* which are common to the Atlantic and to the Indo-Pacific Region suggests that the same scarcity of common forms may also occur in other groups which are pelagic or semipelagic. Should this generalization ultimately be found to be true, we may ascribe this peculiarity of distribution simply to the fact that the cold Atlantic current, flowing northward along the southwestern coast of Africa, the Benguela Stream, and the main westward drift flowing off from the continent form the barrier which separates the present fish fauna of the Indo-Pacific from that of the warm Atlantic, just as the cold current which washes the southern end of the continent of South America checks the mingling of the fishes between the Pacific and the Atlantic, or as the Isthmus of Suez acts as a barrier between the Mediterranean and the Red Sea.

PLATE XV.

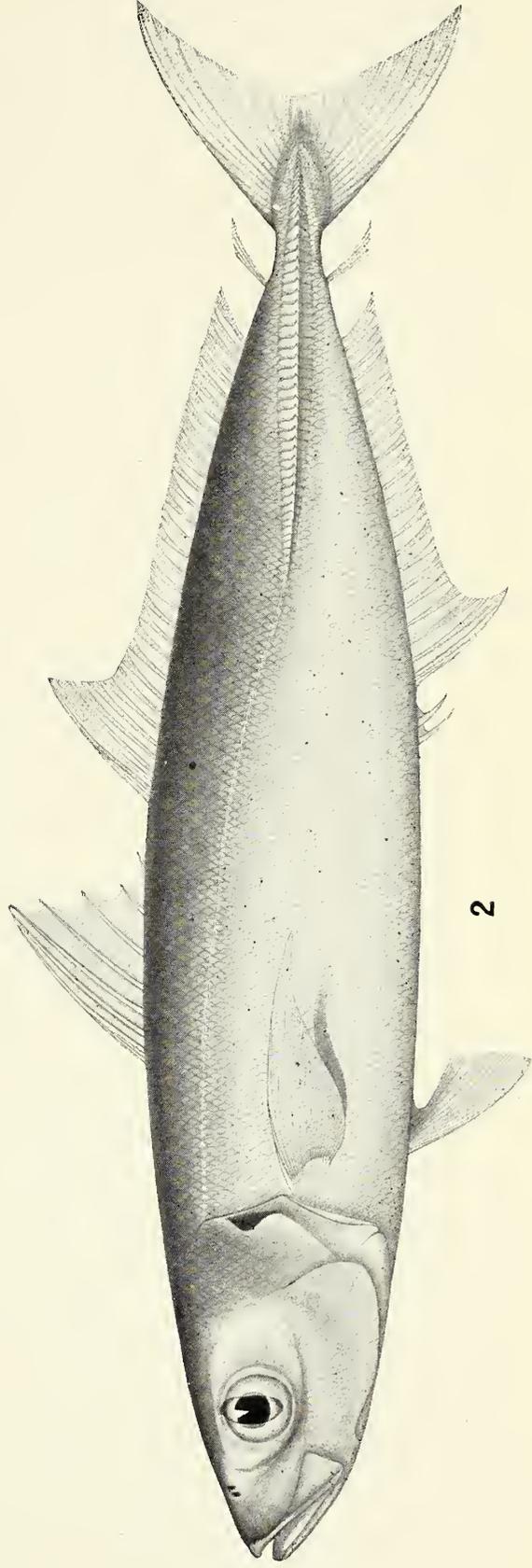
FIG. 1. *Megalaspis cordyla* (Linnæus). Formosa. C. M. Cat. No. 7705.
215 mm. to base of caudal.

FIG. 2. *Decapterus russelli* (Rüppell). Tōkyō Bay. C. M. Cat. No. 7706.
290 mm. to base of caudal.

(Figures one-half natural size)



1



2

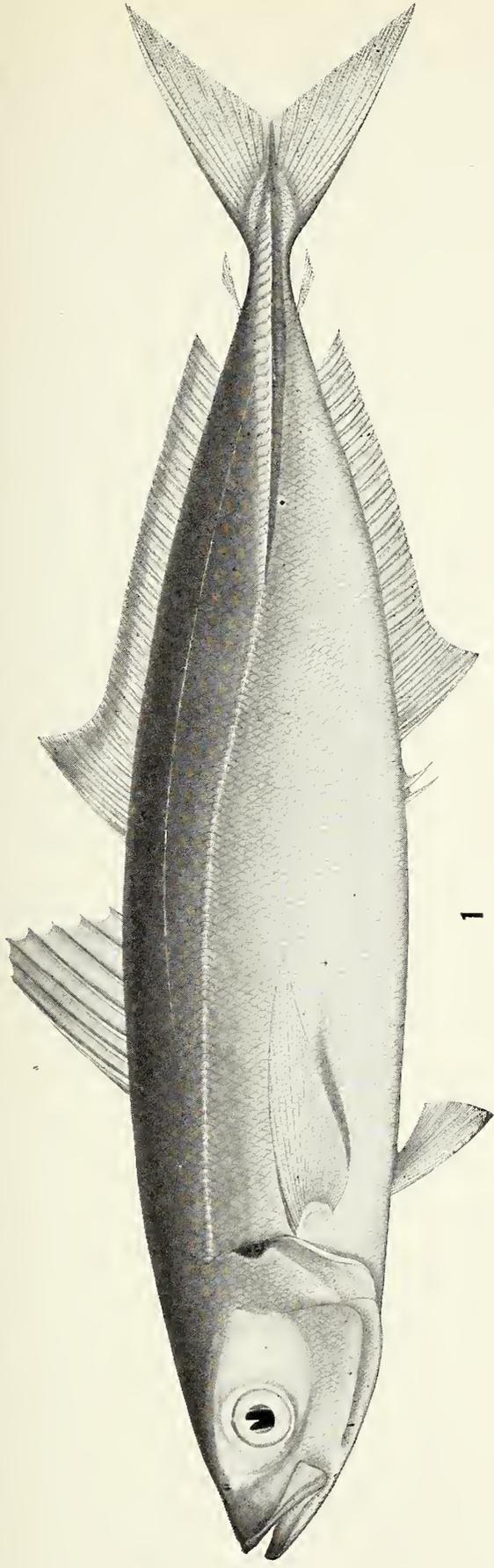
Megalaspis and Decapterus.

PLATE XVI.

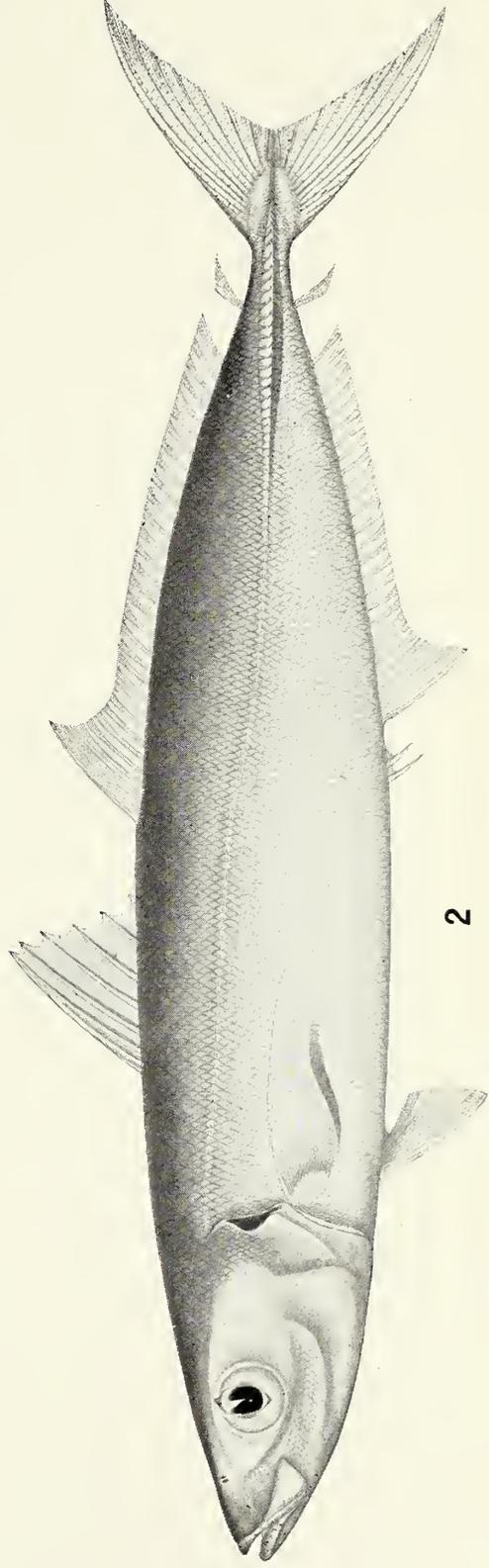
FIG. 1. *Decapterus muroadsi* (Temminck and Schlegel). Kii. C. M. Cat. No. 7707, 260 mm. to base of caudal.

FIG. 2. *Decapterus macrosoma* Bleeker. Bonin Islands. 248 mm. to base of caudal. (Species represented in C. M. by No. 7708, 214 mm. in length of body).

(Figures one-half natural size)



1



2

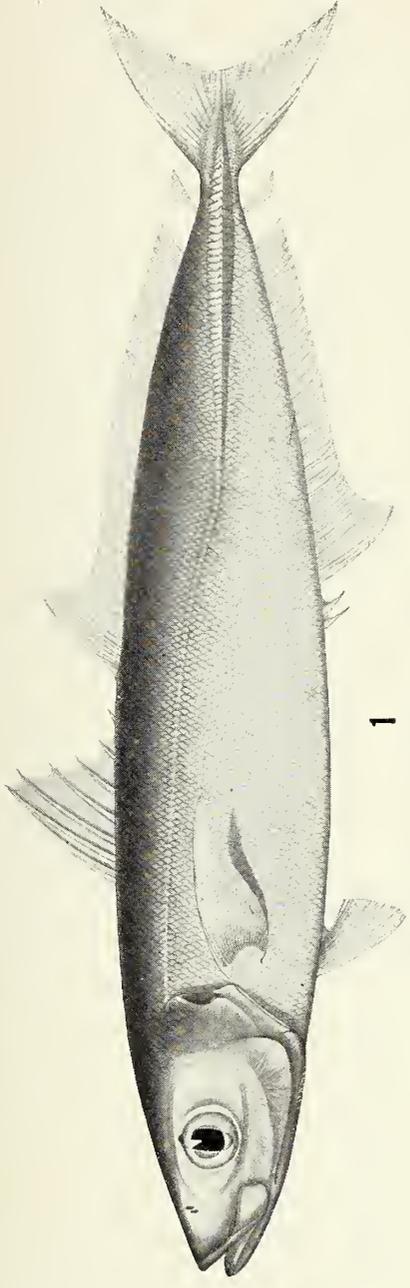
Decapterus.

PLATE XVII.

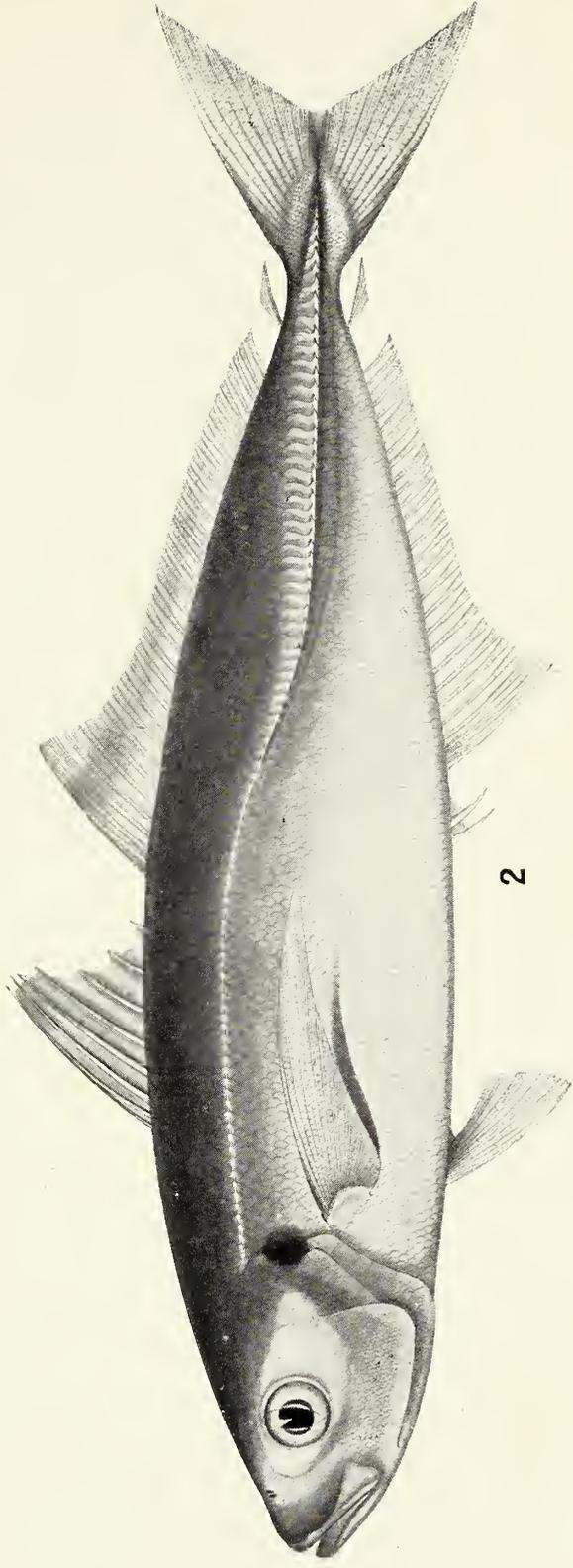
FIG. 1. *Decapterus lajang* Bleeker. Kii. 204 mm. to base of caudal. (Species represented in C. M. by No. 7709, 260 mm. to base of caudal).

FIG. 2. *Decapterus maruadsi* (Temminck and Schlegel). Kii. C. M. Cat. No. 7710. 247 mm. to base of caudal.

(Figures one-half natural size)



1



2

Decapterus.

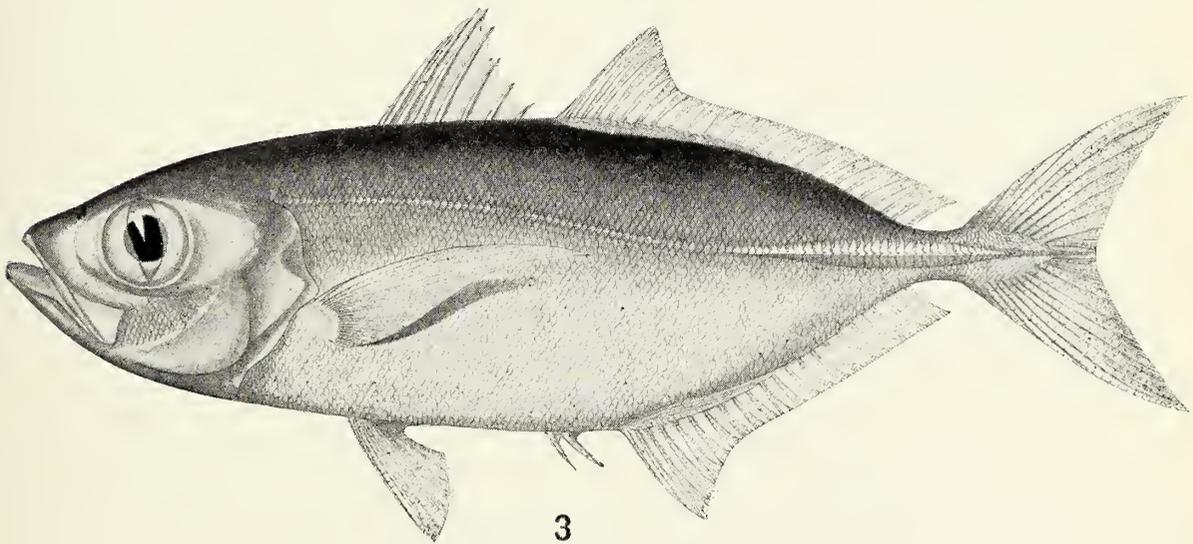
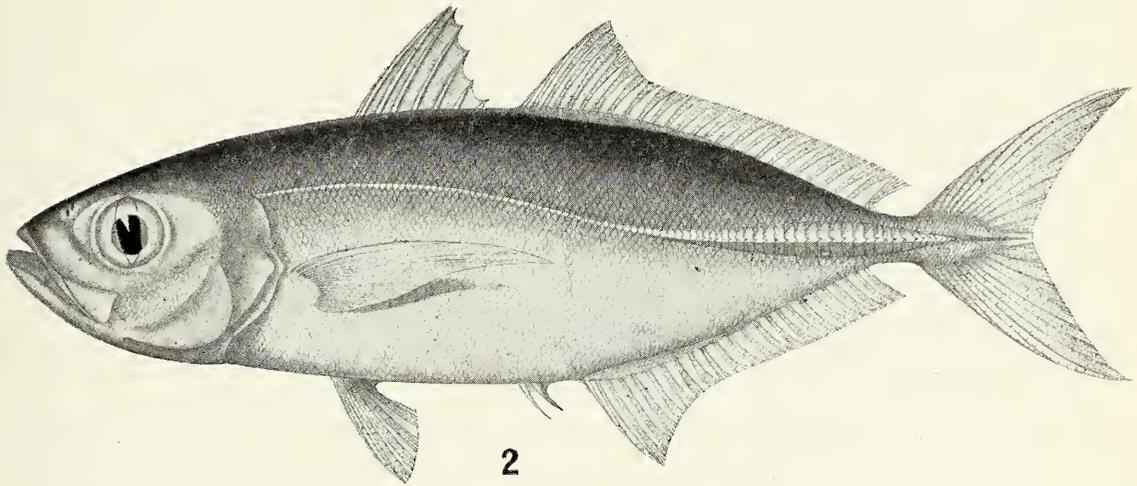
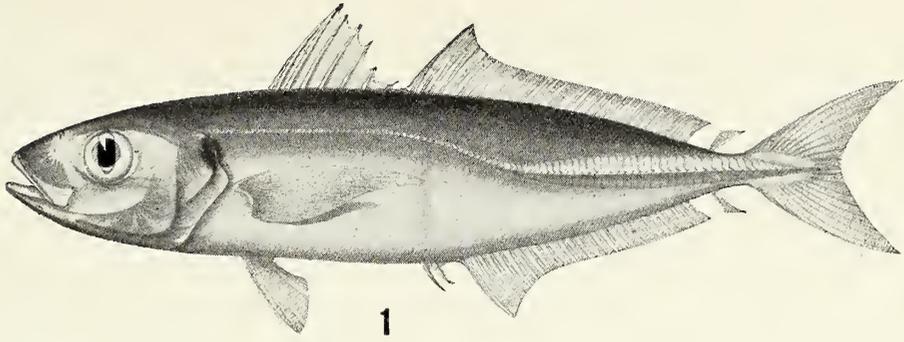
PLATE XVIII.

FIG. 1. *Decapterus dayi* Wakiya, sp. nov. Type. Formosa. C. M. No. 7711. 140 mm. to base of caudal.

FIG. 2. *Selar mauritianus* (Quoy and Gaimard). Kii. C. M. No. 7712. 177 mm. to base of caudal.

FIG. 3. *Selar macrophthalmus* (Rüppell). Bonin Islands. C. M. No. 7713. 175 mm. to base of caudal.

(All figures one-half natural size)



Decapierus and Selar.

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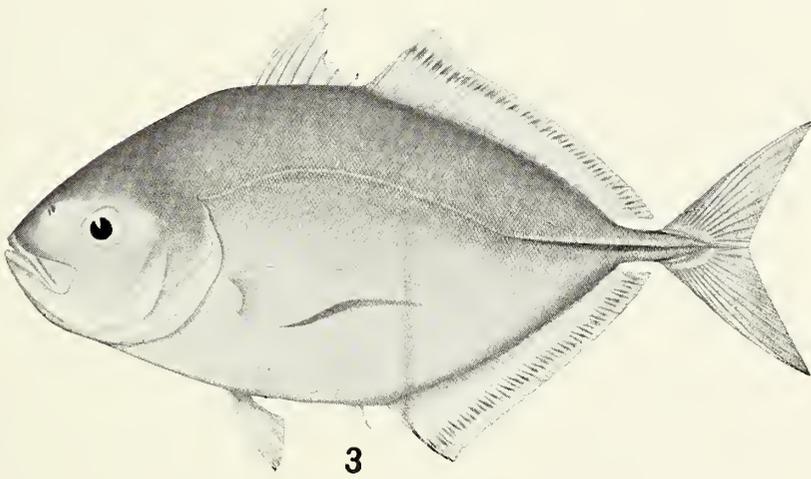
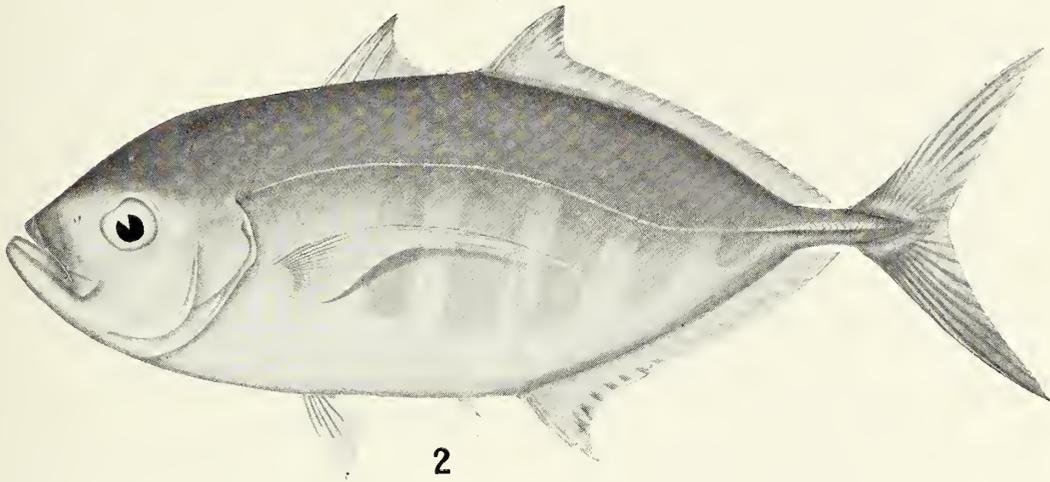
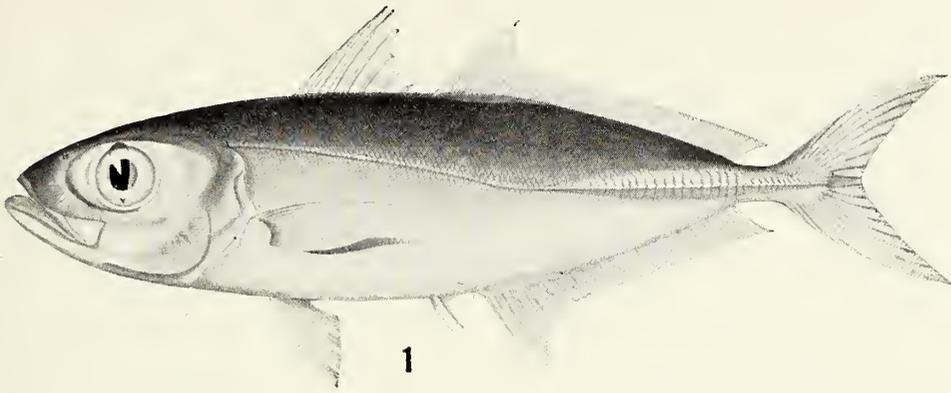
PLATE XIX.

FIG. 1. *Selar torvus* (Jenyns). Bonin Islands. C. M. No. 7714. 218 mm. to base of caudal.

FIG. 2. *Caranx (Carangoides) ferdau* (Forskål). Ryūkyū. C. M. No. 7715. 240 mm. to base of caudal.

FIG. 3. *Caranx (Carangoides) equula* Temminck and Schlegel. Tōkyō Bay. C. M. No. 7716. 195 mm. to base of caudal.

(All figures one-third natural size)



Trachurops and *Caranx*.

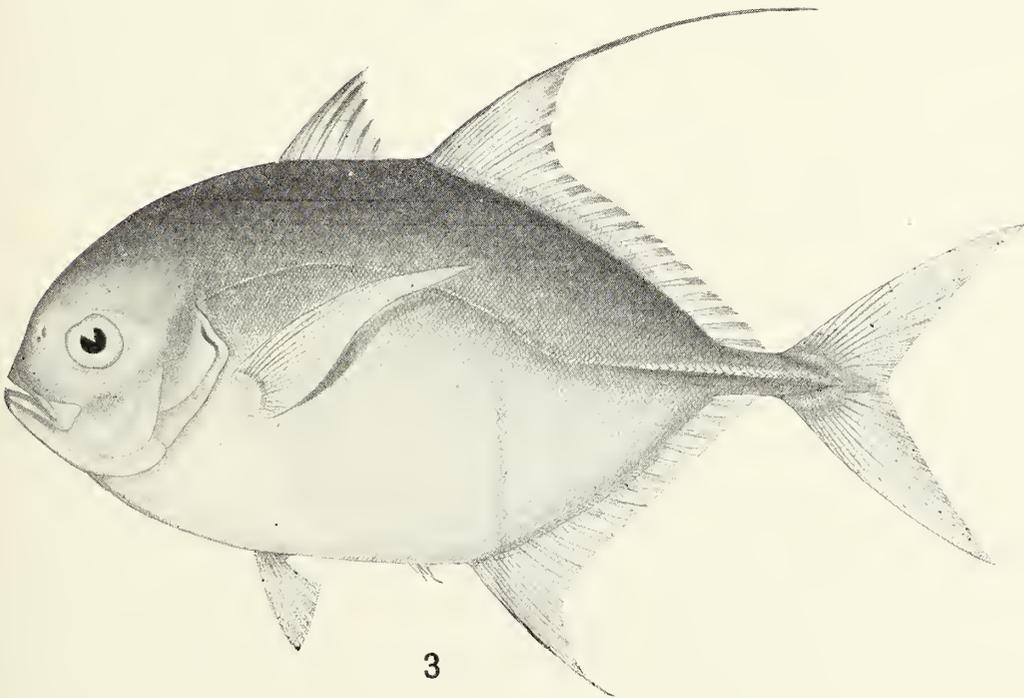
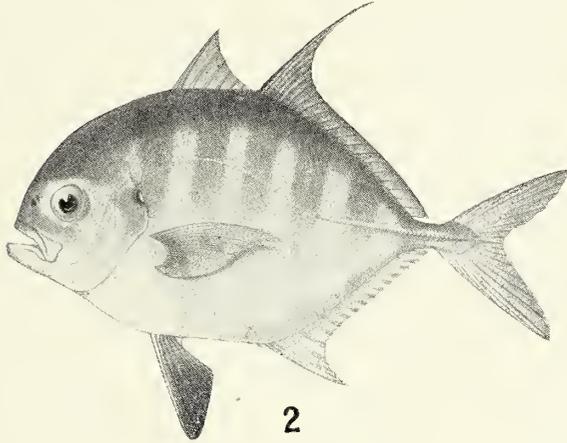
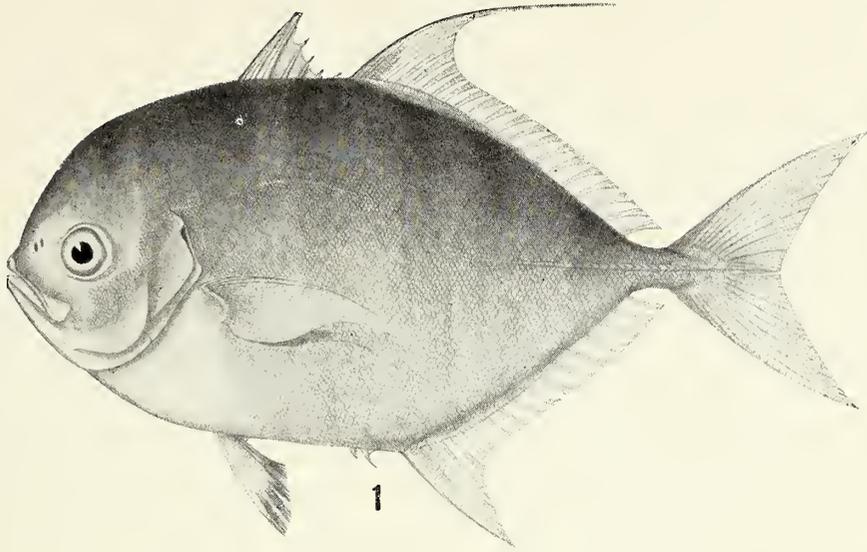
PLATE XX.

FIG. 1. *Caranx (Citula) armatus* (Forskål). Formosa. 123 mm. to base of caudal.

FIG. 2. *Caranx (Citula) schlegeli* Wakiya, *nom. nov.* Nagasaki. C. M. No. 7717. 77 mm. to base of caudal.

FIG. 3. *Caranx (Citula) plumbeus* (Quoy and Gaimard). Kii. C. M. No. 7718. 144 mm. to base of caudal.

(All figures one-half natural size)

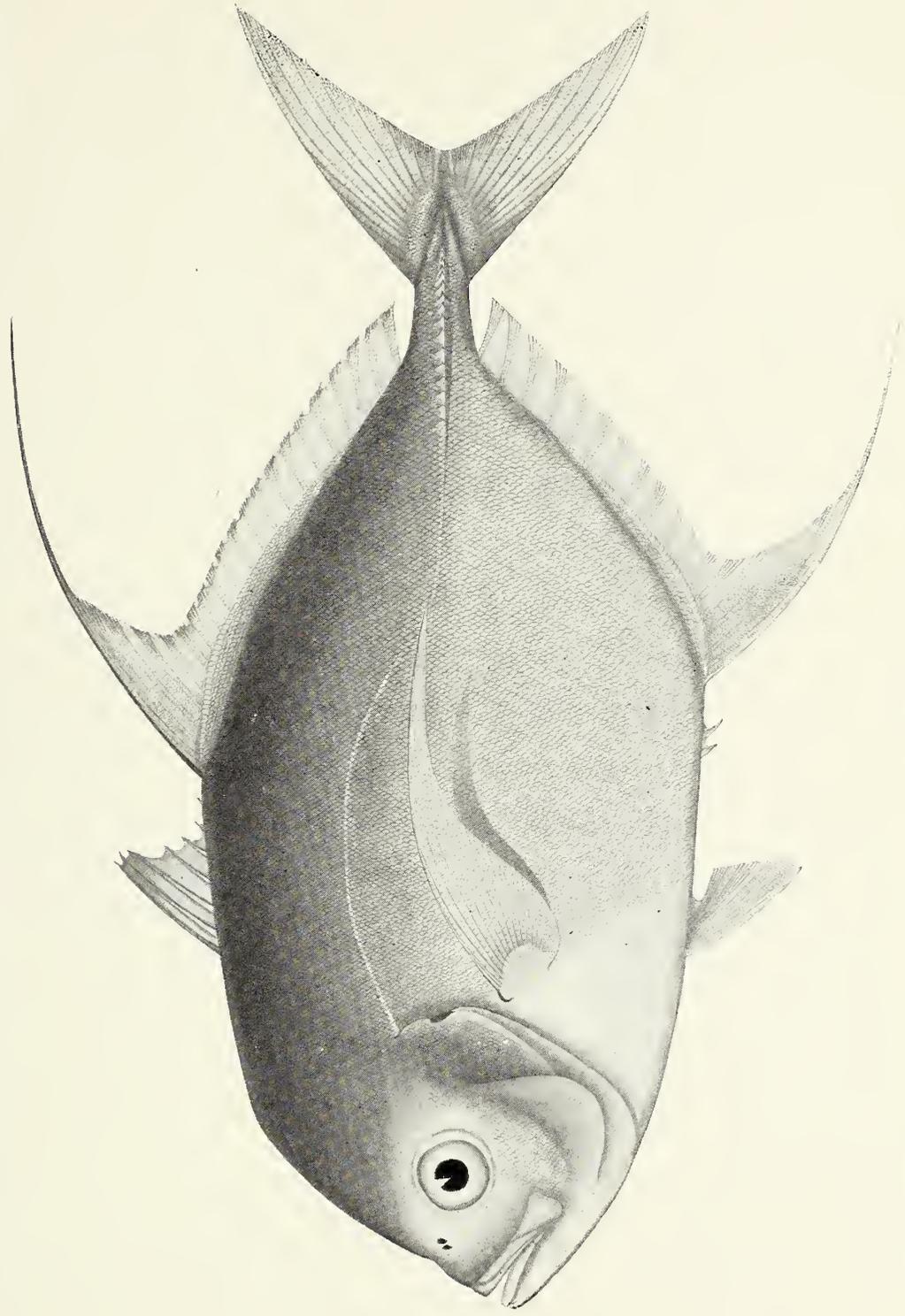


3
Citula.

PLATE XXI.

Caranx (Citula) ciliaris (Rüppell). Formosa. C. M. Cat. No. 7719. 195 mm.
to base of caudal.

(One-half natural size)



Citula ciliaris.

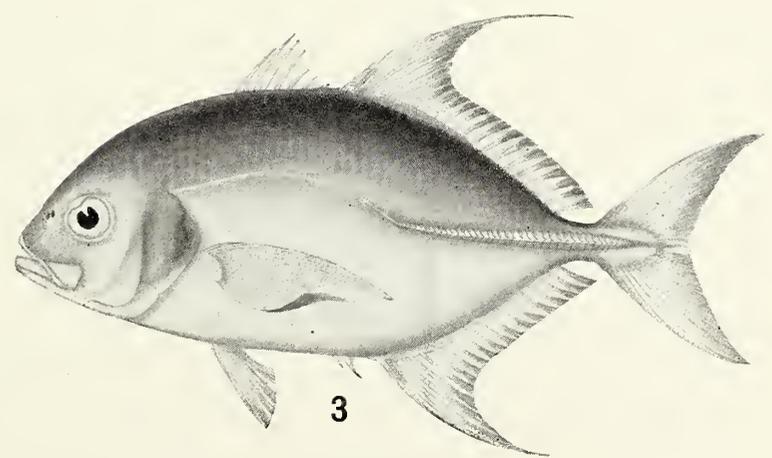
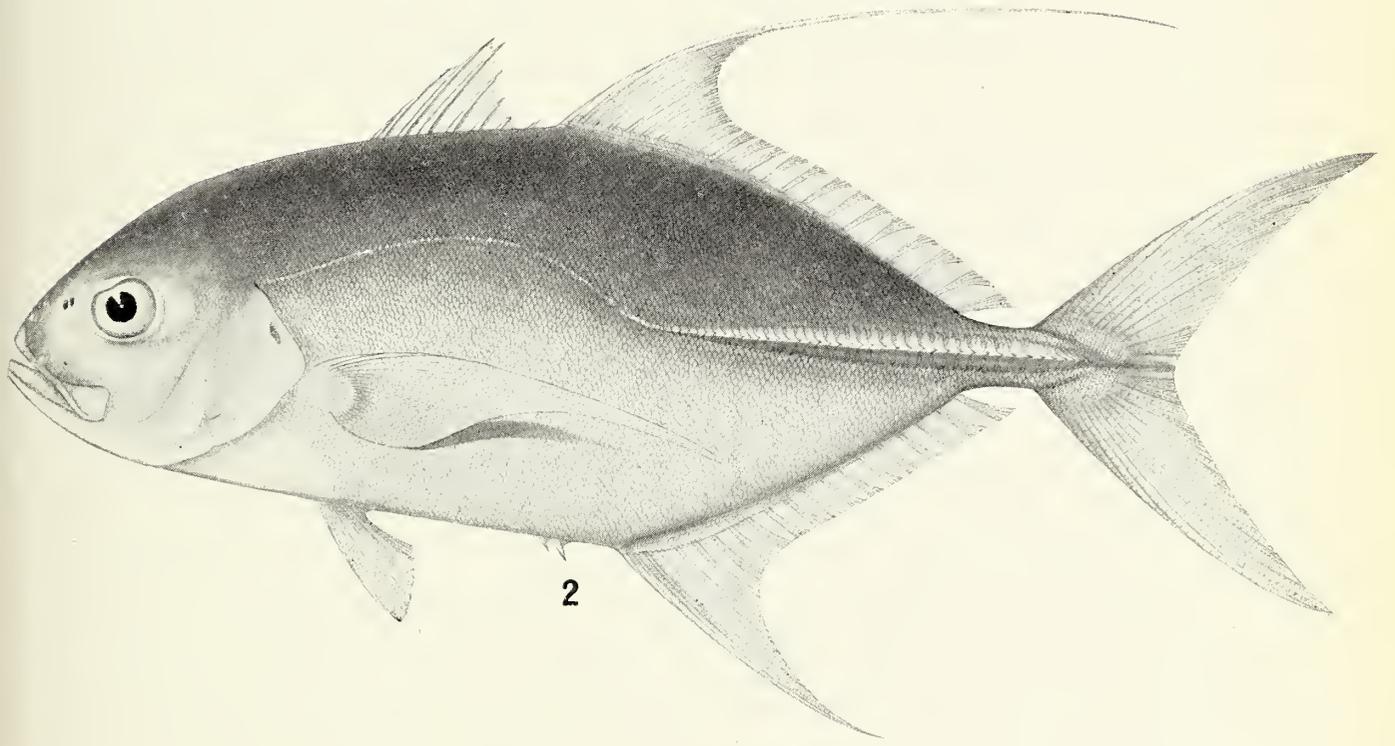
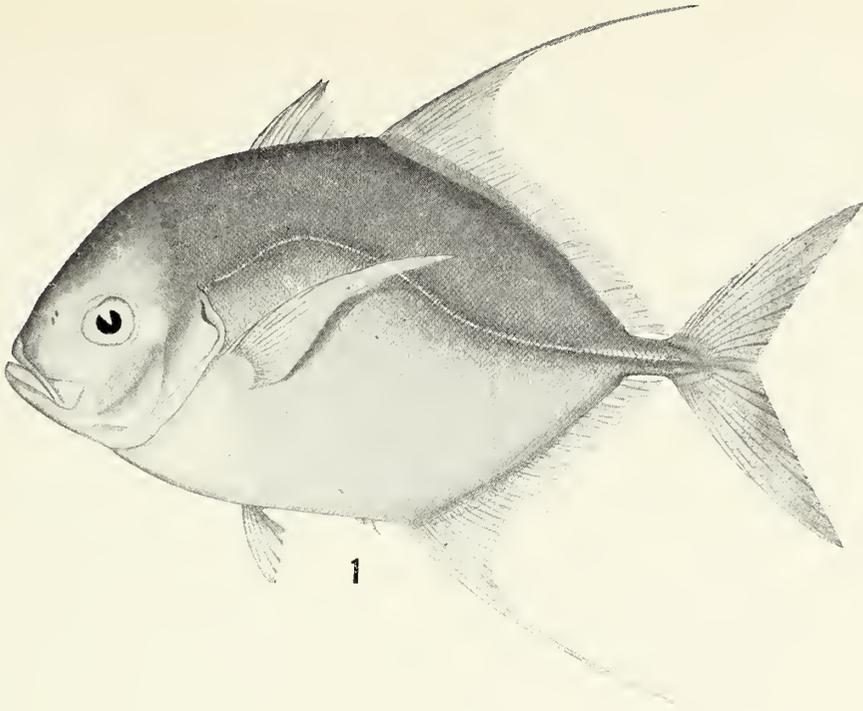
PLATE XXII.

FIG. 1. *Caranx (Citula) uii* Wakiya, *sp. nov.* Type. Kii. C. M. No. 7720. 125 mm. to base of caudal.

FIG. 2. *Caranx (Citula) oblongus* (Cuvier and Valenciennes). Formosa. C. M. No. 7721. 200 mm. to base of caudal.

FIG. 3. *Caranx (Citula) deani* Jordan and Seale. Ryūkyū. C. M. No. 7722. 111 mm. to base of caudal.

(All figures one-half natural size)



Citula.

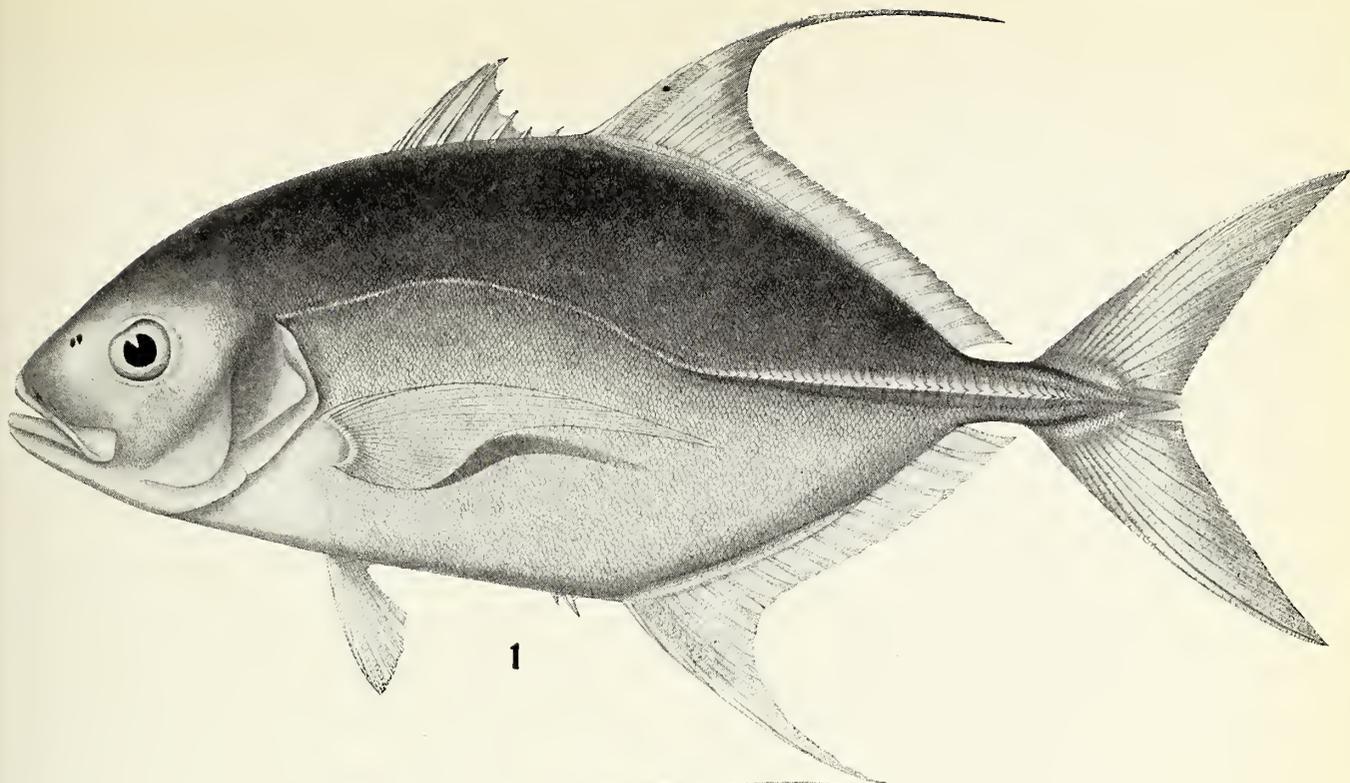
PLATE. XXIII.

FIG. 1. *Caranx (Citula) tanakai* Wakiya, *sp. nov.* Type. Kii. 197 mm. to base of caudal.

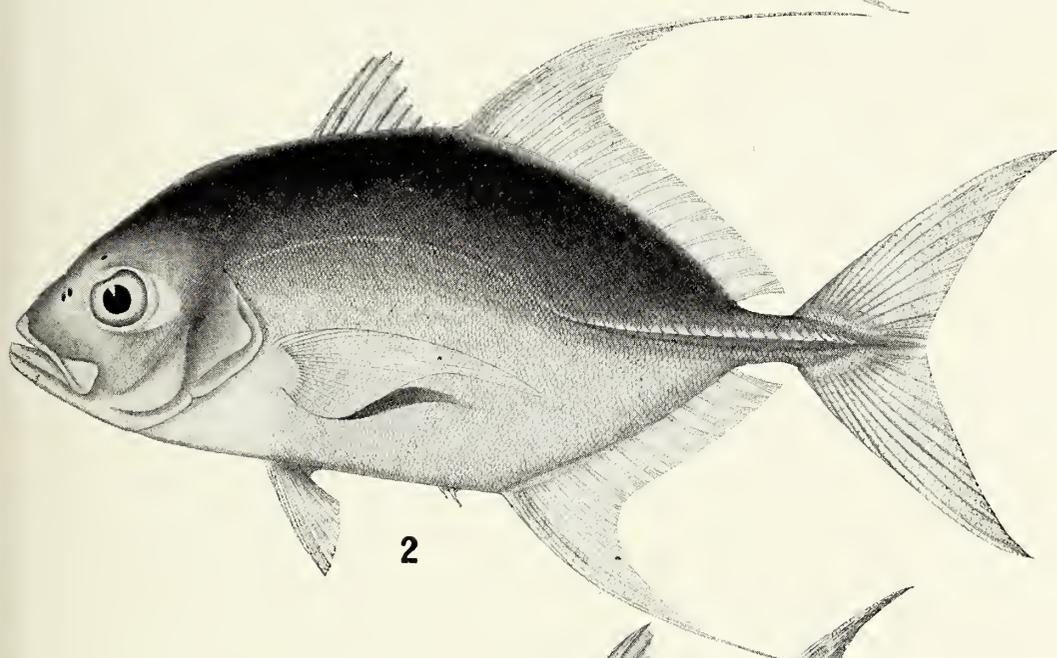
FIG. 2. *Caranx (Citula) dinema* Bleeker. Ryūkyū. C. M. Cat. No. 7724. 154 mm. to base of caudal.

FIG. 3. *Caranx (Citula) malabaricus* Bloch and Schneider. Formosa. C. M. Cat. No. 7725a. 170 mm. to base of caudal.

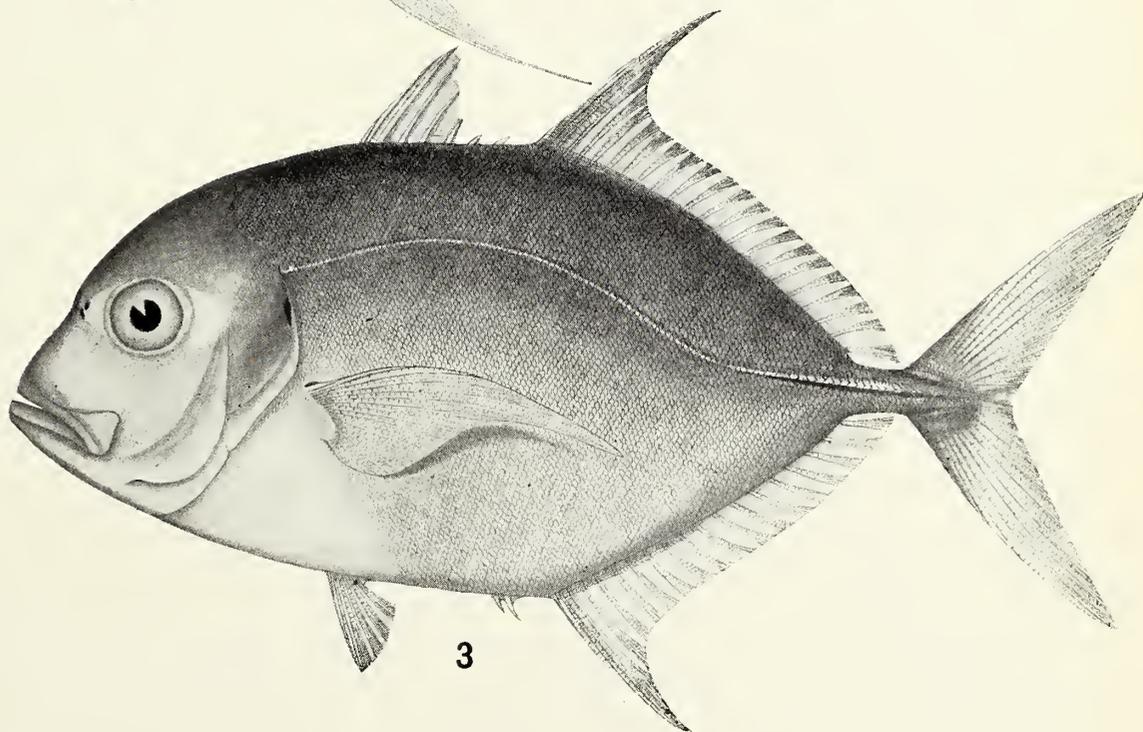
(All figures one-half natural size)



1



2



3

Citula.

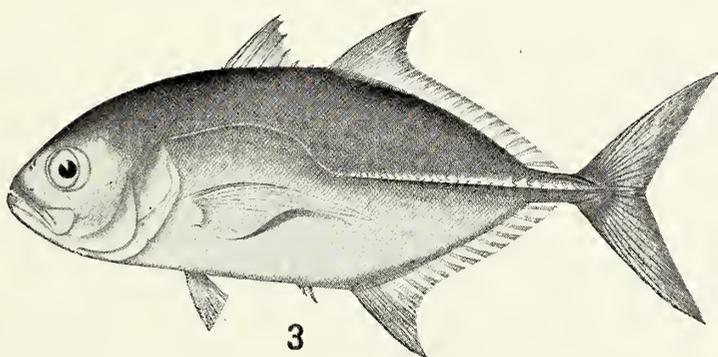
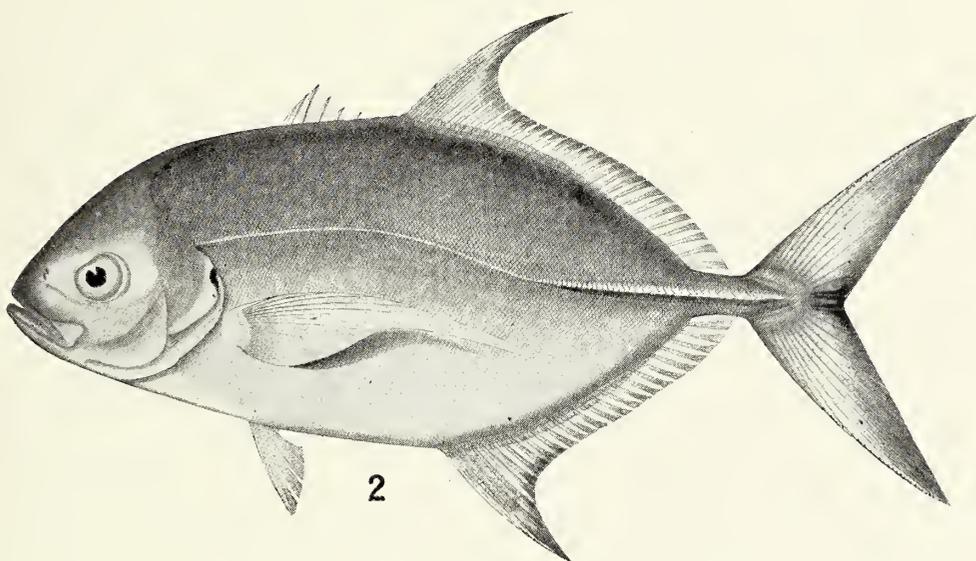
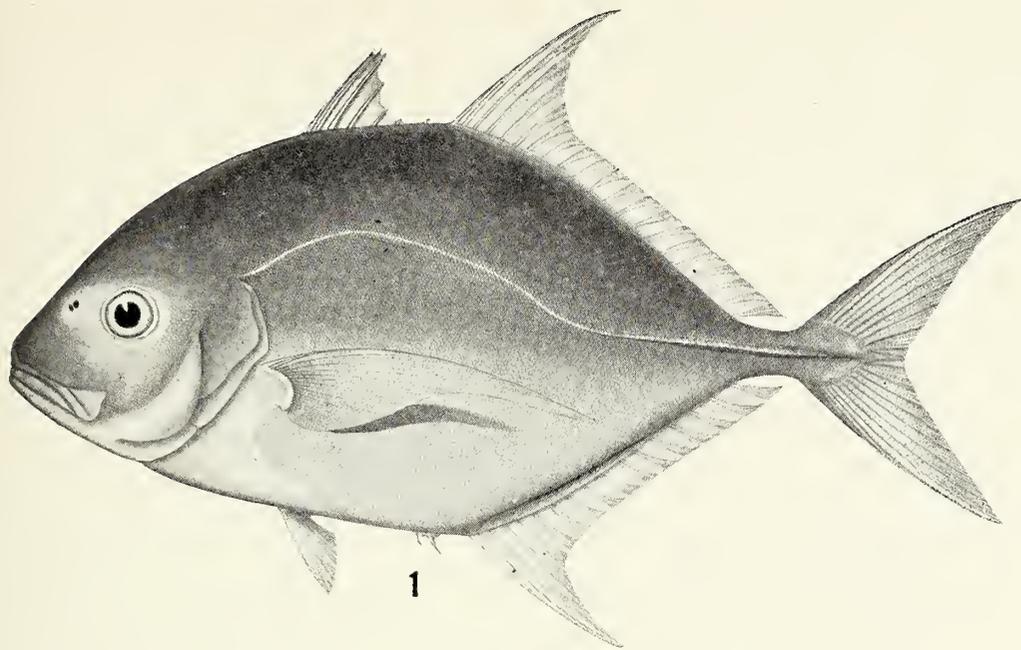
PLATE XXIV.

FIG. 1. *Caranx (Citula) chrysophrys* Cuvier and Valenciennes. Formosa. 157 mm. to base of caudal.

FIG. 2. *Caranx (Citula) hemigymnostethus* (Bleeker). Ryūkyū. C. M. Cat. No. 7727. 212 mm. to base of caudal.

FIG. 3. *Caranx xanthopygus* Cuvier and Valenciennes. Ryūkyū. C. M. Cat. No. 7729. 160 mm. to base of caudal.

(All figures one-third natural size)



Citula and Caranx.

PLATE XXV.

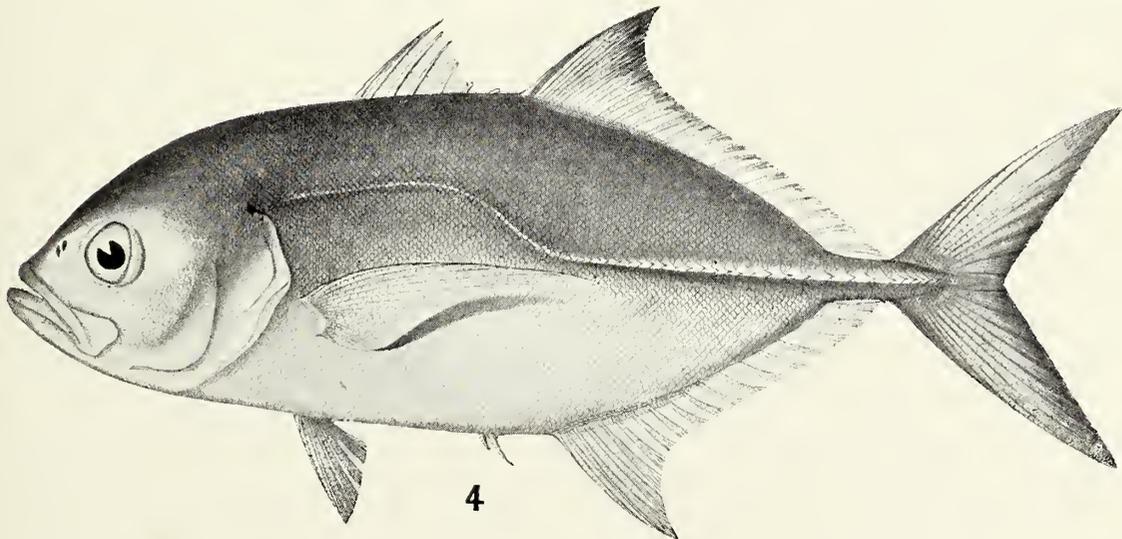
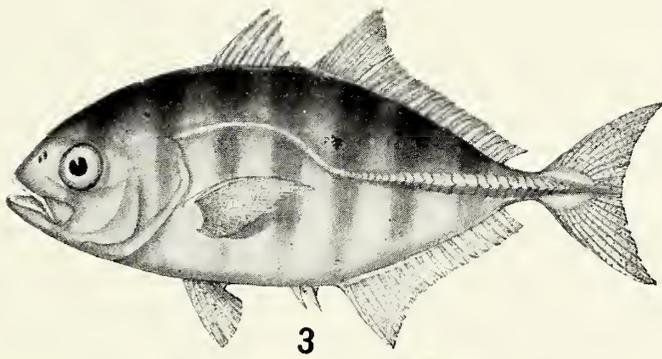
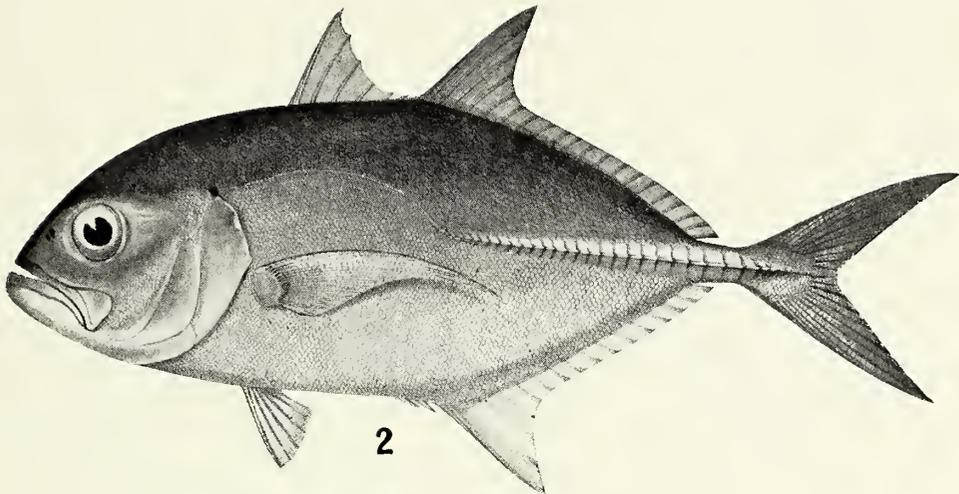
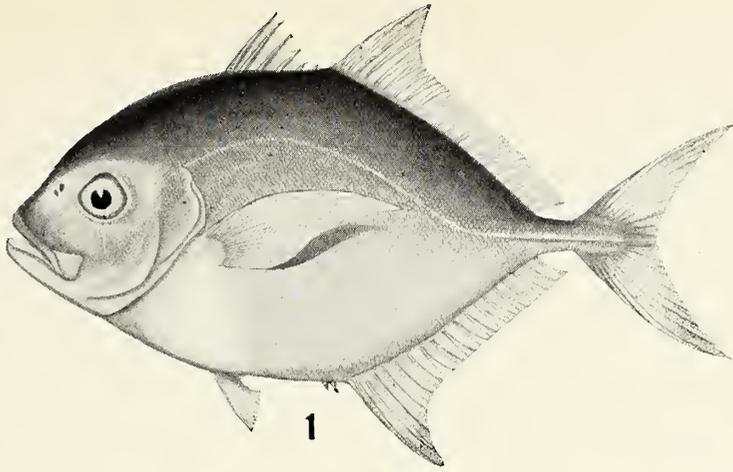
FIG. 1. *Caranx (Citula) cæruleopinnatus* Rüppell. Uwajima. C. M. Cat. No. 7726. 103 mm. to base of caudal.

FIG. 2. *Caranx lessoni* Cuvier and Valenciennes.

FIG. 3. *Caranx sexfasciatus* Quoy and Gaimard. Kii. C. M. Cat. No. 7728b. Young, 50 mm. to base of caudal.

FIG. 4. *Caranx sexfasciatus* Quoy and Gaimard. Kii. C. M. Cat. No. 7728. 166 mm. to base of caudal.

(Figs. 1, 2, and 3 one-half natural size; fig. 4 natural size)

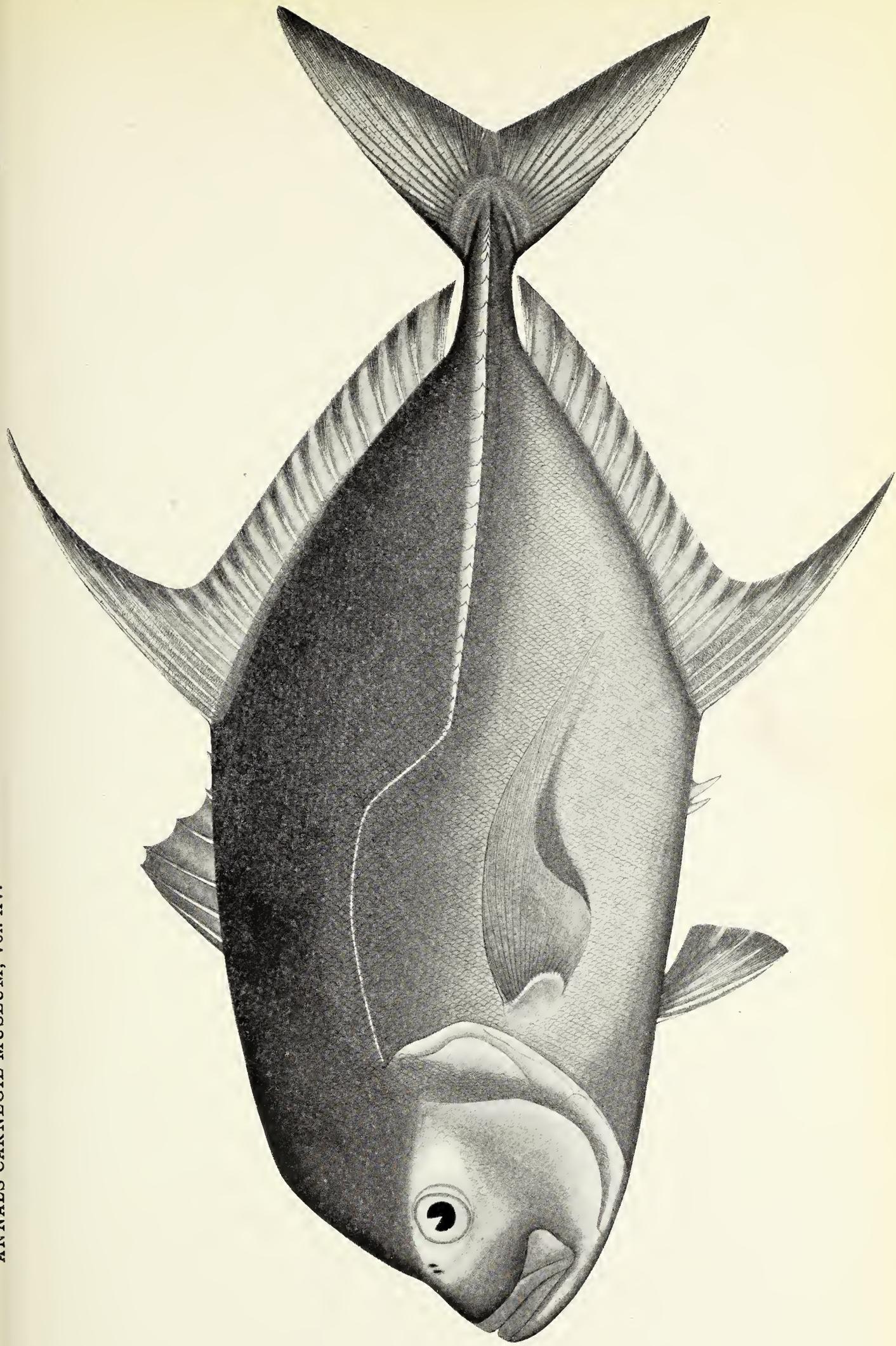


Citula and Caranx

PLATE XXVI.

Caranx ishikawai Wakiya, sp. nov. Type. Bonin Islands. C. M. Cat. No. 7734.
324 mm.

(One-half natural size)



Caranx.

PLATE XXVII.

FIG. 1. *Caranx oshimai*. Wakiya, sp. nov. Type. Formosa. C. M. Cat. No. 7731. 123 mm. to base of caudal.

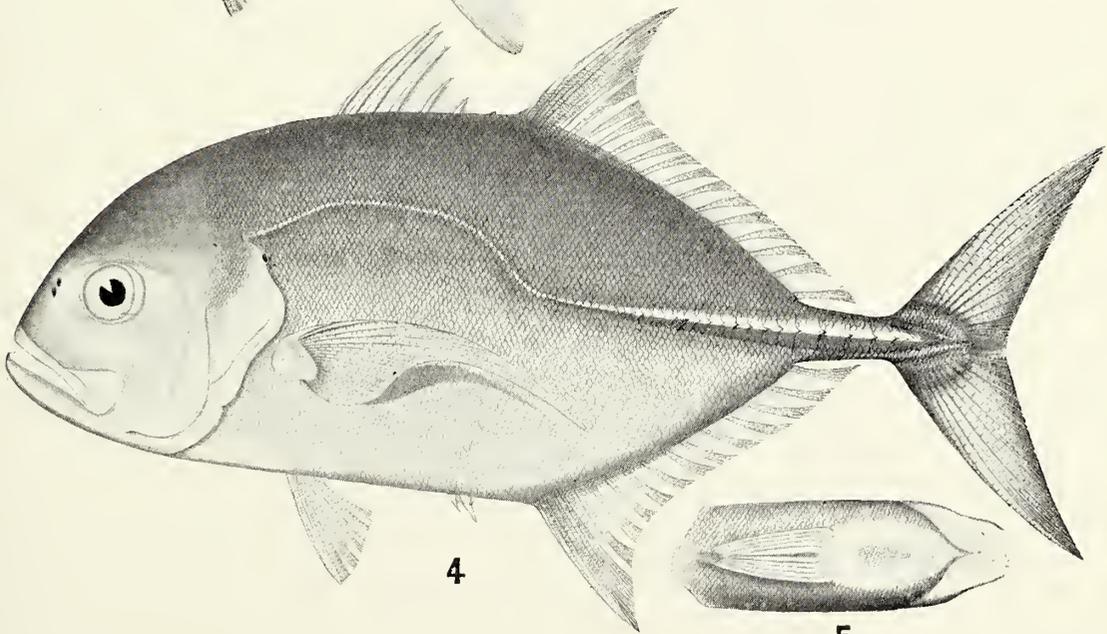
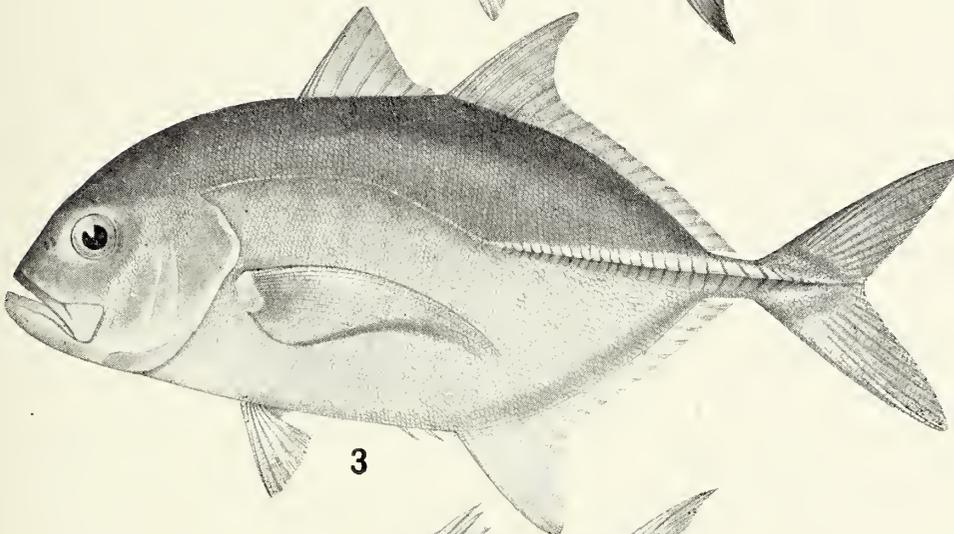
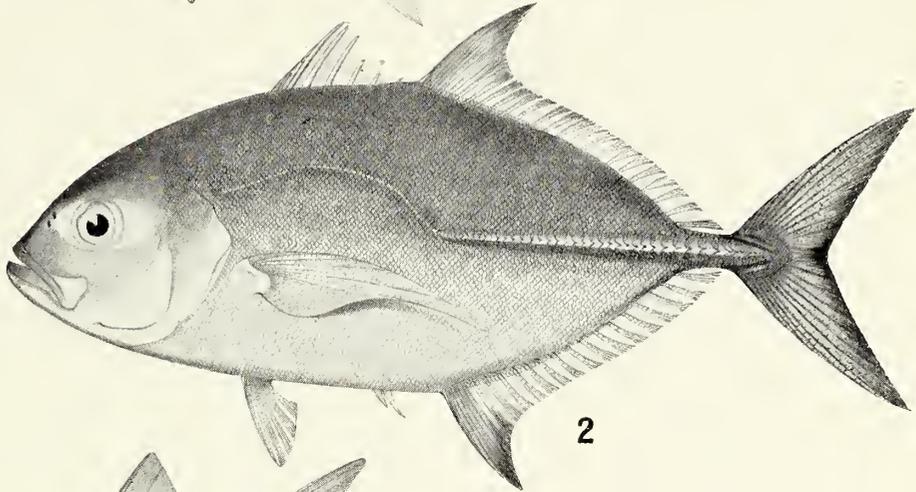
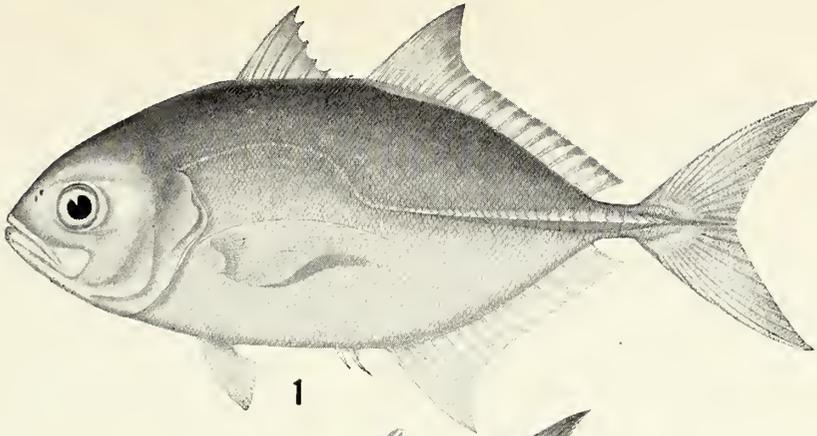
FIG. 2. *Caranx bixanthopterus* Rüppell. Kii. C. M. Cat. No. 7732. 135 mm. to base of caudal.

FIG. 3. *Caranx ignobilis* (Forskål). Nagasaki. C. M. Cat. No. 7735. 147 mm. to base of caudal.

FIG. 4. *Caranx bucculentus* Alleyne and Macleay. Kii. C. M. Cat. No. 7736. 170 mm. to base of caudal.

FIG. 5. View of breast of *C. bucculentus*.

(All figures one-half natural size)



Caranx.

PLATE XXVIII.

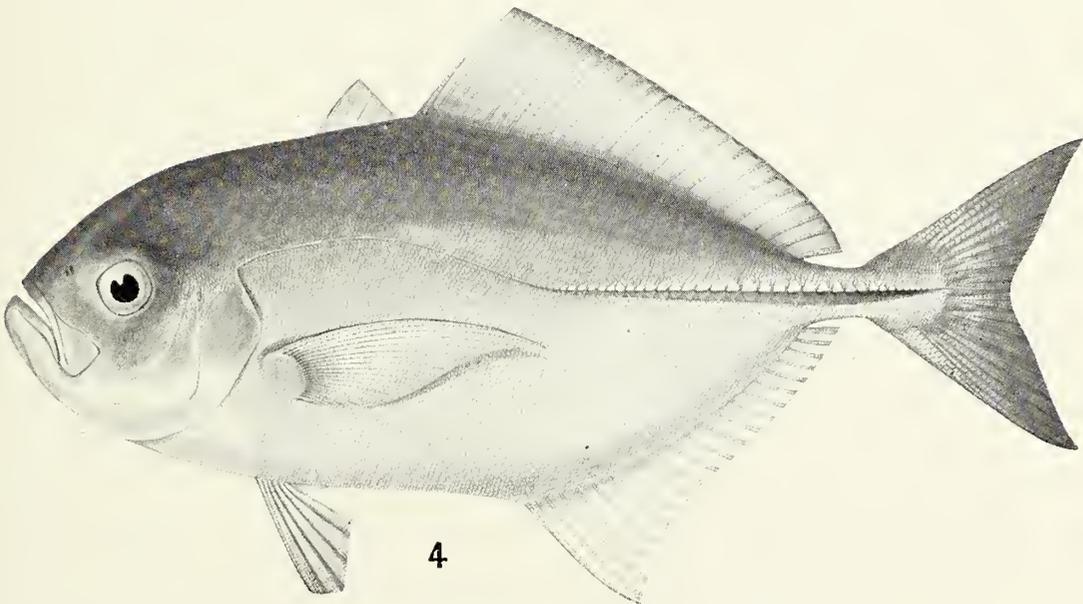
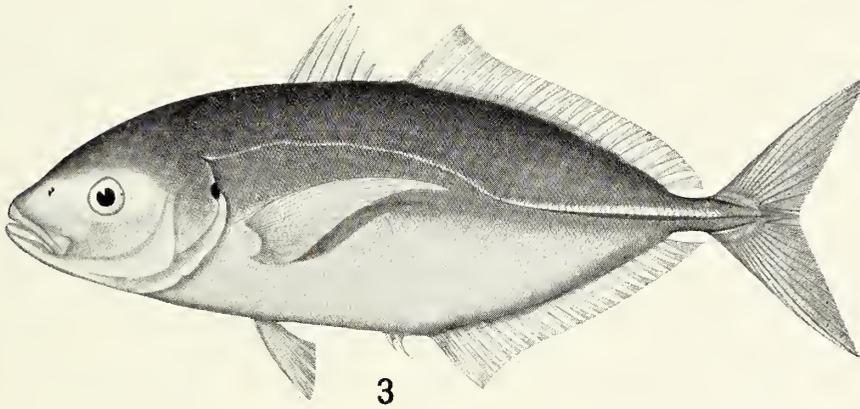
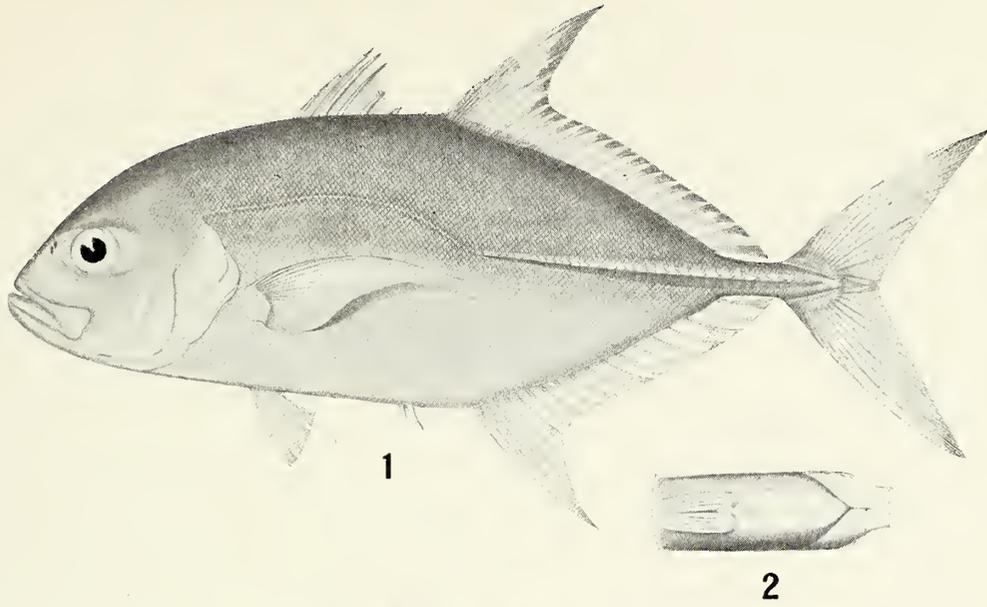
FIG. 1. *Caranx sansun* (Forskål). Ryūkyū. C. M. Cat. No. 7738. 224 mm. to base of caudal.

FIG. 2. Breast of *C. Sansun*.

FIG. 3. *Caranx (Longirostrum) delicatissimus* Döderlein. Kii. C. M. Cat. No. 7744. 200 mm. to base of caudal.

FIG. 4. *Caranx (Uraspis) helvolus* (Forster). Uwajima. C. M. Cat. No. 7746. 250 mm. to base of caudal.

(All figures one-third natural size)



Caranx, Longirastrum, and Uraspis.

PLATE XXIX.

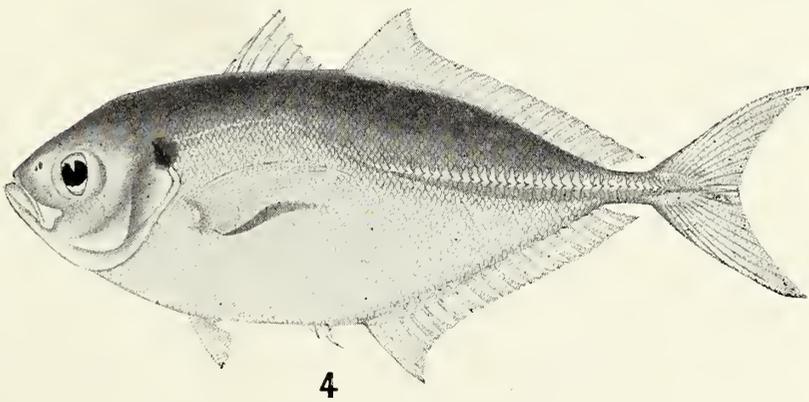
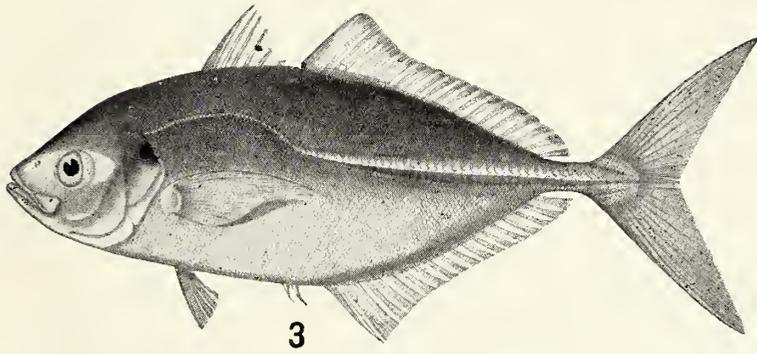
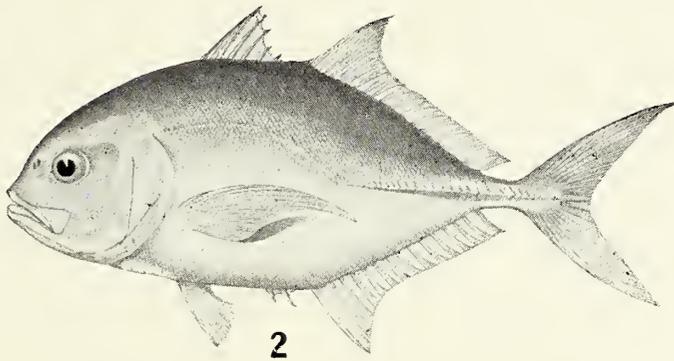
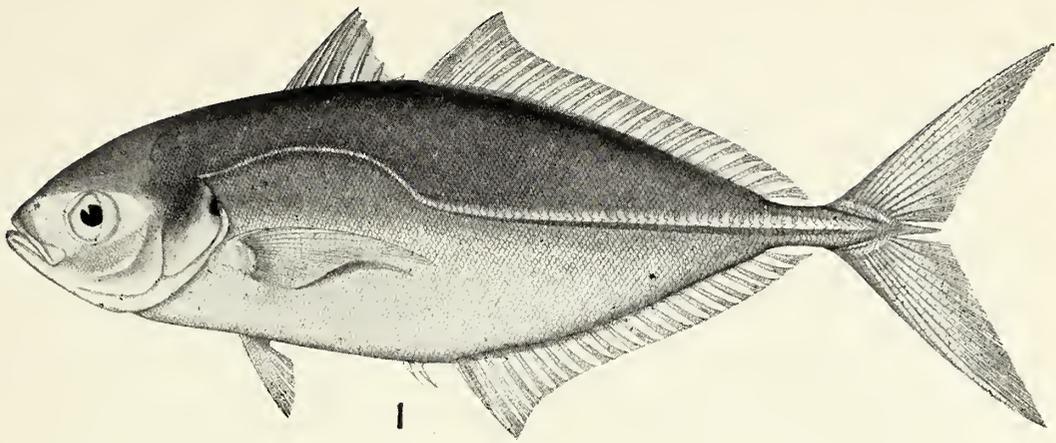
FIG. 1. *Caranx (Atule) djeddaba* (Forskål). Formosa. C. M. Cat. No. 7739. 162 mm. to base of caudal.

FIG. 2. *Caranx jarra* Cuvier and Valenciennes. Bonin Islands. C. M. Cat. No. 7737. 100 mm. to base of caudal.

FIG. 3. *Caranx (Atule) malam* (Bleeker). Formosa. C. M. Cat. No. 7740. 112 mm. to base of caudal.

FIG. 4. *Caranx miyakamii* Wakiya, *sp. nov.* Type. Formosa. C. M. Cat. No. 7742. 119 mm. to base of caudal.

(All figures one-half natural size)



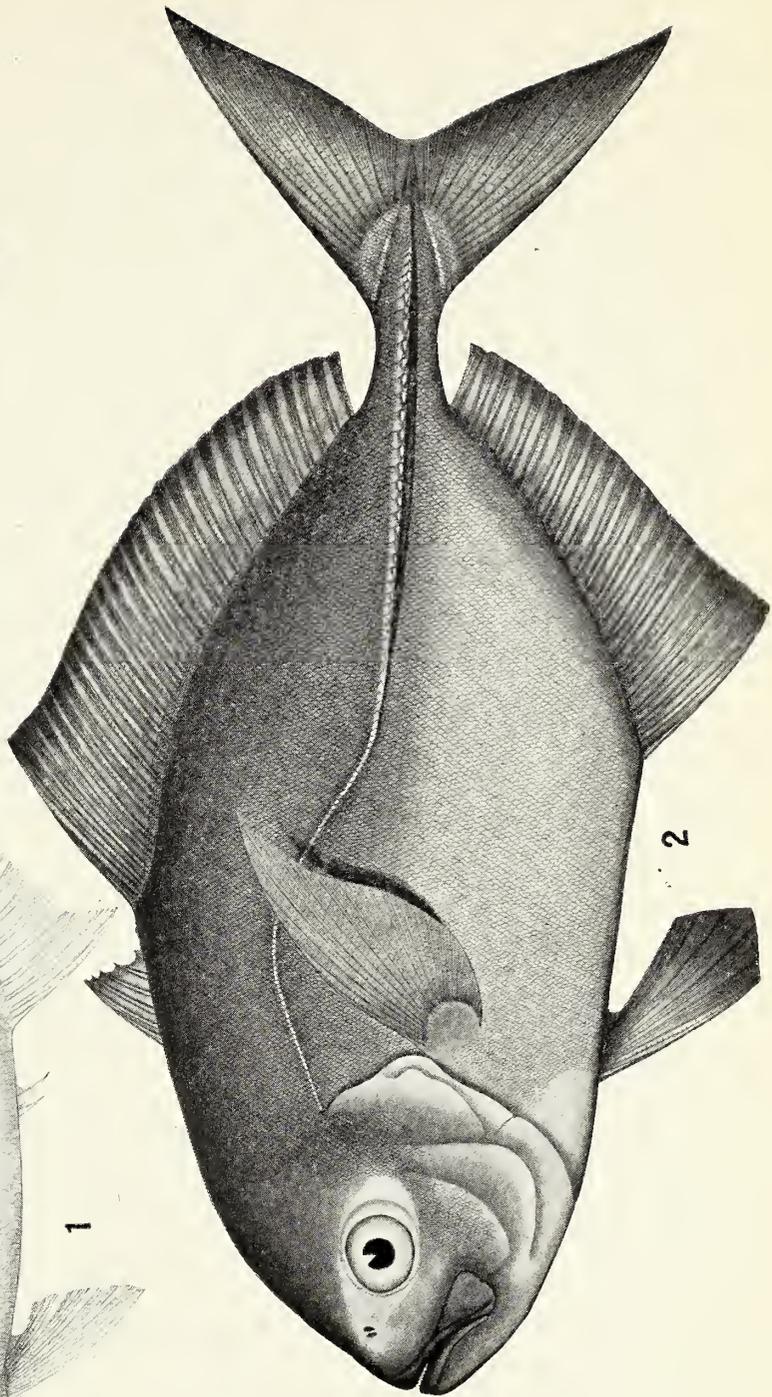
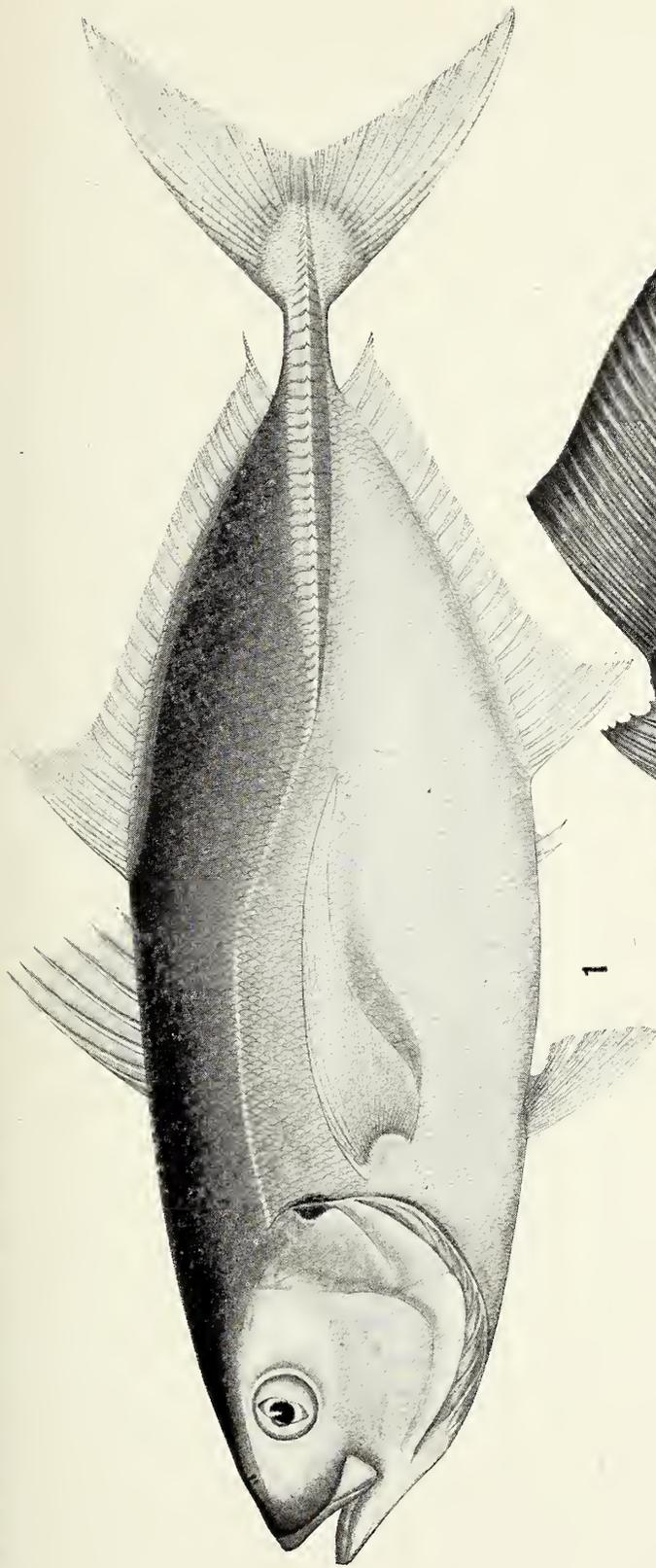
Atule and Caranx.

PLATE XXX.

FIG. 1. *Caranx (Atule) affinis* Rüppell. Formosa. C. M. Cat. No. 7741.
244 mm. to base of caudal.

FIG. 2. *Caranx (Uraspis) micropterus* Rüppell. Kii. C. M. Cat. No. 7747.
210 mm. to base of caudal.

(Both figures one-half natural size)



Atule and Uraspis.

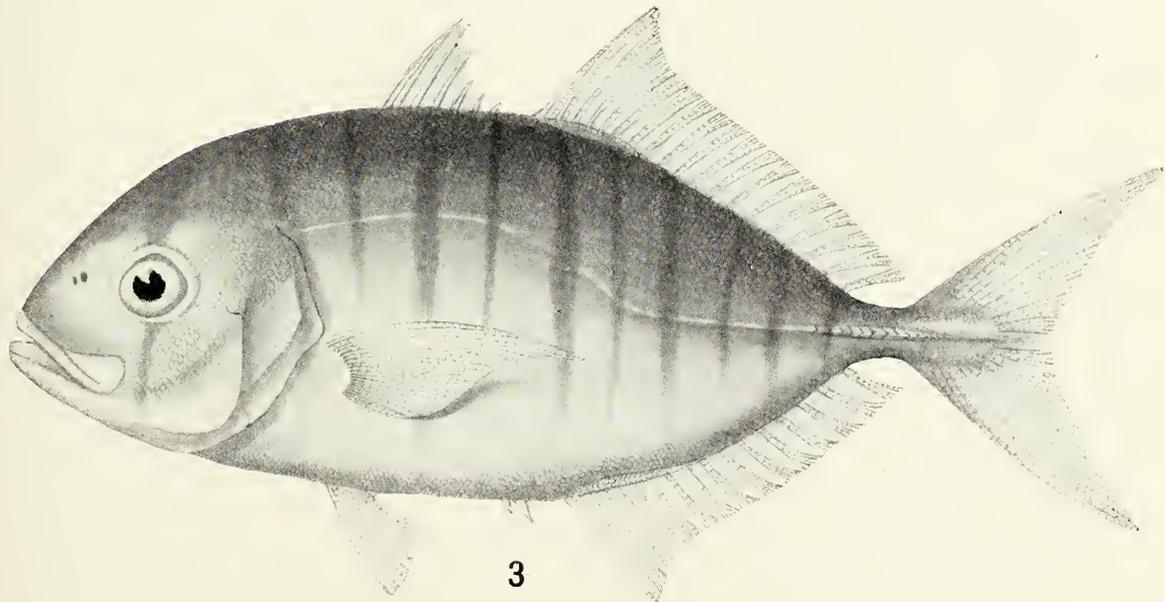
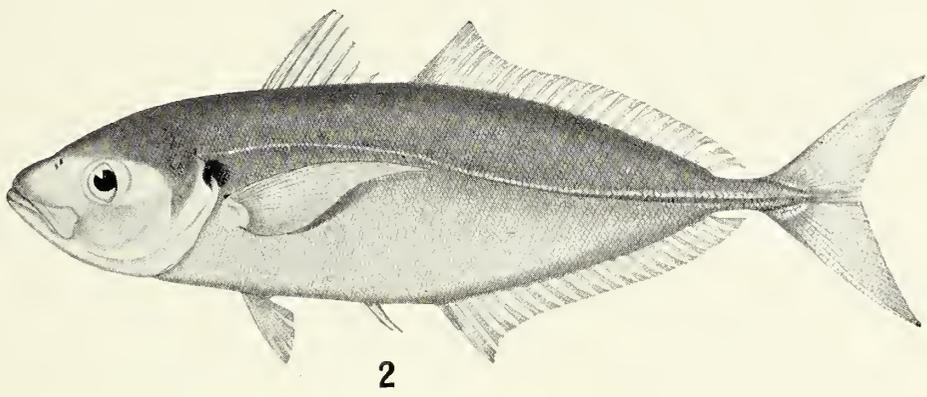
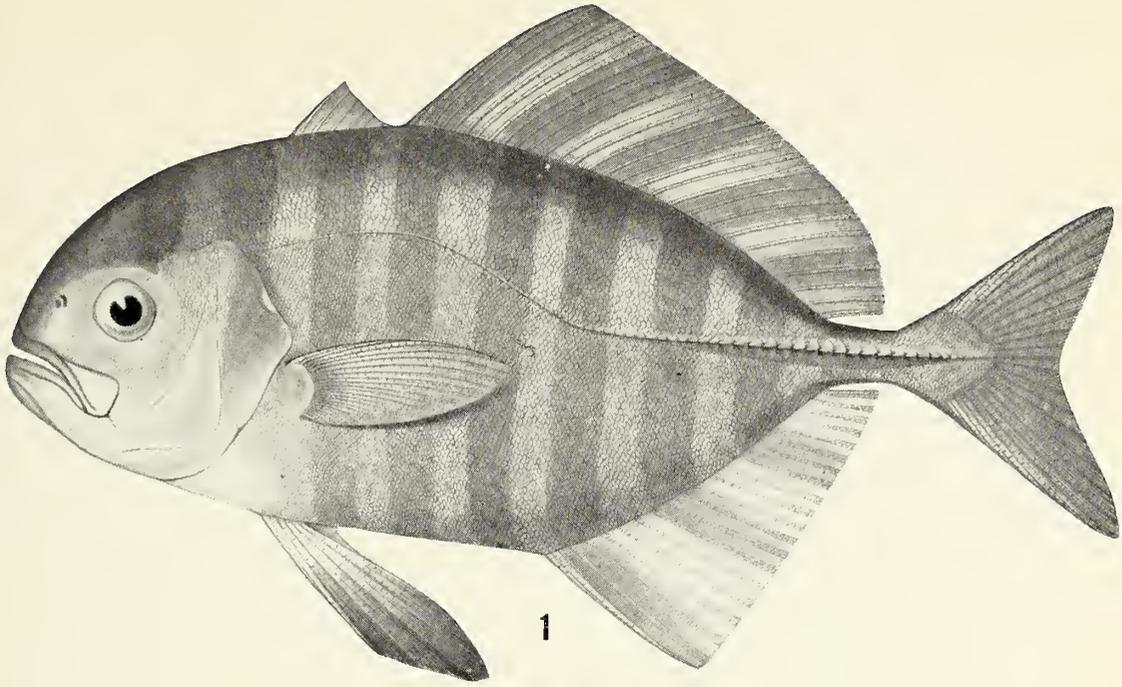
PLATE XXXI.

FIG. 1. *Caranx (Uraspis) uraspis* Günther. Nagasaki. C. M. Cat. No. 7748. 172 mm. to base of caudal.

FIG. 2. *Caranx (Selaroides) leptolepis* Cuvier and Valenciennes. Ryūkyū. C. M. Cat. No. 7749. 141 mm. to base of caudal.

FIG. 3. *Caranx (Gnathanodon) speciosus* (Forskål) Formosa. 85 mm. to base of caudal.

(Figs. 1 and 2 one-half natural size. Fig. 3 natural size)



Uraspis, Selaroides, and Gnathanodon.

PLATE XXXII.

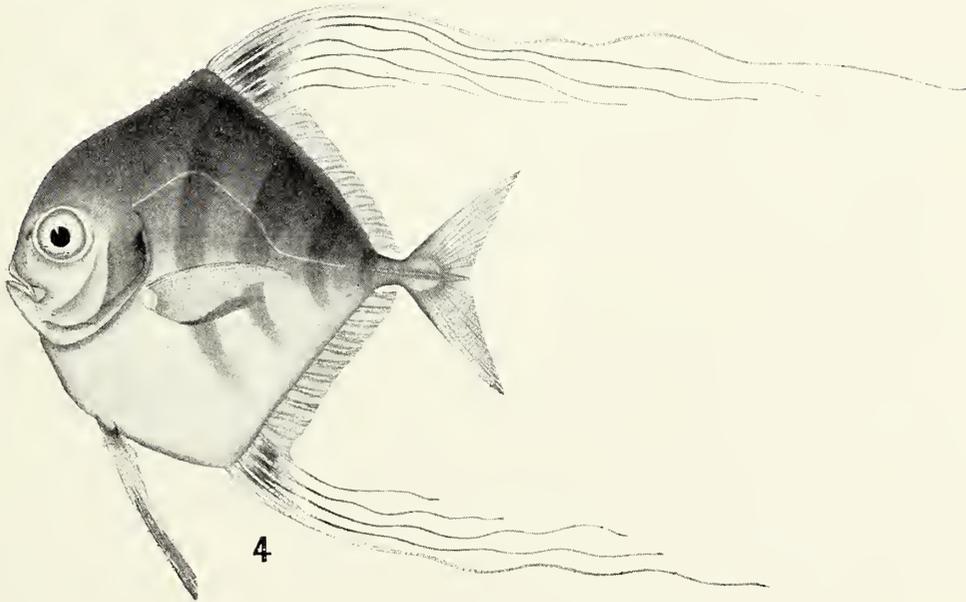
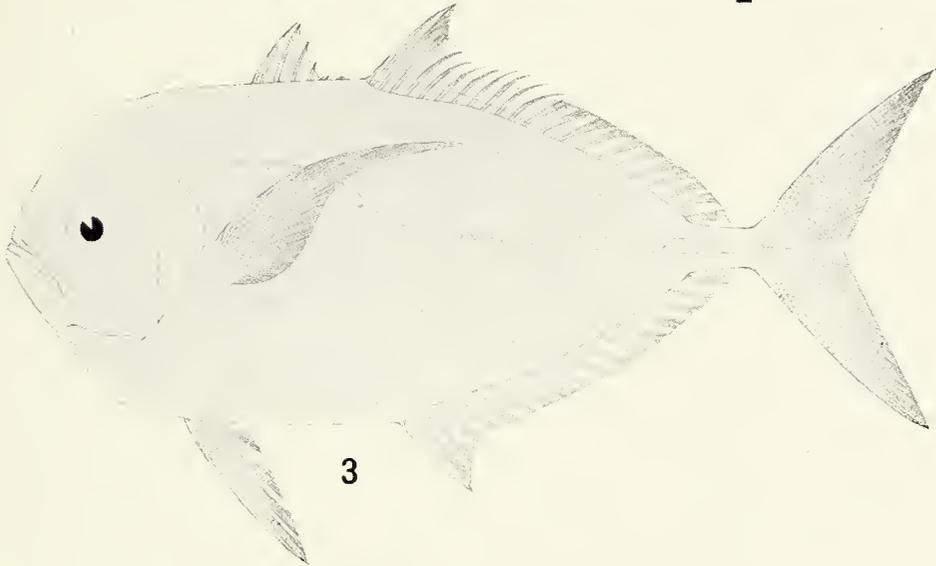
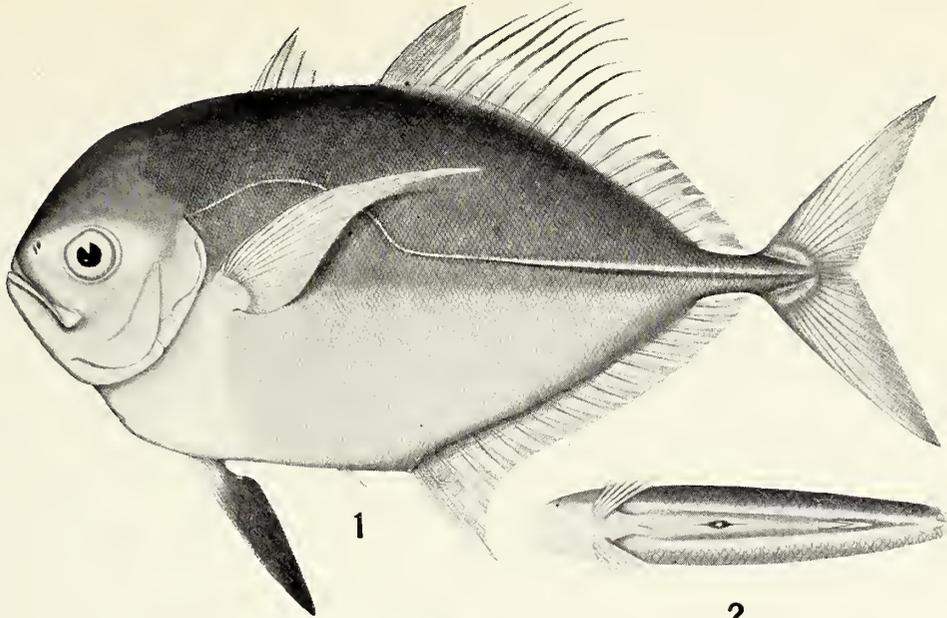
FIG. 1. *Atropus atropus* (Bloch and Schneider) Formosa. C. M. Cat. No. 7750. 214 mm. to base of caudal.

FIG. 2. Breast of *Atropus atropus*.

FIG. 3. *Atropus atropus*. Female.

FIG. 4. *Alectis ciliaris* (Bloch). Bonin Islands. C. M. Cat. No. 7751. 78 mm. to base of caudal.

(Figs. 1 and 3 one-third natural size. Figs. 2 and 4 one-half natural size)

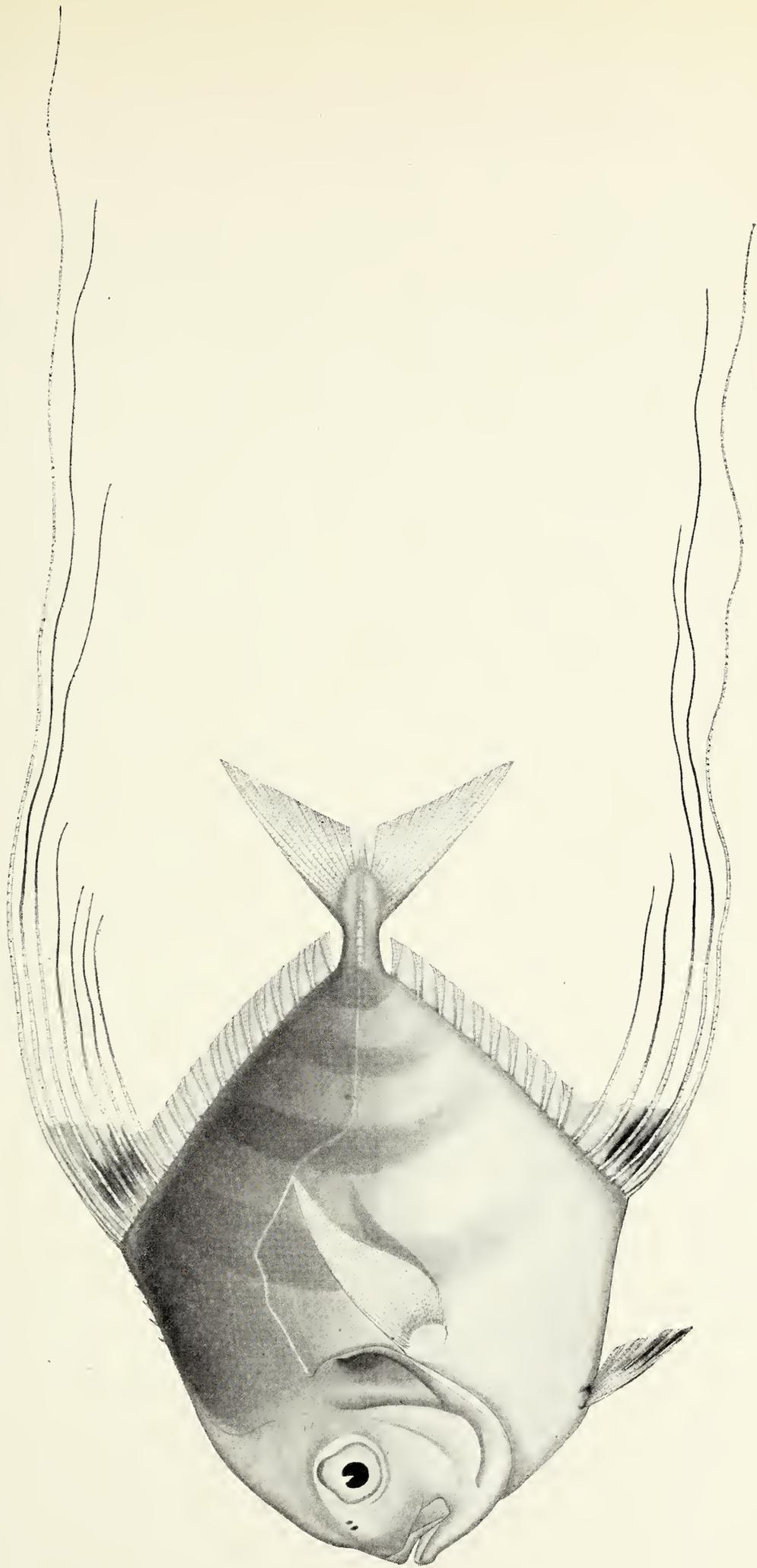


Atropus and Alectis.

PLATE XXXIII.

Alectis breviventralis Wakiya, *sp. nov.* Type. Kii. C. M. Cat. No. 7753. 116 mm.
to base of caudal.

(Figure reduced)



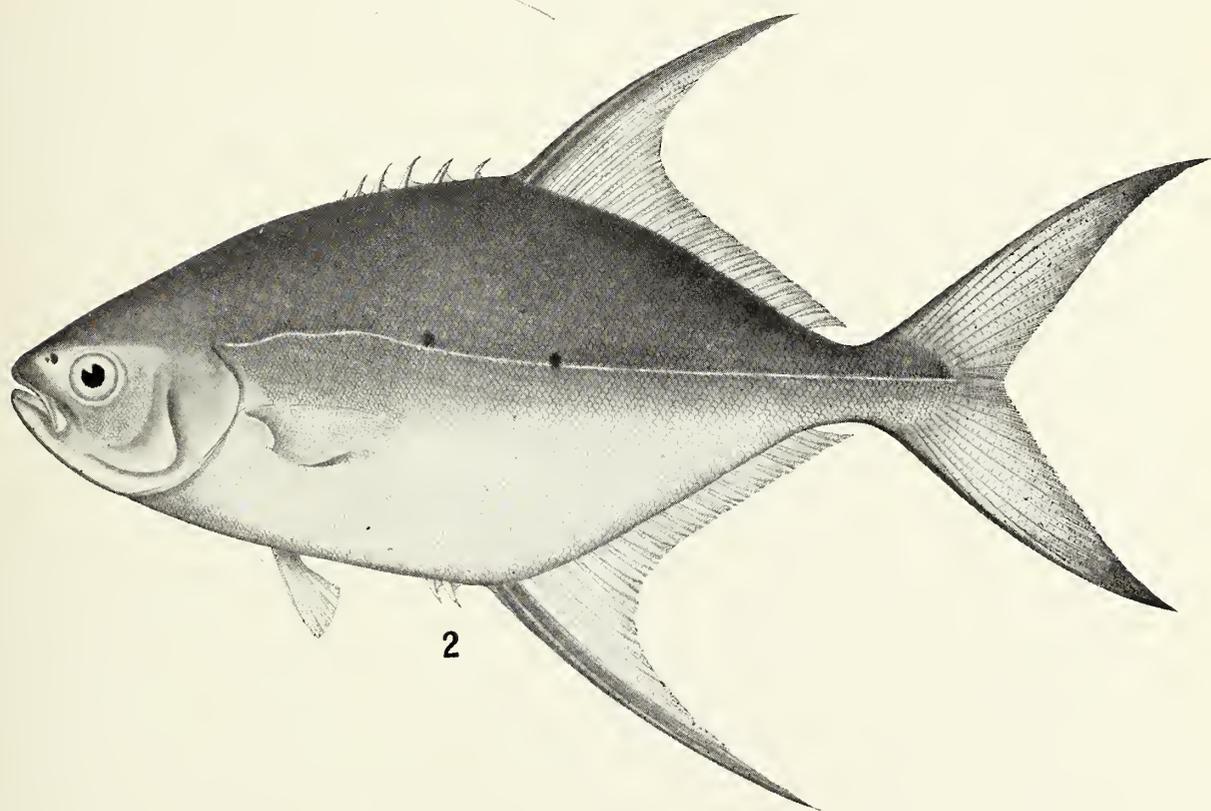
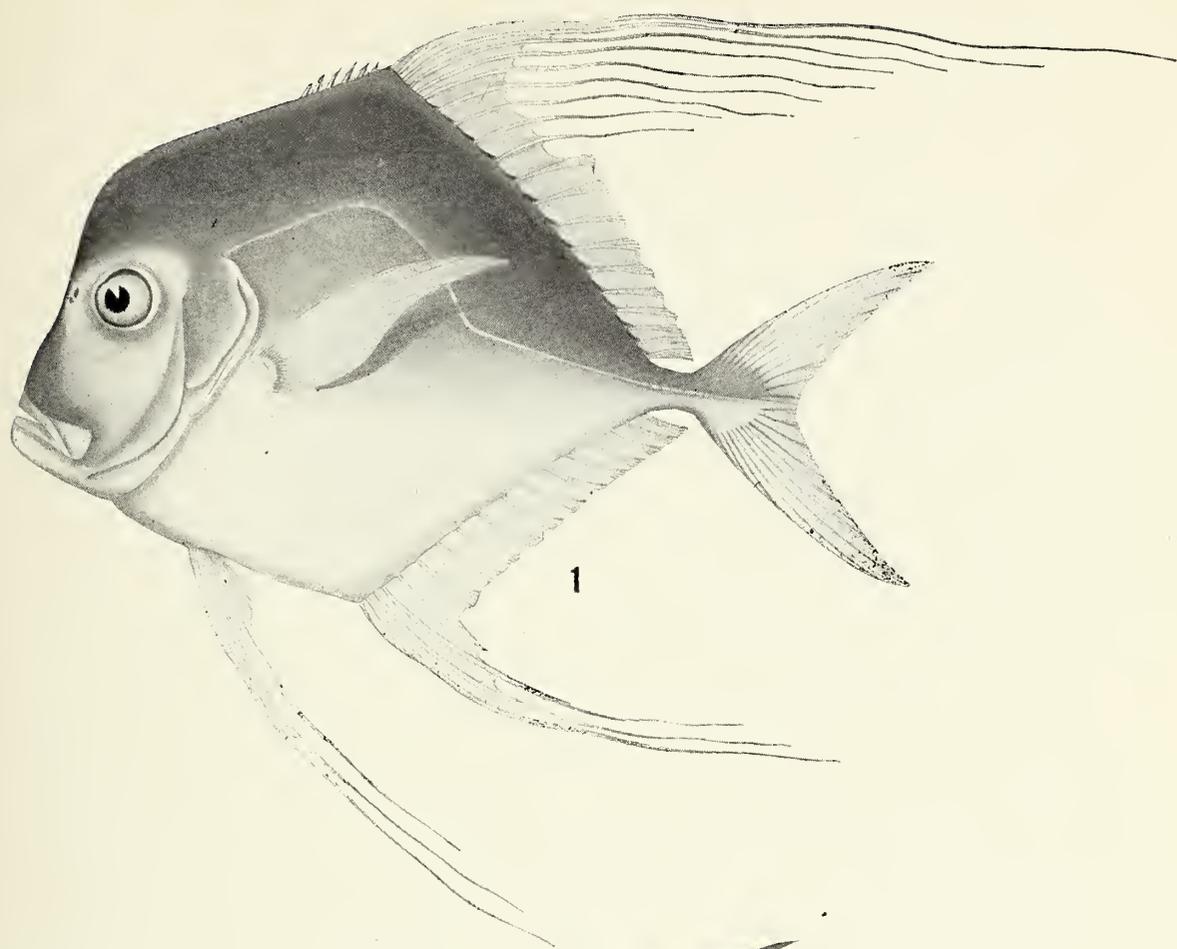
Alectis.

PLATE XXXIV.

FIG. 1. *Alectis major* (Cuvier and Valenciennes). Formosa. C. M. Cat. No. 7754. 130 mm. to base of caudal.

FIG. 2. *Trachynotus quadripunctatus* (Rüppell). Kii. C. M. Cat. No. 7755. 160 mm. to base of caudal.

(Both figures one-half natural size)



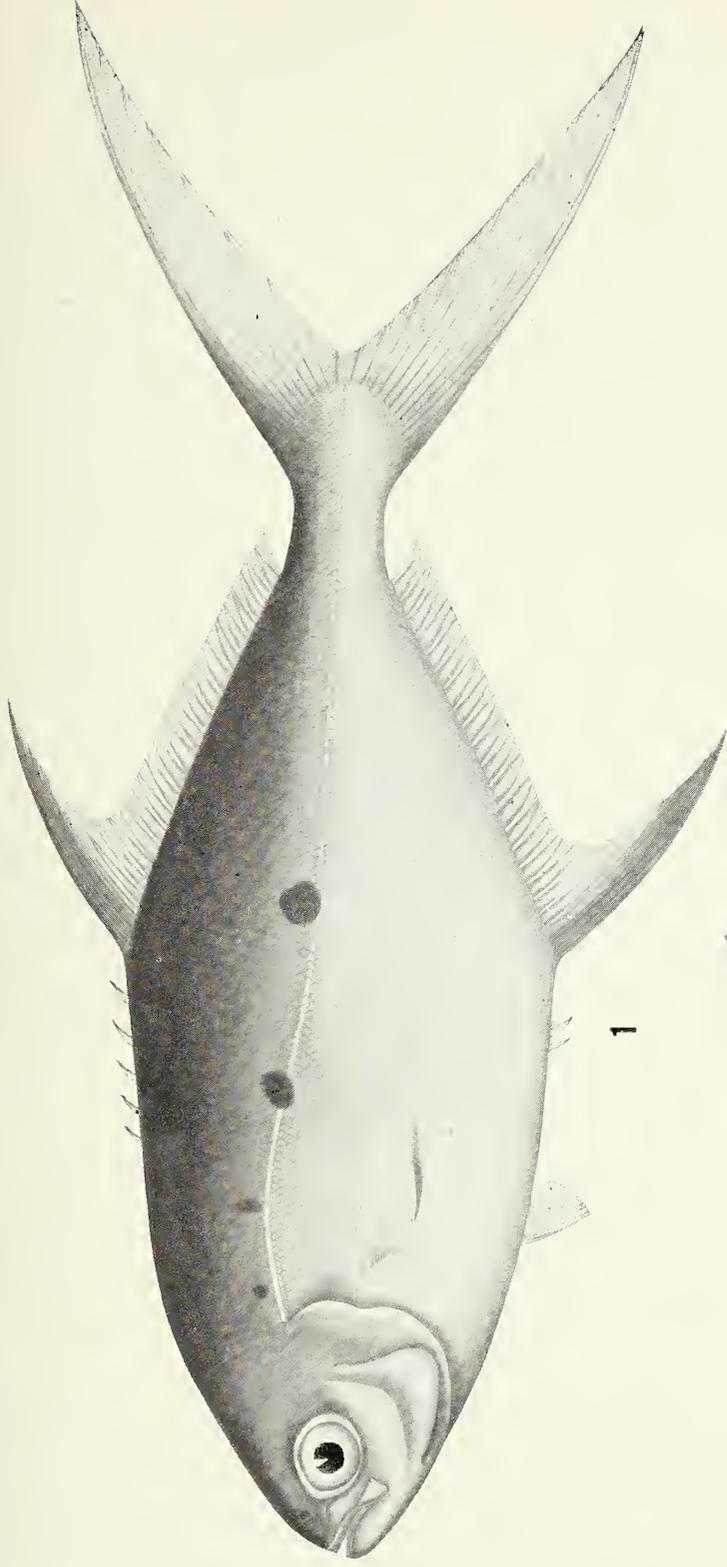
Alectis and *Trachynotus*.

PLATE XXXV.

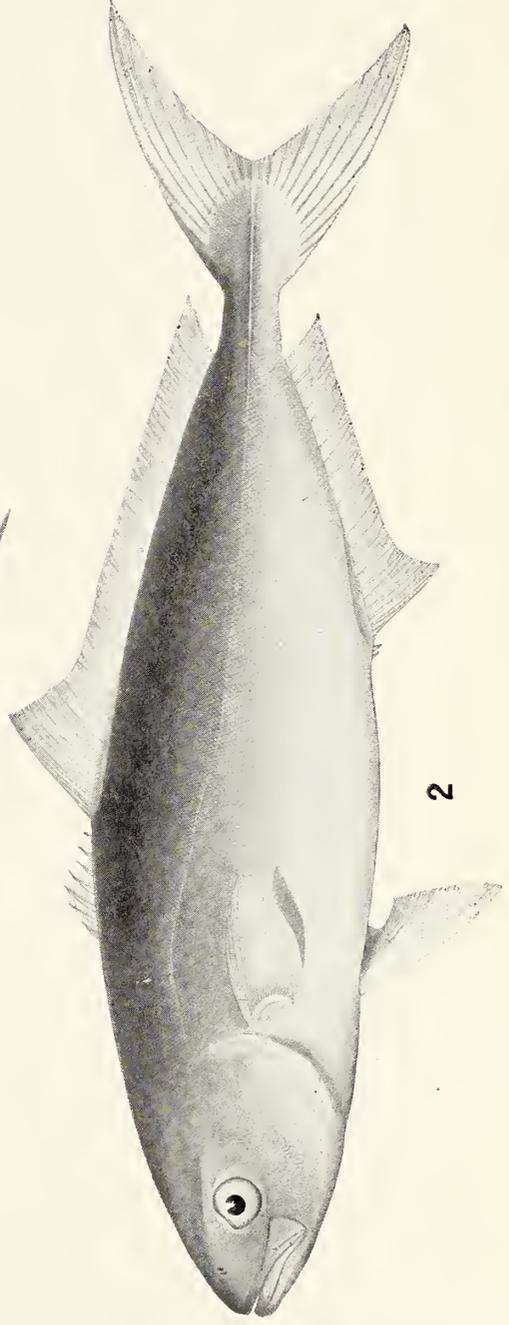
FIG. 1. *Trachynotus jordani* Wakiya, *sp. nov.* Type. Bonin Islands. C. M. Cat. No. 7756. 297 mm. to base of caudal.

FIG. 2. *Seriola aureovittata* Temminck and Schlegel. Kii. C. M. Cat. No. 7757. 300 mm. to base of caudal.

(Figures one-third natural size)



1



2

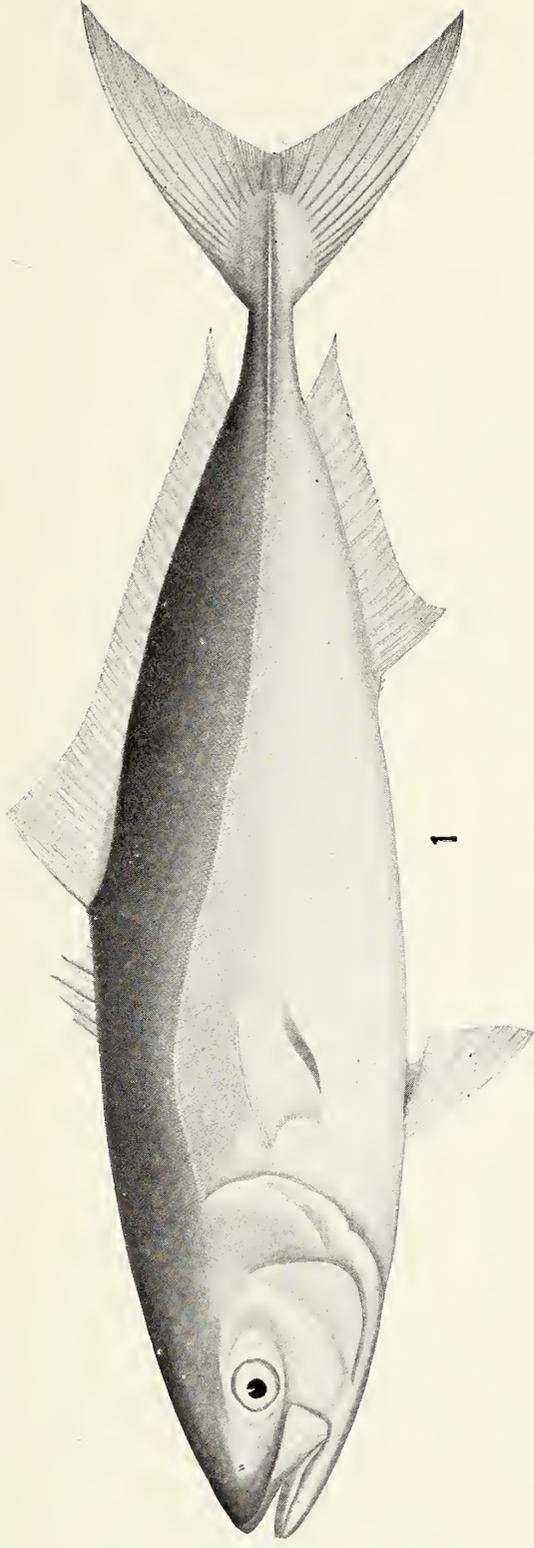
Trachynotus and Seriola.

PLATE XXXVI.

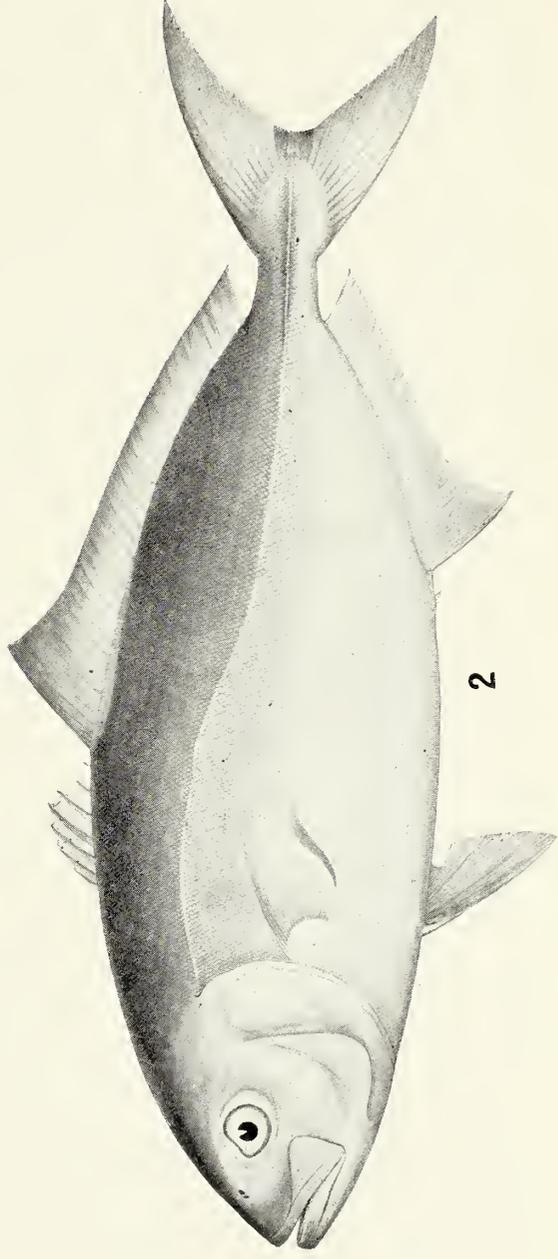
FIG. 1. *Seriola quinqueradiata* Temminck and Schlegel. Kii. C. M. Cat.
No. 7758. 350 mm. to base of caudal.

FIG. 2. *Seriola purpurascens* Temminck and Schlegel. Kii. C. M. Cat.
No. 7759. 285 mm. to base of caudal.

(Figures one-third natural size)



1



2

Seriola.

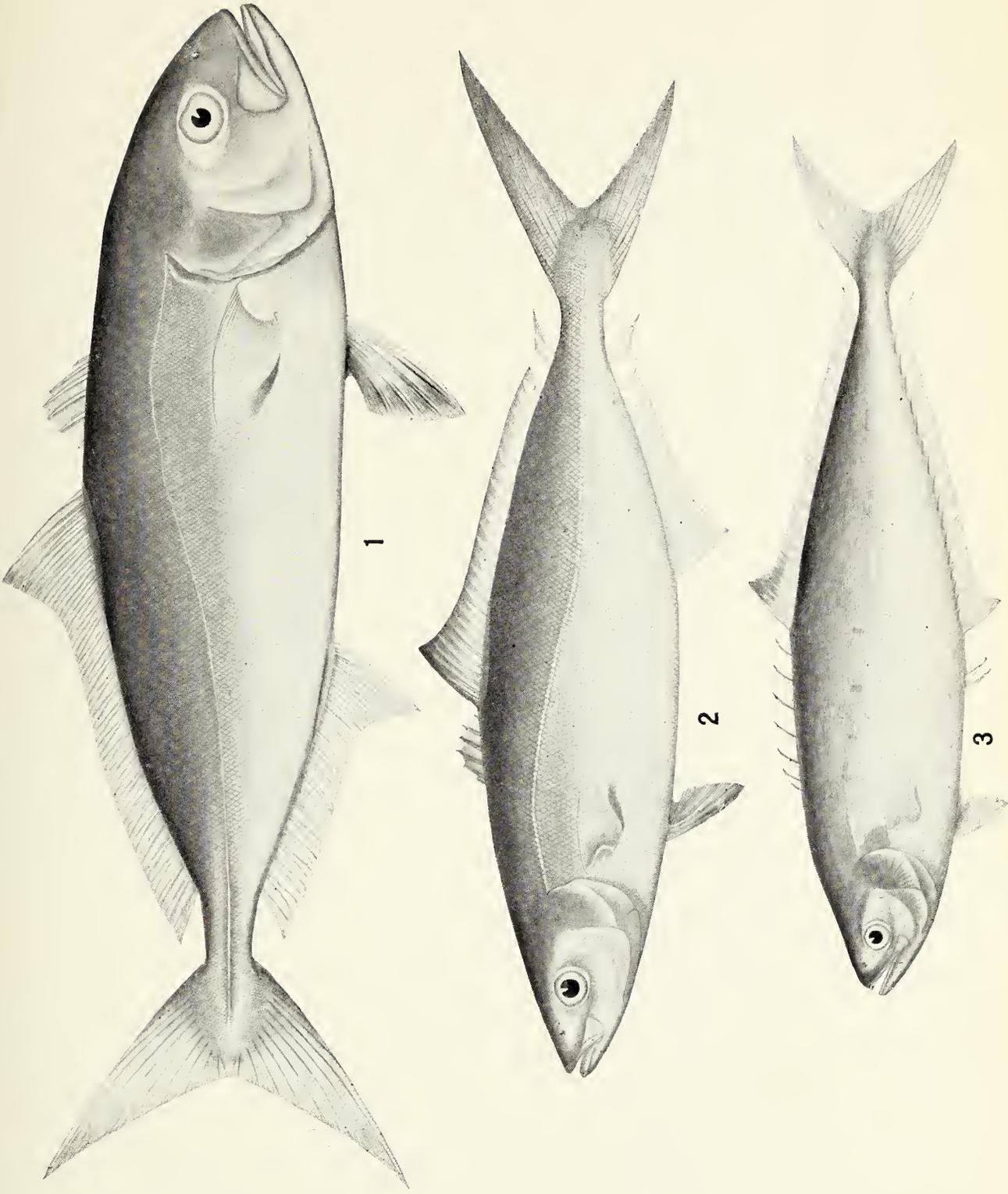
PLATE XXXVII.

FIG. 1. *Seriola cristata* Döderlein. Sagami Bay. C. M. Cat. No. 7760.
344 mm. to base of caudal.

FIG. 2. *Elegatis bipinnulata* (Quoy and Gaimard). Kii., C. M. Cat. No. 7763.
278 mm. to base of caudal.

FIG. 3. *Scomberoides moadetta* (Cuvier and Valenciennes). Formosa. 285 mm.
to base of caudal.

(Figures one-third natural size)



Seriola, Elegatis, Scomberoides.

PLATE XXXVIII.

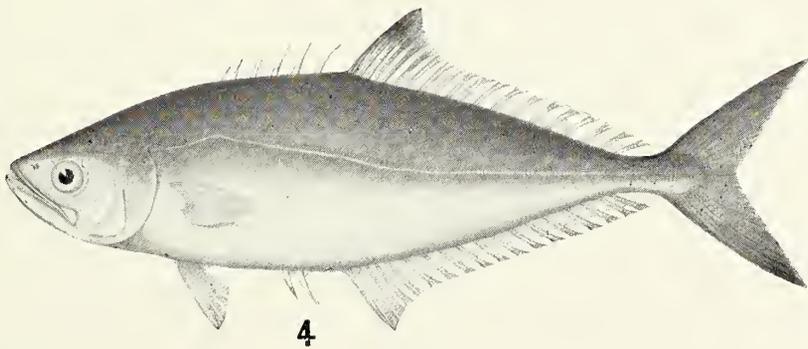
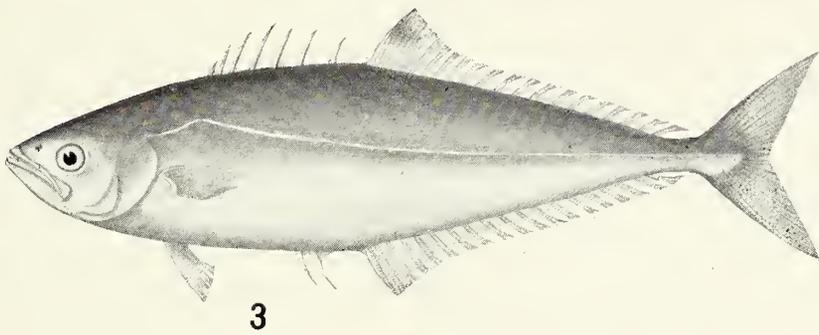
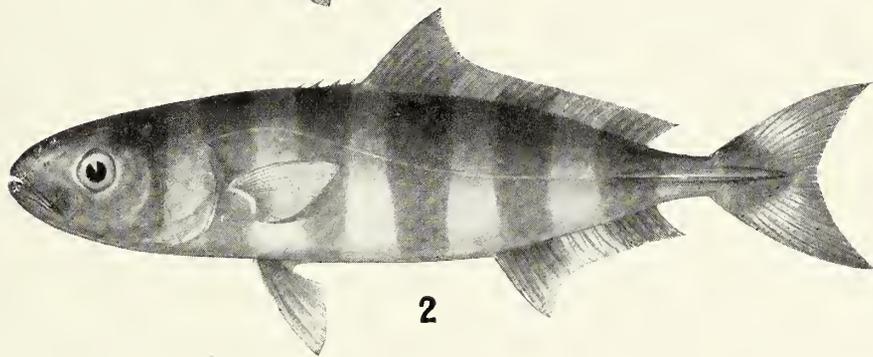
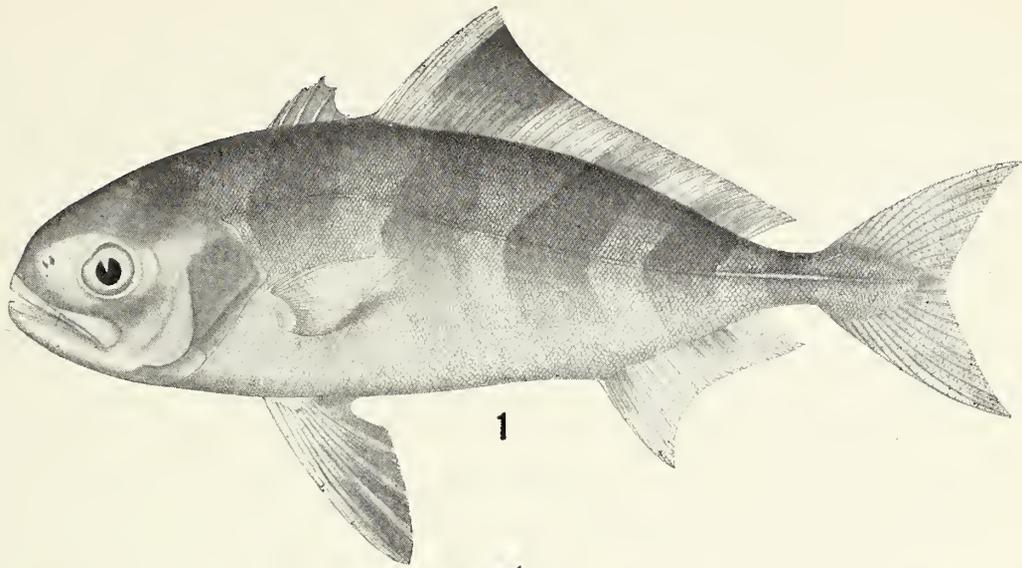
FIG. 1. *Seriolina intermedia* (Temminck and Schlegel). Kii. C. M. Cat. No. 7761. 156 mm. to base of caudal.

FIG. 2. *Naucrates indicus* Cuvier and Valenciennes. Kii. C. M. Cat. No. 7762. 135 mm. to base of caudal.

FIG. 3. *Scomberoides formosanus* Wakiya, *sp. nov.* Type. Kii. C. M. Cat. No. 7765. 130 mm. to base of caudal.

FIG. 4. *Scomberoides orientalis* (Temminck and Schlegel). Kii. C. M. Cat. No. 7766. 125 mm. to base of caudal.

(All figures one-half natural size)



Seriolina, Naucrates, Scomberoides.

XI. ACCOUNT OF A SKELETON OF A GORILLA REMARK-
ABLE BECAUSE SHOWING RECOVERY FROM
GUNSHOT WOUNDS.

BY W. J. HOLLAND.

(PLATES XXXIX—XL)

In the year 1886 I purchased from my friend, the late Rev. Dr. A. C. Good, the skin and skeleton of a Gorilla, killed by a native hunter at Kangvé on the Ogové River. Dr. Good had secured the specimen from the native and had carefully prepared the skin and roughed out the skeleton. The latter was mounted for me by the firm of Ward at Rochester, N. Y., and subsequently the skin was mounted by Mr. F. S. Webster. The mounts were transferred to the Carnegie Museum in the year 1898, and bear the Accession No. 406 (1-2). The specimen is a male, but not especially large in size. The skeleton, as mounted, measures from the base of the astragalus to the top of the occipital crest 147.5 cm., the width across the upper extremities of the humeri is 41.75 cm., the length of the right arm (uninjured) from the top of the humerus to the tip of the middle finger is 101.5 cm., the length of the left arm (injured), measured in the same way, is 97.75 cm. The difference in the length of the arms, due to the injury of the left arm is therefore approximately 3.75 cm. or about 1.5 inches.

The animal, before receiving its *coup de grace* by the native, who killed it, had long before been injured and its left arm broken by a discharge of buck-shot. The injuries indicate that the creature was probably in a tree at the time it was shot, and that the hunter fired from below at no great range. The direction of the paths of the balls which can be traced is from below upward. Their course makes it inconceivable that the shot was received by the animal when upon the ground.

One shot creased the top of the articulating upper surface of the humerus for about three-fourths of its diameter, but did not go through the capsule of the joint. The groove made by the ball terminates in a rounded cavity, where the ball stopped. There is

some evidence that the ball may have been lodged there for some time. It may have even been there at the time the animal was finally killed, and been lost when the skeleton was being prepared for shipment to America. It may, however, at an earlier date have worked out of the joint and lodged itself elsewhere. At all events this ball is lost, though the injury it inflicted on the upper articulating surface of the humerus is well marked.

Another ball struck the front of the shaft of the bone about 55 mm. below the articulating surface of the humerus and passed through, emerging behind about 10 mm. below the epiphysial suture. By passing a splint through the latter wound and laying a splint in the groove on the top of the humerus the paths of the two balls are seen to have been exactly parallel.

One or more balls struck the shaft about 90 mm. below the epiphysial suture and the shaft was transversely fractured, the break being on a plane lying at an acute angle with the axis of the shaft. The lower moiety of the shaft, as a consequence of this fracture, slipped upward, overlapping the anterior part of the shaft by the amount of displacement which has already been noted, that is to say about 3.75 cm. At the break a rather wide interval between the two broken surfaces, about 26 mm. in width, exists. This interval has been more or less solidly filled in by osseous material, which is more or less spongy in structure, but extensively overlaid in places by smooth or finely striated lamellæ of bone, corresponding in appearance to the outer surface of the uninjured parts of the humerus. The spongy character of the interpolated bony material is more plainly visible at the lower end of the infiltrated mass than at the upper end. A few small openings, not bridged over by the bony deposit, are visible. Whether, in case the animal had lived longer, these lacunæ would have ultimately been filled up, it is hard to say. Here and there on the outer surface of the bony deposit appear depressed vermiculate channels, which mark the location of arteries and veins, which nourished the deposit during its growth. These represent the more or less shattered branches of veins and arteries which had been injured at the time when the creature was wounded, but had eventually resumed their functions.

The periosteum both above and below the break seems to have acted normally, but, where disturbed at the place of fracture, its activities were greatly stimulated.

In the plexus of bony material at its lowest extremity imbedded in the spongy tissue of the newly formed bony mass is firmly lodged one of the flattened buck-shot, which the animal received in its arm at the time of injury.

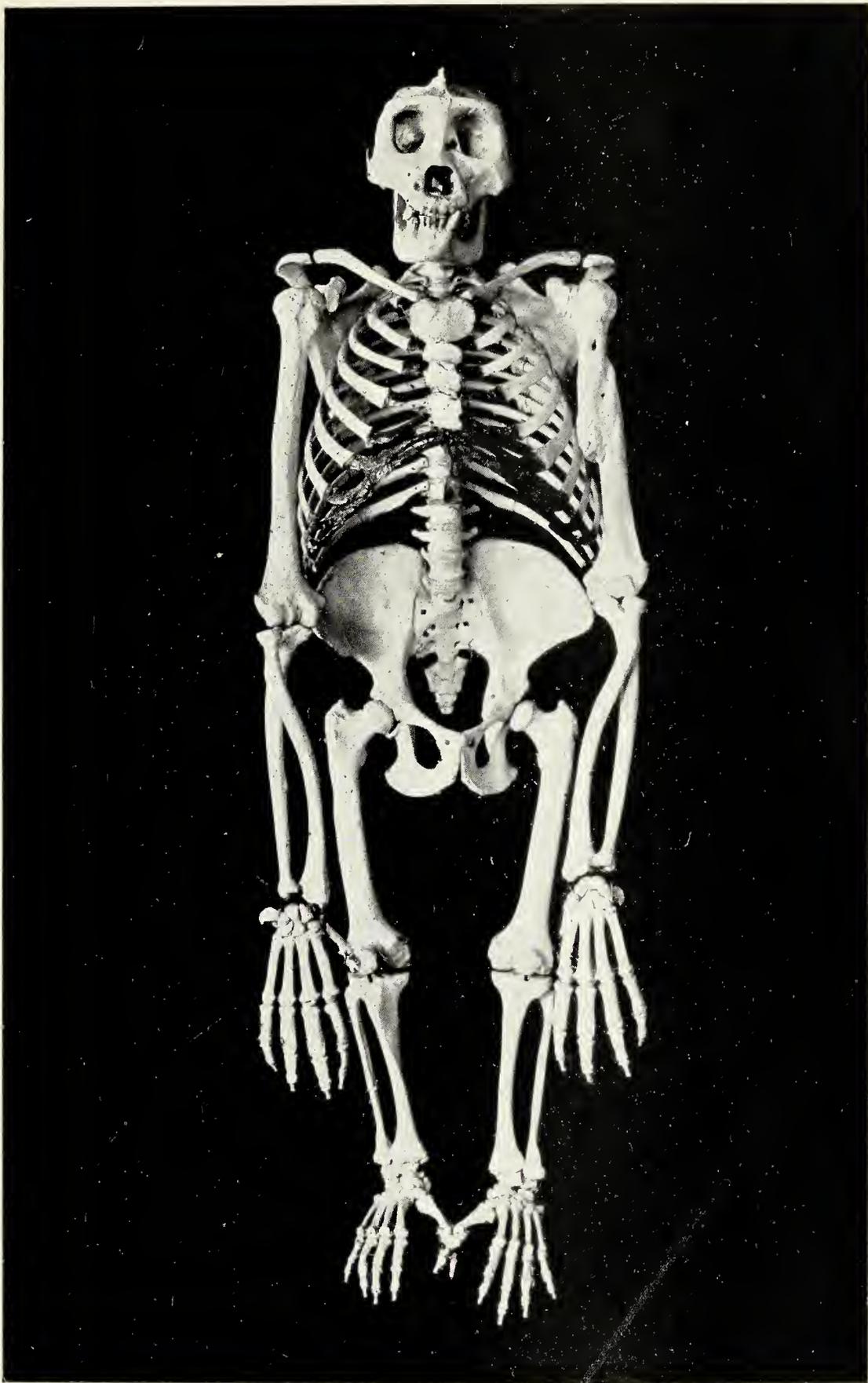
There are evidences of considerable inflammation in the upper joint of the arm, and, while the animal eventually recovered from its wound and was shot at a later date by a ball which penetrated the cranium at the inner angle of the left eye, it may be doubted whether the creature ever entirely recovered the full use of the left arm. The injuries received by the synovial membrane at the upper joint of the humerus and the (at least temporary) lodgment within the capsule of a buck-shot must have caused more or less inflexibility of the joint. This fact in itself may have contributed to the remarkable healing of the fracture, which left the injured arm only a little shorter than its fellow, so little shorter that a casual inspection of the mounted skeleton (See Plate XXXIX) hardly fails to reveal at first glance a difference in the length of the two arms.

An examination of the specimen reveals an extensive exostosis about the neck and on the inner surface of the great trochanter of the right femur. Several of my medical and surgical friends have suggested that this may be due to syphilitic infection. I do not, however, recall at the moment of writing any mention in the literature of the subject of authenticated cases of syphilis among the anthropoid apes, and am inclined to believe that the diseased condition at this point was due to local inflammation, possibly rheumatic in its origin.

On Plate XXXIX, accompanying this brief paper, I give a figure of the mounted skeleton, and on Plate XL views of the injured humerus. A study of these figures shows that the *vis medicatrix naturæ* has asserted itself in bringing about a recovery of the shattered bone, which might have done credit, if not to the most skilful surgeon, at least to some of those who practice the art. The animal made a good recovery from the fracture, which must have antedated its death by a considerable lapse of time. The dentition shows that the creature was more than fully adult, its teeth being well worn, suggesting that at the time of its death it was approaching the limits of gorillan age.

The study of the injuries received by this animal remind us that disease is not confined to human beings, and that, were it not for the healing power of nature, the evidence of which is constantly repeating

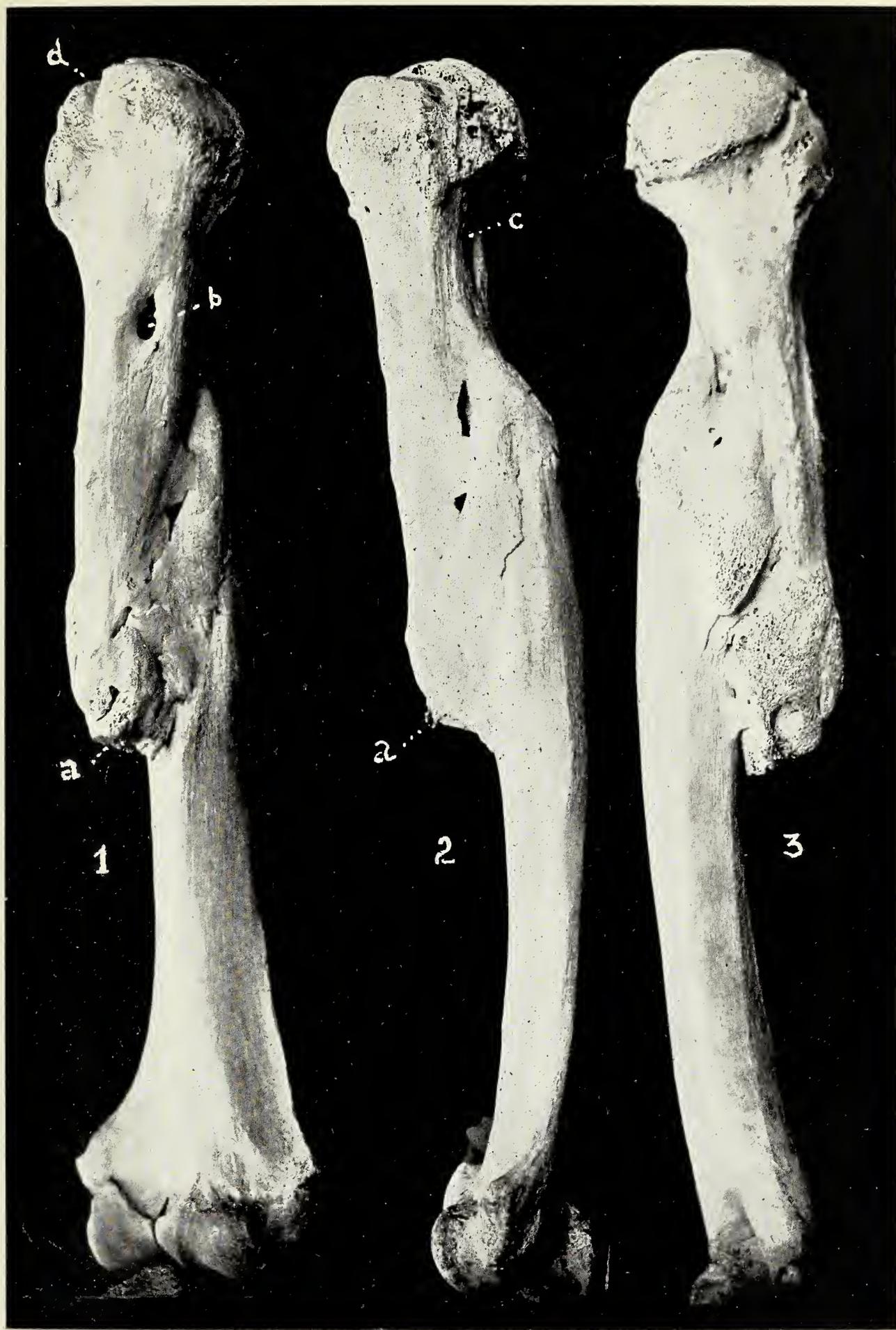
itself in the course of our investigations, it is quite possible that the sum of being on this globe would be much less today than it actually is. In fact in far-back ages the same vital forces, which repaired the break in the bone of this gorilla, repaired breaks of the limbs of reptiles and mammals long since extinct, which lived in Mesozoic and early Tertiary times. We have numerous specimens in our paleontological collections in the Carnegie Museum, which, like this skeleton of a gorilla, reveal the healing of bones broken, some of them millions of years ago.



Skeleton of *Gorilla*.

EXPLANATION OF PLATE XL.

- FIG. 1. Anterior view of injured left arm of Gorilla.
a. Flattened buck-shot imbedded in newly formed bony tissue.
b. Hole made in shaft by buck-shot, the exit of which is shown in Fig. 2 at *c.*
d. Groove made by buck-shot on upper surface of the proximal end of humerus.
- FIG. 2. Lateral view of the same bone.
a. Buck-shot imbedded in bony tissue.
c. Vacuity left by exit of ball, which entered shaft at the point marked *b* in Fig. 1.
- FIG. 3. Postero-internal view of injured left arm of Gorilla.



Injured Left Humerus of *Gorilla*.

XII. DISCOVERY OF FOSSIL MAMMALS IN THE BROWN'S PARK FORMATION OF MOFFATT COUNTY, COLORADO.

BY O. A. PETERSON.

The predominant color of the Brown's Park Formation of Major Powell,¹ is light gray to white. It rests directly, but unconformably, upon the Bridger or the Uinta, and all earlier formations in the region northeast and east of the Uinta and Blue Mountains of Utah and Colorado. The formation consists of finer and coarser sandstones and occasionally layers of finer or coarser gravel. The sandstones are often firm and regularly bedded, but sometimes soft and more easily eroded. The lithological structure is upon the whole quite similar to the Miocene series observed by the writer on the Eastern flanks of the Rocky Mountains and in Montana. These Brown's Park sediments cover a considerable area drained by Green River and the Vermilion Creek in its western portion, while outliers of the sediments extend eastward to the vicinity of the Two Bar Ranch on the Little Snake River, to Cedar Mountain, Lay P. O. on Lay Creek, and to Juniper Springs on the Bear River. The greatest vertical development of this formation is in Brown's Park proper, and may exceed three hundred feet in places, while to the east the formation is thinner.

In 1894, after crossing Green River at Jarvis Ferry, Brown's Park, the writer first encountered the Brown's Park Formation. A hasty examination was made for the purpose of finding fossils, but with little or no success. Only the shaft of one limb-bone was found, and this furnished no satisfactory evidence as to the age of the sediments. To the best of my knowledge previous to this time no fossil vertebrates had been found in the Brown's Park sediments. In 1922 a second opportunity presented itself for a reconnaissance of the Brown's Park region. The Carnegie Museum party, consisting of Messrs. Douglass,

¹F. V. Hayden calls attention to the fact that Brown's Park was originally named Brown's Hole by trappers forty or more years previous to his report. (Preliminary Report of the Geological Survey of Wyoming and Portions of Contiguous Territories, 1874, pp. 64-65). Hayden also describes the color of this formation, regards it as Pliocene, and of six hundred to eight hundred feet in thickness, p. 65.

Coggeshall, Kay, and myself, travelled through nearly the entire length of the Brown's Park formation. Frequent stops were made in looking for fossil remains, but none were found. However, during the past season, 1923, Messrs. Douglass and Kay were more successful. Mammalian remains representing five individuals were discovered, four of them belonging to carnivora and one to the *Camelidæ*. With the exception of one specimen, these, the first discovered mammalian remains, are rather unsatisfactory because of their fragmentary condition. However, enough has been obtained to approximately give the geological age of the Brown's Park formation. Apparently these sediments should be classified as ranging from the uppermost Oligocene to the middle Miocene. Although the genus *Phlaocyon* of Dr. Matthew is recognized, I somewhat hesitate in saying that the Brown's Park series of sediments are, in part, equivalent to the uppermost Oligocene of eastern Colorado.² In the material found there are certain characters, such as the long carnassial tooth of the carnivore and the extremely hypsodont molar of the cameloid, which point more strongly to later horizons, the Gering, Monroe Creek, and possibly the Lower Harrison beds of eastern Colorado, Wyoming, and western Nebraska. It is unfortunate that the tooth of the cameloid mentioned was not found in place. The field-notes, however, indicate that it could not have come from any but the Brown's Park formation. I have given below the horizon, so far as I am able, from the fragmentary evidence at hand. It should be stated that this determination is provisional, subject to verification upon the discovery of more complete paleontological evidence.

CARNIVORA.

*Phlaocyon willistoni*³ sp. nov.

Type: Anterior portion of skull, C. M. Cat. Vert. Fossils, No. 11,332; and a lower jaw, C. M. Cat. Vert. Fossils, No. 11,333.

Locality: One mile south and west of Sunbeam, Moffatt County, Colorado.

Horizon: Lower Miocene, Brown's Park formation.

Specific Characters. Muzzle relatively broad. Alveolar border of maxillary and premaxillary long, teeth large and M¹ and M² more nearly in line externally, when compared with *Phlaocyon leucosteus*

²Bull. Amer. Mus. Nat. Hist., Vol. XII, 1899, p. 131.

³In honor of the late Professor S. W. Williston.

Matthew. The type of the present species is approximately one-fifth smaller than *Phlaocyon leucosteus* and about the size of *Basariscus* of the southwestern United States.

The incisors of *P. willistoni* appear⁴ to be more crowded than in *P. leucosteus* and the distance between I^3 and the canine are proportionally greater in the specimen in the Carnegie Museum. Incisors and canines are broken near the alveolar border, and premolars one and two are lost. P^3 has a simple crown with a small posterior heel, but no tubercle. The sectorial is only one millimeter shorter than

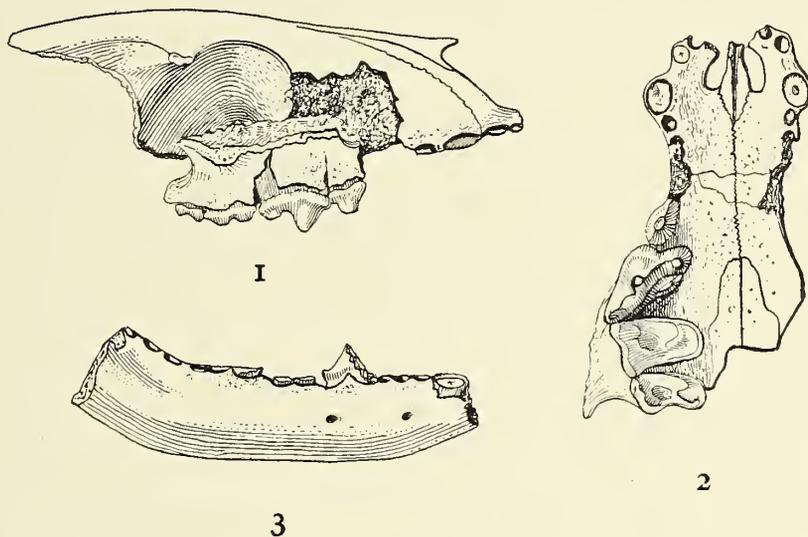


FIG. 1. *Phlaocyon willistoni*, Type, Nos. 11332, 11333.

1, side view; 2, palate views; No. 11332; 3, right jaw seen from side, No. 11333. All figures natural size.

that found in *P. leucosteus*; the tubercle of the crown is rather rounded; and there is a fairly well developed postero-internal cusp on the cingulum. From this cusp backward there is a prominent cingulum, which extends nearly to the apex of the sectorial tubercle. The apparent separation between this sectorial blade and the main cusp is due in great extent to wear, the specimen representing an old individual. The antero-external angle of M^1 is lost and the molars have received much wear, but it is possible to determine that they are of relatively greater size than those in *Phlaocyon leucosteus*,

⁴Measurements are taken in part from the description in the footnote of Dr. Matthew (Bull. Amer. Mus. Nat. Hist., Vol. XI, 1899, p. 54.) and from his illustrations, *ibid.*, Vol. XII, Pl. VI, and Fig. 10, p. 135.

and, as in that species, subquadrate. The specimen has received very little crushing, so that the different measurements obtained are quite reliable.

A lower jaw, minus the angle and with the crowns of the teeth broken off, was found in close vicinity to the skull. This second specimen has been given a different number (No. 11,333), because it is possible that it may not belong with the skull, and that it may prove to pertain to another species. The alveole for the canine is of extraordinary size, indicating a large canine which appears to agree with the large space between the last incisor and the canine of the upper series. P_1 is single-rooted and M_3 has its alveolus on the raised portion of the alveolar border. Its root was single, small, short, indicating a rudimentary condition. The jaw is shallow, heavy, and the under borders well rounded anteroposteriorly.

MEASUREMENTS.

Skull:

Length of alveolar border I^3 to and including M^2	33 mm.
Width of muzzle across base of canines.....	15 mm.
Length of carnassial.....	9 mm.
Length of M^1	6 mm.
Width of M^1	8 mm.
Length of M^2	3.5 mm.
Width of M^2	6.5 mm.

Lower Jaw:

Length from canine to anterior margin of alveolus for M_3	33 mm.
Depth of jaw at sectorial tooth.....	8 mm.

A third specimen, C. M. Cat. Vert. Foss., No. 11,334, found in the same place as *Phlaocyon willistoni*, is a lower jaw, considerably smaller in size than No. 11,333, described above. This undoubtedly represents an additional species, but, since there is no way of comparing it with *P. willistoni*, which has just been described, it seems preferable to only call attention to the chief features of the specimen, which are as follows: the jaw in its general contour is quite similar to that of *Phlaocyon willistoni*; the canine is large and the crown has received considerable wear on the apex; the base of the crown has a heavy cingulum on the inner anterior and posterior faces. P_1 is single-rooted; the three following teeth are double-rooted. The carnassial is a long tooth, with a well developed trigon and a basined

heel, though the two internal tubercles on the heel are not as far advanced as in the type of *Nothocyon annectens* in the collection of the Carnegie Museum from the Nebraskan Miocene. M_2 has three

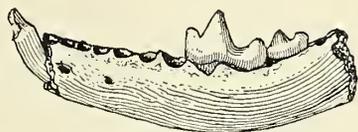


FIG. 2. ?*Phlaocyon*. Left lower jaw. No. 11334. Natural size.

tubercles on the crown, one internal and two external, and does not appear to have advanced far from *Cynodictis* of the Oligocene. On the raised portion of the alveolar border in the specimen being described there is evidence of an alveolus for M_3 . This tooth was in the same rudimentary stage of development as in *Phlaocyon willistoni*, judging from the character of the alveolus.

MEASUREMENTS.

Length of jaw from canine to alveolus of M_3	26 mm.
Length of carnassial tooth.....	8 mm.
Length of M_2	4 mm.
Depth of jaw at M_1 (carnassial).....	5.5 mm.

A fourth individual, representing a carnivore, C. M. Cat. Vert. Foss., No. 11,335, consists of fragments of the anterior portion of both lower jaws, with the premolar teeth. This specimen was found in the same locality and horizon of the Brown's Park formation, near Sunbeam, Colorado. The fragments pertain to a larger animal, with the jaw quite heavy, but relatively deeper than those described above. In fact the fragments indicate an animal larger than *Phlaocyon leucosteus* of eastern Colorado and differ also from the latter by the presence of a posterior accessory cusp on P_3 , but the premolars are, however, very similar in height and general characters. P_4 is represented only by a portion of the crown and the roots of the larger fragment, while the posterior part of the tooth is preserved on the opposite jaw. This tooth has the posterior accessory cusp and heavy cingulum on the posterior and external faces, as is represented in the illustration of *Phlaocyon leucosteus*, Bull. Amer. Mus. Nat. Hist. Vol. XII, 1899, p. 135.

MEASUREMENTS.

Length of jaw from canine to M_1	24 mm.
Depth of jaw at P_4	13 mm.

ARTIODACTYLA.

An isolated tooth (M_3 of right jaw), C. M. Cat. Vert. Foss., No. 11,336, was picked up by Gavin Douglass in the lower part of Sand Wash, west of Two Bar Ranch, Moffatt County, Colorado. This tooth is clearly that of a cameloid closely allied to *Stenomylus*.

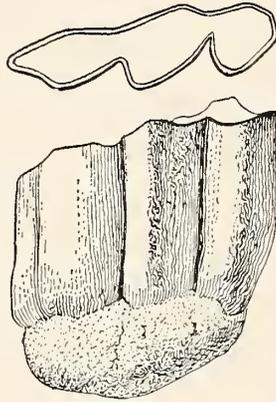


FIG. 3. Cameloid, closely allied to *Stenomylus*. M_3 of right side. No. 11336. Natural size.

The length of the tooth is approximately the same as in the average of *Stenomylus*, but the third lobe is relatively somewhat larger and the anterior lobes are more triangular in diameter. The tooth is, however, of the same hypsodont type as in *Stenomylus*.

MEASUREMENTS.

Antero-posterior diameter of M_3	2 mm.
Transverse diameter of M_3 anterior lobe.....	7 mm.
Height of crown of M_3	16 mm.

XIII. THE LIFE-HISTORY OF THE COMMON WATER-NEWT
(NOTOPHTHALMUS VIRIDESCENS), TOGETHER WITH
OBSERVATIONS ON THE SENSE OF SMELL.

BY PHILIP H. POPE.

(PLATES XLI-LI.)

INTRODUCTION.

After such exhaustive papers as those of Gage ('91b)* and E. C. Jordan ('93) further work upon the life-history of this animal might seem superfluous. However, during several years of collecting and study of various Urodeles I have come upon a number of facts, which are either new, or have been incorrectly interpreted by earlier writers. These observations are based on collections made in Maine, New Hampshire, New York, New Jersey, Pennsylvania, and Illinois, and on experimental work carried on at Harvard during the years 1916 and 1917, continued at the University of Pittsburgh in 1919, 1920, and 1921, and concluded at Cold Spring Harbor in the summer of 1921.

I take this occasion to acknowledge my indebtedness to Dr. Manton Copeland, who first suggested the work on this species; to Dr. G. H. Parker, under whose direction it was first undertaken; to Dr. L. E. Griffin, Dr. and Mrs. H. H. Wilder, Prof. H. D. Fish, Dr. H. H. Collins, and Miss Louise Smith for their valuable advice and suggestions; and to Prof. H. E. Fernald, Miss Louise Smith, and Miss Elnora Lawson for specimens. I wish also to express to Dr. C. B. Davenport my appreciation of the privilege of working at the Biological Laboratory of the Brooklyn Institute of Arts and Sciences at Cold Spring Harbor, and of the many courtesies extended to me while there. To Dr. W. J. Holland I am indebted for the editorial revision of these pages and for seeing them through the press.

* The citations in parentheses refer to the Bibliography at the end of the article.

Part I. LIFE-HISTORY.

The purpose of the first part of this paper is to state the known facts in the life-history of *Notophthalmus*, combined with such original contributions as I have been able to make, and also to suggest further work on points which as yet are not clear.

Gage ('91a) quoted below, has summed up the main facts in the life-history. He says: "I have now demonstrated the following facts with reference to this amphibian:

1. The eggs are internally fertilized;
2. The larvæ have the form and coloration of the adult aquatic form;
3. When the gills are lost, the animal becomes terrestrial, and changes its viridescent color for red;
4. At maturity the red terrestrial form goes into the water and assumes a viridescent coloration;
5. In aquatic forms, whether adult or larval, the epithelium of the mouth is stratified and non-ciliated;
6. In the terrestrial forms, the oral epithelium is ciliated."

Most of the facts in this statement still remain unquestioned. Earlier writers have placed the terrestrial form in a separate species, and some believed it to belong to a separate genus. Gage ('91b) offered such conclusive proof of the unity of the two forms that the fact has never since been doubted.

Gage's annotated bibliography is so complete, that it seems hardly necessary to review the work of the earlier writers.

Jordan ('93) has written an excellent account of the natural history of *Notophthalmus*. His description of the breeding habits, including the egg-laying and the anatomy of the reproductive organs, is especially good. In the main his conclusions are similar to those of Gage, though rather more detailed and accurate in some particulars. The greater part of Jordan's paper is taken up with the maturation, fertilization, and early development of the egg, ending with the formation of the notochord. This subject is not within the scope of the present paper.

I. BREEDING HABITS.

Breeding Season. *Notophthalmus* begins to breed early in the spring and continues until early in the summer. In Maine I have found it mating in early April, soon after the ice left the pools. In western Pennsylvania fifty specimens were collected on March 23, 1920, in a large pool, where they were mating freely. The females in this lot laid eggs in the laboratory March 30.

Unlike the frogs and *Ambystoma*, the breeding season of *Notophthalmus* is quite extended. Jordan ('93) writing of conditions at Worcester, Mass., says: "Egg-laying begins about the tenth of April and is brisk until the first of July. It is probable that for a single individual the egg-laying season lasts for at least seven or eight weeks." Near Pittsburgh my earliest record of egg-laying was March 30. In 1920 and 1921 the newts continued laying until the second week in June, when my departure stopped further observations.

Mating Behavior. In the breeding season, the stout hind legs of the male develop black, horny pads on their inner surfaces. Under the microscope these are seen to consist of a layer of thickened cells, each of which bears a conical point. They suggest the pads on the thumbs of such frogs as *Rana pipiens*, which serve the same purpose. At the same time the tail of the male increases in width until it is fully twice as wide as that of the female, while the thin edges have a wavy appearance because they are longer than the main part of the tail. At this season, the sexes are very easily distinguished by the characters mentioned and also by the larger size and plumper body of the female. Figs. 1 and 2 (Pl. XLI) will illustrate some of these sexual differences.

The male seizes the female around the neck or anterior portion of the body with his hind legs and clings tenaciously for half an hour or more. The female is usually quite passive, remaining quiet, with legs outspread, body straight, and tail curved upward. The male, on the other hand, is very much excited. The cloaca is widely opened and pressed against the back of the female, showing a fringe of villi. The tail is generally curled around parallel to the body and is constantly waving and twitching. The body is doubled up and the side of the head pressed or rubbed against the snout of the female. This position is frequently changed, so as to bring the other side of the head against the nose of the female. After the male has retained his hold for some

time, he begins to shake the female violently and to drag her all around the place. This seldom lasts for more than a few minutes at a time, and it is usually during one of these paroxysms that the male finally shakes himself loose. Jordan ('91) has given us the best account of mating that has yet been published. He says that after the male leaves the female he does not go far, but remains on the bottom near by, with cloaca still everted and body twitching. If the female follows him and touches his tail or cloaca, he is stimulated to deposit a spermatophore. The spermatophore consists of a transparent basal disc of jelly-like substance, having on its upper surface a tapering stem with a conical base surmounted by a white ball of motile spermatozoa. The base is 8 or 10 mm. in diameter, and the stalk rises above it to half that height. The disc is more or less loosely attached to the bottom so that the sperm mass is held up into the water on the slender tip of the stalk. This is well illustrated by Jordan ('93, Plate XIV, fig. 2).

The spermatophore is not always of the typical shape just described. One, which I saw, consisted of an irregular lump of jelly, bearing a single conical point, where a mass of sperms had evidently been detached, and several shorter points sticking out in different directions. A mass of sperms was completely imbedded in the jelly where it could hardly have been functional. The female seems to get the spermatophore by following the male and bringing her cloaca over it. From this it would seem that fertilization must be largely by accident, although Jordan believes that the glands of the cloaca in the female secrete a substance which has a chemical attraction for the sperms. Jordan ('91) says that the male may deposit three spermatophores, but seldom more. If fertilization were wholly dependent upon the spermatophores, it would seem very uncertain, in spite of several matings in a season; but Gage ('91b) has shown that the motile sperms escape freely into the water. If there is real chemical attraction, it seems likely that many of these sperms find their way into the cloaca of the female and effect fertilization without spermatophores. It is certain that the female does not always follow the male, but comes to the surface for a breath, or swims away quite regardless of him.

Some careful experiments on chemotaxis ought to show whether there is really a chemical attraction to draw the sperm into the cloaca of the female. As in most Urodeles, the sperm is stored by the female

in sacs opening on the dorsal wall of the cloaca. These sacs have been variously named. Jordan speaks of the "*receptaculum seminis*," referring to all the sacs as one organ; while Kingsbury prefers to call them spermathecas or merely tubules.

Jordan ('93) has summed up the literature on the *receptaculum seminis* of the female, and seems strongly inclined to believe that the epithelium lining the sperm-sacs has a secretory function to attract the sperm which is stored in these sacs after mating. Kingsbury ('95), who has sectioned and studied the spermathecæ, also believes in the chemotaxis theory. His description of the spermathecæ follows: "They are flask-shaped, the neck is constricted and the diameter of the body of the cul-de-sac varies with the amount of distention caused by the zoösperms contained. The shape of the lining cells was also modified by the same cause; in the empty tubules, however, they were cubical. Each tubule is enclosed in a layer of plain muscular fibers which encircle it. The tubules open upon the lateral walls of the dorsal extension of the (cloacal) cavity, which is divided into two parts by the mesal elevation."

Kingsbury puts the total number of spermathecæ at about fifty-five, each capable of containing large numbers of spermatozoa.

Jordan ('91) has had a female lay ninety-six fertilized eggs after separation from a male, the last of which were laid nineteen days after her isolation. He believes that a single mating in a season is all that is necessary to fertilize all the eggs which will be laid for that year, which seems very probable in the light of Kingsbury's work on the anatomy of the spermathecæ.

Fertilization. Jordan ('93) describes the function of the spermathecæ. He says: "The fertilization of the egg takes place just before the egg is extruded. The spermatazoa, which have long been in waiting in the tubes of the *receptaculum seminis*, are either attracted from their resting places by the passing egg, or forced out by contraction of the surrounding muscles. I have made repeated and careful search for spermatazoa in the oviducts, but have never succeeded in finding one. Neither have I ever found in sections any indication that spermatazoa enter oviduct eggs, although eggs often lie for some time in the mouth of the oviducts. Fertilization, then, would seem to take place only after the egg has left the oviduct and passed into the cloaca."

From the fact that unfertilized eggs are often dropped by females in captivity, and that these eggs are not laid on leaves, but escape into the water, Jordan concludes that the spermatozoa are normally passed out of the spermathecæ during the act of oviposition. It seems probable that this is the function of the smooth muscle fibers, described by Kingsbury ('95) surrounding the spermathecæ.

Jordan also says that the egg is held in place by the sticky secretion poured out of the cloaca. It seems likely that the origin of this secretion is to be found in the tubular pelvic glands, which lie ventral to the spermathecæ.

The purpose of the male in rubbing his head against the female's nose is to stimulate her with the secretion of the glands in the side of the head, thus causing her to follow him.

On the side of the head of the male are three or four shallow pits behind the eye and at a level with it. Of these the hindmost, located on the mass of muscle above the angle of the jaw, is flat-bottomed and slightly crescent-shaped, and about 0.5 mm. in diameter. Hilton ('02) has sectioned and studied these pits. He finds that they are generally present in rudimentary form in the female, making their appearance at about the time that the red form enters the water. In the male they appear earlier, at about the time that the sex can be determined by gross dissection. The pits in the adult male are lined with simple saccular glands, which in turn are lined with columnar epithelium. In the breeding season the glands are greatly enlarged, the fundus becoming filled with secretion and the cells growing shallower, approaching the cubic, rather than the columnar form. So far as I know, no bio-chemist has studied the nature of this secretion. It would be interesting to secure a little of it and note its effect upon an isolated female.

Several males often gather about one female. Jordan ('93) reports finding as many as ten or twelve males thus congregated. He has noted the fact that the males considerably outnumber the females. Among four hundred and twenty-six specimens, he found two hundred and eighty males. My records show a still larger percentage of males: three hundred and thirty-nine out of four hundred and thirty-five. These figures respectively give 65 per cent. and 77.9 per cent. of males. Nevertheless it seems doubtful whether the sex ratio is as unequal as shown by these observations. I should like to know when Jordan collected his newts. Most of mine were taken in the months of

March, April, and May, when they were breeding freely, and a few in November and December, when the fall mating season was on. At such times I believe the males are much more active and conspicuous than the females, and their habit of gathering about one female would render them far more liable to capture. It is my belief that during the breeding season the females are quiet and inconspicuous, except when they are actually mating.

Jordan's specimens were probably taken at all seasons, which would account for the smaller percentage of males. I would like to compare the sex ratio of a large series taken in July or August, or the complete census of a drained pond with the figures given above, for I feel sure that it would show a larger percentage of females.

Toward the end of the breeding season, the males lose the sexual characters, which make them so conspicuous, and for the rest of the summer they can hardly be distinguished from the females. A lot of ninety-six collected in Sunderland, Mass., June 15, 1921, while the females were still laying eggs, contained no conspicuous males and many individuals of doubtful sex. It is my belief that the pits on the sides of the head in the male, would always serve to distinguish the sexes, but I have not taken time to work this out.

Laboratory conditions often check breeding activities. On March 23 and April 1, 1920, I collected two lots of newts. The first lot began to lay eggs March 30, and the second lot as soon as captured. On April 17 oviposition had decidedly fallen off, and on the 23rd it had ceased entirely in two out of my three aquaria. At this time the males had lost the black pads on the hind legs and the feather-edge on the tail and there was very little mating activity. I believe that temperature is the most important factor in this decline. In the pools at this time of year it varied from 13.5° to 21.5° C, and in the laboratory, from 20° to 24° C. Jordan ('93) found that animals kept over winter in the laboratory would seldom lay eggs in the spring. My own experience agrees with this, and I believe that temperature is the chief reason.

The curious phenomenon of mating and deposition of spermatozoa in the fall has been recorded by both Gage and Jordan, but neither is able to account for it. I have observed it both in the field and the laboratory, but can see no real explanation. The fact that no eggs are laid in the fall seems to make it quite superfluous. I believe, however, that it is merely a preliminary to the spring mating

season. Gage says: "In the autumn the males will be found to possess the dark, horny toe-tips and ridges on the thighs. . . . and the tail will be found as fully developed as in April."

On Dec. 3, 1920, I collected one female and five males near Pittsburgh. Mating was taking place in the laboratory Dec. 9, and I isolated the pair. The next day they mated twice, but I was unable to find any spermatophores either time. All of the males captured at this time had the sexual characters mentioned by Gage fully developed. This leads me to think that these characters are retained throughout the winter, and that mating begins in the fall, being interrupted only by the period of inactivity due to cold weather, and beginning again in the spring, as soon as the temperature of the water begins to rise. Newts left in the laboratory will continue mating all winter to some extent, though not as actively as when first captured. I have also seen mating in the middle of July after the usual mating season was over.

If a portion of a natural pond could be screened and the normal activities of a few of the animals watched daily for an entire year, a great many doubtful points might be cleared up.

Ovulation. When laid, the egg has the shape of a sphere, or oval, about 1.5 mm. in diameter, the outer part consisting of a firm and somewhat milky layer of albumen with the egg proper in the center. This is spherical and about one-fourth of a millimeter in diameter. The albumen is much firmer than that of frog's eggs and does not soften and expand during the development of the egg. The membrane covering the outside is not sticky to the touch, but, when first laid, it adheres so firmly to the leaves that it must usually be torn to dislodge the egg.

The manner in which the egg is fertilized has been mentioned in connection with the function of the spermatheca. The eggs are usually laid singly on the leaves of water-plants, although occasionally two, or even three, are laid on the same leaf. *Notophthalmus* usually selects some plant with thin, flat leaves, which can be folded readily to conceal the egg, although such plants as *Myriophyllum* or *Cabomba* may be used, if no others are available. The following description of the egg-laying process is from Jordan ('93): "She then bestrides the chosen spray of water plant and gathers in with her hind legs the surrounding shoots, pressing them close around her

cloaca. She next turns on her side or occasionally on her back, and with forelimbs outstretched and rigid, with hind limbs and twigs completely hiding her cloaca, usually remains perfectly motionless for about six to eight minutes. At the end of that time she slowly leaves the 'nest' which now holds an egg, well protected by the tangle of shoots glued together by the gelatinous secretion poured out of the cloaca."

I have found the eggs in a pond near Pittsburgh on the leaves of *Ludwigia*, *Proserpinacea* and an aquatic species of *Polygonum*. The egg is either placed in the axil of a leaf or the leaves are gathered around it and stuck together; or more often the leaf is folded and the egg laid in the fold, its gelatinous covering holding the leaf in place. In one of my aquaria, I have seen a long leaf of *Polygonum* folded three times with an egg in each fold. Figs. 3 and 4, (Pls. XLII and XLIII) show something of the manner in which the eggs are laid. In this way the eggs are well hidden and protected from natural enemies. I have seen an adult *Notophthalmus* try repeatedly to eat an egg surrounded by the leaves of *Myriophyllum*, but the plant yielded and the lunges made by the newt only pushed it away.

2. DEVELOPMENT OF THE YOUNG.

Development of the Egg. The embryology of *Notophthalmus* does not come within the scope of this paper. Jordan has given a very full account of the formation of the egg and its development up to the time of the formation of the neural groove. It remains for some other investigator to take up the further development of this animal.

Gage ('91b) says: "The eggs hatch in from twenty to thirty-five days, depending on the temperature."

In the spring of 1920 I first found eggs in my aquaria on March 30. On April 11 the first one hatched; the second on April 13, and three more larvæ were seen on the 17th. This makes an incubation period of from twelve to eighteen days, instead of the twenty to thirty-five days set by Gage. He does not state where and at what temperature his animals were kept. Mine were in balanced aquaria at room-temperature, which probably hastened development somewhat.

Aquatic Larva. The larvæ are very small and not active at first. A description follows: Measurements, 8.5 mm. in length. Head nearly round, 1.5 mm. wide, nearly twice the width of the body

behind the limb-buds. Balancers 1 mm. long. Gills a scant millimeter in length. Fore limb-buds elongated, sac-shaped structures. Hind limb-buds cannot be seen. The larva is slender, resembling a mosquito larva in general appearance. The tail is broadly finned, both dorsally and ventrally. The body is well pigmented, and especially the gills and tail.

The older larva is intermediate in appearance between the slender larva of *Eurycea* and the stout, broad-headed *Ambystoma*. The tail is very broad with a thin feather-edge both dorsally and ventrally. Ventrally this keel extends forward only to the cloaca, but dorsally it extends along the back as far forward as the base of the gills, narrowing gradually anterior to the hind legs. The tail has considerable power of regeneration. It is frequently bitten off by some natural enemy, or by other larvæ, and in a short time reproduces the missing tip. The limbs are slender and comparatively long. The toes of the fore and hind feet overlap, as the animal crawls.

The body is rather slender compared with *Ambystoma*. It is half or two-thirds as wide as the head, depending on whether the young newt is scantily or well fed.

The gills show the typical feathery, branched appearance, seen in most larval salamanders. In a larva 25 mm. long they measure about 3 mm. Like the tail, the gills frequently suffer from the greed of other young newts, and so they are often shortened, or even completely lost on one side. Regeneration is rapid, however, so that the loss does not seem to inconvenience the larva. One, which had all the gills of the left side completely bitten off, regenerated slender filaments 1 mm. long in two weeks.

The head is flattened dorso-ventrally. From the dorsal side the part between the eyes and the origin of the gills appears cylindrical. A line of dark pigment runs from the eye to the external nostril, making the snout appear more pointed than it really is. The head is so transparent that the outlines of the brain-cavity can be traced part of the way by the pigment in the lining of the cavity. A dark V can usually be seen with its legs pointing forward at the center of the eyes and its apex about 1 mm. in front of the origin of the gills. Sometimes a similar but inverted figure can be seen in front of this, forming a complete square. Just lateral to the angles of this square can sometimes be seen the silvery white otoliths. Several views of larvæ are shown in Figs. 5-14 (Pls. XLIV-XLVI).

Gage ('91a) wrote: "The larvæ have the form and color of the adult aquatic ones." This description fits the larvæ which have nearly completed their metamorphosis, but in the real larval stage, which lasts for three or four months, the coloration is quite different.

To the naked eye the young newt has a medium brown appearance with a slight tinge of green, flecked with very dark brown dots, and often showing a line of pale brownish spots along the sides above the lateral line. The under parts are immaculate white, instead of appearing yellow, spotted with black, as is the case before metamorphosis.

Under the binocular, the ground-color of the newt is seen to be pale green, tinged with lemon-yellow and thickly dotted with black chromatophores. This color is similar to that of the tadpoles of most frogs. It makes an admirable protective coloring for an animal which lives in pools having bottoms composed of mud. Like many other defenseless animals, the safety of which depends upon their invisibility, the young newts remain motionless most of the time. When they move, it is either in a very slow, crawling manner, or with a sudden and rapid dash to capture prey, or escape danger.

Food. *Notophthalmus* is carnivorous from the first. In my balanced aquaria I kept them in food by occasionally adding water from a culture of small crustacea such as *Cyclops*, and *Cypris*. I have seen larvæ actively chasing *Cyclops*, but more often they wait until the prey swims close by their noses and then snap it up instantly. A small larva captured Oct. 30, 1920, and sectioned the next day, had its stomach full of small crustacea. From this evidence I feel fairly safe in saying that crustacea form a large part of the food of the larva, although I imagine that no insect-larva small enough to be swallowed would be refused. In the laboratory they will eat finely chopped liver or earthworms.

From the fact that the larvæ will stay in *Spirogyra* when it is put into the aquarium, and that the algæ gradually disappear, I was led to believe that they sometimes varied their animal diet, but this was not proved until on Oct. 14, 1921, I put into the jar with my larvæ some one-celled green algæ and found that they eagerly gorged upon it. This alga grew in one of the ponds on the Reed College campus. I am not sure of the species, but think it belongs to the genus *Chlorobotrys*.

Duration of the Larval Stage. The average length of time spent in the larval state is about four months. In New England the eggs are laid from early April to early in July. In late July and August the larvæ can be captured by using a fine-meshed dip-net and dredging among the weeds. In the last week of August, larvæ, which have begun their metamorphosis, will be found; while by the middle of September, larvæ of all sorts are scarce, and those found are usually metamorphic. I have captured them in the true larval state as late as this in a cold, spring-fed pool, but could find none at all in the other pools where they had previously been abundant. Miss Smith ('20) has made collections at a later date.

The time of the change is a little earlier in the Pittsburgh region. On July 17 I collected ten larvæ that were not yet metamorphosing, but were fully grown. Some of them began their change in the laboratory on July 26. On July 31 I collected five more, of which three were already starting to change.

Unfavorable conditions, or other factors in environment, such as the cold water noted above, may delay metamorphosis considerably. Most of the newts hatched in my aquaria in 1920 changed in July. Two of them completed their change on June 28, while three delayed until winter. One of these began metamorphosis Jan. 21, 1921, and the last one completed its change March 18. Four larvæ hatched in the spring of 1921 remained in the larval state until late in the fall. Three of them metamorphosed Nov. 30, Dec. 9, and Dec. 15. At the present writing (Jan. 7, 1922) the fourth is still a typical larva. The fact that I captured a small larva near Pittsburgh on Oct. 30, 1920, shows that this sort of thing sometimes takes place in nature.

However much metamorphosis may be delayed, the larvæ never grow beyond a certain size before metamorphosis. The largest I have measured was 32 mm. in length. Gage ('91b) says: "The size attained before transforming is quite various... Indeed they may remain in the branchiate condition until they are as long as the adult aquatic ones, and two or three times the length of the red ones found in nature." I cannot agree with him on this point for the reason stated above, but must conclude that Gage confused the larvæ with those of some other species, possibly *Eurycea ruber* or *E. bislineata*, or perhaps *Gyrinophilus*, all of which may attain considerable size before transformation.

Metamorphosis. As the young larva approaches metamorphosis, the feather-edges of the tail begin to shrink until the tail becomes nearly round and is narrower than the body. At the same time the color undergoes change. The white abdomen begins to turn yellow and the back to darken and turn green, until at the completion of the change the general coloration is that of a dark specimen of the aquatic adult. The vermilion spots now appear on the back, though usually fewer in number than in the adult. The lungs develop, and the larva begins to come to the surface for air while it is still quite small, but the gills persist and apparently continue to function until the changes in the tail and in coloration are nearly complete. Then they begin to shrink at the tips until they become mere stubs and disappear entirely within two weeks. The remains of the gills lie down flat against the sides of the neck, showing as mere patches of black, thus completely covering the gill-clefts, which are closing up in the mean time.

The change in habits is as striking as the change in appearance. Instead of resting in the weeds, or actively searching for prey, the newly changed newt floats passively at the surface with its nose as far out as possible and its limbs sprawling into the water at random. Figs. 12, 13, and 14 (Pls. XLV and XLVI) show characteristic poses. If disturbed, the newt swims with difficulty and soon floats up to the surface again. It is no longer adapted to an aquatic life, and, when given the opportunity, will invariably crawl out of water and hide in moss or other shelter.

Figs. 5 to 15 (Pls. XLIV-XLVI) show practically all the stages of metamorphosis. Figs. 5 and 6 are slightly enlarged, but all the rest are of natural size, except Fig. 15, which is reduced a little. Figs. 5 to 9 inclusive are successive pictures of the same animal. Fig. 5 shows it as a typical larva, with broad tail, feathery gills, and the typical larval pattern even to the silvery white under-parts. Fig. 6 shows the general shape of head and body from the dorsal view. The narrowed base of the gills is quite characteristic. Fig. 7, taken six days later, shows how rapidly metamorphosis is taking place. The tail is narrow and the coloration practically that of the adult, but the gills remain nearly or quite of full size. A comparison of Figs. 7, 8, and 9 with Figs. 5 and 6 will, however, show a change in the gills. In the metamorphosing animal they seem to be slightly more bushy and to curl forward in a manner characteristic of this stage. This

change of position is probably due to an antero-posterior degeneration in the epibranchial cartilages similar to that described in *Eurycea* (*Spelerpes*) by Miss Smith ('20a). These cartilages support the gills, and, as they become loosened from the rest of the hyobranchial skeleton during metamorphosis, they must allow much greater freedom of movement at this time. While I have not observed this process in this species, it probably takes place much as in *Eurycea*. Figs. 8 and 9, taken the next day, show little change, although a trace of the vermilion spots on the back can be seen.

Figs. 10 to 15 show successive views of other animals, covering the period between July 26 and Aug. 15, 1920. There were five animals in this lot, but owing to their activity, only three were ever successfully photographed on one plate. Fig. 10 shows a typical larva at the top, and at the left, a metamorphic animal in a characteristic pose, showing the narrowing of the tail. In Fig. 11, the typical shape of the larval head can be seen in the animal in the lower left hand corner. The uppermost of the other two shows a slight narrowing of the tail, while the lower one has completed this process and its gills have begun to shrink. Figs 12, 13, and 14 are given to illustrate late stages in metamorphosis. Fig. 12, photographed Aug. 1, shows but little change. The newt with its head at the surface still has traces of gills left. This Figure and Figs. 13 and 14 show the characteristic attitudes of the newly changed newt. The animal at the surface in Fig. 13 is in a typical pose. Fig. 14 very plainly shows the vermilion spots on the floating newt. It also shows one unchanged larva with the tip of its tail bitten off by one of its fellows. Fig. 15 is a dorsal view of two completely metamorphosed animals. All traces of gills are lost and the young newts look thin and emaciated. Their color at this time was similar to the adult, only darker dorsally. These animals had been out of water for ten days.

Just after metamorphosis, is the most critical stage in the life of young *Notophthalmi* reared in the laboratory. They may live for a while, but refuse food for some time, and generally die within a few weeks at most. Three months was the longest time that I ever succeeded in keeping one. If it had turned red in that time, I should have felt that the mystery of the color change was half cleared up.

Possibly the refusal to eat at first is due to structural changes in the mouth. Miss Smith ('20) has described the mechanism of a change in the hyobranchial apparatus of *Eurycea bislineata* at the

time of metamorphosis. In that case the manner of capturing the prey changes from simply snapping it up with the jaws, to throwing the tongue well out of the mouth. *Notophthalmus* also changes its habits of feeding in a similar way after metamorphosis, for the land form can extend its tongue nearly an eighth of an inch to capture small insects.

3. TERRESTRIAL STAGE.

This is the most puzzling part of the life-history of *Notophthalmus*. The red newt was once placed in a separate genus and its identity with the water-newt was not fully settled until 1889, when Cope, following several earlier workers, stated that the red and viridescent forms were merely stages of one and the same animal.

It is not the purpose of the present paper to repeat Gage's admirable review of the development of this belief. It is my intention, however, to review carefully the evidence from which the conclusion was drawn. This consists of five main facts:

1. At the time of metamorphosis, the larva becomes terrestrial. Both Monks ('80) and Gage ('91b) have observed this fact and it agrees with my own observation.
2. The terrestrial form is not always red, but often approaches the viridescent coloration.
3. The terrestrial form has been known to change from the red to the viridescent coloration. This change may be induced artificially by keeping the newt in wet moss in the dark.
4. The terrestrial form is adaptable to aquatic life, with non-ciliated oral epithelium and aquatic respiration. Gage ('91b) says that this change comes when the sexual glands are mature, either in fall or spring.
5. The intermediate sizes between the aquatic larvæ and aquatic adults are not to be found in the water, but on land.

It will be noticed that while there is a large mass of evidence here, much of it is circumstantial. *Notophthalmus* has never been reared in captivity from the egg to the adult. That is not surprising, for this would require at least four or five years and constant care. The land-form has been adapted to water, but has never in captivity been

induced to lay eggs, from which *Notophthalmus* larvæ have been reared. The larvæ often metamorphose in the laboratory, but, while they acquire the rounded tail and rough skin of the terrestrial form, they are always viridescent in color with yellow abdomens. It has been assumed, that, if kept long enough under the right conditions, they would turn red. This is probably true, but at this stage they are very hard to rear and always die within two or three months. The actual finding of the land form in its transition to the aquatic adult would complete the chain of evidence for the identity of the two species and also settle the question of the season when the newts return to the water.

Dr. H. H. Wilder has very kindly given me the following unpublished observations: "In Princeton, Mass., is a small ice-pond known as Echo Lake, where *Notophthalmus* was always very abundant. In the latter part of August, 1893, I found a great many newts along the wooded side of the pond, where the water was shallow. For a distance of at least 50 feet along the shore and from the land 10 feet out into the pond, newts were so abundant that one could hardly step without crushing one. These animals showed all possible shades of color, from the red woods form to the green aquatic adult. I collected 60 or 80, killed them, and laid them out on the table, arranged in a series which graded in two ways; first in color, as noted above, and secondly in roughness of skin, beginning with those that were so rough and dry that they repelled water, and ending with the smooth skin of the adult water-form. These two characters showed complete correlation in their variation, for the reddest animals had the roughest skin and the greenest ones were the smoothest."

In addition to this, Miss Louise Smith has sent to me forty-three newts collected on land and fourteen from the water at Williams Pond, Mt. Toby, Sunderland, Mass. on Oct. 2, 1921. Of these she writes: "Most of them were very near the Williams Pond and all of them were within a mile from there. . . . The color varies much more and approaches that of the aquatic adult much more closely than even the darkest of the little ones found far away from water, though many have a rusty tinge. One is scarlet and one a rich wine-color. We got some from the water too,—the brightest scarlet one of all was swimming around to his heart's content and there were many more that were not typical water adults.

"I feel convinced myself that at Williams Pond, Mt. Toby, *Notophthalmus* goes back to water late in September and early in October and a few stragglers early in the following spring. I think so, because we always find animals with a reddish tinge to a greater or less degree and rough skin, both in and out of the water at these times and no others, although we have not collected there in August."

The appearance and behavior of these animals, which Miss Smith sent to me alive, will be discussed later. The finding by two good observers of the land animals returning to the water supplies a strong link in the chain of evidence at one of the points where it was most needed.

The premises given above will be discussed point by point.

1. The description of the metamorphosis given on a previous page should suffice to prove that the larva always becomes terrestrial after the loss of its gills.

2. It is agreed that the animal loses its red color upon reaching maturity and going into the water, but it has usually been called a red animal while on land.

3. Several writers have observed the change from the red to the viridescent coloration, but none have seen a newt change from green to red in captivity. The green color seems to be associated with a damp, cool habitat, as in swamps or woods, while the reddest ones are found in hilly regions, usually at a distance from the water.

Several naturalists have induced the change from red to green by keeping the newts in wet moss or leaves for several weeks or putting them into the water.

Gage ('91b) has experimented with them and concludes by saying: "These experiments and observations seem to the writer to entirely preclude the notion that the red form owes its coloration to either food, season, or situation, but that it is normal for a given stage of its growth and development."

None of these workers has measured the animals with which he experimented. It seems probable to me, that, if Gage's conclusion is the correct one, a small newt could not be induced to change its color, but a large one that is almost ready to change would do so quite readily.

Gage also says that the change of color coincides with the maturity of the sexual glands and that at this time the animal will readily take

to the water, if given the opportunity. In order to verify this point, I dissected seventeen land newts that were evidently about to re-enter the water. These animals were collected Oct. 2, 1921, by Miss Louise Smith, part of the lot which has been mentioned earlier. They were killed Oct. 26, and dissected later. The total length varied from 62 to 83 mm., the average being 77.11 mm. Three of these had the appearance of the ordinary aquatic form, and ten looked like the typical land form. The other four were intermediate in appearance. Upon dissection all were found to have well developed gonads. While the largest males had testes which were larger and showed the tubules more plainly than those of the smaller newts, the small males had sexual glands which were surprisingly large. One newt 70 mm. long had testes measuring 5 mm. in length. In the females also there seemed to be no clear correlation between the size of the animal and the state of development of the ovaries, although the ovary does not develop as early as the testis. The smallest animal in the lot had the smallest ovaries and the size of the individual eggs was only about half that of those in the large ones. Evidently the largest animals of both sexes would have become sexually mature the following spring, but it is hard to say whether all of them would have done so. In all of these animals the pits on the sides of the head could be seen, their size depending on the sex. In the male they were large and distinct, but in the female they were small and sometimes hard to find.

For comparison I also dissected seven smaller land newts collected at Branchville, N. J., in June, 1920, and kept alive for a month after that. These newts were all red and varied in length from 32 to 60 mm. In two males, measuring 54 and 58 mm. in length, the testes were respectively three and five mm. long, with a large, crescentic fat body curving around the ventro-median edge. In three females, measuring 60, 53, and 44 mm. in length, the ovaries were very small and the eggs microscopic, the whole organ being very small in the smallest animal. In the remaining two newts the gonads were too small to be found by gross dissection. None of these newts showed any sign of the pits on the sides of the head.

This evidence confirms what Gage says about the maturity of the sex glands at the time when the land form re-enters the water. From my dissection I should say that most and possibly all of the newts collected by Miss Smith would have become sexually mature the

following spring. It is hard to account for the early growth of the testis in the male. An adult in the breeding season had a testis only 6 mm. long, as compared with 5 mm. in a young newt 58 mm. long, which was evidently only two years old. In the adult, however, the gland was plumper and would probably weigh twice as much. It also lacked the fat body that was so conspicuous in the young male. I do not believe that the large size of the sexual glands in the young male indicates that they resort to the water to breed and then take to the land again. If so, these small newts would be found with the older ones in the water during the breeding season and I should also expect to find the external sex characters developed, such as the pads on the hind legs and the broad tail. I would wish to dissect a larger series, before drawing definite conclusions about the maturing of the testes. A good series of sections would show whether they are really mature, or not, in the small newt.

In regard to the pits on the sides of the head, I agree with Hilton that they appear in both sexes at or before the time when the red newt enters the water. The two small males which I dissected, however, fail to bear out his statement that the pits appear as soon as the sex can be determined by gross dissection, for neither showed a sign of any pits.

4. If red land newts are kept in a jar of water and no opportunity given to crawl out on land, they soon become completely adapted to water life, with aquatic respiration and ciliated oral epithelium. They also tend to lose their bright red color and to become greenish, although I have noticed that red animals kept for several months in the laboratory generally turn to a darker and duller color, whether kept in moss or water. When first put into water, the newts usually try to climb out and sometimes struggle violently with their narrow tails. I have seen them cling to each other and sink together like drowning men and even float up to the surface half helpless until the water was drawn off to allow them to rest on the bottom. Within a few days, however, they were able to swim well and seemed contented in the water.

Gage ('91b) evidently believes, that, when this adaptation occurs, the animal takes on all the characteristics of the aquatic adult, including the broad, thin edges on the tail. This is probably true, but I should like to prove it by taking careful measurements of several terrestrial specimens of different sizes and watching them closely for

several months, after they were adapted to water, to see if the tail really increased in width and length in proportion to the body.

One peculiar thing about this adaptation is that animals which have refused food while kept in moss, will soon eat freely when put into water. I have seen a newt eat a worm in water that it had refused fifteen minutes before on land. None of the twenty-three newts, which I adapted to water at different times, fasted for more than six days after being placed in water, although some of them had refused food for over a month previously.

If bits of earthworm or raw liver are dropped into the jar, the adapted animals will soon begin to nose about the bottom until they find and eat the food, just like the aquatic adults. I believe that this change in feeding is due to a difference in the sense of smell, which seems to be much more pronounced both in the aquatic larvæ and adults than in the land form. This will be discussed more fully later on.

5. Jordan ('93) has grasped an important fact. He says: "One of the first things that strikes the collector of the aquatic form, is the comparative absence of all newts below a certain general grade of development. These young and immature individuals are not to be found in the water by using a net with fine meshes, but may be discovered on land by turning up the stones and logs on the shores of the pond, and one is hence tempted to infer what Gage has concluded, viz: that the red terrestrial form is merely an immature condition of the common aquatic newt." . . .

"I do not yet feel prepared to say that I regard the assumption of the terrestrial habit as a necessary stage in the development of every individual. It is quite possible that certain individuals attain maturity without ever leaving the water, although perhaps the great majority of newts pass their 'Wanderjahre' on land."

The measurement of a large series of animals offers a piece of tangible evidence and this has led me to measure all the specimens available and tabulate the results in graphic form. The courtesy of Dr. W. J. Holland of the Carnegie Museum has made it possible to measure the large series collected by D. A. Atkinson and others. The series in the American Museum of Natural History has also been available through the kindness of Mr. G. K. Noble.

The results of these measurements give a fair survey of the entire life-history of *Notophthalmus*.

Figs. 16 and 17 give the results of all my measurements of total length in the land and water forms respectively. The total length in millimeters is shown on the horizontal line. The vertical lines represent the frequency of the occurrence of any one length. Fig. 16 shows the results of measuring two hundred and eighty-four of the land form from sixteen different collectings, taken at various times and places. The shortest of these measures only 28 mm., while the longest is 100 mm. and the average total length is 62.62 mm. When this is compared with Fig. 17, which shows the measurements of eight hundred aquatic newts representing twenty-nine collectings with minimum and maximum at 71 mm. and 124 mm. and average at 93.05 mm., there can be no further doubt of the fact that the red form is a younger stage of the viridescens. Fig. 16 shows forty-eight individuals or 16.9 per cent. of the total number above 80 mm., and 20 individuals, or 7.04 per cent. above 85 mm.; whereas Fig. 17 shows only thirty-six animals, or 4.5 per cent. of the total number smaller than 81 mm. It looks, then, as if we might take 80 to 85 millimeters as the average length of the terrestrial newts when they re-enter the water to remain for the rest of their lives, and that the variation on both sides of these points is not more than could be expected. With this evidence I feel confident in saying that all newts come out of the water at metamorphosis and that they reach an average length of 80 to 85 mm. before returning to the water.

Fig. 18 gives the same data in a little different form. The entire number was divided into classes according to length, those above 30 mm. and not over 35 mm. with the mean at 32.5 mm. being placed in one class, those over 35 mm. and including 40 mm. in the next class, and so on, while the frequency of individuals in each class is shown vertically. The dotted line represents the terrestrial form and the broken line the aquatic form, while the parallel black line shows total numbers of both kinds. The measurements of aquatic larvæ are not included, for they have not the same significance. They would vary according to age and condition of nutrition from 8.5 mm. at the time of hatching to 28 mm. to 34 mm. at metamorphosis.

The measurements of a large series of animals seems to me the only certain way of telling the exact duration of the terrestrial stage. The two hundred and eighty-four terrestrial specimens, whose measurements appear in Figs. 16 and 18, were collected during every month in the summer from April to October inclusive. Supposing

growth to be continuous during the summer and to be stopped completely during the winter, the total length measurements of such a series could be expected to show a straight line, or at least the animals would not be likely to fall into any well marked groups. Fig. 16 fulfils this condition as closely as could be expected. On the other hand, the measurements of a large series taken in one place at the same time, ought to give as many modes as there are years between the time of hatching and the return to aquatic life. My series is too small and was collected at too many different times and places to allow me to draw any exact conclusions. However, I have the measurements of fifty-five animals, collected at Branchville, N. J., in June, 1920, and five more from Amherst, Mass., taken the same month. When these are plotted, as seen in Fig. 19, the newts are seen to fall into three very well marked groups. The first group of fifteen individuals has an average length of 33.93 mm.; the second, taking animals from 42 mm. to 52 mm. inclusive, contains eighteen newts, and has its mean at 46.86 mm., while the third and largest group, containing twenty-seven animals, shows a flatter curve and has a mean of 58.45 mm. Since these groups are so distinct, I feel justified in concluding that they represent animals which are one, two, and three years old. According to this graph, the average growth between the first and second years was 13.51 mm. and between the second and third 11.00 mm. Evidently very little growth takes place after metamorphosis in the fall of the same year that the young newt has hatched, for fourteen newts fall into a well marked group 32 to 35 mm. in length. It will be remembered that the larvæ attain a length of 28 to 34 mm. at metamorphosis, so that, when they show so little increase late in the following June, the young newts must have barely begun to grow. Growth during the second summer is rapid and is a little slower during the third. The curve of the third year is broader and flatter than the first two. This is probably due to the increasing effect of varied environment in retarding or stimulating growth. The fact that there are more individuals in the group is probably because the larger animals are more conspicuous and therefore more likely to be seen, especially by a collector who is not a scientist.

To this graph can be added, with no overlapping, the measurements of the fifty terrestrial or changing animals, collected by Miss Smith Oct. 2, 1921. Of the fourteen taken in the water at this time,

seven were distinctly rougher, had narrower tails and most of them were redder than the typical aquatic adult, so that in the making of the graphs they have been placed among the terrestrial newts, although they were evidently just returning to the water. These animals had the advantage of nearly a whole summer over those taken in New Jersey in June, so that they would be nearly a year in advance so far as growth is concerned. The mean length of this group is 79.7 mm., which would show an average growth of 21.25 mm. for the fourth summer. This comparison is of less value than it would be, if all the newts came from the same place, but in the want of better data I give it for what it is worth.

As compared with the other figures, 21.25 mm. seems like a very large growth for a single season. It is nearly twice as much as the 11.00 mm. given for the previous season, and of course it is possible that there is another group with a mode at about 69 mm., representing the fourth summer, while this last one represents a fifth. If such a group existed, I should expect to find some of the New Jersey newts falling into it, and, since there were none in that lot longer than 64 mm., I am inclined to think that all the larger animals had returned to the water either earlier in the same spring or the preceding fall. Since I can find no direct evidence for the existence of such a group, I shall attempt to explain the wide gap between the third and fourth groups in another way.

A series of measurements shows that the tail is decidedly longer in the aquatic adult than in the terrestrial form. To learn more of the nature of this change at the time of the return to water, I measured as large a series as possible of both forms, taking the length of tail to the posterior angle of the hind limb and the length of head and body from that point to the snout. The results of these measurements are shown graphically in Fig. 20 (Pl. XLIX). The newts were divided into groups according to total length as in Fig. 18 (Pl. XLVIII) and the average percentage of the tail to the total length is shown vertically, while the length groups are plotted horizontally. The figures at the left show percentage, while the three rows of figures underneath show the mean length of the class, the frequency and the percentage of the length of the tail to the total length. All of the animals measured were plotted together regardless of their color or maturity.

The tail is seen to be from 48.58 per cent. to 59.82 per cent. of the total length of the animal. A glance at the graph shows a fairly

steady increase in the proportional length of the tail, correlated with the growth in total length of the animal. It also shows the tail of the aquatic adult to be decidedly longer than that of the land form.

The only inexplicable thing about this graph, is the decided drop in the class having 102.5 as its mean. From the general contour of the curve, I should expect the tail in this class to average 57 per cent. at least, instead of 54.32 per cent., but, while this average is a little above the average length of tail at the time of the return to water, it is surprisingly low, and somewhat weakens the conclusion which I should otherwise be tempted to draw, that unusually long specimens are merely long-tailed individuals.

It will be noticed that the increase in length of tail is fairly steady until the 72.5 group is reached, when there is a very marked rise to the level of the 77.5 and 82.5 groups, which are followed by another rise. Since we have seen that most of the newts enter the water at the length of about 80 mm., I conclude that the tail increases decidedly in length just before the newt enters the water, followed by a short time when it shows little growth. Then comes another period of growth of the tail, slow at first, but becoming more rapid as the newt grows older. The significance of this will be discussed further on, but it is sufficient now to note that it occurs, and that the growth of 21.25 mm. between the third and fourth groups probably represents increased length of the tail rather than rapid growth of the entire animal.

To clear up this point, a large series of newts of both phases should be collected in one locality, as nearly as possible at the same time, and not only measured, but weighed as well.

A possible explanation of increased growth seen after the time of the return to water, would be the taking up of water by the cells of the body and a consequent increase in size at the expense of specific gravity, somewhat in the same way that rapid development occurs in the young tadpole of the frog, while it is still nourished by the yolk, and growth consists of the imbibition of water and the rapid formation of new cells from material already stored in the body. If it could be shown that there is a storage of food in the fat body which decreases after the return to water, this would seem more probable. As it is, only the collection and weighing of a large series as suggested above, could prove such a theory.

In a short paper, published in 1921, I made the statement that I believed that four years was the probable duration of the sojourn of the newt on land. This statement was made before the complete series of measurements had been finished and the conclusion was too hastily drawn. I would now say that most of the newts enter the water at the end of the fourth summer, when they are three and a-half years old and have reached the length of about 80 mm. Probably some remain on land until the next spring, as Miss Smith has suggested, and possibly a few of them even longer. Figs. 16, 17, and 18 (Cf. Pls. XLVII and XLVIII) show so much overlapping, that it does not seem likely that the return to water always occurs at the same age or at the same time of year.

Gage ('91b) believes that the terrestrial form enters the water either in the fall or spring, when the young newts are two and a-half or three years old, but he offers no evidence in support of his belief, except his observations. Most naturalists have done considerable guessing about the time of year when *Notophthalmus* re-enters the water after its life on land. The observations of Dr. Wilder and Miss Smith place it from late August to October, and I feel that their observations supply by far the most satisfactory evidence, which has as yet been published.

The fact that the longest specimens of the terrestrial form are considerably longer than the shortest of the aquatic form has been mentioned. However, these last figures may not be as significant as they seem, because, out of the seven animals longer than 90 mm., five are from North Carolina, where Brimley ('21) has found that all the newts leave the water in the summer and return again in the fall. For this reason it seems likely that these large land forms are merely adults temporarily adapted to terrestrial life. If all such animals were eliminated, much of the overlapping in the graph would disappear.

The newts collected by Miss Smith, Oct. 2, 1921, were sent to me alive at Portland, Oregon, where they arrived in good condition on Oct. 14. In order to see if they were really returning to the water I put them into aquarium jars with moss in one end and two inches of water in the other, so that they could live either in or out of the water, as they liked. Both lots were fed once or twice a week by putting bits of raw meat or earthworm into the water. This method failed to reach the newts which remained on the moss, and, in order to feed

these, I released a culture of *Drosophila* in the jar as often as I could get the flies in sufficient numbers.

The fourteen taken from the water were all put on the moss at first and at the end of two hours nine of them were in the water. These newts soon divided themselves about equally into two groups, those which remained in the water, and those which lived in the moss. The lines of these groups were not rigid, for the aquatic animals often crawled out, as typical aquatic adults will do, and I often saw some of the terrestrial group in the water. Seven of these animals were typically aquatic or transitional, when they were received, and at the time when they were last measured, Dec. 18, 1921, seven of them were typical aquatic adults and were found in the water. The measurements showed so little change since October that no conclusion can be drawn. I can only say that half of these newts taken from the water have been acting like terrestrial animals for the two and a-half months that they have been in the laboratory. The only real sign of change, which I can see, is in the color. When received, one was red all over and three others were reddish or yellowish olive. At the present writing (Jan. 7) all are olive with no sign of red left, though five still retain the bright orange of the belly as contrasted with the pale yellow of the aquatic adult.

The newts taken on land showed more of the expected change. At first almost all of them remained on land, but on Oct. 17, ten of them were in the water, and one pair was mating. These were isolated and the male later extruded two spermatophores. Seventeen of these animals on Oct. 26, were preserved for dissection and six others died about this time. One of these was a gravid aquatic female. On Dec. 1 four of the newts in the water showed all the characters of the typical adult male in the breeding season, clasping pads on the hind legs and broad, finned tails. Mating took place occasionally and still does. By the middle of November this lot was divided into distinct land and water groups like the other. When received, only two of this lot could have passed for aquatic adults. Of the seventeen preserved Oct. 26, three were of the typical aquatic form and so were at least two of those which died at about the same time, while of the twenty survivors on Dec. 21, eight had all the appearance of adults. One is a gravid female and two others have the male sexual characters fully developed. At this date, I found nine animals on land and eleven in the water, with two pairs mating. Three of

the newts found in the water could be described as yellowish or reddish on the dorsal side, though none of them were really red. All of the rest, including those found on the moss, were olive above, but those on land were orange below instead of yellow. It will be seen then, that at least eleven of these newts have really changed from the terrestrial to the aquatic form in the two and a-half months during which they have been kept, while the rest have changed color although they are still rough skinned. It seems likely that more will adapt themselves to water before spring. If I can get these animals, which were taken on land, and were really terrestrial forms, to lay eggs, which will hatch into the typical *Notophthalmus* larva, I shall feel that the chain of evidence for the identity of the two forms is practically complete.

It seems very strange that the newts captured on the land should adapt themselves to water more readily than a part of those taken in the water at the same time, and I am at a loss to account for it. However, I am not too ready to draw conclusions from animals kept in the laboratory, where conditions are very different from those in nature. If these newts had been left alone, the coming of winter would have compelled them to hibernate either in the water or on land long before this time, so that it is hardly fair to say that they would, or would not, have entered the water this year, basing conclusions upon their behavior under the conditions of equable temperature and limited food-supply, which obtain in the laboratory.

Occurrence. In a brief paper published in April, 1921, I tried to set forth some of the peculiar features in the distribution of the terrestrial form. From the changes at metamorphosis and from the series of measurements, I am convinced that all the individuals of the species pass through the terrestrial stage, in spite of the fact that they are very scarce in some localities. I quote: "I can go to seven pools or streams within a mile of my home in central Maine and find the water form or the larva at the right time of year, but in all my life I have never seen more than five or six specimens of the land form from that locality.

"In some regions, usually hilly, the land form is very abundant, coming out in large numbers after showers. Is it possible that the nature of the country changes the habits of the animal? Such an explanation does not seem very plausible to me, but I can think of no better." (Pope, '21)

Since I have never been able to find the terrestrial form in any abundance, I do not feel qualified to write very much about its habits. However, through the kindness of Miss Smith, I have the following account of its occurrence and habits in a locality where it is abundant. The first paragraph of this quotation is from Smith ('20b) and the remainder is unpublished.

"Several trips have been made by different members of the Department of Zoology of Smith College to the 'Williams Pond,' on the northwest slope of Mt. Toby in the town of Sunderland, Mass. This pond, formed by the damming of a small branch, is almost a quarter of an acre in surface and from one to two feet in depth. . . The dam is an unusually good vantage ground for observing and collecting *Notophthalmus viridescens*, which are always present in considerable numbers.

"The land form of *Notophthalmus* is sometimes very abundant in certain regions of Mt. Toby, and at other times, is almost entirely lacking in the same localities. As described in *Copeia* (March 25, 1920) upwards of twenty-five specimens were collected from a certain hollow near the 'Williams Pond' on the western slope of the mountain on Sept. 23, 1917, and thirty-five on Sept. 28, 1919. Some of these had evidently just metamorphosed and the others may have been about to go back into the water at the end of their terrestrial period. At no other times have I known of terrestrial larvæ being found in the vicinity of this pond, (which is always teeming with the aquatic form) although I have searched for them in the late fall and throughout the spring.

"About a mile and a-half from this pond, on the road that skirts Bear's Den Hill, so-called, on its south-east aspect, the land form has been found in phenomenal numbers three times to my knowledge. On a rainy day in May 1915, Dr. H. H. Wilder, in walking along this wood-road, counted over 60 of the scarlet form crawling over the surface of the ground and in May, 1916, and again in 1918, parties from the college, of which I was a member, had similar experiences. In 1916 we found the animals nearly to the top of Bear's Den Hill, a height about 250 feet above the 'Williams Pond' and 450 feet above sea-level. It may be significant that these three trips were made during or immediately after a heavy rain, as diligent searching in this locality at other times has resulted in only a few specimens.

"Although there is no other known breeding place on Mt. Toby,

the distance and rough character of the hill between this place and Williams Pond, make it questionable as to whether these animals were bred in that pond. The fact that the terrestrial forms are not found at all times may be because they burrow deeply into the ground and come out of hiding only when it is raining or when they are ready to go back to the water. If, however, as is quite possible, these animals had found their way around the hill from the known breeding place, the fact that they could migrate so far would easily account for the fact that they are so seldom found near the habitat of the aquatic stage in so many localities."

Dr. Chase of Western Reserve, has found the land form nearly at the top of Mt. Monadnock, in Jaffrey, N. H. This mountain rises to a height of nearly 2500 feet above the surrounding country and 3100 feet above sea-level. It is well wooded nearly to the summit, but I doubt if there are any pools above the base of the mountain. There are no natural barriers like the cliffs on Bear's Den Hill, but it seems certain from both Miss Smith's and Dr. Chase's accounts that *Notophthalmus* travels to considerable distances on land from its breeding places, as well as to considerable heights in mountainous country.

The almost total absence of the terrestrial form from localities where the aquatic form is abundant and its disappearance at times from localities where it is sometimes very plentiful, remain riddles as unsolved as the scarcity of the adults of *Ambystoma maculatum* or the total disappearance of the spadefoot toad, *Scaphiopus*.

Pike ('86) says: "The young of the second year sometimes leave the water altogether and secrete themselves in damp places. When droughts occur and the ponds dry up, I have often dug them out, all huddled together more than a foot below the surface, and when the clayey ground has become so parched that they are unable to burrow, they are often seen several together, dead and dried up."

Pike may have the real answer to the question in this paragraph, but it needs confirmation.

Color and Appearance. The general appearance of the land form, even in alcohol, is smoother and plumper than the adult and the coloration is much more uniform. A few black dots appear on the tail, sides, and abdomen, but few or none on the back, while the whole appearance is pale. A land animal is conspicuous in a jar of alcoholic specimens because of these differences in color and markings.

The vermilion spots appear before metamorphosis, but the black borders do not usually surround them completely until the second or third year. The spots on a large red newt are very conspicuous. The brilliant red spot, with a clear ring of jet-black, stands out very sharply on the duller, and otherwise spotless dorsal surface.

The tail is narrow and slender, but decidedly compressed, especially at the tip. While it is far rounder than in the adult, it is not truly cylindrical, as in the case of *Plethodon*.

As has been noted, the color is quite variable. Again I must refer to Gage ('91). "The general coloration of the body is almost always lighter on the ventral than on the dorsal portion and differs greatly in different specimens. In some specimens, it is a bright color in which yellow is very prominent, in others the shade is more red and in still others it is a dingy reddish brown." Fig. 21 is a photograph of two typical red newts.

Other terms used by various writers are: "vermilion," "scarlet," and "pale orange."

Texture of the Skin. Much has been written about the rough skin of the land form as contrasted with the smooth-skinned adult. While there is a real difference between the two, I think that it has been over-emphasized. After the larval period, *Notophthalmus* is distinctly a rough-skinned animal. The adult is never slippery like *Ambystoma* or *Desmognathus*. The fact that the adult is generally wet, makes it appear smoother than the land form and some of them are really quite smooth, but under the binocular the skin of both forms is seen to be covered with fine tubercles or papillæ. These have somewhat the appearance of a volcanic crater, a roughly conical shape with a slight depression in the center where the duct of one of the dermal glands opens to the surface.

In the aquatic form the skin shows considerable variation under the binocular. In some cases, especially those of large, smooth newts, the papillæ stand well apart with broad, flat spaces between them. In other animals the papillæ are set closer, stand higher above the surface of the skin, and the skin itself is more wrinkled between them.

In the land form, this condition is still more marked. The papillæ are larger in proportion to the size of the animal, and, as noted by Gage, are often brown at the tips, while the wrinkles are deeper than in the adult. However, this difference is rather in degree than in

kind, and I would hesitate to say that one form is rough and the other smooth.

A cross-section of the skin shows the papilla as a thickening of the epidermis with the duct of a gland opening through it. This gland is large and saccular, lined with nuclei, like the other, more numerous dermal glands, but, unlike them, the nuclei are smaller and more numerous; and the contents of the gland do not stain so deeply with eosin. Possibly it is the secretion of these glands which makes *Notophthalmus* respected by some of its natural enemies.

In order to test the disagreeable properties of the secretion of these glands, I held an aquatic *Notophthalmus* in my teeth for one minute while it struggled. It felt slippery to my tongue, but no taste was perceptible, until two minutes after it was released, when I noticed a slight bitter taste which was not very strong nor very disagreeable and lasted for only a minute or two. The flow of saliva was not noticeably increased. Thinking that the more poisonous part of the secretion might not be discharged unless the animal were strongly irritated, I took the animal again and bit off the tip of its tail, holding the tail in my mouth for a full minute afterward. Irritation seemed to have no effect, for the taste was less strong than before.

It has seemed to me that there must be something disagreeable about *Notophthalmus*, for I have left it in the same aquarium with young pickerel, which would promptly swallow a large minnow, but never offered to touch the newt. Larvæ will be eaten at once by sunfish, minnows, or pickerel, but the adults seem to be immune. The only evidence of natural enemies which I have ever seen, was the occurrence of several newts with the tail gone a little behind the cloaca. Since *Notophthalmus* cannot autotomize its tail, I believe that it was bitten off by some natural enemy, possibly a turtle, or muskrat.

I have been told that garter-snakes in captivity will eat the land form very readily, and it is quite possible that water-snakes and frogs prey on the aquatic adult. To test this, I placed two newts in a large jar, containing an adult green frog, *Rana clamitans*, and three bull-frogs, *Rana catesbeiana*, of about the same size as the green frog. In fifteen minutes one of the newts was gone and the other had disappeared at the end of two hours.

Food. Pike ('86) says the food of the land form consists of: "Spiders, insects, earthworms, etc." and believes that the change of food influences the change of color. Gage ('91) gives them the same

bill of fare, mentioning insect larvæ in addition. Dr. Parker tells me that he has seen them on Mt. Monadnock, crawling up under a wormy mushroom in the woods to catch the maggots which fell out.

Feeding the red ones in the laboratory was a problem at first. Some will soon learn to take pieces of raw meat or earthworms from the end of a pin but others refuse to eat, even with this painstaking method. A hint from the American Museum led me to try releasing a culture of *Drosophila* in their jar and then the problem was solved. The movement of the flies attracts them, and while they cannot follow to the top of the jar, they are on the alert to snap up any fly which crawls within reach. Six newts will dispose of one hundred or more flies in an hour or two.

Respiration. The lungs are very much like those of *Necturus*, although they are much longer in proportion to the size of the animal. They are slender and delicate, extending well back into the pelvic region and growing larger at the posterior end. The throat is in continuous, rapid pulsation at a rate that is very variable. Whipple ('06) has timed these throat-movements carefully and found that in different specimens and at different times, they vary from one hundred and four to two hundred and thirteen per minute. These rapid throat-movements serve only to change the air in the mouth and throat in bucco-pharyngeal respiration. This is varied by pulmonary respiration, which Whipple describes:

“As a result of the prolonged depression of the floor of the mouth, air is first drawn in through the open nares, as in bucco-pharyngeal respiration. This part of the process is known as aspiration. During the latter part of the act of depression, however, when the external nares are closed, air is drawn from the lungs into the mouth through the opened glottis and the air in the mouth thus becomes a mixture of pure and impure air. This part of the process is termed expiration. When the floor of the mouth rises again, some of this mixed air is forced into the lungs, the external nares being still closed. This constitutes the process of inspiration. Finally the external nares are opened again, and the fluctuating movements of bucco-pharyngeal respiration are resumed.”

The fact that the land form can be made to eat by adapting it to water, has already been mentioned. This might suggest that they sometimes go into the water to feed. The fact that they are often found at some distance from water, makes this seem unlikely, but

another explanation seems more probable. As we have noticed, the red newt is seldom seen except during or after a rain. Is it not probable that abundant moisture quickens its sense of smell and that it comes out to feed at such times? If this is so, it does not seem strange that the animals eat better in water than on land.

4. AQUATIC ADULT.

Change in Form and Color from Land Form. Little can be added to what we know of the coloration of the two forms. The change at the time of entering the water may be great or small, according to the color of the terrestrial animal, but there will always be some change, for I have never seen a terrestrial specimen as dark green as the typical aquatic adult. On the whole there is much more uniformity of color in the aquatic adult than in the terrestrial form, although some animals are pale with the black markings over sides and tail forming a very conspicuous pattern.

The color over the back and sides is uniform, dull olive green, frequently quite dark and growing paler on the tail. This dark color ends abruptly at the origin of the limbs so that the upper side of these is green and the under side yellow. On each side, at about two-thirds of the distance from the line bounding the yellow to the ridge of the backbone, is a row of bright vermilion spots surrounded by rings of black pigment. These spots vary in number from three to eight on a side and extend from the head to the inguinal region. They are usually round and about one-half a millimeter in diameter. In addition to these bordered spots some animals show a number of finer red dots, sprinkled irregularly along the sides.

The small black spots, scattered over the back, seem to appear at or soon before the time of going into the water, for the red newt seldom shows them. The under parts grow considerably paler at this time. Instead of the clear, bright orange of the land form, the under parts of the adult are clear, bright yellow, sprinkled with black spots. The size and distribution of these spots is variable. Some females especially, have the abdomen very finely speckled.

The principal change of form is in the tail. In the smallest of the land animals this may be shorter than the combined length of head and body. It grows longer in the larger ones, while in the adult it always exceeds the length of the head and body. Soon after the return to the water it also broadens considerably, developing a fin

both dorsally and ventrally. This change is easily explained by the change in function. On land the tail is an unimportant balancing organ, sometimes used as a hook in climbing, but in the water it becomes the principal organ of locomotion. Fig. 20 (Pl. XLIX) shows that the increase in length occurs at two different times; the first is when the land animal is about 75 mm. long, that is during the last summer of its life on land, while the second begins after the newt has entered the water and has had time to establish itself. This is probably the first summer after the return to water, for it begins at the length of 85-90 mm. The flat part of the curve between the two points showing growth may mean that the tail is broadening rather than lengthening just at this time. Width is now more important than length, for a narrow tail is of little use in swimming.

The width of the tail varies with sex and season. In the female the tail is usually narrower than the body, while that of the male nearly equals the width of the body at most times, and decidedly exceeds it during the breeding season.

Respiration. In the aquatic adult, there are two forms of respiration, which might be termed aquatic and pulmonary, corresponding to aerial and pulmonary in the terrestrial form. Copeland ('13) has described the first process accurately:

"Certain intermittent mouth movements of *Diemyctylus* are conspicuous. These consist of a rather slow expansion of the floor of the mouth, followed by a sudden contraction, at which time the mouth is slightly opened. If carmine suspended in water is squirted from a pipette over the snout, it is drawn in through the extended nares as this expansion progresses, and expelled from them and from the mouth, when the contraction follows."

The rate of these throat movements is much slower than in the land form. The rate varies considerably, (from 3 to 23 per minute) according to Whipple ('06) and the amount of expansion is not always uniform. However, these slow oscillations almost always expand the throat more widely than the rapid motions of the terrestrial form. As Whipple ('06) has written such a careful account of aquatic bucco-pharyngeal respiration, including a table showing the frequency of the throat movements in four animals, I shall not allude to it further in this paper.

Once in two minutes on the average, the animal swims to the surface, expels a bubble of air, snatches a mouthful of air with a

quick jerk of the neck and then floats passively at the surface or sinks again with all four legs sprawling in the water. Frequently one or two bubbles are set free after the newt reaches the bottom again.

Whipple ('06) describes this act as: "A quick gulping motion by means of which the water in the mouth is replaced by air. This is immediately followed as the head again returns to the water by a forcible swallowing motion as the result of which the air is forced from the mouth partly into the lungs and partly out through the nostrils."

I found that the frequency of this aerial respiration of the adult averaged once in 2.85 minutes. Four experiments were performed in which the animals were watched for thirty minutes and the frequency of taking breath noted. The results are shown in the following table:

Expt.	Respirations	Shortest Interval	Longest Interval
I	11	1.5 Minutes	6 Minutes
II	2	4.5	24.5
III	9	1	9
IV	10	1.5	5.5

To determine whether this pulmonary respiration is essential, I have experimented on several newts by confining them in a wire cage so that they could not reach the surface. When the cage containing a newt was set into a jar of water containing about one gallon, with a control animal in the jar outside the cage, the newt in the cage became very restless within an hour and tried constantly to reach the surface. This continued without much change for several hours and the animal invariably died within ten or twelve hours, while the control animal outside the cage, where it could breathe at the surface, showed no ill effects.

To make sure that death was not due to the exhaustion of oxygen in the water, I confined a newt in a cage in one of my balanced aquaria, where there was no other animal life, but where the plant growth was thrifty enough to supply oxygen for several fishes. Under these circumstances death could hardly be due to lack of pure water. The newt thus confined tried persistently to reach the surface for an hour or so after it was put into the cage but after that showed no signs of discomfort for five days, when it was found dead on the morning of the sixth day.

Whipple ('06) has confined newts in small wire cages in a tank of running water with a specimen of *Necturus* in the jar to keep the air from collecting in the cage. Such animals remained perfectly normal for periods of seven to ten days with no apparent inconvenience, although the capillaries of the skin distended with blood to an unusual degree. Possibly the difference in results may be due to the running water being more heavily charged with air, or it may be that my animal died from some other cause than lack of oxygen, since it is hard to believe that it would have drowned after living for five days.

These experiments and the fact that newts remain more or less active under the ice in winter, lead me to believe that pulmonary respiration is not absolutely necessary to life provided that the water is pure.

Habits. When *Notophthalmus* is kept in the laboratory, it will thrive in any jar or aquarium regardless of depth if kept supplied with food such as raw meat, fish, liver, earthworms, etc. If, however, a stone is put into an aquarium so as to reach the surface of the water, the newts frequently crawl out of the water and sometimes remain for hours with the head and part or all of the body exposed, until the skin becomes quite dry.

At such times aerial respiration is going on, the throat pulsating rapidly in much the same way as in the terrestrial animal. As a rule, the water newt will crawl out of water and remain from five to fifteen minutes before beginning aerial respiration. The newt may or may not open the mouth and gulp at the beginning of this breathing process. Whipple ('06) found that this delay was due to the fact that the nostrils were filled with water, which must be expelled before respiration could begin.

Why *Notophthalmus* should crawl out of the water in this way is not clear to me. I once kept nineteen newts for over a month in a jar ten inches in diameter with three inches of water in it. This water was usually changed once a week and seldom became very foul, though there was probably little oxygen left in it. A pile of stones in the middle gave an opportunity for the newts to crawl out of water, which they did constantly. A record shows that there were always from one to ten newts on the stones all the time, with head or head and body out of water. When the stones were crowded, they

climbed over one another to get as high as possible, and then raised their heads straight up into the air like seals on a rock.

I kept a record of the number of newts on the stones each hour of the day between 7:00 A. M. and midnight to see if time of day or conditions of lighting made any difference. The results of this were purely negative, showing nearly the same numbers for any time of day.

One is first led to believe, that, when the water loses its oxygen, the newts take to aerial respiration, but, if so, I would expect a change of water in the jar to make a decided difference. Since I could see no such effect, I doubt if this is the explanation.

I have never seen the aquatic adults out of the water in their natural state. Possibly the light out of doors is too strong, but, if so, they might be expected to crawl up on logs or stones at night, as turtles do in the day time. I have looked for them at night in ponds where they are abundant, but have never seen any out of water.

Notophthalmus is a sluggish animal. It crawls slowly about the bottom or through the weeds of the pond or rests quietly for hours, sometimes coming up for a breath. Even in its feeding habits, *Notophthalmus* is not very active. Much of its prey consists of molluscs, which require no agility to capture, but, even when catching tadpoles or insects, the newt shows so little intelligence or activity, that one is led to wonder how such a blundering creature can catch food enough to live. I have noticed one approaching a school of little tadpoles feeding along the bottom. The newt slowly swam a few inches toward the tadpoles and then stopped. This was repeated three or four times, until it suddenly seized a tadpole that swam close to it. The tadpole struggled violently and escaped, without the end of its tail, alarming the rest of the school and leaving the newt without "a square meal."

I have caught them with a fish-hook, using worms for bait, but not by the usual method. When the hook is held quietly near the newt it will seize the worm and cling to it so tenaciously that it may be lifted out of the water before it will let go.

I have frequently seen *Notophthalmus* in what might be called a state of hypnosis. The body is usually slightly curved and is perfectly rigid and motionless. The head is bent slightly downwards, the tail may be thrown into waves or kept straight, while all four legs are strongly flexed. The eyes may be open or depressed and closed.

In one case I saw another newt swim past and strike the rigid animal, making it drift away passively without a sign of life. This state of hypnosis seldom lasts more than a few minutes, when the newt slowly resumes its normal activities and swims away. I feel sure that this has nothing to do with mating activities, for the two cases studied most carefully occurred in February, when little mating was taking place. Both of these were males, but whether this behavior is confined to that sex, I cannot say.

Occasionally *Notophthalmus* may be seen to yawn widely, opening the mouth to an angle of 90°, expanding the throat to its fullest extent and bending the neck slightly at the same time.

Notophthalmus is not nocturnal in its habits. It may be seen at any time of the day regardless of the sun, feeding, or moving about in shallow water. When taken into the laboratory, it seems to be as active by night as by day.

When kept in a glass jar, the newts have a habit of swimming along the sides of their prison, noses to the glass, pawing at it constantly. If the water is shallow enough, they will raise themselves against the glass and try to climb out of the jar. A theory has been advanced that this behavior was due to the reflections in the glass, that the newt sees its own image and paws at it. I can see no evidence in favor of this, for when the jar is lined with black paper, the animals still persist in their efforts. Furthermore, when a small mirror was left in the jar for two hours, the newts paid no further attention to it than to climb upon it.

The newts tend to gather on the side of the jar towards the light, as though they were positively phototropic. When black paper was first put around the jar, they stopped swimming against the sides for a time, but soon resumed it. When a two inch gap was left in the paper on the side next the window, two newts swam to it at once and began to play back and forth in the lighted streak. During the next hour, there were usually from one to three newts at the lighted side but sometimes it was deserted for several minutes at a time, while half a dozen animals were struggling against the black paper several inches away. From such results, it is hard to believe that phototropism plays any great part in the life of *Notophthalmus*.

Notophthalmus seems to have little if any period of hibernation. Pike ('86) writes: "It may be caught from March to December, as

it bears a very low temperature, and I once saw it swimming under the ice in a pond near Fort Hamilton." Gage ('91b) cites both Storer and Holbrook to the same effect. My Pittsburgh records run from March 23 to December 4, at which latter date, Mr. O. C. Wood reports finding them very abundantly. The day was cold after a period of unseasonably warm weather and the newts were lying passively about the pond, apparently stupefied by the cold.

Food. *Notophthalmus* is essentially carnivorous in all stages of its life-cycle. Its food consists of anything of an animal nature not too large to be swallowed nor too active to be captured. Various naturalists have listed the food of this form.

Pike ('86) says: "Its food is very varied. It will take aquatic and other insects, small tadpoles, worms, especially earthworms, and it will eat small pieces of raw beef and fish when hungry. . . . They are very fond of the small, fresh-water bivalves, so abundant in most of the ponds they frequent. Many are swallowed whole; one I dissected had four, shells and all, in its stomach."

Gage ('91) writes as follows: "The food consists of insect larvae, like caddis worms, adult insects, various aquatic worms, earthworms, small crustacea, bivalve and univalve molluscs. In captivity they learn to take bits of meat from a stick, to catch flies thrown on the water and to catch tadpoles."

Jordan ('93) says: "They are exceedingly voracious, and, when freshly captured, almost invariably have their stomachs distended with partially digested prey. They feed chiefly upon insect larvæ and small mollusks, which they swallow bodily. Among the most common objects in the stomachs of the newts are the mollusks, *Bythinella*, *Valvata*, *Planorbis*, and *Cyclas*; orthopteran and dipteran larvæ; small water-spiders; encased Phryganid larvæ; small crustacea, and the like."

Copeland ('13) made the following report on the contents of a dozen stomachs of newts, which I collected in the early part of August: "Admitting of identification were four snails of two genera, one water boatman (*Corisa*), one caddis-worm, several midge larvæ (*Chironomidæ*) and three amphipod crustaceans."

There is little left to add to this mass of evidence. The bivalves mentioned by Pike are probably *Cyclas*. When several newts are brought into the laboratory and placed in glass jars, they will fre-

quently pass several empty shells of this mollusc. The contents have been digested, but the acids of the stomach appear to have had little effect upon the shell. I once dropped several beetle larvæ, found under stones in a wet place in the winter, into a jar containing some newts. One immediately seized a grub by the tail, when the latter, which was an inch long and armed with a formidable pair of jaws, turned around and bit viciously at the eyelids and other parts of the newt's head. The salamander squirmed in evident pain and used its paws to push away the grub but refused to let go. The grub slowly disappeared, tail first and although I saw blood start when it bit the tip of the newt's lower jaw, it must have settled up its accounts inside.

The method of catching tadpoles employed by *Notophthalmus* has been mentioned already. I have put masses of frog eggs into the aquarium and seen my animals gorge upon them. The jelly makes the eggs hard to swallow but I have seen a salamander literally wade into an egg mass, disengaging and swallowing one egg at a time. Newly hatched tadpoles make even better food and the newts eat them freely.

Habitat. Any pond, lake, or pool, with plenty of water-plants or with marshy shores, or any sluggish stream where conditions are similar, forms a suitable environment. I have mentioned seven stations near my home where *Notophthalmus* can be found. One of these is an abandoned granite-quarry containing a pool of water; two are little marshy ponds, formed by the damming of brooks; another is a sluggish brook, forming broad pools in a field; another a large pool, where muck has been dug; still another the shallow, marshy shore of a lake; and the seventh the mouth of a brook, emptying into Lake Cobbosseecontee. These stations seem quite typical and show a variety of conditions. The quarry is in woods on top of a hill. It contains a pool from three to five feet deep in its deepest part, depending upon the season. As may readily be imagined, the water in such a shallow pool in the rocks grows very warm in the summer. Yet the place is always well stocked with *Notophthalmus* and is also a favorite breeding place for *Ambystoma maculatum*. The location of this pool is interesting also, for it is on the top of a hill at least a quarter of a mile from any other body of water. *Notophthalmus* must have reached it by migration over land while in its terrestrial stage. This quarry is shown in Fig. 22.

I have seen *Notophthalmus* only once in any of the numerous lakes of that part of Maine and that was on a shallow and somewhat marshy shore. Smaller bodies of water seem to be preferred.

Distribution. *Notophthalmus* is widely distributed throughout the eastern part of the United States. I have collected it in Maine, Massachusetts, Illinois, New Jersey, New York, and Pennsylvania.

Cope ('89) says: "This variable species is the aquatic salamander of the eastern region of North America." He gives a list of specimens in the National Museum captured in all parts of the eastern United States from Connecticut and New Jersey westward to Wisconsin and Illinois, and southward to Louisiana, Alabama, and Georgia, with one collection from St. Catherine's, Canada. Records for the land form, listed separately as *Diemyctylus viridescens miniatus*, extend this range somewhat, including "Hudson Bay," "Upper Mississippi Valley" and "Brazos River, Texas."

Adaptability to terrestrial life. If taken from the water and kept in wet leaves or moss, *Notophthalmus* will live indefinitely. Gage ('91) has noted this, and says: "Furthermore, viridescent specimens from the water have been kept in the air for several months, but there was never any indication of a return to the red garb of the immature form."

I have taken adults out of the water a number of times and kept them for several months. For the first few days they are inactive. They remain in hiding most of the time, the skin looks smooth and sticky and the animal seems to be uncomfortable. After a week or two, the skin grows rougher and drier and the newt has become more active. The tail narrows considerably during this period of adaptation. In a broad-tailed male the thin feather-edges fold over to one side and dry down to the skin on the side of the tail. Such thin parts of the skin seem to die and slough off.

Newts thus removed from the water usually refuse food at first. Out of fifty-one so treated in the course of various experiments, only seven would eat during the first week. In the second week, nine more took food; in the third week seven more began to eat, while two others ate after longer periods. Out of the entire fifty-one there were twenty-six which refused to eat at all while the experiments lasted.

Possibly this refusal to eat at first is due to changes in the mouth-parts. The aquatic adult, like the aquatic larva, seizes its food with its jaws, while the terrestrial newt, as noted before, throws its tongue well out of its mouth to capture its prey. After the aquatic adult has become adapted to terrestrial life and has learned to feed, it extends its tongue as far from the mouth as the land form. There must be a decided change in musculature to allow this, so that the delay in feeding may be due to the necessity for these changes in the mouth-parts.

It would be interesting to make careful dissections and paraffin sections of the tongue and hyoid region of newts undergoing this adaptation, for I can think of nothing exactly comparable to it. The change in feeding habits seems to occur in response to a change in food correlated with the forced change in environment. In view of this and of the fact that in the South it always comes out of the water in the summer, it appears to me that *Notophthalmus* is a very adaptable animal, and possibly one, which is undergoing an evolutionary change and becoming more terrestrial.

It seems probable to me that this adaptability serves to save the animals in time of drought. It has been noticed that *Notophthalmus* tends to crawl out of the water and breathe air when kept in the laboratory. This occurs at any time of day, but perhaps a little oftener at night.

Let us speculate a little on what may happen when a pool goes dry. As the water becomes decreased in volume and consequently grows foul, the newt may leave it at night, and sit on rocks or the banks. By the time the water is all gone, most of the newts would have become somewhat adapted to terrestrial life by continued exposure to air, and would start off across country at night to look for another pool. This is a mere conjecture, and probably seldom occurs, for most of the ponds or pools where *Notophthalmus* occurs are of a permanent character.

Since the foregoing paragraph was first written, Miss Smith has described such a pond near the "Williams Pond." She says: "It probably is normally fifty yards across, but is now completely dried up and has a pathetic little group of skeletons in the middle of it, where the water last was." Evidently not all of the newts escaped from this pond when it dried up, but it is quite possible that some of them may have done so.

SUMMARY OF LIFE-HISTORY

1. *Notophthalmus* breeds in shallow ponds or sluggish streams from March to July.
2. Fertilization is internal by means of spermatophores; mating serving merely to bring the sexes together and to stimulate them into sexual activity.
3. The spermatozoa are stored in spermathecæ in the dorsal wall of the cloaca of the female, fertilization taking place when the eggs are laid.
4. The pits on the side of the head of the male are lined with glands, which evidently serve to stimulate the female at the time of mating.
5. Mating also takes place in the fall from September to December, although no eggs are laid. This seems to be preliminary to the mating season in spring, for it continues more or less all winter in the laboratory.
6. The eggs are laid singly on the leaves of submerged water-plants, grass, etc. They hatch in twelve to eighteen days in the laboratory.
7. The larva hatches in a very undeveloped condition. It has "balancers" on the head, the fore limbs in the "bud"-stage, and no hind limb buds.
8. The food of the larva consists chiefly of small crustacea with probably some green algæ in addition.
9. Before metamorphosis the color changes from greenish brown with white under parts to the dark olive of the adult with vermilion spots on the sides and yellow abdomen.
10. At metamorphosis the gills are lost, as well as the broad feather-edges of the tail; respiration becomes aerial; the young newt swims with difficulty and comes out of the water, if given the opportunity.
11. The young newt does not become red at once, but remains green for some time, at least in the laboratory.
12. The manner of securing prey changes at metamorphosis from seizing it with the jaws to capturing it by throwing the tongue well out of the mouth after the manner of toads.
13. The terrestrial form is not always red, but varies between that color and a reddish brown, sometimes approaching the green of the adult. Red is the prevailing color of the terrestrial form, but the greenish phase is sometimes found. Color alone is not a constant

character, but varies from brilliant orange to different intensities of olive-brown regardless of sex or season. The olive phase becomes more abundant as the land form approaches maturity.

14. Red animals may be changed to the viridescent color in the laboratory but the opposite change has never been induced. Olive appears to be the more stable color.

15. The terrestrial form is readily adaptable to water and feeds more readily in water than on land.

16. The respiratory movements of the land form consist of a rapid pulsation of the throat varied by occasional larger expansions of the throat and heaving of the sides. Probably most of the respiration takes place in the throat and a little in the lungs.

17. The food consists principally of small insects, larvæ of insects, spiders, and small crustacea. *Drosophila* furnishes a good diet in the laboratory.

18. The skin of the land form is similar in structure to that of the adult, though noticeably rougher, while both are rough as compared with the larva.

19. A series of measurements shows that the newts probably remain on land until they are three and a-half or four years old, when they attain a length of from 80 to 85 mm.

20. The proportional length of the tail increases from the time of metamorphosis until the animal has reached its full length as an adult.

21. The red newt probably returns to water in the latter part of the fourth summer of its life.

22. In the South the terrestrial stage is a seasonal phase, all the newts leaving the water in the spring and returning in the fall.

23. Although all individuals pass through the terrestrial stage, terrestrial newts are extremely rare in some localities, where the aquatic form is abundant.

24. Respiration in the land form is of two types, aerial bucco-pharyngeal and pulmonary.

25. When the newts enter the water at maturity the color changes from red to a dull olive-green on the dorsal side and bright yellow spotted with black on the abdomen.

26. Respiration in the adult is aquatic bucco-pharyngeal and pulmonary by means of air taken at the surface.

27. Pulmonary respiration is probably not necessary to life, for

bucco-pharyngeal and dermal respiration can take its place.

28. In the laboratory *Notophthalmus* will often crawl out of water and remain for hours, changing its respiration to aerial bucco-pharyngeal.

29. *Notophthalmus* is a sluggish animal, diurnal in its habits, and blundering in its feeding.

30. There seems to be little or no period of hibernation for the adult.

31. The food is very varied, consisting of almost any small form of animal life.

32. The aquatic stages of *Notophthalmus* are found in lakes, ponds, or sluggish streams; small bodies of water, where weeds are abundant, being preferred.

33. The range of *Notophthalmus* is quite extensive, from Maine and Canada westward to Wisconsin and southward to Texas and Louisiana.

34. Aquatic adults may be adapted to life on land and kept indefinitely in wet moss; but they usually refuse food at first.

Part II. SENSE OF SMELL.

In 1912 Reese experimented on the aquatic adult of *Notophthalmus* and concluded that: "The olfactory sense is the one mainly used by *Diemyctylus* in recognizing food." Copeland ('13) performed a series of much more careful experiments and found that: "In all likelihood sight is the sense used by *Diemyctylus* in the capture of actively moving organisms; whereas other food located through vision is often recognized as such by the sense of smell."

At Dr. Copeland's suggestion I set out to complete his work by studying the sense of smell in the immature terrestrial form of *Notophthalmus*. It later occurred to me that the sense of smell in the aquatic larva was equally important and that careful work on the sense of smell in all three phases of this unusually adaptable animal might throw some light on the nature and importance of the olfactory sense in amphibians. In this part of the present paper I shall describe the experiments performed on aquatic larvæ, young terrestrial animals, and aquatic adults adapted to life on land (not trying to repeat Copeland's work on the aquatic adult) and shall attempt to show the relation of the sense of smell to the normal activities of the animal.

I. SENSE OF SMELL IN THE AQUATIC LARVA.

Two methods were used in working on the larva: first Copeland's method of the baited bag as used with the aquatic adult; and secondly water shaken up with the normal food of the animal and squirted over the nostrils with a pipette, as was done by both Reese and Copeland.

The method used in the first case was to put the larvæ in a battery-jar four inches in diameter and to suspend two gauze bags two or three millimeters above the bottom and about one centimeter from the opposite sides of the jar. One of these bags was filled with chopped earthworms and the other with earth. The position of these bags was reversed once in ten minutes, so as to bring the bag of earth into the place where the baited bag had been. Ten experiments were performed using four different lots of animals. The presence of the food was recognized in ten seconds to two minutes after the bags had been put into the jar. The young larvæ would begin to search aimlessly with their noses to the bottom, turning this way and that sometimes snapping at random but usually working towards the baited bag. When the bag was reached, it was usually nosed, frequently for half a minute or more and often bitten. The motion of another larva sometimes attracted a newt, after it had been stimulated by the odor from the bag. It would crawl towards the other animal and sometimes seize it by the nose, leg, or tail. In no case was the bag of earth bitten or even approached. The exact record of a typical experiment follows:

- Aug. 31, 1916; 9:25 A. M. Bags put into battery-jar containing five larvæ. Bait was noticed in thirty-five seconds by one animal.
- 9:27. First animal moving slowly toward bait, two others beginning to nose about the bottom.
- 9:29. All five animals sense food, but only two seem to know where it is.
- 9:31. All animals turning towards bait.
- 9:33. All moving toward bait, one snapped at bag.
- 9:35. Position of bags changed. No attention paid to unbaited bag, though larvæ had just been clustered around baited one, when it was in the same place.
- 9:38. One approaching the baited bag and another the unbaited one, though not coming very close to it. Four are still in region where bait was.

- 9:40. Two more starting for baited bag.
- 9:41. All searching for bait. One started for the unbaited bag and two others followed, approached to within two millimeters, then stopped and turned to one side.
- 9:45. Two nosing and snapping at the baited bag. One searching in region of the unbaited bag, and nosing bag. Does not snap at it.
- 9:50. Position of bags changed, animals scattered, none within an inch of where baited bag was put.
- 9:52. Three animals approaching bait.
- 9:53. Four animals moving toward bait, one snapped at another. The fifth searching.
- 9:57. Two constantly nosing bag and snapping occasionally.
- 10:00. One still nosing bag, others scattered and apparently indifferent, perhaps because odor is diffused through water by this time.
- 10:02. Three searching near bag, one snapped at another and scattered them.
- 10:04. One nosed unbaited bag for about fifteen seconds and then left it.
- 10:10. Position of bags changed. Two animals near bait, but paid no attention to the unbaited bag when it was placed near them.
- 10:13. Three animals searching aimlessly.
- 10:19. Four animals remain grouped near the unbaited bag, but pay no attention to it.
- 10:21. One approaching bait.
- 10:25. Bags removed. Animals were rather indifferent for the last fifteen minutes of the experiment. Before that there were from one to four near the bait all the time after they had it located.

This experiment and the others made in the same way show two things very plainly; first the recognition of food at a distance and secondly the small part played by sight in the finding of it.

Copeland ('13) believed sight to be an important factor in the feeding reactions of the aquatic adult. He says: "All these tests and subsequent ones, indicate that the approach to an object, edible or inedible, is a visual reaction, and that under the conditions described, if smell plays a part in food recognition, it does so after the animal has discovered and moved to the source of stimulus." And again: "These tests show conclusively that *Diemyctylus* is

able to discriminate perfectly between two bags, one containing meat and the other not, and that the food sensing occurs after the bag is approached and before it is snapped at, or taken into the mouth."

The results of my experiments on the larvæ show the reverse to be the case, for, as far as I could judge, it was always the odor diffusing from the baited bag that caused the newt to approach it. The first sign of recognition would be the searching reaction mentioned above, while the approach to the bag was almost always slow and indirect, giving little indication that the animal saw it. The fact that the unbaited bag was nosed twice and approached twice more looks more as if sight were concerned, but certainly it is far less important than in the aquatic adult, where Copeland found the unbaited bag approached nearly half as many times as the baited one. From these experiments, and from watching the young larvæ catch *Cyclops* and *Cypris*, I believe the eyes to be functional only for short distances, and that it is the sight of objects in motion and not the objects themselves, which induces the newt to follow or approach anything, as Copeland found in the aquatic adult. This seems to be true when the larvæ snap at each other.

To see if larvæ would find food quickly, if it were put freely into the jar, I dropped some pieces of finely chopped earthworms into a dish containing nine newts. One minute later three larvæ were hunting within four centimeters of the bait. In two minutes five were hunting and one approaching the bait, snapping occasionally at random and at the end of four minutes the first one had found and eaten a piece of worm.

From this it is very evident that the larvæ can recognize food at a distance when it is not in motion, but they show little intelligence in finding it. If sight were important I should expect the newt to recognize an object, as the adult evidently does, and to approach it, but the larva must nearly touch its nose to the worm before attempting to seize it.

Both Reese and Copeland found that the aquatic adult would snap at beef juice when squirted over the nostrils with a pipette. The experiment described below gave similar results. To make sure that it was not the sight or the motion of the pipette that caused the snapping reaction I first used pure water in the pipette and when the results were seen to be strictly negative, substituted worm-juice prepared by chopping up a large earthworm and shaking up the

pieces with a little water and then filtering to remove all mucus and solid particles.

July 5, 1920. This experiment was performed on nine animals collected July 3. I took filtered worm-juice in a long pipette, brought the tip of it carefully within five millimeters of the snout of the newts and forced out the liquid gently. All nine larvæ responded in about two seconds with a little start. One followed and snapped at the pipette and four snapped at random. All began to nose about the bottom of the dish.

One more type of experiment was tried in order to eliminate the visual factor entirely. A thimble of porous paper was set into the jar containing the larvæ, left there several hours and then several cubic centimeters of filtered worm-juice was introduced with a pipette and allowed to diffuse into the water of the dish.

In the first experiment, performed on four larvæ, one recognized the food and began nosing about in three minutes, although it was three centimeters away from the paper-thimble, when the worm-juice was introduced. Two minutes later, a second animal, five centimeters distant, noticed the worm-juice and crawled straight for the paper, nosed it and climbed part way up its side, snapping at it several times. A third began to search in ten minutes and the fourth in fifteen. Two other experiments with different animals gave similar results.

These experiments make me feel that there can be no question of the recognition of food at a distance by some means other than sight. It must be either smell or taste, senses which are not easily distinguished in an aquatic animal. Herrick ('08) says that the significant difference is not in stimuli, but in character of responses. Smell is chemical perception at a distance and the response is approach or retreat. Taste is applied to an object in the mouth and the response is either swallowing or rejection.

If we are satisfied with Herrick's definition, there can be no doubt that it is smell, which causes the young newts to approach the bait. However, there are two possibilities of taste being concerned. First, water is taken into the mouth through the nostrils in bucco-pharyngeal respiration, and, if there are taste-buds in the mouth, I can see no reason why they should not be stimulated. Another possibility is that there are external taste-buds on the head or gills, like those on the barbels and the ventral edge of the tail in *Ameiurus*, and that

these may be stimulated by food-substances diffused in the water. This possibility is suggested also by a feeding reaction, which I have seen in the larvæ of *Ambystoma maculatum*. In feeding some larvæ with bits of earthworm held on a pin, I noticed that if the food touched the gills, the larvæ seized it at once. A little experimenting on half a dozen larvæ showed that all reacted in the same way.

In this last instance, and, as I believe, in *Ameiurus* also, the food must actually touch the gills or barbels before it is perceived by the organs, so that they do not function at a distance and could hardly cause the reactions described.

In order to avoid possible confusion with the sense of taste, the nostrils of four animals were plugged with white vaseline and their reactions to worm-juice from a pipette were noted.

To make sure that the animals were reacting normally, they were tested first with clear water from the pipette, to which they gave no reaction, and then with worm-juice. All four reacted actively in fifteen seconds to two minutes. No attention was paid to the pipette; but the animals nosed about the bottom, snapped repeatedly and acted as if they were trying to burrow into the bottom of the dish. They were then taken out of the water, their snouts dried a little with filter-paper and smeared with white vaseline in order to plug the nostrils. They were then put into a dish of fresh water and their reactions tested after they had had time to recover a little, in five to eight minutes. None of the four showed the least reaction to the worm-juice. Another test, made an hour and a half later, gave equally negative results, except in the case of one animal, which reacted at that time, when the vaseline had probably come out of the nostril.

II. SENSE OF SMELL IN THE TERRESTRIAL FORM.

The first work undertaken on this part of the problem was done with an odor stream apparatus at the suggestion of Dr. G. H. Parker. The apparatus used was somewhat like that used by Risser in his work on the toad. Figs. 23 and 24 (Pl. LI) are diagrams of this apparatus. Water is allowed to flow through the siphon from the upper bottle into the lower one, displacing the air in the second bottle and forcing a slow current of air into the odor chamber, C, where it is led almost to the bottom of a vial containing the odoriferous substance used. A pinch-cock served to shut off the current, which was

regulated by a screw-cock. From the odor-chamber, air passes upwards through a hole in the center of a plate of glass on which the newt is allowed to crawl. To confine the animal and also to guide it near the source of the odor, an enclosure of wire gauze was made in the shape of a figure-8, with the narrow part about an inch wide. Fig. 24 is a top view of this plate, showing the shape of the enclosure. The apparatus was tested with ammonium chloride by putting a little hydrochloric acid into the bottle and holding an open bottle of ammonia close to the opening in the plate, the white fumes showing the direction of the current of air. When this was seen to be very irregular, an electric fan was placed to one side of the apparatus, so directed as to draw the air across the plate towards the fan. This was found to draw the current of air across the narrow part of the enclosure and to work very satisfactorily. The plate was kept covered with a piece of wet towel paper during the experiments. With an apparatus of this sort, there could be no possibility of sight confusing the results, so that any reaction must be due to smell alone. If positive reactions to food-substances could be demonstrated with such an apparatus, the existence of a sense of smell and its relation to the finding of food would be proved.

Most of the substances, used as food by the newt, have little or no smell to the human nose. A food-substance with an undoubted odor, would furnish the best proof of a sense of smell. The little red dung-worm, *Allelobophora fætida* was tried, because of its rank smell, when irritated. First the newts were fed with it regularly for some days and after they had had time to become accustomed to it as food, one or two animals at a time were placed in the enclosure, with the current of air passing over the pieces of one or two specimens of *Allelobophora*, freshly cut up and put into the vial.

In the first set of experiments, carried on from Nov. 22 to Dec. 15, 1916, four animals were used. They were put on the plate singly, left for from twenty to thirty minutes and watched closely. Several times the air stream was allowed to pass into the enclosure for some minutes before the vial of chopped worms was added to make sure that there would be no reaction without the odor of food. In these experiments, a circular enclosure of paraffined paper was used instead of the one described as having the form of figure-8, and the electric fan was not used.

In all twelve experiments were performed. The hole in the plate

was approached twenty times and the animal showed some response fifteen times. This usually consisted of a pause, sometimes accompanied by a lowering of the head. It was hard to be certain that this was a reaction to smell, as it was so slight, and, furthermore, it occurred a few times when only air was passing through the apparatus. Sometimes the newt reacted in a very decided way by stopping and searching about close to the hole, putting its nose down to the hole or even snapping at it. Such clear reactions occurred nine times in the course of the twelve experiments. In six of these experiments, the newts gave no reaction whatever, so that I do not feel that the results of this set of experiments were conclusive.

After the apparatus had been improved, as shown in Figs. 23 and 24, a second set of experiments was performed with much better results. The same four newts were used, but two of them were put into the enclosure at once and watched for from twenty to thirty minutes as before. The number of times each animal passed through the narrow part of the enclosure past the hole in the plate was noted, as well as the times when it stopped or paused and also the times when it showed an unmistakable positive reaction to the odor of food. A tabulation of these results shows that in the ten experiments, the newts passed close to the opening 129 times, showed some reaction 64 times and gave good positive reactions 38 times. The exact account of one of these experiments follows:

Mar. 21, 1917. Odor of dung-worm.

4:23. P. M. Both animals from dish 3 put on plate.

4:25. No. 2 approached hole, stopped and turned back. Repeated within one minute.

4:27. No. 1 approached, paused and passed on. Repeated within one minute.

4:28. No. 1 approached hole, stopped and nosed it for forty seconds, then put nose into the hole and pushed as if trying to crawl down it, then passed on.

4:30. Came to hole again, stopped, searched about and crawled on.

4:32. Approached and tried to crawl into the hole for a full minute, passed on.

4:34. Came to hole and nosed it for five seconds, searched about for ten more and then turned back.

4:47. Approached, paused, and turned back.

4:50. Came to hole, paused, and went on.

- 4:36. No. 2 nosed the hole and turned back.
4:39. Repeated the reaction.
4:41. Passed by hole without pausing.
4:45. Climbed out of enclosure.
4:46. Ditto.
4:50. Experiment stopped.

It will be noticed that one animal was much more active than the other, until No. 2 became aroused toward the end of the experiment. However, the behavior of the two animals was quite similar.

It is easy to see how the newts might pause or stop when they came to the narrow part of the enclosure regardless of odor, and in fact they sometimes did so, when only the air-current was passing through, but when a newt stopped, nosed or snapped at the edge of the hole, searched about near it and even tried to crawl down it, I can explain its behavior only on the ground that it was stimulated by the odor coming from the hole and that it was trying to find the food which was the source of that odor.

Irritating Odors. A series of experiments was conducted with the same apparatus, using various strong smelling substances not in any way associated with food. The response to these substances was usually to stop suddenly and retreat or sometimes to hurry past. In general, the results were much clearer than those with the worm.

The reactions to different substances will be discussed separately.

Alcohol 95 per cent. Six experiments. Newts would come up to the hole in plate, stop sharply and usually turn back. Reactions very well marked.

Ether. Three experiments. Results similar to those with alcohol, though not quite so clear.

Chloroform. Six experiments with clear reactions. Animals would usually retreat. Climbed out of enclosure frequently.

Formalin 5 per cent. One experiment. Results not perfectly clear. Newts nosed hole and drew back several times at first and frequently passed by without reacting. Toward the end of the experiment, they became very active and passed back and forth over the hole, paying no attention. Results not clear.

Aqua Ammonia. Four experiments. Responses very clear. Newts would stop with a jerk and retreat. Crossed the center only a few times and then hurried past the hole. Never passed it without showing a response. Animals seemed to learn to avoid the center of the

enclosure, for they staid in the ends most of the time by the close of the experiments.

Oil of Thyme. Four experiments. Some clear reactions, but newts frequently passed by regardless of the odor. Oil of thyme is evidently less irritating than other substances used.

Oil of Cloves. Four experiments. Reactions better than with oil of thyme. Responses very clear at first, but before the end of the experiment the newts would evidently get used to the odor and pay little attention to it.

The results of these experiments seem to show that *Notophthalmus* is sensitive to irritating odors, but not necessarily that it has a sense of smell. Most of those substances are irritating and possibly somewhat painful when in contact with the nasal epithelium. Ether and chloroform would probably not be irritating, but their strong odor and physiological effect would be quite enough to explain the reaction to them. It seems to me that little light can be thrown on the normal activities of the animal by working with reagents of this kind, which are never met with in nature. Nevertheless it may be that reactivity to irritating substances would serve to warn the newt against such disagreeable insects as stink-bugs and bombardier beetles.

Feeding Experiments. The method used in these experiments was to give the newt its choice between its natural food, a piece of earth-worm, and a piece of paraffin made to resemble the worm in shape, size, and color. To keep the worm from struggling, it was first killed in hot water. The worm and the paraffin were placed side by side on the floor of the terrarium and attention was called to the two by moving the paraffin with a long needle. When the newt started for the bait, the needle was withdrawn and the worm and paraffin allowed to lie perfectly motionless. The following experiment is typical.

Oct. 25, 1916. Piece of dead worm put into the terrarium and attention called to it by moving a piece of paraffin close by. One of the newts approached and nosed the paraffin but took and swallowed the motionless worm close by. Both of the other newts in the dish did the same.

This experiment was repeated fifteen times with very uniform results. Out of thirty-one experiments, the worm was chosen twenty-five times and the paraffin six times. I found that if the paraffin were kept constantly in motion, the newt would approach and seize it almost at once without stopping to test it by nosing it, and would

usually swallow it if allowed to do so. These results are similar to those of Copeland ('13) in working on the aquatic adult. He concludes: "The seizure of a moving inedible object is a reaction probably correlated with the character of the natural food of the newt. In all likelihood, sight is the sense used by *Diemyctylus* in the capture of actively moving organisms, whereas other food located through vision is often recognized as such by the sense of smell."

My observations on the land form agree very well with these conclusions, only I would lay still more stress on the importance of sight. My animals were fed frequently with bits of earthworm held on a needle. Whenever the cover was taken from the terrarium they would begin to move about and usually to crawl toward the experimenter. At such times, the motion of another newt would attract them. Frequently two would approach each other and one would seize the other by the nose, leg, or tail, clinging tenaciously. At any time, they could be diverted from food by the motion of the hand near the terrarium or by another newt. Motion attracts them at once and they act as though they associated it with food, but there is no evidence that they distinguish one object from another by sight. Paraffin will seldom be touched unless it is in motion, but, if it is moved, it will usually be seized and often swallowed.

The fact that a bit of paraffin will be swallowed, suggests that taste cannot be of any great importance in feeding. At the same time, any irritating substance will be rejected promptly. A piece of paraffin smeared with clove oil will seldom be touched even if in motion, but if it is taken, it will be put out of the mouth and the snout wiped on the ground with every indication of discomfort.

From these experiments it looks as though sight were a more important sense than smell in the capture of food. It is easy, however, to see the importance of smell. Many of the small insects and crustacea that form the natural food of the newt, have the habit of feigning death, if disturbed. Supposing that a newt approached and snapped at a sow-bug, *Oniscus*, after being attracted by its crawling. The sow-bug would fold its legs and lie perfectly motionless but the newt would doubtless recognize it as food by its smell and persist until it was captured. A little experimentation along these lines would be interesting.

It seems to me that there can be little doubt that the reactions described are due to the sense of smell. The parts played by sight

and smell are fairly obvious and on land there can be no confusion with taste. It may be said that for absolute proof, the olfactory nerves should be cut or the nostrils plugged and the reactions noted. Under the circumstances, I can see little need of such an operation and furthermore I always feel a little suspicious of the reactions in a mutilated animal.

III. SENSE OF SMELL IN AQUATIC ADULTS ADAPTED TO LAND LIFE.

The adaptability of the aquatic adult has been mentioned in Part I, as well as the fact that the feeding habits change again and resemble those of the land form.

The purpose of the experiments was to determine whether these artificially adapted newts retain their sense of smell in spite of the change. The four newts used in these experiments were taken from the water Nov. 9, 1919, and kept in a terrarium from that time until the experiments were begun, April 23, 1920, about five and one-half months. Most of the work was done by the method already described under the terrestrial form, the choice between a bit of worm and a piece of paraffin. Out of twenty-four experiments on the four animals, the worm was chosen eleven times after the newt had nosed the combination from five to forty seconds. The paraffin was seized four times, and sometimes swallowed. Nine times the newts nosed the combination and passed on in apparent indifference. Twice in the course of one experiment, one of the newts passed over the spot, where a piece of worm had been smeared over the damp paper covering the bottom of the jar. Both times it stopped, lowered its head to within one millimeter of the paper and began to nose around like a hound looking for the scent. This behavior is very suggestive, and, if I had been able to get it often, or from many animals, I should feel quite confident in calling it an olfactory reaction.

The responses of these adapted newts are so much like those of the land form that they require little comment other than to say that so far as appears, the adapted animals resume all the activities of the immature terrestrial animals.

IV. AQUATIC ADULT.

The work of Copeland ('13) on this form was so carefully done that it does not seem necessary to repeat it. His conclusions have been commented on earlier, and it seems sufficient to say here that in their essential points my own observations agree with them.

SUMMARY OF SENSE OF SMELL.

I. AQUATIC LARVA.

1. The larvæ of *Notophthalmus* will respond to food-substances placed in the aquarium, by searching about the bottom and snapping the jaws.
2. This response is not due to sight, for larvæ will snap and search at random when worm-juice is squirted over their nostrils from a pipette, and will gather about a bag or a thimble of paper only if food is inside.
3. When the nostrils are plugged with vaseline, there is no response to worm-juice, showing that the reactions described are olfactory rather than gustatory.
4. Sight is functional at short distances, and is chiefly used to perceive motion, as the capture of small crustacea is evidently a visual reaction.

II. TERRESTRIAL FORM.

1. When the odor of worms is passed through a hole in a glass plate, on which newts are crawling, they will often stop and nose or snap at the edge of the hole.
2. When newts are given a choice between a piece of worm and a piece of paraffin, they will almost always choose the worm, if both are motionless, but will seize and often swallow the paraffin if it is moved.
3. When irritating substances are used in the odor stream apparatus, the newt backs away sharply.
4. The reactions described cannot be due to either sight or taste and hence must be olfactory in their nature.
5. The motion of the hand or of another animal will always divert a newt from food. Sight appears to be far more important than smell in the finding of food, but smell is useful in recognizing food-substances when there is no motion.

III. AQUATIC ADULTS ADAPTED TO LAND LIFE.

Experiments with a worm and piece of paraffin gave the same results as in the typical terrestrial form.

IV. WATER ADULT.

The sense of smell in this form has been so well proved by Copeland that further work seems unnecessary.

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FIG. 1



FIG. 2

Fig. 1. Male aquatic adult in breeding season, showing broadened tail and pads on hind legs.

Fig. 2. Female aquatic adult in breeding season.

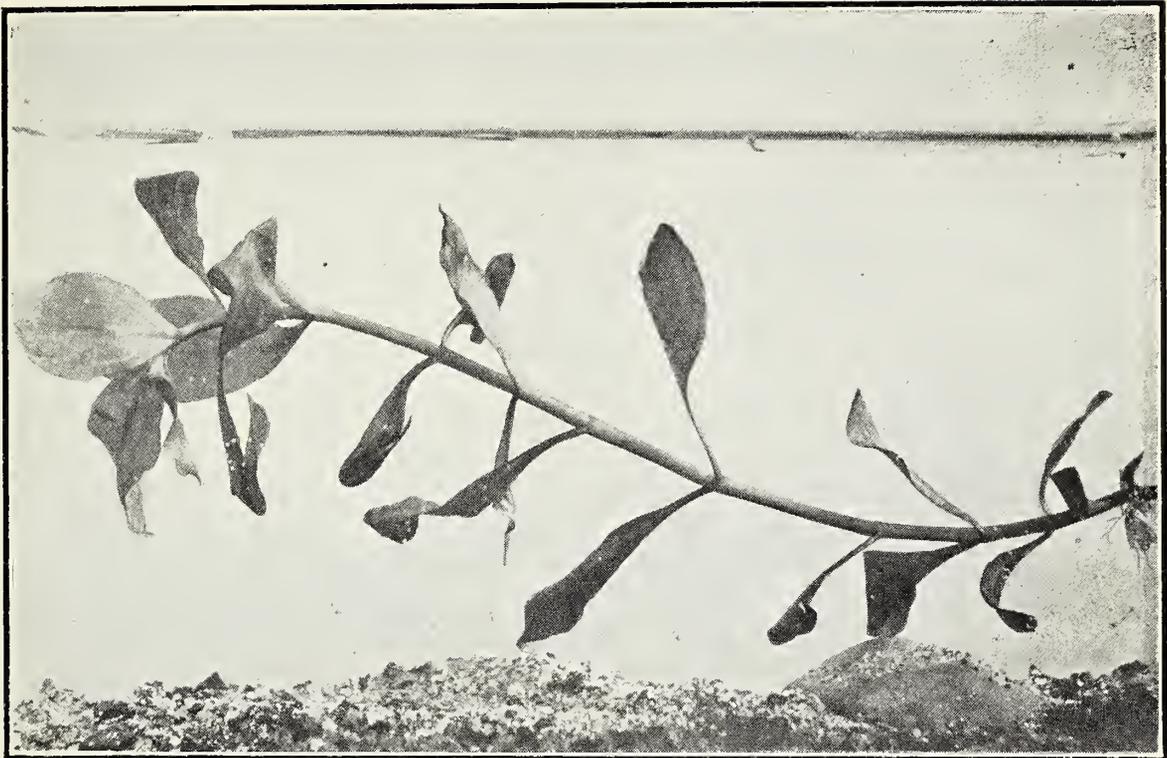
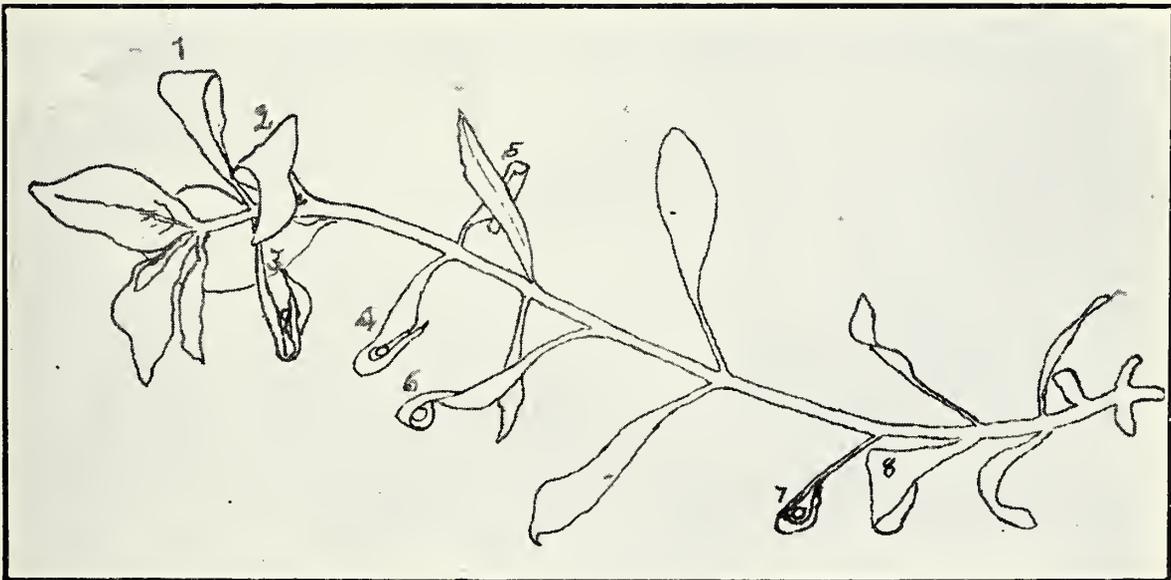


FIG. 3



KEY TO FIG 3

Fig. 3. Shoot of *Ludwigia* showing eight eggs in folds of leaves. The position of the eggs is indicated in the accompanying key, or outline drawing.

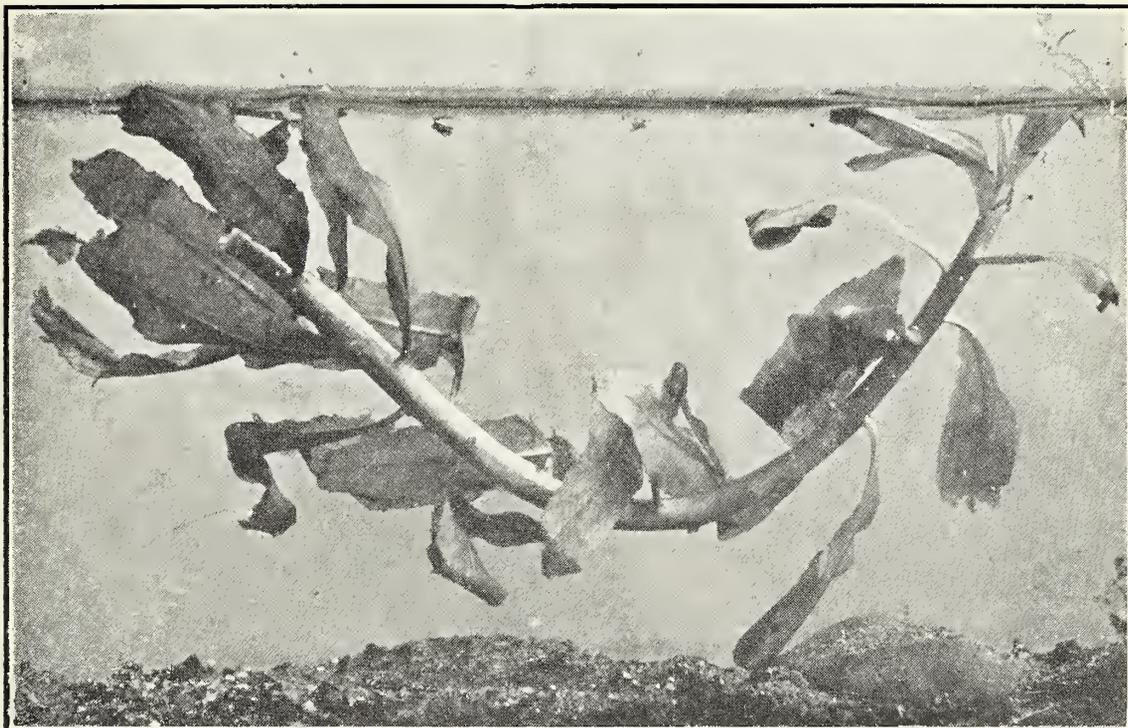
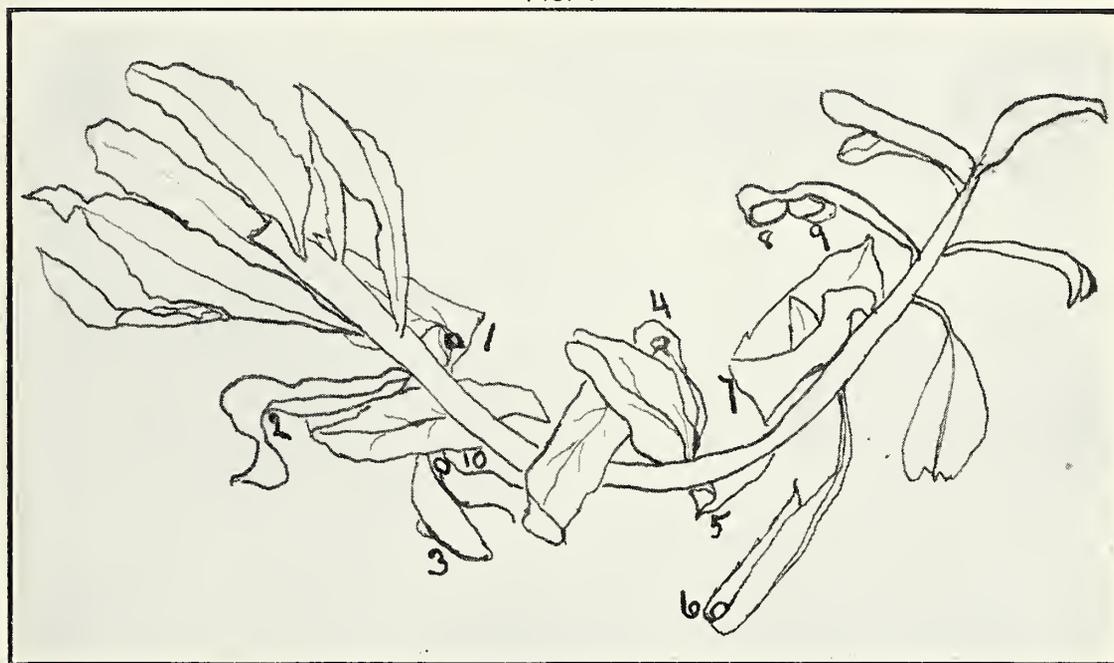


FIG. 4



KEY TO FIG 4

Fig. 4. Shoot of *Proserpinacea* on which are ten eggs. The position of these eggs is shown in the accompanying key, or outline drawing.

EXPLANATION OF PLATE XLIV.

- Fig. 5. Young larva showing full development of gills and tail. August 8, 1920. (Slightly enlarged.)
- Fig. 6. The same larva, dorsal view, showing shape of head and appearance of gills on August 8. (Slightly enlarged.)
- Fig. 7. The same larva, August 14. Metamorphosis already begun; tail narrow; color-pattern changing.
- Fig. 8. The same specimen, August 15, showing the narrow tail, red spots on the back, and large bushy gills.
- Fig. 9. The same specimen, August 15, dorsal view.



FIG. 5



FIG. 6



FIG. 7



FIG. 8

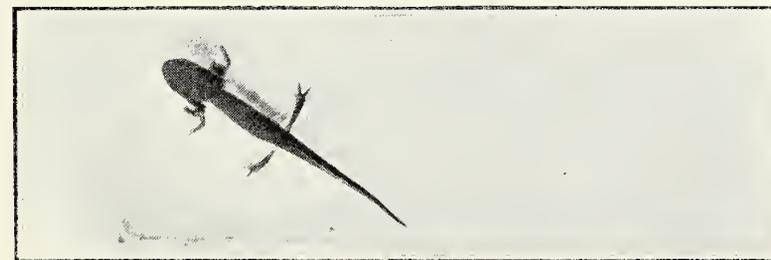


FIG. 9

For the explanation see opposite page.

EXPLANATION OF PLATE XLV.

- Fig. 10. Typical larva above; at left metamorphic specimen in characteristic pose, showing narrowing of tail.
- Fig. 11. Specimen at lower left-hand corner shows typical form of larval head. The upper specimen shows slight narrowing of the tail. The lower specimen reveals the completion of the narrowing of the tail and the commencement of the absorption of the gills.
- Fig. 12. Photograph, August 1. Specimens above still show traces of gills. Specimen at left, with head pointing downward, shows progress in narrowing of tail. The small specimen below among the weeds shows the loss of the end of the tail, which has been bitten off.

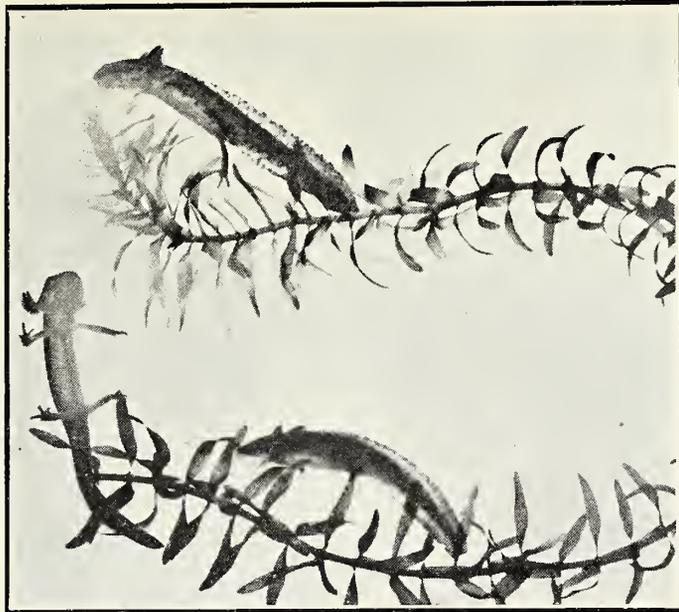


FIG.10



FIG.11

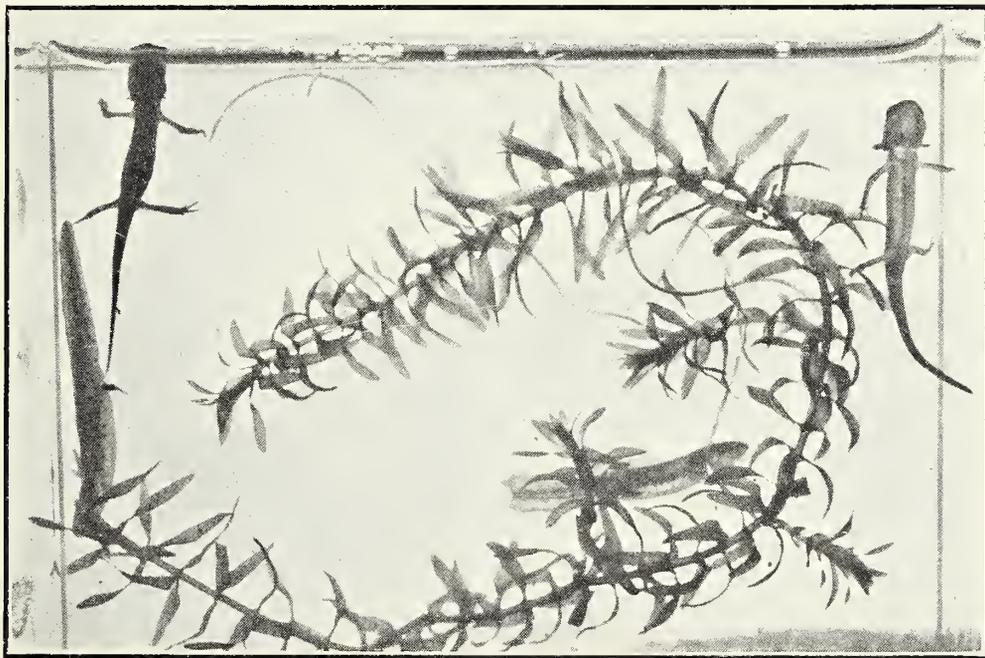


FIG.12

For explanation of figures see opposite page.

EXPLANATION OF PLATE XLVI.

- Fig. 13. The animal at surface of water shows a typical pose. The two lower specimens are less advanced in the process of metamorphosis.
- Fig. 14. The specimen floating at the surface plainly shows the vermilion spots. The specimen resting on the weed with its head pointing downward shows the end of its tail bitten off by one of its fellows.
- Fig. 15. Dorsal view of two completely metamorphosed larvæ. (Slightly reduced in size.) August 15.

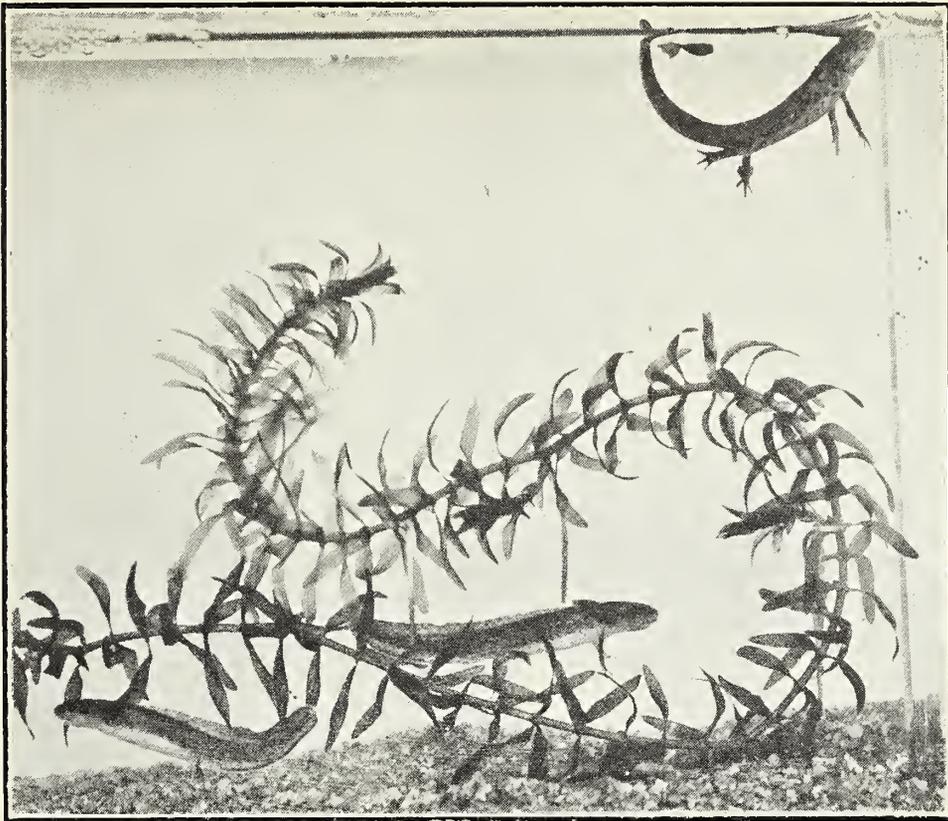


FIG 13

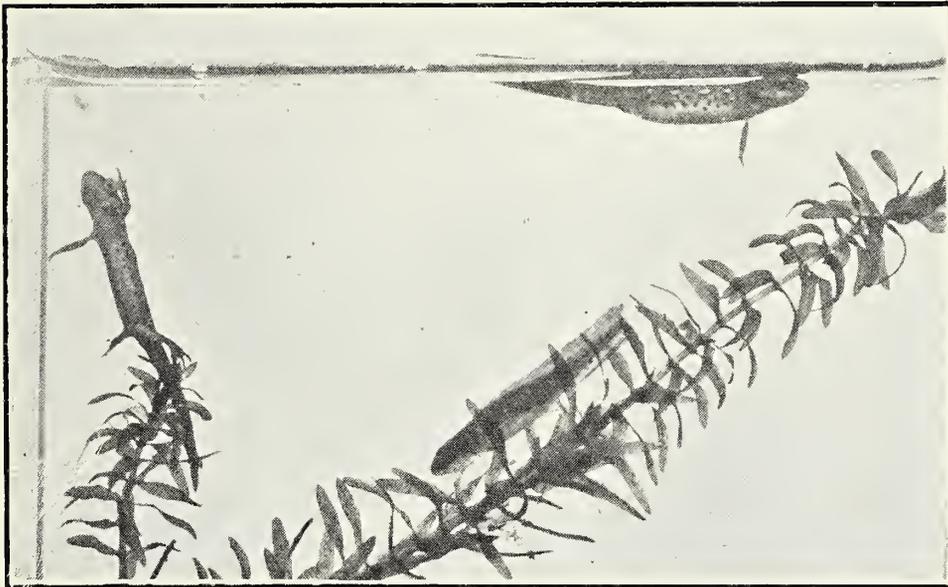


FIG. 14



FIG 15

For explanation of figures see opposite page.

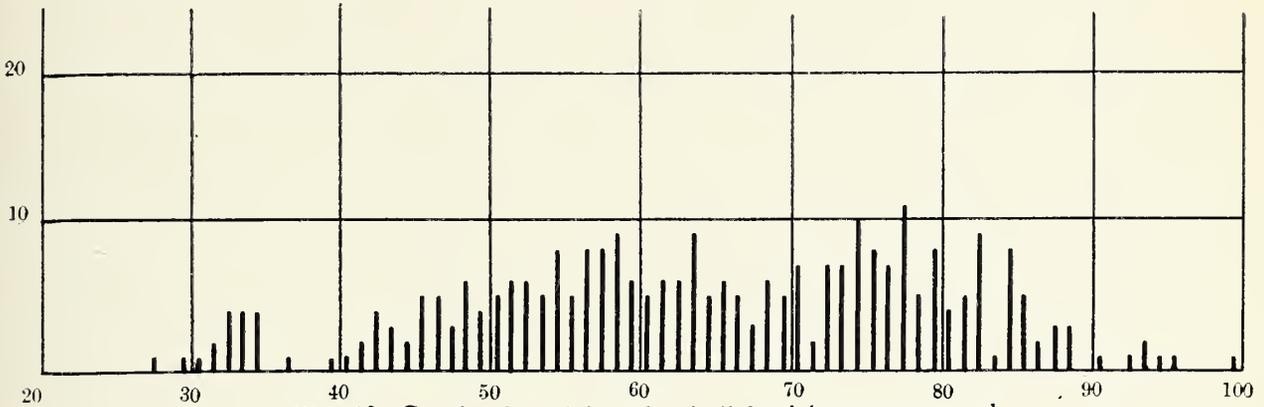


Fig. 16. Graph of total length of all land-forms measured.

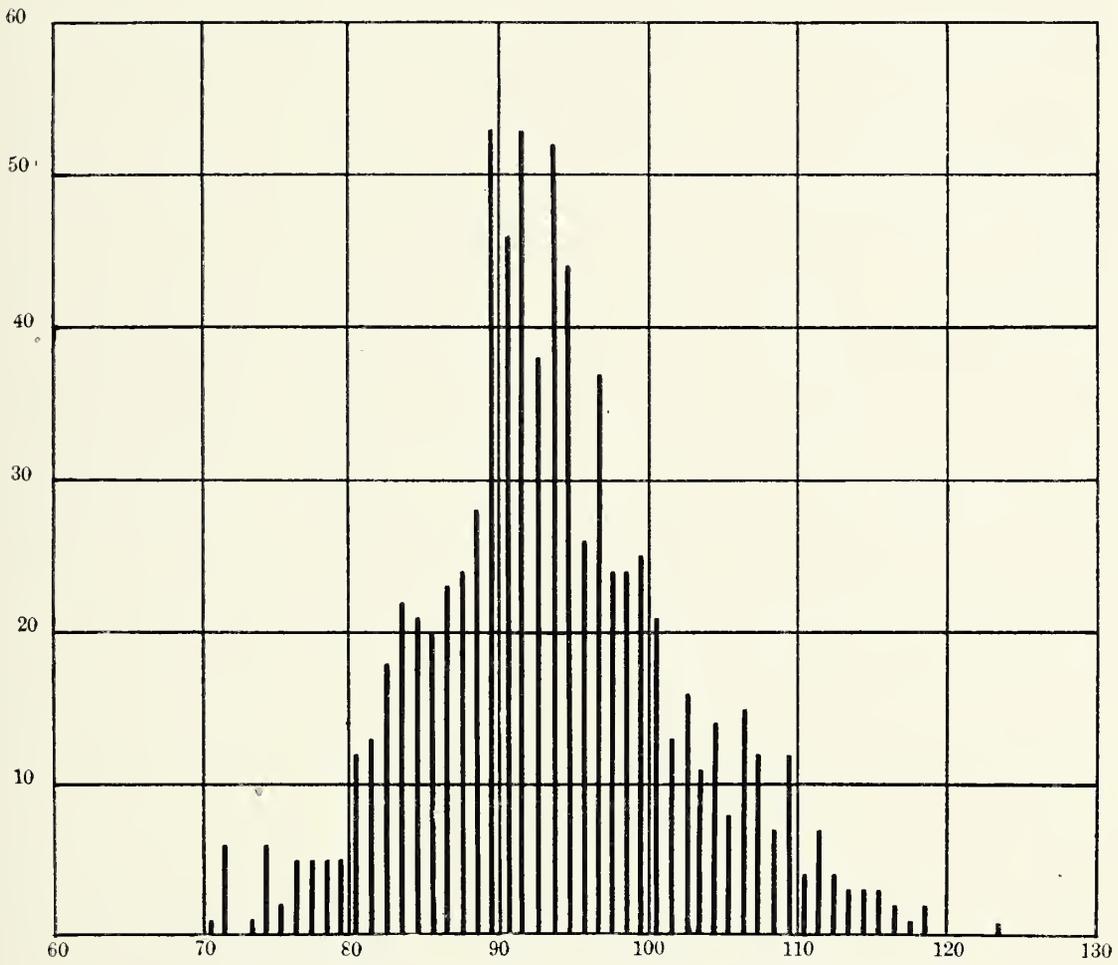


Fig. 17. Graph of total length of all water-forms measured.

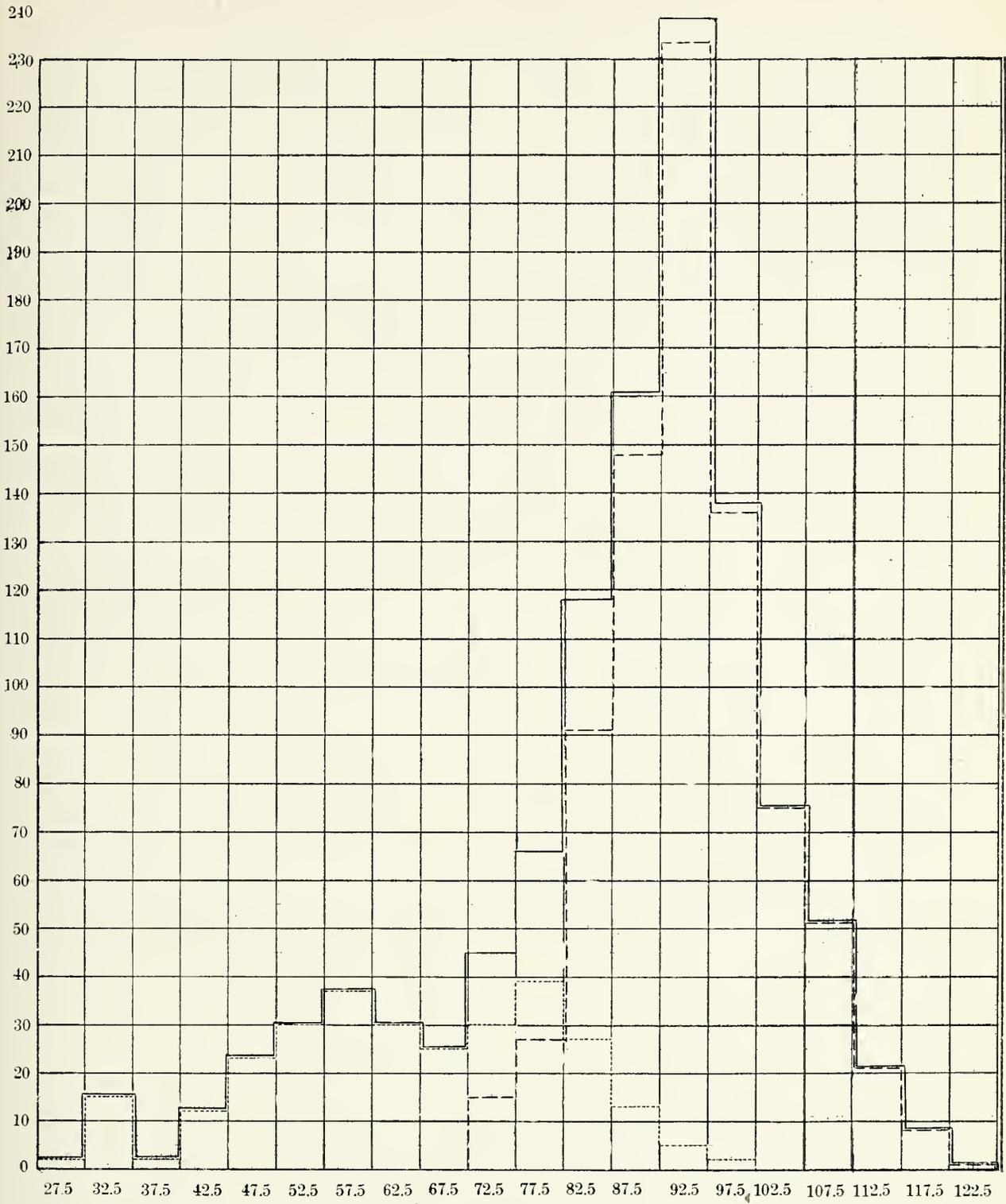


Fig. 18. Graph of total length of all terrestrial and aquatic forms measured, grouped in classes.

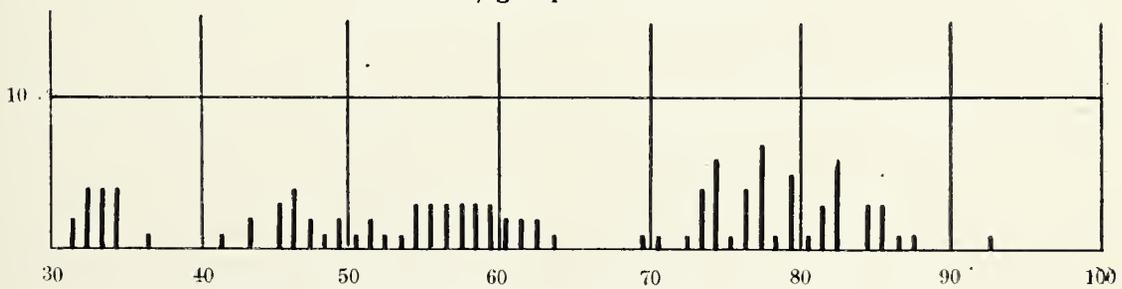


Fig. 19. Graph of total length of terrestrial newts collected in June, 1920, together with fifty taken October 2, 1921.

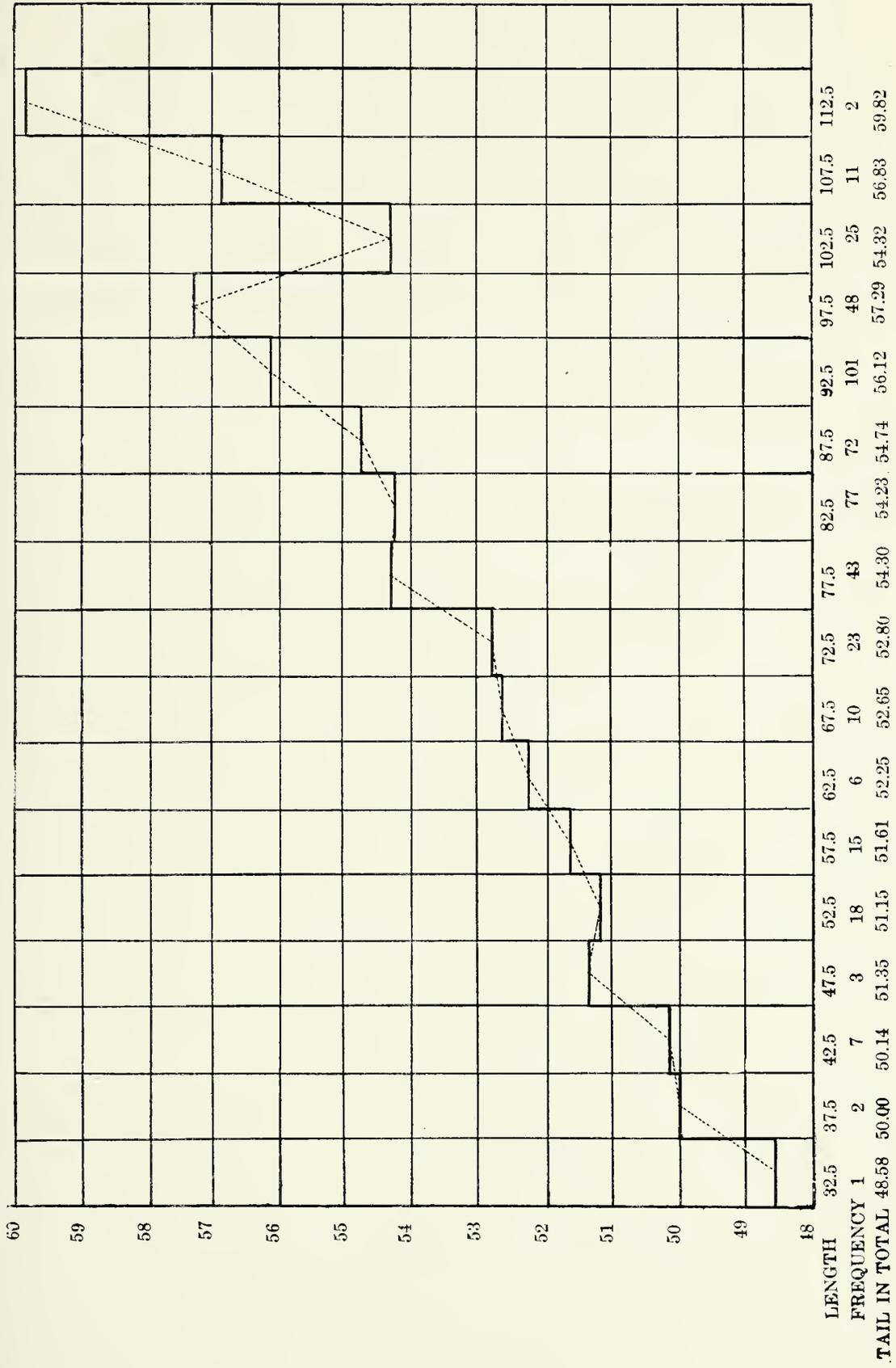


Fig. 20. Graph showing percentage of length of tail to total length.

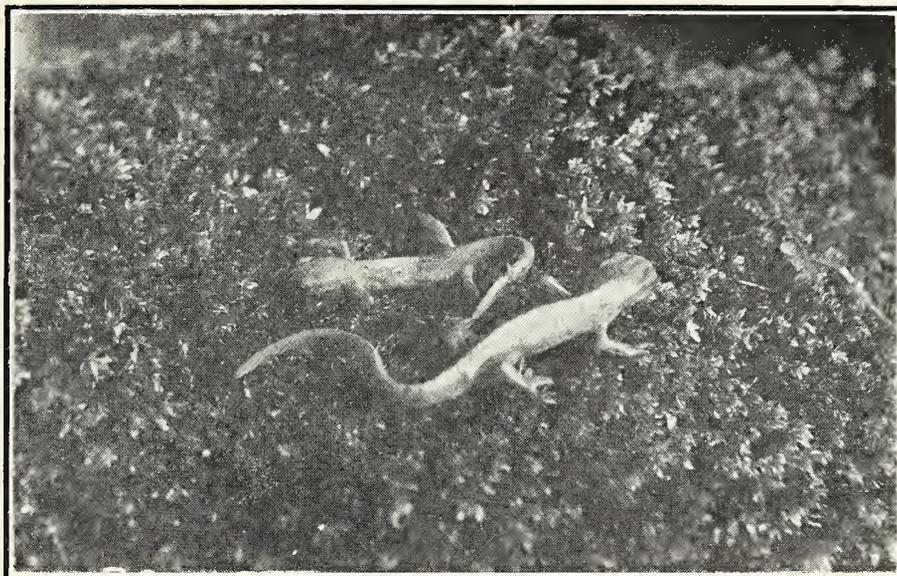


FIG 21

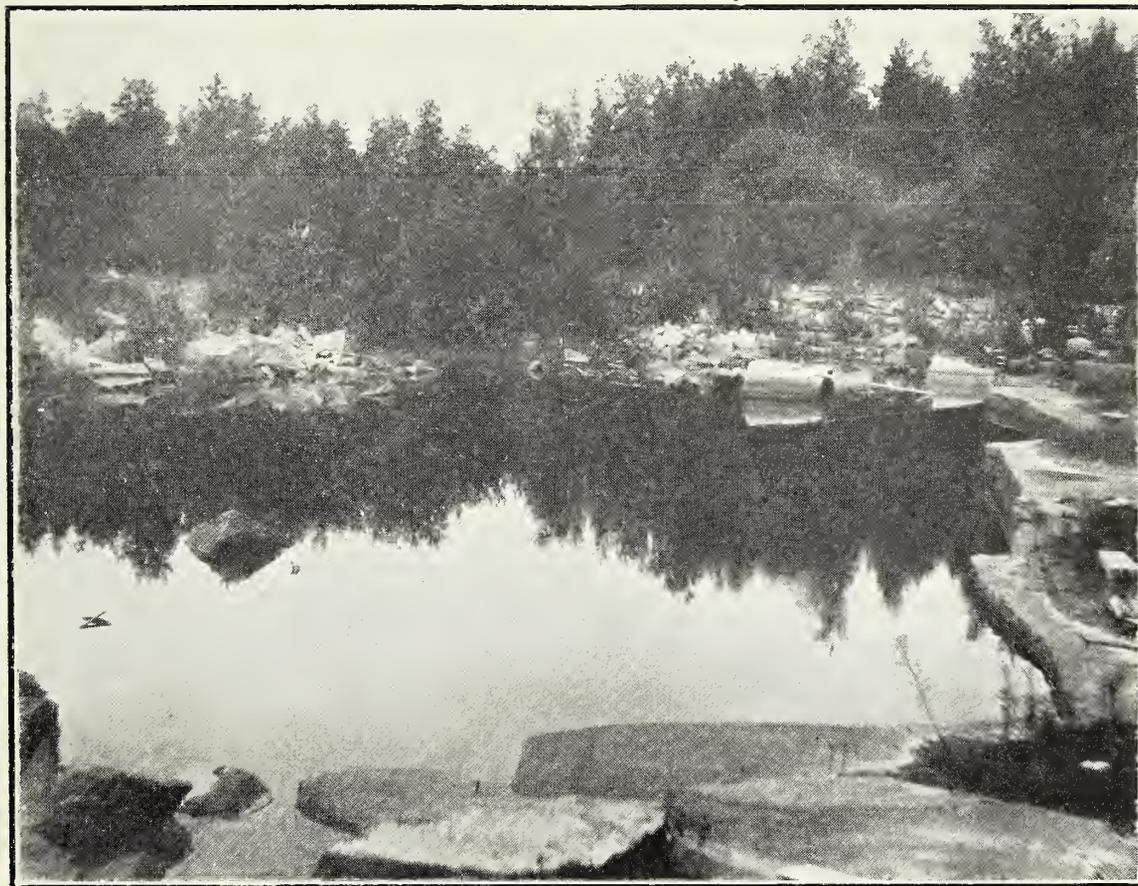


FIG. 22

Fig. 21. Two typical terrestrial newts.

Fig. 22. Pool in old quarry where newts abound.

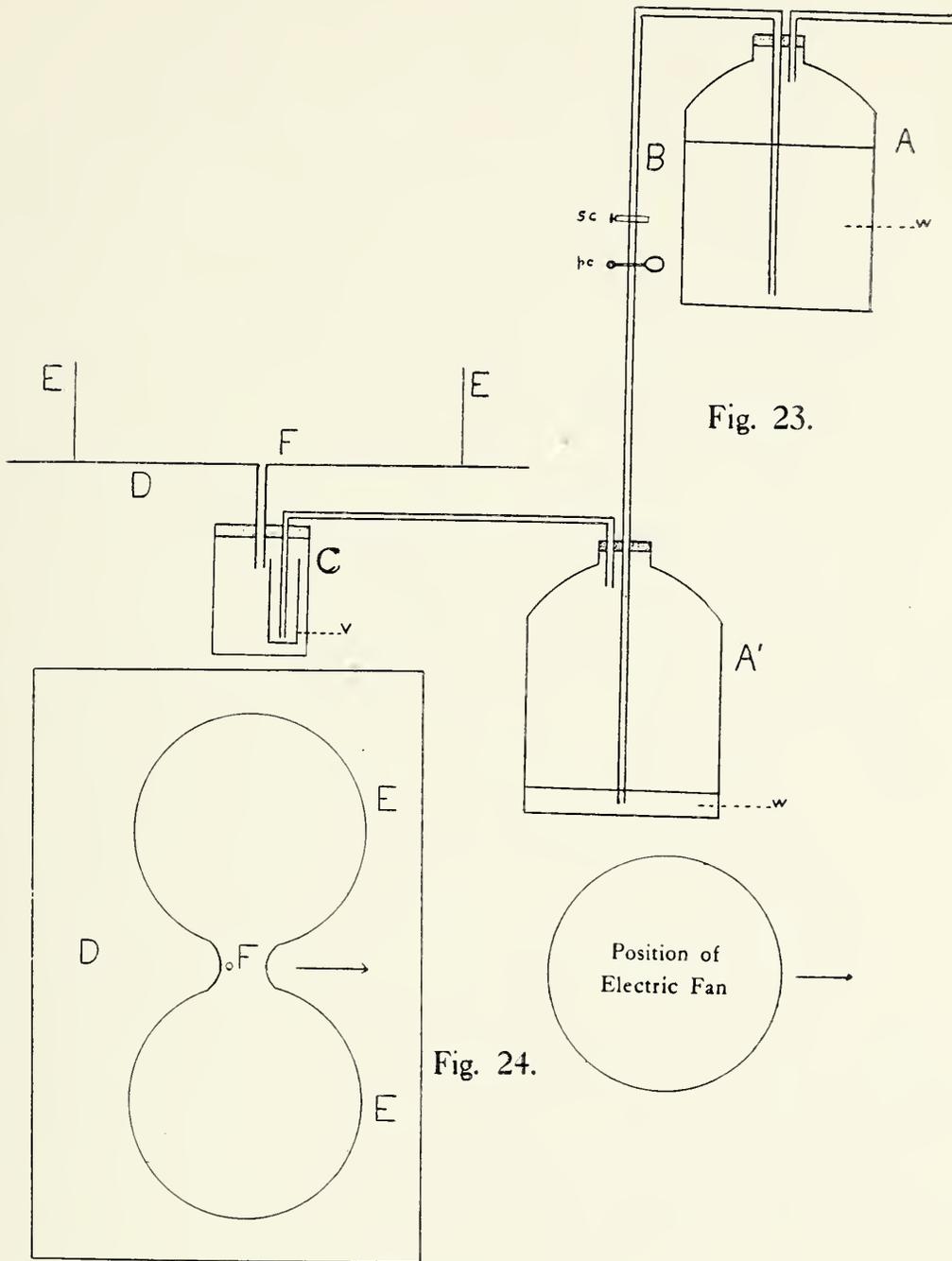


Fig. 23.

Fig. 24.

Fig. 23. Odor stream apparatus. A, A', Water-bottles connected by the siphon, B, and interchangeable; C, odor-chamber where air passes into vial, *v*, and out through hole, F, in glass plate, D. E, E, enclosure of wire gauze made to guide animal across hole, F. *w*, water, *sc*, screw cock, *pc*, pinch cock.

Fig. 24. Top view of glass plate and wire gauze enclosure shown in Fig. 23, showing position of electric fan to produce air currents indicated by arrows. Abbreviations as in Fig. 23.

XIV. THE OREODONTS OF THE LOWER OLIGOCENE.

BY F. B. LOOMIS.

In 1901 Earl Douglass¹ described a new genus of Oreodonts under the name *Limnenetes*, based on material found in 1899 in the lower Titanotheres beds on Thompson Creek, near Three Forks, Montana. He erected two species, *L. platyceps*, based on a skull, and *L.? anceps*, based on a palate, making the former the type of the genus.

A later expedition in 1903 brought to the Museum more material of this same age, especially a skull of *L.? anceps* and limb bones of *L. platyceps*. These specimens, now in the Carnegie Museum, are of especial interest as early and primitive representatives of the large phylum of the *Oreodontidæ*. They have typical oreodont dentitions and skulls, except that, like *Protoreodon*, the orbit is not closed behind, but is confluent with the temporal opening. Through the courtesy of the Carnegie Museum, especially of Mr. O. A. Peterson, I have had the opportunity of studying this material, which should be more fully known, in order that its fundamental position in the phylogeny of the Oreodonts may be better appreciated.

Studying the otic region of these skulls, along with the dentition and general form, it becomes clear that, though similar in form, these two species are early representatives of two lines of Oreodonts, which later diverge widely, *L. platyceps* have the large and inflated bullæ characteristic of *Eucrotaphus* (often called *Eporeodon*) and most of the Miocene representatives of this group; while *L.? anceps* has the tiny bullæ and dental characters of *Merycoidodon* (*Oreodon*). Inasmuch as a study of this family has shown the bulla and its character to be deep-seated and constant, it is necessary to recognize that this latter species is the representative of a separate genus, for which I suggest the name *Oreonetes*.

¹ Trans. Amer. Phil. Soc., Vol. XX, 1901, p. 259.

OREONETES gen. nov.

The genus is based on the species *L.?* *anceps*, which was founded on a palate, but the skull since found on Big Hole River, north of Dillon, Montana, and numbered 1052 in the Carnegie Museum, gives the characters which make the genus. This genus, I define as an Oreodont with a low, slightly arched, mesocephalic skull; low sagittal and lambdoidal crests, not prolonged behind; with the orbit open behind; light zygomatic arches; tiny bullæ; and very short paroccipital processes. Beside the above characters, which are surely generic, there are certain other features, which may have generic value; but, until more species are found, this is not certain. These features, to which I refer, are the deep, sharply bounded antorbital fossa and the double opening of the infraorbital foramen over the interval between the third and fourth premolars.

In relation to other Oreodonts this genus is closest to *Merycoidodon*, than which it is more primitive, and to which it is apparently ancestral. *Oreonetes* and *Merycoidodon* are the only two genera of the whole phylum which have the tiny bullæ, and *Oreonetes* is its representative in the lower Titanotheres beds, *Merycoidodon* appearing in the upper Titanotheres beds, and becoming very prolific throughout middle Oligocene times, after which it disappears entirely. What the predecessor of this genus may be is as yet unknown; for *Protoreodon* of the Uinta beds in the late Eocene is not the direct ancestor of this or *Limnenetes*, its feet and dentition being already more specialized than is the case in most of the representatives from the lower Titanotheres beds.

The genus *Limnenetes* in the character of the orbit and shape of the skull is similar to *Oreonetes*; but it has the large bullæ, which associate it with *Eucrotaphus*. However the dentition of *Limnenetes* is specialized, and not as primitive as that of most species of *Eucrotaphus*; so that, while this genus is a representative of the early Oreodonts, and still has many primitive features which place it near *Eucrotaphus*, it cannot be considered as the ancestor of such a primitive genus as *Eucrotaphus*. The relationships of these early genera may be expressed by the diagram on the next page (Fig. 1).

These two important species are here more fully illustrated than was done at the time of their first description.

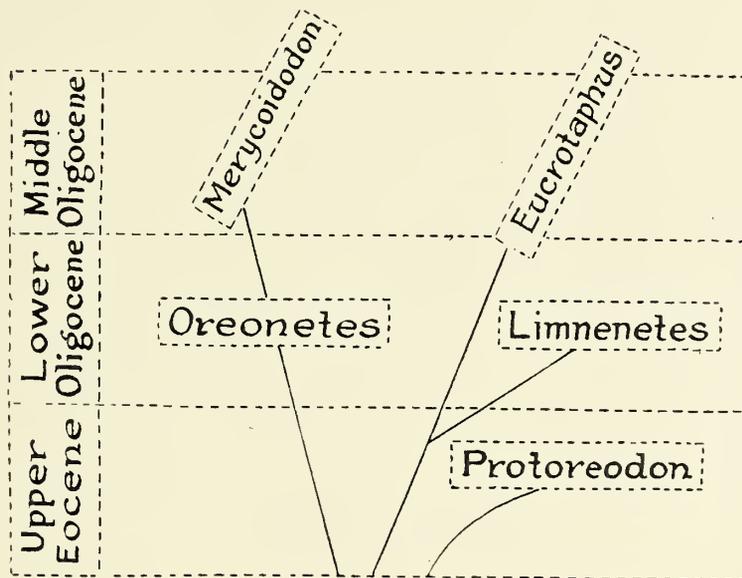


Fig. 1. Diagram showing geological horizons and probable relationships of early Oreodonts.

1. *Limnenetes platyceps* Douglass.

(PLATE LII, figs. 1-3; PLATE LIII, figs. 2-7.)

L. platyceps Douglass, Trans. Amer. Phil. Soc., 1901, Vol. XX, p. 260.

In describing this species and establishing the genus Douglass emphasized the fact that the orbit opens behind, the large bulla, and the free interparietal bone. He saw it was related to *Eucrotaphus* and called it probably ancestral. Unfortunately the type is an old individual, with the teeth excessively worn, so that only their size is distinguishable. Associated material however, gives many characters, not available in the type. The species is easily recognized, when the orbital region is present, by the lack of an antorbital fossa. Among the associated material No. 303 has premolars ² and ⁴ and molar ¹ of

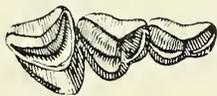


Fig. 2. *Limnenetes platyceps*; crown view of upper premolars 2-4. No. 303, natural size.

the upper jaw, and No. 1086, though young and having milk premolars, has molars ¹ and ² in place. From these specimens the upper molar characters are deciphered. The molars are low-crowned and similar to those of *Merycoiodon*. Premolar ⁴ has no pit in the anterior external corner, as do most Oligocene forms. The anterior portion of premolar ³ is simple, having only a trace of the anterior crescent on the inner side and no anterior intermediate crest from the primary cusp, as in most Oligocene genera. Premolar² is similar, but smaller. These characteristics show that the genus and species is already specialized, and is not the immediate ancestor of *Eucrotaphus*, which has the pit in the anterior external corner of premolar ⁴ and also the intermediate crest and crescent on the front part of the third upper premolar. In other words, while primitive in the shape of the skull and having the orbit open behind, this genus is specialized in its dentition.

The figures will give most measurements, but the following are characteristic of the teeth:

Upper premolar 2.....	6 mm. long by	4.5 mm. wide.
Upper premolar 3.....	7 mm. long by	6 mm. wide.
Upper premolar 4.....	6 mm. long by	6 mm. wide.
Upper Molar 1.....	11 mm. long by	11 mm. wide.
Upper Molar 2.....	14 mm. long by	12 mm. wide.

Several specimens have portions of the limb bones, but No. 1184 has the most, and those figured all belong to that specimen, serving to give an idea of the build of this animal. They are slender and rather long, suggestive of such a form as Peterson² has illustrated under *Merychyus*.

The humerus is slender and light of build, with a very high great trochanter and a prominent lesser trochanter. The shaft is slender and more nearly straight than is usual in Oreodonts. The epicondylar pit is deep. In this specimen the radius and ulna are represented by about half their length, but indicate a long fore limb, the ulna having a very long olecranon process, and the radius is considerably flattened, as in *Merychyus*, though not so much so. There is a complete pelvis, which is rather short and widely expanded toward the rear. The femur was long and slender, with the ends enlarged, but the whole bone is not preserved. The tibia is complete, and for an Oreodont

² Ann. Carnegie Museum, Vol. XV, 1923, pp. 96-103, Pl. VIII.

decidedly long, but the cnemial crest is short and prominent. One median and a couple of lateral metatarsals show the foot to be distinctly elongated and of the *Merychyus* type. The toes are slender and long with narrow unguals.

2. *Oreonetes anceps* Douglass.

(PLATE LIII, PLATE LIV, figs. 1 and 2.)

Limnenetes? anceps Douglass, Trans. Amer. Phil. Soc., Vol. XX, 1901, p. 262.

Douglass based this species on a palate, which of course did not give the characters mentioned above as characteristic of the genus. No. 1052 is a good skull, found at a later date, and has almost the

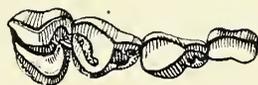


Fig. 3. *Oreonetes anceps*; crown view of upper premolars 1-4. No. 1052, nat. size.

same shape and size as *L. platyceps*, though it is slightly longer and slenderer, but the tiny bullæ and the dental characters are entirely distinctive. In front of the orbit there is a large and sharply bounded antorbital fossa, which makes the species easily recognizable. In the upper dentition, premolar ⁴ has the posterior crescent failing to reach the anterior external corner of the tooth, and two small pits there, representing the larger pits on the anterior portion of the premolar farther forward. This form represents a perfect transitional type in the line toward *Merycoidodon*. No. 11,256 is the muzzle of a slightly smaller individual.

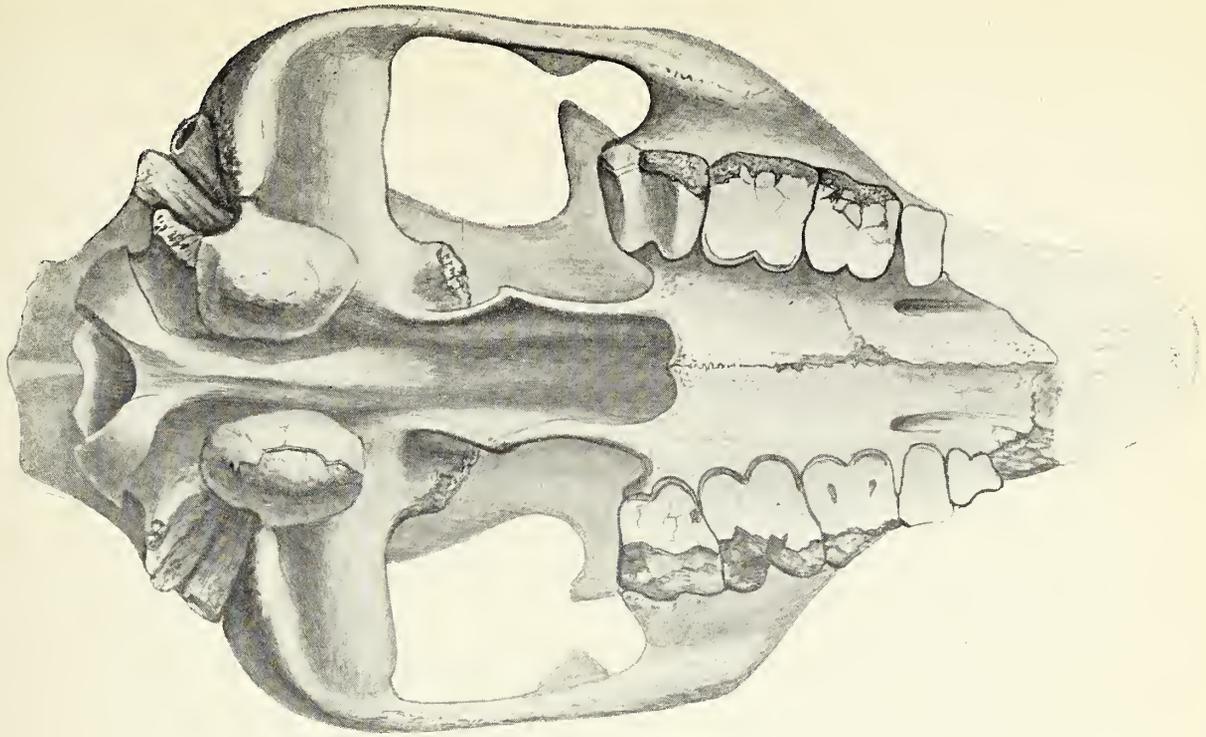
Measurements of the skull can be taken from the figures, but the following details of the dentition may be helpful.

Length of the upper premolar series.....	23 mm.
Length of the upper molar series.....	26 mm.
Upper premolar 2.....	6 mm. long by 4.5 mm. wide.
Upper premolar 3.....	7 mm. long by 6 mm. wide.
Upper premolar 4.....	5 mm. long by 7.5 mm. wide.
Upper molar 1.....	8 mm. long by 9.5 mm. wide.
Upper molar 2.....	9 mm. long by 11.5 mm. wide.
Upper molar 3.....	11 mm. long by 12 mm. wide.

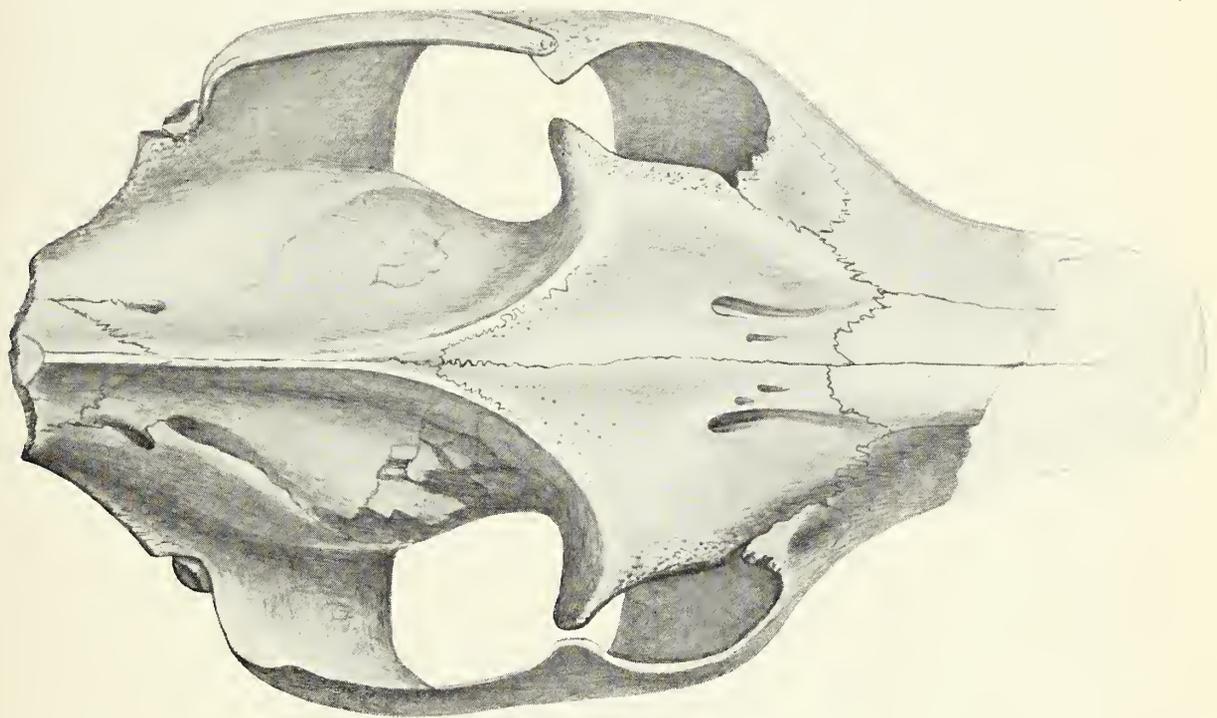
EXPLANATION OF PLATE LII.

- Fig. 1. Skull of *Limnenetes platyceps* from below. Type, No. 701; original No. 49.
Fig. 2. Skull of *Limnenetes platyceps* from above. Type, No. 701; original No. 49.
Fig. 3. Left side of pelvis of *Limnenetes platyceps*. No. 1184.

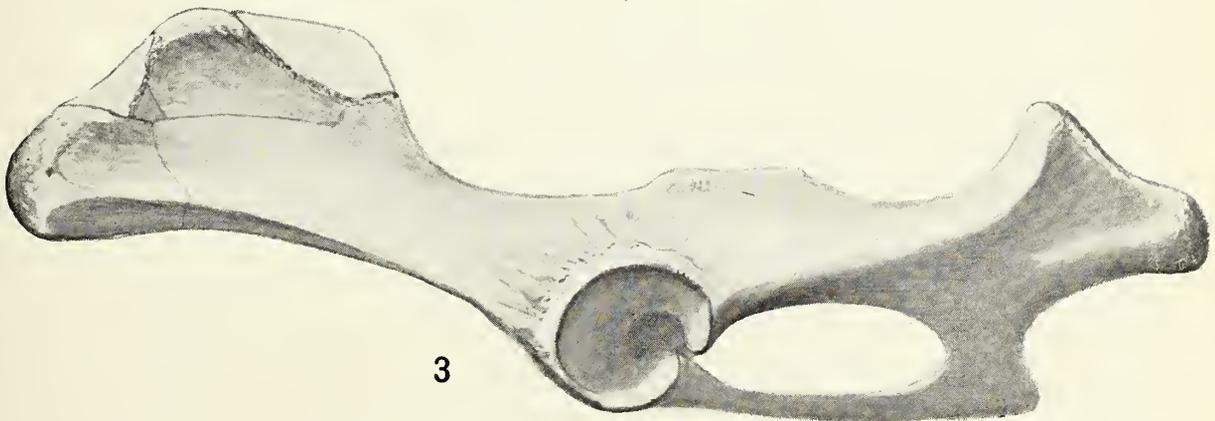
(All figures natural size.)



1



2



3

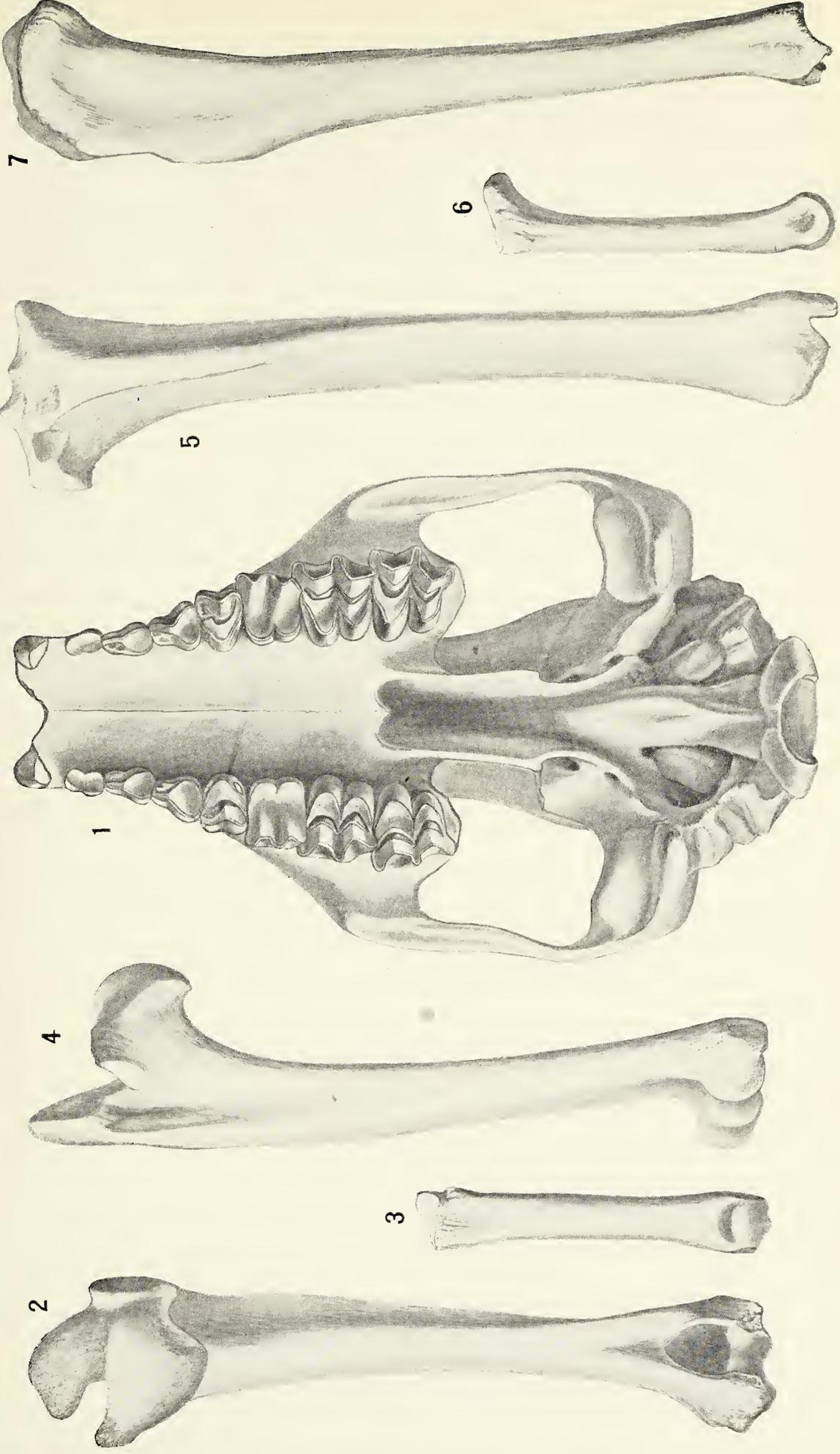
Limnenetes platyceps Douglass.

EXPLANATION OF PLATE LIII.

- Fig. 1. Skull of *Oreonetes anceps* from below. No. 1052.
Fig. 2. Humerus of *Limnenetes platyceps*, posterior view.
Fig. 3. Metatarsal III of *Limnenetes platyceps*, anterior view.
Fig. 4. Humerus of *Limnenetes platyceps*, side view.
Fig. 5. Tibia of *Limnenetes platyceps*, anterior view.
Fig. 6. Metatarsal III of *Limnenetes platyceps*, side view.
Fig. 7. Tibia of *Limnenetes platyceps*, from the side.

Figs. 2 to 7 are taken from specimen No. 1184.

(All figures natural size.)

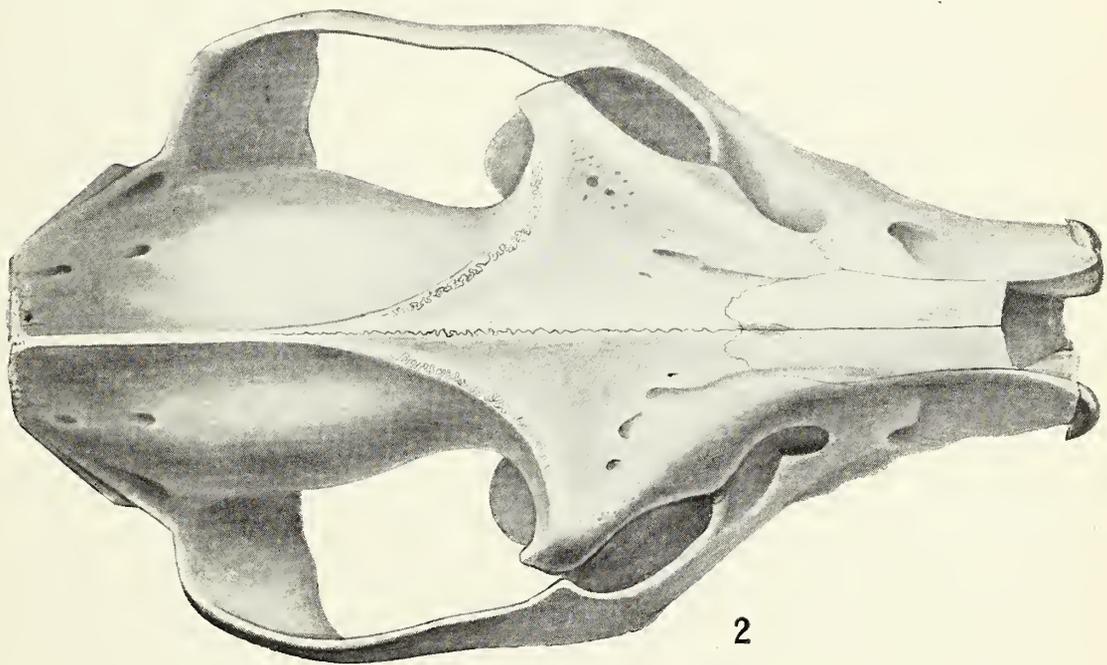
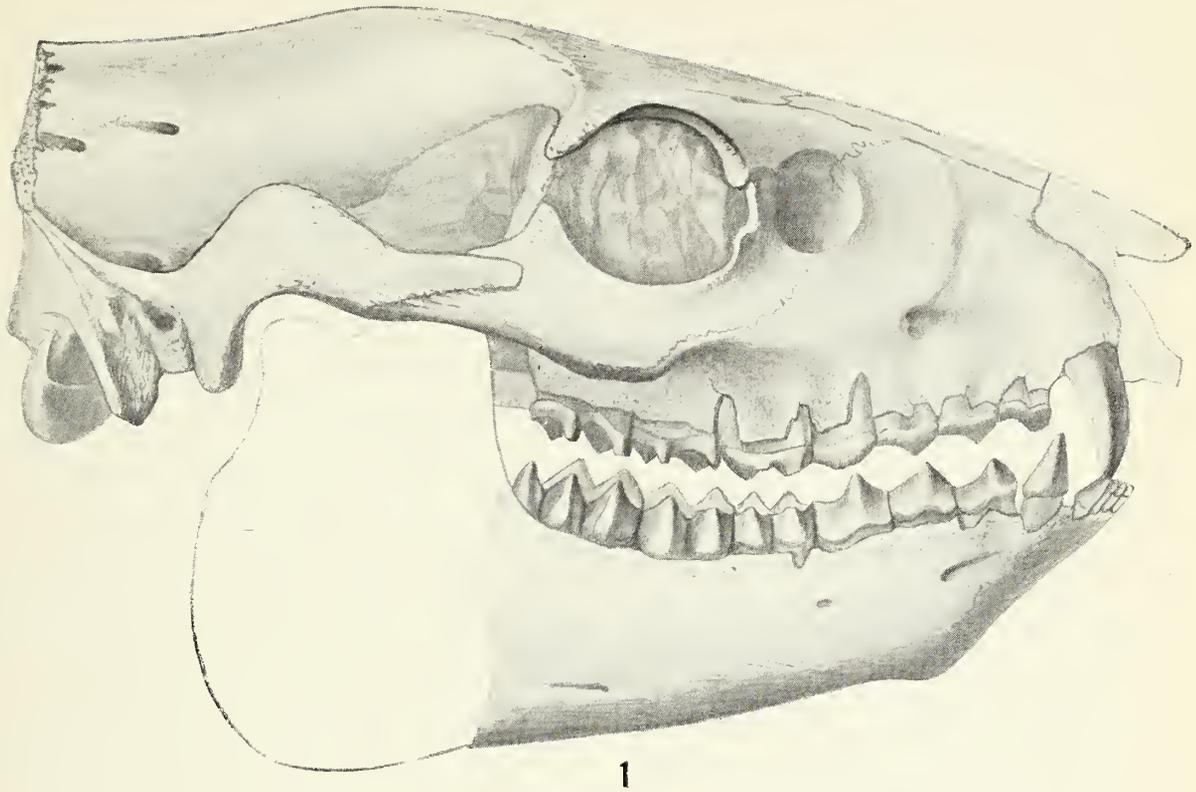


Oreoneles and *Limnætes*.

EXPLANATION OF PLATE LIV.

- Fig. 1. Skull and jaws of *Oreonetes anceps* from the side. No. 1052.
Lower jaw, No. 1118.
- Fig. 2. Skull of *Oreonetes anceps* from above. No. 1052.

(All figures natural size.)



Oreonetes anceps (Douglass).

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Publications of the Carnegie Museum

Serial No. 121

ANNALS
OF THE
CARNEGIE MUSEUM

VOL. XV. No. 4.

August, 1924



For sale by Messrs. Wheldon & Wesley, Ltd., 2-4, Arthur St., New Oxford St., London, W. C. 2, England: Messrs. R. Friedländer u. Sohn, 11 Carlstrasse, Berlin, N. W. 6, Germany: Maruzen Company, Ltd., 11-16, Nihonbashi, Tori-Sanchome, Tokyo, Japan: and at the Carnegie Museum, Schenley Park, Pittsburgh, Penna., U. S. A.

PUBLICATIONS OF THE CARNEGIE MUSEUM

SERIAL No. 118

ANNALS
OF THE
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VOL. XV. No. 4.

W. J. HOLLAND, *Editor*

PUBLISHED BY THE AUTHORITY OF THE
BOARD OF TRUSTEES OF THE CARNEGIE INSTITUTE
SEPTEMBER, 1924

CARNEGIE INSTITUTE PRESS
PITTSBURGH

ANNALS
OF THE
CARNEGIE MUSEUM

VOLUME XV, NO. 4.

EDITORIAL NOTES.

The delay which has occurred in the publication of the recent numbers of the ANNALS and MEMOIRS of the Carnegie Museum has been occasioned by the fact that the Trustees of the Institute some time ago undertook to enlarge the printing facilities under our roof in order that the publications of the Institute as well as those of the Library should thence be issued. The installation of the necessary machinery and the adjustment of the force to their respective tasks, has been a process which has involved, as all such undertakings, more or less experimentation, accompanied by unavoidable delays. Now that the "Hill Difficulty" has been surmounted we may fondly indulge in the hope that the printing of the ANNALS and MEMOIRS may more nearly conform to our engagements with our subscribers. It always has been our purpose that the ANNALS should appear in quarterly numbers. The MEMOIRS appear at irregular intervals. We hope that our subscribers will pardon the inevitable delays which have occurred, and that the authors of various papers, which are in our hands awaiting publication, will not charge the Director of the Museum and the Editor with intentional neglect.

Under an arrangement made by the Director of the Museum, Mr. J. LeRoy Kay, who for a number of years past assisted Mr. Earl Douglass in the field, has been brought to Pittsburgh and has been assisting in the Paleontological Laboratory in working out some of

the material which has been collected in recent years. Mr. Kay's knowledge, obtained in the field, of the interrelation of the various blocks containing the fossils which were taken up has proved of much value. His addition to the working staff has also enabled us to accomplish a great deal, as he is a very faithful and competent workman. The time of Mr. Louis S. Coggshall, Mr. S. Agostini, and Mr. Kay has been almost exclusively devoted to the remains of sauropod dinosaurs, which have been brought in from the field. Among these specimens is a very interesting individual in which almost the entire series of vertebræ as well as the skull are found in place together with the limb bones also articulated and in place. Mr. C. W. Gilmore has recently spent some time at the Museum, having been invited by the Director to undertake the careful investigation of this and one or two other specimens, upon which no doubt we shall ere long receive his observations with a view to publication.

A striking exhibit in the Section of Ornithology is that mounted by Mr. Gustave A. Link, Jr., representing a Great Horned Owl attacking a skunk. It is a fact, which may not be known to many, that the Horned Owl has a penchant for skunk-meat, a taste which must have been acquired. The nests of the Great Horned Owl when discovered are reported to generally reveal a strong odor of the mephitic beast, upon which they prey, and fragments of the skin and bones of skunks are generally discovered in the nests of these great birds. The background of the group was painted by Mr. George Miksch Sutton.

Alongside of this group preparations are being made shortly to install a group representing the Raven, studies for which were made some time ago near Huntingdon, Pa. The Raven has come to be one of our rarer Pennsylvanian birds. While rather common in the region of the Rocky Mountains, it seems to be verging upon extinction in the eastern United States, and it is proposed in Pennsylvania to enact a law forbidding the killing of Ravens for the time being. The small amount of damage which is done by these big crows certainly does not appear to justify their entire destruction, as the relatively small amount of injury inflicted upon crops by deer and bears does not warrant the annihilation of these interesting animals. The conservation policies pursued in Pennsylvania during the last twenty-five years have been a very great credit to the Common-

wealth and to the sportsmen of Pennsylvania. In this connection great credit is due to Mr. John M. Phillips, the enthusiastic and wholesouled head for many years of the Game Commission of the State, to whose initiative and energy the Commonwealth owes a large debt of gratitude.

A party consisting of Mr. John B. Semple, W. E. Clyde Todd, and Mr. George Miksch Sutton, set out for Hudson Bay to make a collection of Blue Geese as well as other birds. The expenses of the trip were in large part borne by Mr. Semple and this expedition has, therefore, been styled "The John B. Semple Expedition to Hudson Bay." The party returned to Pittsburgh after having successfully completed their undertaking, and it is proposed to set up a group representing these geese in the surroundings where they were obtained.

Through the renewed generosity of Mr. John B. Semple, the Museum was able to send a second expedition under his leadership to Cape Sable and the Florida Everglades. Mr. George M. Sutton of the Ornithological Section was detailed for this work, and during the month of March Mr. Semple and Mr. Sutton succeeded in securing a small, but very important, collection of birds.

The force in the Paleontological Laboratory has been busily engaged during the past winter in preparing some of the important specimens brought in last year from the National Dinosaur Monument. One of these, a Sauropod Dinosaur, has been mounted in relief and placed upon exhibition. It is the most complete specimen of a Sauropod Dinosaur known to science. We hope to publish a complete description of this specimen, and of several others recently prepared, in these Annals in the near future.

Mr. Howard Carter, the distinguished Egyptologist, visited Pittsburgh on May the 19th. The Director and Museum Committee of the Board of Trustees, had the pleasure of entertaining Mr. Carter at luncheon upon this occasion, and the Editor of these pages had the honor of introducing Mr. Carter to his audience in the evening.

The habitat-groups, representing the Black Bear, the Virginian Deer, the Raccoon, and the Foxes, are nearing completion. In fact, the group representing the Black Bear was opened to public view on Founders Day, 1923, and that representing the deer on Founders Day, 1924.

We have recently received from our friends in Western Africa two excellent specimens of the Giant Pangolin (*Manis gigantea* Illiger). We also have been kindly supplied with a photograph showing these animals in action, which reveals the fact that almost all specimens hitherto mounted have been given an attitude which does not belong to them in life.

The twenty-eighth celebration of Founders Day took place at the Institute on April 24, 1924, Col. Samuel H. Church, President of the Board of Trustees, presiding. The principal address was made by Mr. Coningsby Dawson. The occasion was one which will long be remembered by those who had the privilege of being present.

XV. NEOTROPICAL HOMOPTERA OF THE CARNEGIE MUSEUM.

PART 3. REPORT UPON THE COLLECTIONS IN THE SUBFAMILY *Bythoscopinae*, WITH DESCRIPTIONS OF NEW SPECIES.

(PLATES LV; LVI, FIG. 4; AND LIX, FIG. 1.)

BY HERBERT OSBORN.

The additions to the Bythoscopid fauna of South America included here only serve to emphasize the wealth of species to be discovered, when there shall be an intensive collection of these little creatures in the various habitats included in the great Amazonian basin. It may be assumed as practically certain that these species represent a wide diversity of host-plants, and careful collection of material, with accurate records of the plants on which they occur, would serve an important purpose in determining their biological relations, and also the possibilities of their dispersion and economic menace to other countries. Doubtless many of the species are restricted to tropical plants, but our experience with a number of destructive pests, which have been introduced in the past, justifies a careful study of the possible immigrants from this region.

Owing to the brevity of many of the early descriptions, or the fact that they did not include mention of important characters for identification, there has been no little difficulty in arriving at positive conclusions as to some of the species. As the types of Stål's species are preserved in the Naturhistoriska Riksmuseet at Stockholm, it seemed especially desirable to secure reliable figures, at least for some of the most uncertain species. Through the generous cooperation of Dr. W. J. Holland, the Director of the Carnegie Museum when these studies were begun, and of Dr. Sjöstedt, the Intendent of the Riksmuseet, it has been possible to secure the services of a competent artist, Madame Ekblom, to prepare illustrations from a number of the types.

The plates accompanying this and the following paper are the result of this fortunate arrangement. In addition to the fact that these plates have enabled us to definitely fix some of the uncertain species, we feel sure they will prove of special value to future students of the group, who may not be able to consult the types in Stockholm.

In this connection, I wish to express my appreciation of the help given me by Mr. Douglas Stewart, the successor of Dr. Holland in the Directorship of the Carnegie Museum.

Order **HEMIPTERA** Linnæus.

Suborder **HOMOPTERA** Latreille.

Family **CICADELLIDÆ** Latreille.

Subfamily **BYTHOSCOPINÆ** Dohrn.

Genus **AGALLIA** Curtis.

Agallia Curtis, Entomological Magazine, Vol. I, 1833, p. 193.

1. **Agallia punctaticollis** (Stål) (Plate LV, fig. 3).

Bythoscopus punctaticollis Stål, Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 54.

The original description given by Stål is as follows:

“Pallide testaceo-flavescens; maculis duabus parvis basalibus verticis, limbo interno lororum, maculis duabus anterioribus transversis thoracis, angulis basalibus scutelli et basi femorum nigro-fuscis; frontis lituris duabus elongatis, linea media longitudinali maculaque utrimque magna irregulari thoracis mediaque scutelli testaceis; tegminibus testaceo-, nigro-fusco- et sordide albido-variis. ♂. Long. 5.5, Lat. 1.75 mm.—(Mus. Holm.).

Caput leviter reclinato-declivum, vertice basi sursum libere prominente, lineola media suturaque frontali testaceis; fronte triangulari, latitudine basali nonnihil (quarta fere parte) longiore, a basi vix ad medium subito valde, dein apicem versus magis sensim et minus angustata, sutura frontali obtuse angulata. Thorax longitudine plus duplo latior, distincte punctatus, scutello nonnihil longior. Tegmina abdomen nonnihil superantia, testaceo-venosa, areis duabus internis clavi testaceis, tertia nigra, macula ante medium apiceque albidis; corio areolis nigro-fuscis, discoidalibus et costalibus macula media sordide albida notatis.”

The main points of the foregoing are set forth in the following lines:

Pale reddish yellow; two small black spots on base of vertex; internal border of loræ, two anterior transverse spots on thorax, basal angles of scutellum, base of femora, black fuscous; front with two elongated lines. Middle longitudinal line and a large spot of variable size on each side of thorax, and middle of scutellum, testaceous; elytra varied with testaceous, blackish, fuscous, and dull white.

Head slightly obliquely sloped; base of vertex elevated; middle line and suture of front testaceous; front triangular, basal width somewhat (almost one-fourth) longer.

Stål's original description, with the appended synopsis of its main points, taken together with the figure of the type by Madame Ekblom, should make the identification of this species an easy matter. However, no specimens, which can be referred to it, have been seen by the writer.

2. *Agallia signata* (Stål) (Plate LV, fig. 1).

Bythoscopus signatus Stål, *Eugenies resa*, Ins. Hemipt., 1858, p. 291.

The diagnosis given by Stål is here reproduced:

"Pallide griseo-flavescens, margine ad oculos, maculis 2 superis lineisque 2 percurrentibus mediis basin versus sæpe confusis verticis, macula media vittaque utrimque e lineolis transversis frontis, vitta clypei, linea media, maculis nonnullis anticis duabusque majoribus late oblique triangularibus (singula interdum in duabus partita) thoracis, angulis basalibus, macula media vittaque ante hanc scutelli, maculis magnis femorum anteriorum vittaque lata posteriorum, abdomine (exceptis incisuris), areolis clavi albido-venosi venisque corii pallide sordide testaceo-flavo-hyalini nigro-fuscis, hujus lineola basali ad suturam clavi nec non macula prope costam ante medium albidis. ♂, ♀. Long. 4, Lat. 1.33 mm.

Patria: Buenos Ayres, Monte-Video.

Prope *B. venosum* locandus, longior, major. Caput supra visum valde obtuse rotundato-subangulatum, vertice supra brevi, ubique æquilongo, facie nonnihil reclinato-decliva. Thorax vertice supero vix ter longior, longitudine fere duplo et dimidio latior, transversim rugulosus. Tegmina apice haud marginata."

Dark gray and resembling the darker forms of *A. sanguinolenta*. Prof. Stål's description, quoted above, was based on specimens from Buenos Aires and Montevideo. A single specimen in the collection of the Carnegie Museum from La Plata, Argentina, (Holland *coll.*), agrees well with the description, and especially with the figure drawn from the type by Madame Ekblom.

3. *Agallia phalerata* (Stål) (Plate LVI, fig. 4).

Bythoscopus phaleratus Stål, Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 54.

The description published by Stål is here given:

"Pallide subsordide testaceo-flavescens, pedibus sæpius purius flavescens; faciei parte dimidia apicali (excepto margine genarum), fascia inæquali inter oculos maculisque duabus basalibus magnitudine variantibus, sæpe cum fascia illa confluentibus, thoracis margine antico, vitta media maculaque utrimque sæpe cum vitta connexa, maculis tribus haud raro confluentibus scutelli et tunc hoc totum occupantibus, disco dorsali abdominis tegminibusque nigricantibus aut nigro-fuscis, venis suturaque clavi, vena corii ad suturam clavi nec non macula utrimque subapicali oblonga marginali pallide sordide testaceo-flavescens. ♀. Long. 4.5, Lat. 1.33 mm.—(Mus. Holm. et Stål).

B. Fruticola angustior. Caput supra visum brevissimum, late rotundatum, medio brevius, facie levissime convexa, paullulum reclinato-decliva. Thorax antice rotundatus, longitudine plus duplo latior, scutello nonnihil longior. Tegmina abdomine nonnihil longiora, venis subtilibus."

A free translation of part of the original description is here given:

'Pallid, somewhat soiled reddish yellow; feet quite frequently purer yellow; the apical half of the face, except the margin of the cheeks, together with a shorter or longer band between the eyes, two basal spots of varying size, which are often confluent with the band just mentioned, the front margin of the thorax, a median stripe, and a spot on either side of it, often uniting with this stripe, three spots upon the scutellum, occasionally confluent, and then occupying the whole of its surface, the dorsal disk of the abdomen, and the elytra, black or blackish fuscous; the face, the suture of the clavus, the veins of the corium as far as the suture of the clavus, together with an oblong marginal subapical spot on either side, pallid dirty reddish yellow.'

The figure on Plate LVI together with the foregoing text should facilitate the determination of this species. However, no specimens, which can be referred to it, have been thus far seen by me.

4. *Agallia assimilis* (Stål) (Plate LV, fig. 4).

Bythoscopus assimilis Stål, Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 55.

Stål's description is herewith given:

"Dilute testaceo-flavescens, pedibus, abdomine tegminibusque sordide pallidioribus; maculis tribus basalibus verticis, sutura frontali

clypeoque fere toto nigricantibus; thoracis linea media longitudinali maculaque utrimque arcuato-oblonga, illa cum angulis basalibus scutelli dilutius, his valde obscure fusco-testaceis; tegminibus dilute fusco-testaceo-venosis, venis clavi, macula obliqua ad suturam clavi prope apicem nec non macula basali areolæ basalis mediæ corii subalbidis. ♀. Long. 6, Lat. 1.75 mm.—(Mus. Holm.).

Præcedenti [*punctaticollis*] affinis, statura similis, præter colorem pallidiorem picturamque differt fronte proportionaliter latiore, utrimque minus profunde sinuata, a basi vix ad medium nonnihil, dein apicem versus parum angustata, vitta utrimque lineolis transversis fusco-testaceis formata; sutura frontali recta. Thorax impunctatus."

A free translation of the first paragraph of the foregoing follows:

Rather dilute testaceous yellow; feet, abdomen, and elytra more pallid; three spots at base of vertex, frontal suture and clypeus almost entirely black; a middle longitudinal line on the thorax and an oblong arcuate spot on each side, the former together with the basal angles of the scutellum more faintly, the latter very darkly, fuscous-testaceous; elytral veins pale fusco-testaceous; veins of clavus, oblique spot at suture toward apex, and also a spot at basal areole, and at basal and central areoles of corium, dull white.

Allied to *A. punctaticollis* and of similar size, but the color is paler and the general appearance, as given on Plate LV, fig. 4, is different. The front is proportionally wider, less deeply sinuate on each side; base not, middle somewhat, then toward apex strongly narrowed, stripe on each side of transverse line fusco-testaceous, frontal suture straight. Thorax impunctate. I have not seen this species, but the description of Stål accompanied by the free translation above given together with the figure given on Plate LV, should serve to identify it.

5. *Agallia peregrinans* (Stål) (Plate LV, fig. 2).

Bythoscopus peregrinans Stål, Eugenes resa, Ins. Hemipt., 1858, p. 291.

The description given by Stål is here quoted in full:

"Pallide griseo-flavescens; maculis 2 superis verticis, maculis 3 scutelli pectoreque nigricantibus; venis tegminum ultra medium subalbidis. ♂, ♀. Long. 3.25, Lat. 1 Millim.

Var. vitta utrimque inæquali frontis, clypeo maculisque ocellorum nigro-fuscis.

Patria: Insulæ Taiti et Oahu, California, Rio Janeiro; *var. e* Rio Janeiro.

Caput obtuse rotundatum, vertice supero ubique æquilongo, facie nonnihil reclinata, fronte latitudine nonnihil longiore, prope basin utrimque sinuata, dein leviter angustata. Thorax vertice ter longior, longitudine duplo et dimidio latior. Tegmina haud marginata."

From the localities cited by Stål it appears that he may have had more than one species in hand, when he wrote his brief diagnosis. The figure of the type, given on Plate LV, may serve to identify the species, but I have seen no specimens, which could without question be referred to it. •

Genus *MACROPSIS* Lewis.

Macropsis Lewis, Trans. Ent. Soc. London, Vol. I, 1835, p. 49.

6. *Macropsis elegans* (Van Duzee).

Pediopsis elegans Van Duzee, Jamaican Hemiptera, Bull. Buffalo Acad. Nat. Sci., Vol. VIII, 1907, p. 58.

Small, slender; head wider than pronotum; vertex very narrow at apex, a little wider at eyes; front broad, narrowed rapidly to clypeus; clypeus and loræ short. Pronotum angular anteriorly, the striæ minute, distinct; hind border concave. *Genitalia: female*, last ventral segment short, narrowed and subtruncate behind, with a slender tail-like appendage about half-way from middle on each side; pygofers short, broad.

Pale yellowish creamy, the prothorax with the borders and a median stripe bright red; tips of tarsi blackish.

Length: 3.5 mm.

One specimen, Ft. Principe, Rio Guaporé, Brazil, August, 1909, C. M. Acc. No. 4043 (Haseman *coll.*). Originally recorded as found in Jamaica, the present record appears to indicate that the species has a wide distribution.

Genus *BYTHOSCOPIUS* Germar.

Bythoscopus Germar, Silbermann's Revue Entomologique, Vol. I, 1833, p. 180.

7. *Bythoscopus pallidus* sp. nov.

Robust; head broad, narrower than pronotum; vertex very short; front tumid, narrowed very abruptly from antennal pits; clypeus longer than broad; loræ short; cheeks broad, sinuate. Pronotum large, transversely striate, hind border concave; elytra minutely punctate, and setose. *Genitalia: female*, last ventral segment a little longer than preceding; hind border nearly truncate or slightly concave; ovipositor scarcely longer than pygofer; *male*, last ventral segment slightly longer than preceding; plates fused, elongate, triangular, somewhat spoon-shaped, narrowed, acute, slightly upturned at tips.

Uniformly pale greenish yellow; abdomen above slightly tinged with fulvous; elytra hyaline, with minute whitish setæ.

Length: female, 5 mm.; male, 4.5 mm.

Described from one female, *type*, from Barra, Rio Grande, Brazil, Dec. 5, 1907, C. M. Acc. No. 3533; one male, *allotype*, taken near Ft. Principe on the Rio Guaporé, Brazil, Oct. 25, 1909, C. M. Acc. No. 4043 (Haseman *coll.*).

This species is apparently nearly related to *B. misellus* Stål, described from Mexico, but is larger; the female segment nearly truncate; and the male, which apparently belongs with this female, has a very distinct structure for the fused plates.

8. *Bythoscopus nigrifrons* sp. nov.

Small, robust; head very short, narrower than pronotum; vertex narrowly visible from above; front flattened, tumid below, overhanging the clypeus and loræ; clypeus short, not reaching margin of cheeks; loræ small, oblique; cheeks short, lower margin sinuate. Pronotum distinctly striate, about four times longer than vertex, truncate behind; plates short, broad at base, abruptly narrowed to blunt tips, depressed on the disk and minutely punctured, and setose.

Brown; vertex and front black; narrow margin of vertex, ocelli, and the entire face below antennal pits, whitish or faintly tinged with reddish. A small patch in the posterior margin of pronotum, and the disk of the scutellum, fuscous; elytra setose, densely black; the apical cells margined with fuscous. Beneath brown, the femora and hind tibiæ more or less suffused with fuscous; spine of the latter whitish; tarsi brown.

Length: 3.5 mm.

Described from one specimen, male, *holotype*, from Chapada, Brazil, Nov., C. M. Acc. No. 2966 (H. H. Smith *coll.*).

This is a rather striking species, considerably smaller than *B. misellus*, and most clearly distinguished by the black vertex and front, and the shape of the male plates.

9. *Bythoscopus lautus* Stål. (Plate LIX, fig. 1).

Bythoscopus lautus Stål, Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 55.

The original description of this species by Stål is as follows:

"Sordide albida, maculis quattuor verticis, duabus ocellos cingentibus, nigris; vittis duabus obsoletis frontis, vitta genarum, linea media longitudinali verticis thoracisque, hujus etiam maculis duabus minoribus anterioribus parteque basale anterieus undata, maculis scutelli areolisque tegminum nitidulorum pallidissime subtestaceis, horum venis albidis. ♀. Long. 4, Lat. 1.25 Millim.—(Mus. Holm. et Stål).

Statura fere *B. Fruticolæ*. Vertex basi levissime reflexus; facies leviter convexa, subreclinato-decliva. Thorax longitudine duplo fere et dimidio latior, scutello nonnihil longior."

A free translation is herewith given:

Dirty whitish; four spots on the vertex, two encircling the eyes, black; two faint stripes on the front, a stripe on the cheeks, a median longitudinal line on the vertex and the thorax, the latter also with two smaller anterior spots, and the basal part, which is anteriorly wavy, the spots on the scutellum and the areoles of the slightly shining elytra, very pale subtestaceous; the veins of the elytra whitish. ♀. Length, 4, width 1.25 mm. (In the Museum at Stockholm and in the Collection of Stål.)

Size almost that of *B. fruticola*. Vertex at the base very slightly reflexed, face slightly convex, slightly sloping backward. Thorax almost two and one-half times broader than long, not longer than the scutellum.

The above description and translation, together with the figure of the type by Madame Ekblom, should enable the student to recognize this species, which as yet has not been seen by the author. Judging from the figure it belongs to the genus *Agallia*.

Genus IDIOCERUS Lewis.

Idiocerus Lewis, Trans. Ent. Soc. Lond., I, 1835, p. 47.

10. *Idiocerus occipitalis* sp. nov.

Slender; head very broad, much exceeding pronotum in width, moderately arched; vertex as long at middle as next the eye, rounded uniformly to front; front narrowing uniformly to clypeus. Pronotum short, narrow, nearly twice as long as vertex. Elytra narrow. *Genitalia: female*, last ventral segment larger than preceding, rounded, produced, dark brown in contrast to the pale venter; ovipositor and pygofer brown.

Dark chocolate-brown to blackish, most of the vertex and the disk of pronotum light yellowish, bordered anteriorly with brownish and enclosed by a broad dark blackish band, which includes the lateral and posterior parts of the pronotum; the eyes and a narrow margin of vertex and a broad stripe between the eyes bordered with brown; lower part of face whitish; scutellum blackish; elytra dark brown or piceous, sub-hyaline; veins blackish. Beneath, thorax and legs white.

Length: 3 mm.

One specimen, *type*, taken at Santarem, Brazil, Dec., 1909, C. M. Acc. No. 4043 (Haseman *coll.*). The large yellow spot of the vertex and pronotum imparts an appearance very different from that of the common forms of this genus.

11. *Idiocerus albicollis* sp. nov.

More robust than *I. occipitalis*; head broad, moderately arched; vertex scarcely longer at middle than next the eye; front convex, abruptly narrowed from antennæ to clypeus; clypeus broad, about one-half longer than wide; apex a little expanded and rounded; loræ slightly tumid, extending nearly to margin of cheek; cheeks narrow, margin nearly straight. Pronotum short, about one-half longer than vertex. *Genitalia: male*, plates elongate, triangular, slightly acuminate, and upturned at tip.

Brown; vertex and anterior part of pronotum yellow; face, thorax, and legs whitish; abdomen tinged with brown; elytra sub-hyaline, tinged with brown; costal and outer apical areoles fuscous, leaving a transparent area on the outer costal areole.

Length: 3.25 mm.

Described from one male specimen, the *type*, from Chapada, Brazil, Nov., C. M. No. 2966 (H. H. Smith *coll.*). This species has the general appearance of *I. occipitalis*, but the large yellow spot of vertex and pronotum is reduced on the pronotum, and the pronotal border and frontal bands are lighter brown; the ocelli are encircled by fuscous, and the elytra have more transparent areas.

12. *Idiocerus eburneomaculatus* sp. nov.

Head much wider than pronotum, broadly arched; vertex as long at middle as next the eye; front convex, narrowed sharply below the antennæ; clypeus long; loræ large, somewhat tumid; cheeks narrow, margins nearly straight. Pronotum twice as long as vertex, hind border truncate or faintly concave; scutellum large, acuminate; elytral veins weak. *Genitalia: female*, last ventral segment short, truncate; ovipositor extending a little beyond pygofer; *male*, last ventral segment longer than preceding, narrowed posteriorly; plates compressed, reaching tip of pygofer.

Bright fulvous yellow; vertex faintly greenish yellow, with two large quadrate patches of fulvous; two transverse fulvous dots just above ocelli; ocelli red. Pronotum fulvous, with four light greenish yellow stripes not reaching the hind border; scutellum fulvous, faintly marked with yellow stripes; base of clavus yellowish; two ivory-white spots on the corium, one below the middle and the other at tip of clavus; elytra otherwise transparent, tinged with golden yellow; a small spot on membrane at tip of clavus and some of the apical veins fuscous.

Length: 4 mm.

Three specimens: two females, one male; *type*, *allotype*, and *paratype*, from Brazil, taken along the Rio Guaporé below Rio S. Miguel Aug. 22, C. M. Acc. No. 4043 (Haseman *coll.*).

13. *Idiocerus costalis* sp. nov.

Head slightly wider than pronotum, short; vertex rounding uniformly to front; ocelli rather near together; front distinctly convex, short, narrowed abruptly to clypeus; clypeus short, somewhat tumid; loræ long, reaching margin of cheek; cheeks triangular; outer border nearly straight, somewhat reflexed. Pronotum short, nearly twice as long as the vertex from the dorsal view; hind border truncate; scutellum broad, acuminate at apex; middle apical cell narrow, preceded by ovate anteapical. *Genitalia: male*, plates broad at base, contracted to slender, acute, upturned tips.

Dull olive-brown; apex of scutellum yellowish; ocelli, eyes, base of clavus, the costa to the cross-vein and the elytral veins, dark fuscous, or blackish; wings smoky.

Length: 3.5 mm.

Described from one male specimen, *type*, from Province del Sara, Bolivia, 450 M., taken Nov., 1909, C. M. Acc. No. 4549 (Steinbach coll.).

This is a small species, particularly distinguished by the opaque blackish costa.

14. *Idiocerus breviatus* sp. nov.

Head large, broad, bluntly rounded in front; vertex very broad, margins nearly parallel; ocelli rather near together; base of front sub-angular, narrowed abruptly to clypeus; clypeus short; loræ long, extending beyond clypeus, merging with cheek-margin; cheek-margin slightly sinuate. Pronotum short, shorter than vertex; scutellum triangular; elytra broad and short, but extending far beyond the short abdomen. *Genitalia: male*, plates broad at base, narrowed to near the center and extending as long, narrow, upturned acutely pointed tips.

Light brown; vertex and pronotum somewhat vitreous; elytra sub-hyaline, somewhat fuscous on basal part and with abrupt termination at end of clavus; apex milky hyaline; hind tibiæ and tarsal joints dusky.

Length: 3 mm.; width: 1.5 mm.

One male specimen, *type*, from Chapada, Brazil, Dec., C. M. Acc. No. 2966 (H. H. Smith coll.).

This species is remarkable for its very broad and short body, and may be particularly distinguished by the strong contrast between the smoky and milky parts of the elytra.

15. *Idiocerus flavotinctus* sp. nov.

Head very broad; vertex short, margins parallel; ocelli rather close together; front narrow at base, widening to antennal pits; clypeus twice as wide as long, slightly expanded, truncate at tip; loræ large, merging with border of cheek; cheeks triangular, margin nearly straight. Pronotum twice as long as vertex; scutellum large, acuminate; elytra much longer than body. *Genitalia: male*, plates elongate, triangular, compressed, and upturned at tip.

Yellowish, somewhat suffused with greenish; elytra transparent, tinged with golden yellow; ocelli brown and margined with brownish; base of corium with a fuscous spot; elytral veins pale, wing-veins black; tips of rostrum and tarsal claws fuscous; venter greenish yellow; tergum golden yellow, tinged with reddish on the disk. Male plates greenish, tipped with fulvous brown.

Length: 6 mm.

Described from one specimen, male, *holotype*, from Mana River, French Guiana, June, 1917, C. M. Acc. No. 6008 (Klages *coll.*).

16. *Idiocerus principensis* sp. nov.

Head broad, distinctly arched; vertex margins parallel; ocelli nearer to the eye than to the middle line; front narrowing sharply to clypeus; clypeus broad at base, narrowed to tip; loræ reaching margin of cheek; cheek broad, margins nearly straight. Pronotum half longer than vertex; scutellum slightly acuminate. *Genitalia: female*, last ventral segment short, as long as preceding, faintly sinuate.

Light greenish, a common median stripe on vertex, pronotum and scutellum extending to a transverse band between ocelli, and a large roundish spot near the eye and a stripe behind it on pronotum, orange-red; inner border of clavus brown, commissure greenish white; outer part of clavus and the elytra hyaline, smoky at tip; a spot at base of corium and a dot on the disk dark fuscous; ocelli black. Beneath pale gray.

Length: 4 mm.

One specimen, *type*, from Ft. Principe, Rio Guaporé, Brazil, Aug., 1909, C. M. Acc. No. 4043 (Haseman *coll.*).

This is a handsome little species, somewhat resembling *I. flavidus*, but distinguished at once by the three orange-red stripes on the pronotum, which are in line with the spots of the vertex, and the central one with stripe on disk of scutellum.

17. *Idiocerus exquisitus* sp. nov.

Head broad, strongly arched in front, longer at center than next the eye; front rounded, short, contracted to clypeus; clypeus short, scarcely longer than wide; loræ broad, merging the cheek-margin; cheek triangular, border nearly straight. Pronotum scarcely longer than vertex; sinuate behind; scutellum acuminate; elytra long, rather slender. *Genitalia: female*, last ventral segment short, truncate; pygofers polished; *male*, plates narrow, compressed, curved upward, tips acute.

Greenish white, a fulvous stripe on middle of vertex and pronotum; ocelli dark brown, abdomen above black on base of middle line; apex with a large yellow spot at each side on segments two to four; elytra transparent, a large fuscous spot on the costa beyond the middle, and a dusky patch at end of clavus on inner border.

Length: 2.5 mm.

Three specimens, *type*, *allotype*, and *paratype*, from Rio Machupo, Bolivia, near Rio Guaporé, Aug. 25, 1909, C. M. Acc. No. 4043 (Haseman *coll.*). This very elegant little species is the smallest of the genus, which I have ever encountered, being smaller even than *I. minutus*, and is very distinct from other species in the markings on the abdomen, and the fuscous spots on the elytra.

18. *Idiocerus figuratus* sp. nov.

Broad, short; head much wider than pronotum, broadly rounded; vertex broad, as long at middle as next the eye. Pronotum strongly arched, nearly twice as long as vertex; hind border concave. *Genitalia: female*, last ventral segment slightly longer than preceding, truncate behind; ovipositor extending beyond pygofers.

Dark apple-green; vertex with two large orange-red oval spots. Pronotum with an orange fulvous arch, and narrow hind border; scutellum with disk and lateral angles, elytra with base of clavus, and a sub-sutural stripe, fulvous; face above blue-green; an orange-red band, including ocelli, from lower borders of eyes; lower part of front and clypeus yellowish white. Beneath greenish; tarsal claws blackish.

Length: 3 mm.

Described from two females, *type* and *paratype*, from Chapada, Brazil, Oct., C. M. Acc. No. 2966 (H. H. Smith *coll.*).

19. *Idiocerus flammeus* sp. nov.

Small; head wider than pronotum, distinctly arched; vertex as long at middle as next the eye; front somewhat tumid; clypeus widened to tip; cheek-margins sinuate. Pronotum twice as long as

vertex, slightly concave behind; elytral veins indistinct. *Genitalia: female*, last ventral segment elongate, convex; plates bulbous at base, narrow, compressed, sparsely setose at tip.

Pale yellowish, tinged with bright fulvous or sanguineous; vertex with two broad stripes extending from near base to the ocelli. Pronotum tinged with fulvous; scutellum with two whitish spots on the disk; elytra hyaline; abdomen above more or less tinged with sanguineous, below yellowish; tips of hind tibiæ and the tarsal claws fuscous.

Length: 3 mm.

Described from five specimens, four females and one male, *type*, *allotype*, and *paratypes*; two females and one male from Province del Sara, Bolivia, C. M. Acc. No. 5064, Nov., 1912; two females from Province del Sara, Bolivia, 450 M., Nov., 1909, C. M. Acc. No. 4549 (Steinbach *coll.*).

20. *Idiocerus vittatus* sp. nov.

Head broad; vertex long, somewhat longer at middle than next the eye; front broad, short; clypeus widened toward the tip; loræ broad, nearly touching cheek-margin; border of cheek slightly sinuate. Pronotum short, about one-half longer than vertex. *Genitalia: male*, plates elongate, triangular; tips compressed and upturned.

Apple-green with three dark orange-red stripes on the pronotum, the median one extended over vertex to base of front and united with a cross-band between ocelli and backward to the middle of the scutellum; a large spot between this stripe and the eye, and a broad stripe on each side of the pronotum. Base and inner border of clavus rich brown, as also outer border of clavus and most of corium; a black dot at base of corium and on the disk, and a fuscous spot on the costal border; apical veins dark; membrane smoky. Beneath pale greenish or dirty white; ocelli black; tip of clypeus dusky.

Length: 3.5 mm.

Described from a single male specimen, *holotype*, from Ft. Principe, Rio Guaporé, Brazil, Aug. 26, 1909, C. M. Acc. No. 4043 (Haseman *coll.*).

21. *Idiocerus fulvotinctus* sp. nov.

Small; head broad, distinctly arched; vertex broad; front broad, somewhat tumid; clypeus short; borders of cheeks nearly straight. Pronotum short, about twice as long as the vertex. *Genitalia: male*, plates somewhat swollen at base, narrowed beyond middle, compressed and a little upturned at tip.

Greenish yellow, deeply tinted with orange or fulvous; vertex, hind border, median line, pronotum, hind border, and indistinct median

line, greenish; elytra sub-hyaline, greenish, deeply tinged with orange; face mostly fulvous; cheeks greenish; ocelli reddish; abdomen fulvous.

Length: 3 mm.

Described from three male specimens, *type* and *paratypes*, one a little more deeply tinted with fulvous than the others, from Province del Sara, Bolivia, 450 M., Nov., 1909, C. M. Acc. No. 4549 (Steinbach *coll.*).

This species approaches *I. fulvus* and *I. ocellatus*, but lacks the dark dots on the elytra, and differs in the color-pattern, as well as the genitalia.

22. *Idiocerus rugifrons* sp. nov.

Face, vertex, pronotum, and scutellum minutely rugose; head wider than pronotum, scarcely produced before; vertex broadly sub-angulate; ocelli scarcely farther from each other than from margin of eye; front broad, rounded to clypeus; clypeus contracted at middle; loræ elongate, reaching border of cheek; cheek rather broad, rounded, scarcely sinuate on border. Pronotum short; lateral margin reduced to an angle; hind border truncate; elytra with short oval anteapical cell. *Genitalia: male*, plates narrow at base, divergent, and contracted behind the middle, compressed, rounded and blunt at tip.

Dark olive-green, tip of scutellum brighter green; elytra sub-hyaline, suffused with brownish; cross-vein, base and apex of outer apical, and the apical veins fuscous; lower part of face bright green; thorax dark brown; abdomen and legs lighter brown. Male plates brownish, inner borders greenish with a discal fuscous dot.

Length: 3.5 mm.

Described from one male specimen, *type*, in the author's collection, collected by H. S. Parish, at Bartica, British Guiana, Mar. 20-30, 1901.

This species is near to *Bythoscopus* in shape, but the vertex and pronotum are minutely rugose, instead of striate, and the face agrees better with the species of *Idiocerus*.

XVI. NEOTROPICAL HOMOPTERA OF THE CARNEGIE MUSEUM.

PART 4. REPORT UPON THE COLLECTIONS IN THE SUBFAMILY JASSINÆ, WITH DESCRIPTIONS OF NEW SPECIES.

(PLATE LVI, FIGS. 1-3; PLS. LVII-LVIII; PL. LIX, FIG. 2.)

BY HERBERT OSBORN.

In this part of the study upon the neotropical Homoptera in the Carnegie Museum there are presented the results of further work upon the species of the subfamily *Jassinæ*, already to some extent dealt with in Part 2 of this series of papers. There has been a special effort made to identify and place in order the species treated by earlier authors, especially by Stål and by Berg, who in times past have been among the leading contributors to the description of South American species in this subfamily. Allusion has already been made in the preceding paper (*Neotropical Homoptera of the Carnegie Museum*, Part 3) to the fact that the Carnegie Museum has acquired a series of exact drawings of a number of the types of the species named by Stål, which are preserved in the Naturhistoriska Riksmuseet in Stockholm. One of the interesting results of the examination of these figures is the discovery that our common *Euscelis exitiosa* Uhler is *Thamnotettix obscurinervis* Stål, a fact which would not have been surmised from the use of Stål's description alone.

Many of the species in this group, notably *Euscelis obscurinervis*, *Thamnotettix colonus*, and *Deltocephalus flavicosta*, are recognized as serious economic pests in the United States. We may quite reasonably presume that these species have found their way into this country, either by gradual dispersion from the tropical regions, or by introduction through human agencies. There is every reason to expect that other species, especially those which swarm upon the native grasses of the pampas of the upper La Plata and the Amazons, might, if once introduced into North America, become economic pests of great importance. It is therefore a matter well worthy of

our attention to determine what species occur in the neotropical regions, and to learn as much as possible concerning their habits, host-plants, and means of dispersal.

Order **HEMIPTERA** Linnæus.

Suborder HOMOPTERA Latreille.

Family **CICADELLIDÆ** Latreille.

Subfamily JASSINÆ Amyot et Serville.

Genus **XESTOCEPHALUS** Van Duzee.

Xestocephalus Van Duzee, Trans. Am. Ent. Soc., Vol. XIX, 1892, p. 298 (*nomen nudum*); Bull. Buffalo Soc. Nat. Hist., Vol. V, 1894, pp. 197, 215.

1. ***Xestocephalus pulicarius*** Van Duzee.

Xestocephalus pulicarius Van Duzee, Bull. Buffalo Soc. Nat. Hist., Vol. V, 1894, pp. 197, 215; *ibidem*, Vol. VIII, 1907, p. 62; Vol. IX, 1908, p. 216.

Small, robust; head scarcely as wide as pronotum, rounded in front; vertex one-half longer at middle than next the eye. *Genitalia: female*, last ventral segment twice as long as preceding, truncate, or faintly sinuate; *male*, valve hidden; plates narrow, spine-like, acute at tip, extending to tip of pygofer.

Light brown or fulvous with fuscous and whitish spots; vertex with a central white stripe with a median fuscous line, on each side of which is a quadrate fuscous spot, connected with an anterior broken band, which includes the white-bordered ocelli; elytra with elongated white spots on the veins and two yellowish transparent spots on the costa, the outer one enclosing a fuscous dot.

Length: 2.5 mm. to 3 mm.

This species has been recorded from a wide area, extending from Quebec and Maine to Florida and the West Indies. Van Duzee noted it as occurring in Jamaica.

There are at hand specimens from the Province del Sara, Bolivia, 450 M., Dec., 1918, C. M. Acc. No. 6443, and C. M. Acc. No. 5064, from the same locality; Las Juntas, Bolivia, C. M. Acc. No. 5066 (Steinbach *coll.*). There are also specimens from Taperina and Santarem, Brazil, C. M. Acc. No. 2966 (H. H. Smith *coll.*). The specimens from the last two localities are somewhat darker and a little smaller than the Bolivian specimens, but agree in color-pattern. The species evidently varies somewhat in size and in the distinctness of the light markings, but no more than might be expected in the case of an insect having such a wide range.

2. *Xestocephalus superbus* (Provancher).

Deltocephalus superbus Provancher, Pet. Faune Entom. Canad., Vol. III, 1890, p. 339.

Xestocephalus fulvocapitatus Van Duzee, Bull. Buffalo Soc. Nat. Hist., Vol. V, 1894, pp. 197, 215.

Larger than *X. pulicarius*, with less definite markings, though in part similar; head short, rounded in front; vertex slightly longer at middle than next the eye, about one-half as long as pronotum. *Genitalia: female*, last ventral segment twice as long as preceding, slightly sinuate.

Brown; vertex light brown to yellowish, with faint clouding; face brownish, margin of front darker. Pronotum minutely irrorate; scutellum with black triangles at base; elytra fuscous, with a few light spots on the clavus and subhyaline spots in the outer areoles.

Length: 3.5 mm.

One female specimen from Province del Sara, Bolivia, Dec., 1912, C. M. Acc. No. 5064 (Steinbach *coll.*) and another female from Don Diego, Dept. of Magdalena, Colombia, 100 ft. above sea-level, C. M. Acc. No. 1999 (H. H. Smith *coll.*). These agree very closely with North American specimens, and can be separated from *X. pulicarius* mainly by their larger size and the obscure markings of the head and pronotum.

3. *Xestocephalus tessellatus* Van Duzee.

Xestocephalus tessellatus Van Duzee, Bull. Buffalo Soc. Nat. Hist., Vol. V, 1894, p. 216.

Head narrower than pronotum, rounded in front; ocelli slightly above the margin of the vertex; vertex short, rounded to front; front broad at base, narrowing abruptly to clypeus; clypeus a little longer than broad, sides parallel; loræ rather large, nearly reaching border of cheek; cheeks short, margins slightly sinuate. Pronotum broad, strongly arched in front, hind border scarcely concave. *Genitalia: female*, last ventral segment longer than the preceding, hind margin slightly sinuate; *male*, valve minute or hidden; plates elongate, tapering to acute tips, reaching almost to apex of pygofer.

Light brown, checkered with fuscous and yellowish; head and pronotum light gray, with faint fulvous irrorations. Pronotum with two black dots on the anterior border; scutellum with a black triangle on the basal angles; beneath, face mottled with fuscous and whitish; legs light brown; tibiæ annulate with fuscous.

There are numerous specimens in the collection of the Carnegie Museum, representing several localities: Rio de Janeiro, Brazil, July, 1908, C. M. Acc. No. 3702 (Haseman *coll.*); Pará, Brazil, Dec. 6,

1907, C. M. Acc. No. 3533 (Haseman *coll.*); Province del Sara, Bolivia, Nov., 1912, C. M. Acc. No. 5064 (Steinbach *coll.*); Don Diego, Department of Magdalena, Colombia, 100 ft. above sea-level, July, C. M. Acc. No. 1999 (H. H. Smith *coll.*).

This is a common species, ranging from as far north as Ohio, and throughout the southern United States, through Mexico, Central America, and South America, to southern Brazil. It shows considerable variation in the tessellation, but, considering its wide range, maintains a fairly uniform appearance.

4. *Xestocephalus brunneus* Van Duzee.

Xestocephalus brunneus Van Duzee, Bull. Buffalo Soc. Nat. Hist., Vol. VIII, 1907, p. 62.

Head narrower than pronotum, strongly arched, almost paraboloid in front, nearly as long as pronotum. *Genitalia: female*, last ventral segment nearly twice as long as preceding, sinuate, or slightly notched behind; *male*, valve hidden, plates triangular, narrowing to rather acute points tipped with black.

Darker and richer brown than *X. superbus*, with very faint markings; head, pronotum, and scutellum with scarcely any trace of markings, outer part of elytra with smoky areas, the antepical and outer apical areoles somewhat hyaline.

Length: female, 3.25 mm.; male, 2.75 mm.

There is a series of specimens taken in the Province del Sara, Bolivia, 450 M., C. M. Acc. No. 5064 (Steinbach *coll.*); one individual from Santarem, Brazil, Dec., 1907, C. M. Acc. No. 4043 (Steinbach *coll.*); and another from Corumbá, Brazil, March, C. M. Acc. No. 2966 (H. H. Smith *coll.*). These specimens agree very closely with the description given by Van Duzee, based upon material from Jamaica and the eastern United States.

5. *Xestocephalus irroratus* sp. nov.

Head narrower than pronotum, rounded, faintly subangulate in front; vertex twice as wide as length at middle, one-third longer at middle than next the eye, rounded to front; front convex, not especially tumid, narrowed abruptly from antennæ to clypeus; clypeus long, twice as long as wide, sides nearly parallel; apex truncate; loræ large, merging with border of cheek; cheeks broad at base, distinctly sinuate below the eye. Pronotum short, about one-half longer than vertex, lateral border rounded, hind angles distinct, posterior border concave; scutellum short; elytra slightly exceeding abdomen. *Geni-*

talia: female, last ventral segment short, scarcely twice as long as preceding, hind margin scarcely sinuate, with a distinct shallow notch at the middle.

Dull fulvous, minutely irrorate with brownish, the brown merging into somewhat definite spots on front; clypeus, cheeks, and elytra having some ivory-whitish spots on the disk; costa subhyaline; some fuscous patches on the apical veins.

Length: 3 to 3.25 mm.

This species approximates *X. tessellatus* in size and color, but is much more finely maculate and the ivory-white spots of the elytra are mostly in the areoles and not on the veins.

There are four female specimens, *type* and *paratypes*, in the Museum: one from Province del Sara, Bolivia, 450 M., Dec., 1918, C. M. Acc. No. 4443, and three from the same locality, Feb., 1913, C. M. Acc. No. 5064 (Steinbach *coll.*).

Genus NIONIA BALL.

Nionia Ball, Proc. Biol. Soc. Wash., Vol. XXIII, 1891, p. 165.

6. *Nionia major* sp. nov.

Robust, larger than *N. gagatina* (*q. v.*). Distinctly punctate; head wider than pronotum, strongly angulate; eyes prominent; vertex very short, a narrow border before the much produced pronotum; front convex, punctate, striate at sides; clypeus tumid on basal part. Pronotum extending forward of anterior border of eyes, densely punctate; scutellum acuminate. Elytra coriaceous, veins margined with series of punctures, outer anteapical open. *Genitalia: male*, plates narrow, elongate triangular, tips acute and nearly reaching tip of pygofer.

Shining blue-black; tips of elytra and hinder abdominal segment brownish; plates light brown.

Length: male, 6 mm.; width, 2.25 mm.

Described from four males in the collection of the author from Chulumani and Coroica Yungas, Bolivia, *type* and *paratypes*; one *paratype* presented to the collection of the Carnegie Museum.

7. *Nionia gagatina* sp. nov.

Similar to *N. palmeri* Van Duzee. Head broad, much produced; vertex very short, scarcely more than a border in front of the anteriorly produced pronotum; front broad, convex, punctate, minutely striate at sides; clypeus slightly swollen at base; pronotum densely punctate, faintly striate; scutellum minutely punctate. Elytra coriaceous,

veins bordered with punctures, outer anteapical open. *Genitalia: male*, plates narrow, triangular, tips acute, upturned, nearly reaching tip of pygofer.

Shining black, faintly bluish; tips of elytra and of femora, tibiæ, and tarsi embrowned. Hind margin of abdominal segment narrowly pale.

Length: 4.8 mm.

The collection of the author includes several male specimens, one labelled as from "Archidona (Ecuador) R. Hænsch.," and six from "Chulumani, Bolivia, Dec. 9, '98." The specimen from Archidona, secured many years ago from a German dealer, bears the label: "*Bythoscopus gagatinus* Bredd." An exhaustive search of the entire literature of the subject shows that no South American species, which could possibly be referred to the genus *Nionia*, has ever been published by Breddin. The only species, to which Breddin has applied the specific name *gagatinus*, is from southern Java, and belongs to the heteropterous genus *Biasticus*. The label on my specimen is therefore evidently a manuscript name, or was written in error by the dealer. Nevertheless I have adopted it for this species.

7a. *Nionia gagatina* var. *brunnea*, var. nov.

Like *N. gagatina* in size and form, but slightly narrower. The elytra, legs, and under side of abdomen brown.

Four specimens from Coroica Yungas, Bolivia, April 16, 1899.

8. *Nionia minor* sp. nov.

Similar to *N. major* and *N. gagatina*, but much smaller. Head broad, angulate; vertex very short; front convex, punctate; clypeus convex; pronotum coarsely punctate and faintly transversely striate, or rugose; scutellum acuminate, minutely punctate; elytra coriaceous, veins bordered with punctures, outer anteapical open, or with trace of terminal cross-vein. *Genitalia: male*, plates narrow, triangular, tips acute and reaching nearly to tip of pygofer.

Shining black, faintly bluish; tibiæ and tarsi embrowned.

Length: male, 5.5 mm.

Except for size, this species is close to *N. gagatina*. It is very similar to our North American *N. palmeri* (Van Duzee), with which it agrees in size and form, but from which it differs in the shorter apical part of the vertex and the longer, more acute male plates.

9. *Nionia postica* (Stål) (Plate LVI, fig. 3).

Bythoscopus posticus Stål, Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 54.

Stål's Latin description of this species reads as follows:

"Subdepressus, niger, tegminum opacorum apicibus sordide testaceo-flavo-hyalinis; limbo dorsali abdominis, apicibus femorum, tibiis tarsisque flavo-testaceis. ♂. Long. 4, Lat. 1.5 Millim.—(Mus. Holm. et Stål).

Species insignis, subdepressa. Caput vertice sat brevi, fronte admodum reclinato-decliva, subtiliter coriacea. Thorax longitudine plus duplo latior, anterius rotundato-productus, subtiliter transversim rugosus. Scutellum subtiliter rugosum, thorace tertia parte brevius. Tegmina opaca, venis (partis apicalis exceptis) utrimque distincte punctatis."

From this description I have been led to feel that *B. posticus* Stål must be referred to the genus *Nionia*, together with *B. gagatina*, even if these species may not perhaps be identical. The figure, drawn by Madame Ekblom from the type in the Museum at Stockholm, clearly shows that the species falls into the genus *Nionia*, but the much longer vertex, as shown in the drawing, does not confirm its identity with *N. gagatina*.

The figure brings out the punctate characters and the much produced head, the prothorax extending even with the front border of the eyes, and the form of front, clypeus, and the male plates corresponding closely with these parts in other species of *Nionia*. The male plates are larger and appear to extend beyond the tip of the pygofer; the scutellum is shorter, not acuminate, and the outer anteapical appears to be closed by a cross-vein.

As compared with the other species Stål's statement "*Caput vertice sat brevi*" is not distinctive, since in other species the vertex is reduced to a very narrow margin in front of the pronotum.

Genus DICYPHONIA Ball.

Dicyphonia Ball, Proc. Iowa Acad. Sci., Vol. VII, 1900, p. 69.

10. *Dicyphonia picturata* sp. nov.

Head a little narrower than pronotum; vertex scarcely as long as width between the eyes, twice as long at middle as next the eye; disk with broad depression; front broad at base, narrowing from eyes to clypeus, distinctly convex; clypeus long, twice as long as width at

base; apex slightly widened; loræ almost reaching margin of cheeks; cheeks rather broad, slightly sinuate from hind margin of eye. Pronotum strongly arched in front, emarginate behind, nearly one-half longer than vertex; lateral margins carinate; clavus with numerous cross-veins; costa with about seven oblique cross-veinlets. *Genitalia: male*, valve long, obtusely angular; plates broad at base, narrowed to the blunt, slightly upturned tips, reaching the apex of pygofer; margins of pygofer thickened, with short bristles at apex.

Black and ivory-white; vertex black, with borders of ivory-white; face with two black bands at base of front, and a large V-shaped black mark, extending from lower border of eyes on outer margin and apex of front, inner margin of cheek and all of clypeus; a large triangular spot on front and the loræ, ivory-white. Pronotum, with anterior, discal, and lateral areas, black; a middle and posterior band, and lateral margin, whitish; scutellum black, with a transverse spot and the apex ivory-white; elytra milky-white or subhyaline, with the veins and cross-veins densely fuscous, or blackish; thorax black with ivory margin; legs whitish; hind femora and tibiæ, except the knees, blackish. Abdomen black; margins of basal segments and the apical part of pygofer yellowish.

Length: male, 3.5 mm.

Described from a single male specimen, *type*, in the collection of the author, from Coroico Yungas, Bolivia, April, 1899.

Genus HULERIA Ball.

Hulëria Ball, Canadian Entomologist, Vol. XXXIV, 1915, p. 167.

11. *Hulëria rugosa*, sp. nov.

Head about equal to hind part of pronotum in width; distinctly produced, the borders elevated and apex porrect; vertex nearly as long as width between the eyes, three times longer at middle than next the eye, strongly rugose, two ocellus-like spots near the eye; ocelli on border between vertex and front, about one-fifth the distance from eye to tip; front broad between antennal pits, narrowing uniformly to base of clypeus, strongly rugose, clypeus enlarged toward the tip, twice as long as width at base; apex truncate, minutely rugose; loræ long, distant from edge of cheek, rugose; cheeks broad, deeply sinuate below the eye, with rugosities arranged in three different series. Pronotum one-fourth longer than vertex, sloping forward; anterior border strongly arched, hind border distinctly concave; the anterior half rugose and pitted, the hind part coarsely, transversely striate; scutellum with the central areas longitudinally rugose; clavus with two veins connected by a transverse veinlet; elytral veins elevated; apical veins four, and in some cases apparently

with the indistinct veinlet forming a fifth vein at end of costa. *Genitalia: male*, valve small, inconspicuous; plates broad at base, narrowing very abruptly and extended as compressed, tips slightly upturned to near the end of the pygofer; pygofer compressed.

Vertex blackish, except at the border; pronotum brown, somewhat infuscated at the middle of the anterior part and greenish at the sides; scutellum olive-green, the central areas, two dots on the anterior margin, and a dot on each side on the lateral margin, and the suture, fuscous; elytra brown, some of the nervures a little lighter; the costa blackish. Beneath, dark olive-green; pleural pieces, bases of anterior and middle femora, and an indistinct band near the tips, the tips of the tibiæ and the tarsal claws, fuscous, or blackish; abdomen with a series of dark patches on the outer part of the ventral segments.

Length: male, 8 mm.

Described from twenty-eight specimens, all males, from Coroico Yungas, Bolivia, April 16, 1899, in the author's collection. *Type* and *paratypes* in the collection of author, Ohio State University; *paratypes* in the Carnegie Museum, Pittsburgh, Pa.; U. S. National Museum, Washington, D. C.; and the American Museum of Natural History, New York City.

The prevailing color is brown, varied with fuscous and greenish; olive-green below; head slightly curved upward; face, vertex, and anterior part of pronotum, strongly rugose; posterior part of pronotum, disk of scutellum, and pleural pieces, finely rugose, or striate.

12. *Huleria affinis* sp. nov.

Shape of head, and rugose surfaces similar to those of *H. rugosa*. Clypeus narrowed at the middle; apex broadened, truncate. *Genitalia: male*, valve minute, or concealed; plates narrowed abruptly at base, tapering to tips, which are somewhat compressed, rounded, and nearly as long as the pygofer.

Vertex black, with lighter patches on the hind border. Pronotum olive-green with a few fuscous dots, especially in the pits of the anterior part; scutellum with the disk fuscous and the apical part green; elytra brown with the veins lighter; costa dark, beneath greenish yellow; anterior and middle femora fuscous to beyond the middle; tips of tibiæ and tarsal claws dusky; abdomen greenish, tinged with yellow.

Length: 6.5 mm.

Described from a single male specimen, *type*, in the collection of the author, from Chulumani, Bolivia, taken Dec. 9, 1898.

Similar to *H. rugosa*, but smaller and differing in color and in the genitalia. While it is possible that intermediate forms may connect this with *H. rugosa*, there seems too much difference to place it in that species without additional material. Moreover the full series of *H. rugosa* shows no tendency to variation in the direction of *H. affinis*.

Genus SCAPHOIDEUS Uhler.

Scaphoideus Uhler, Trans. Maryland Acad. Sci., Vol. I, 1889, p. 33.

13. *Scaphoideus fasciatus* Osborn.

Scaphoideus fasciatus Osborn, Jour. Cinc. Soc. Nat. Hist., Vol. XIX, 1900, p. 190.

Scaphoideus fasciatus Van Duzee, Bull. Buffalo Soc. Nat. Sci., Vol. VIII, 1907, p. 69.

Scaphoideus fasciatus Osborn, Ohio Naturalist, Vol. XI, 1910, p. 252.

Head wider than pronotum, obtusely angulate; vertex about one-third longer at middle than next the eye; margin subacute; front broad, narrowing to base of clypeus; clypeus long; loræ distant from margin of cheeks. Pronotum strongly arched in front, truncate behind; lateral margins very short; elytral appendix narrow. *Genitalia: female*, last ventral segment somewhat concavely excavated, slightly prominent at the middle; *male*, valve short; plates oval, short, one-half as long as pygofer, bluntly rounded at apex with a discal brown fascia, as described from Haytian specimen.

Ivory-white; vertex with obsolete pair of dots near apex; faint fuscous spot on the disk; face white with two marginal bands above; a band between lower part of eyes, including antennal pits and a band across clypeus, loræ and lower border of cheek, fuscous. Pronotum with fuscous points on anterior border; a larger patch behind the eye, the basal angles of scutellum, a cruciate patch on elytra, and a darker border, fuscous; the hinder part of the cruciate mark is reduced at the middle, the distinct darker border separating it from a lighter patch, beyond which next to costa is a darker oblique patch; the veins toward apex fuscous; the first and fourth apical areoles, hyaline; second and third more or less infuscate; legs whitish; femora annulate or largely fuscous.

Length: 4.5 mm.

A single female specimen from Bahia, Brazil, March, 1908, C. M. Acc. No. 3529 (Haseman *coll.*) is referred to this species, although slightly larger than the female type, with which it has been compared. It is evidently nearly related to *S. ornatipennis* Stål (see Pl. LVII, fig. 2) but that species has the base of the scutellum black, the dots of the vertex more distinct, and the pattern of the cruciate mark is shown as having continuous bars reaching the costa and a large shield-like white mark within the cross on the suture. There is also

some difference in the frontal markings, this species having the marginal white line at base of the front continuous. These species are closely related to *S. neglectus* and *S. cruciatus* of the Atlantic and Gulf Coast of the United States; and it is possible that with sufficient material it might be possible to connect all into a single species with geographic variations. I also have specimens referred to *S. fasciatus* from Guatemala.

14. *Scaphoideus ornatipennis* (Stål) (Plate LVII, fig. 2).

Jassus (Deltocephalus) ornatipennis Stål, *Eugenies resa*, Ins. Hemipt., 1858, p. 294.

The original description given by Stål is as follows:

"Pallide sordide griseo-flavescens; frontis margine basali, fascia intraoculari aliaque mox infra oculos supra genas utrimque continuata, maculisque femorum nigricantibus; tegminibus pellucidis, fasciis 2, una media, altera mox ante medium sita subobliqua, in tegminum disco confluentibus, flavo-testaceis, fusco-marginatis, maculam communem commisuralem aliamque costalem subdecolores inter se relinquentibus; areolis apicalibus fusco-limbatis. ♀. Long. 3.5-4.5, Lat. 1-1.5 millim.

Patria: Callao, Puna.

Eximia species, secundum exempla in spiritu asservata descripta. Caput subobtusum triangulare, vertice medio quam utrimque ad oculos dimidio longiore, basi oculo singulo vix latiore, thorace paullulum brevior.

The species is well marked by the elytral design, and evidently is closely related to *S. fasciatus* Osborn, described from Hayti. From the description it is smaller and the figure of the type indicates differences in the color-pattern. The geographical records cover quite different regions. No specimens, which seem to be clearly referable to this species, have been seen by me.

Genus DELTOCEPHALUS Burmeister.

Deltocephalus Burmeister, *Genera Ins.*, Vol. I, 1838, Pl. 14, subgen. 3.

15. *Deltocephalus flavicosta* Stål

Jassus (Deltocephalus) flavicosta Stål, *Bidrag till Rio Janeiro-Traktens Hemipter-fauna*, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 53.

Head slightly wider than pronotum; vertex one-third longer than next the eye, slightly wider between eyes than length at middle; front tapering to clypeus; clypeus longer than wide, narrowed toward tip; loræ not reaching margin of cheek; cheek margin nearly straight.

Pronotum slightly longer than vertex, rounded in front, scarcely sinuate behind; posterior borders broadly rounded; scutellum very small, not as long as pronotum, about as long as the vertex; elytra somewhat longer than body. *Genitalia: female*, last ventral segment rather short, concave behind; the margin thickened and faintly notched; *male*, valve rounded behind; plates short, tapering nearly uniformly to acute tips.

In the darker forms, dark fuscous or blackish with six yellow dots on the vertex, a dot at the extreme tip of vertex, ocelli and a dot next the eye, short arcs and a central disk on the front and the costal border of elytra yellow; two whitish oblique spots toward the tip of the wing; beneath black; legs, borders of the abdominal segments have a patch on the pygofers pale. In the paler forms the color above is brownish; elytral veins whitish, bordered with fuscous; vertex brown instead of black, but the yellow dot on vertex in front and the yellow border of elytra agree with those of the darker form.

This is a common insect distributed all the way from southern South America to the northern United States. It seems most probable that it has spread northward from a tropical habitat. The specimens in hand are from Bahia, Brazil, 1907, C. M. Acc. No. 3441; San Antonio, Rio Guaporé, July and August, 1909, C. M. Acc. No. 4043 (Haseman *coll.*). One of these specimens bears the record, "sweeping on island in Rio Guaporé." The above are light-colored forms. Three specimens from Province del Sara, Bolivia, Nov. and Dec., 1912, C. M. Acc. Nos. 5043 and 5064, and one Dec., 1918, C. M. Acc. No. 6443 (Steinbach *coll.*).

Many other specimens have been seen from various South American localities, and the species is, no doubt, very generally distributed, probably in grassy areas. The specimens above listed seem quite clearly to fall into two varieties: the Brazilian specimens, which are light; and those from Bolivia, which are dark. However these variations are in general not associated with geographic distribution.

16. ***Deltocephalus lepidellus*** Stål. (Plate LVII, fig. 1).

Jassus (Deltocephalus) lepidellus Stål, Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 53.

A free rendering of Stål's original description is here inserted:

'Pale, sprinkled with fuscous and brown spots; elytra dull yellow-testaceous; the swollen veins and costal border (base excepted) whitish; areoles narrowly margined with fuscous; the entire outer apical cell and costal spot near middle, fuscous; femora black-spotted. Male, length 4 mm.; width, 1.25 mm.

Related to *D. ocellaris* and *D. formosus*. Head bluntly triangularly rounded; the vertex a trifle longer than the basal width; two small black spots close together at apex, and behind these two large irregular yellow-testaceous spots; front with transverse fuscous lines; cheeks and loræ spotted with fuscous. Thorax somewhat longer than vertex, yellow-testaceous, whitish behind, in front with small fuscous spots. Scutellum pale, angles yellow-testaceous. Elytra somewhat surpassing the abdomen, apex broadly and obliquely rounded; veins swollen, whitish; the discoidal and inner areoles yellow-testaceous, narrowly and irregularly margined with fuscous. Four apical areoles, middle uncolored, margined with fuscous; costal margin (base excepted) hyaline. Fuscous spot at middle, behind the spot two transverse veins, between spot and exterior apical areole three small squarish areoles. Abdomen black, border yellow. Feet pale yellowish, femora broadly ringed with black.'

The figure of this species, drawn by Madame Ekblom from Stål's specimen, shows a female instead of a male, the sex given to the type in the original description; however, the figure agrees well with the description, and presumably is that of a female, which accompanied the male which was described. It shows the species to belong to the group with divided middle antepical areole and two cross-nervures, as in *T. shermani*. It is very similar to the species described below as *T. venatus*, differing in its broader form and somewhat different appearance, as delineated.

17. ***Deltocephalus anticus*** Stål. (Plate LVIII, fig. 4).

Jassus (Deltocephalus) anticus Stål, Bidrag till Rio Janeiro-Traktens Hemipterfauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 53.

The original description given by Stål may be paraphrased as follows:

Pale fuscous-testaceous, base of femora more obscure. Vertex, thorax, scutellum, and scutellar border of clavus yellowish; elytra at costa with oblique fuscous lines, toward apex with minute white hyaline spots. ♀. Length: 4.25 mm.; width 1.25 mm.

Head angularly produced, vertex flattish, forming an acute angle; base between eyes one-third of length, almost equal to single eye. A faint evanescent impressed longitudinal line toward apex; face strongly oblique, thorax somewhat shorter than head, two and one-half times wider than long, rounded in front; scutellum barely as long as thorax; elytra much longer than abdomen, valve at apex broadly rounded, fusco-testaceous-hyaline obscurely veined, apical areoles at base and discoidal at claval apex with minute white hyaline spots.

We have not seen specimens, which answer to this description or the figure of the type, but the above translation, together with the figure of the type, should readily enable it to be recognized. It has apparently something of the character of *Platymetopius*, especially in the narrow front and the costal veinlets.

18. ***Deltocephalus marginelineatus*** Stål. (Plate LIX, fig. 2).

Jassus (Deltocephalus) marginelineatus Stål, Eugenes resa, Ins. Hemipt., 1858, p. 294.

The original Latin description of this species is here inserted:

"Pallide sordide flavo-testaceus, supra fusco-adspersus et irroratus, facie flavo-albida; capite triangulari, latitudine basali nonnihil longiore; tegminibus fascia lineari subapicali fusca, apice imo pallidiore, areolis (costali transversim oblique fusco-lineata excepta) minutissime fusco-irroratis, disco macula singula parva albida notatis. ♀. Long. 4, Lat. 1.25 millim.

Patria: Rio Janeiro.

Caput latitudine basali nonnihil longius, oculis supra visis oblongis; vertice latitudine basali dimidio longiore, levissime concaviusculo, apice lineola, prope apicem lineolis 4 longitudinalibus pallidis ornato; fronte valde reclinato-decliva. Thorax vertice tertia parte brevior. Tegmina abdomen superantia, minute fusco-irrorata, margine costali fusco-lineato areolarumque macula minuta media albidis. Pectus fuscum, limbo incisurisque tenuiter flavescentibus."

This description may be paraphrased as follows:

'Pale dull yellow-testaceous; dotted and sprinkled above with fuscous; face yellow-whitish; head triangular, somewhat longer than its basal breadth; the elytra marked by a fuscous subapical linear band, at the apex decidedly paler; the areoles very finely sprinkled with fuscous, all (except the costal areole, which is marked by transverse oblique fuscous lines) having on the disk a single small white spot. ♀. Length, 4 mm., width, 1.25 mm.

Habitat: Rio Janeiro.

Head somewhat longer than its width at base, the eyes, viewed from above, oblong; vertex one-half longer than its basal width, very slightly inclining to become concave, ornamented at the apex with a fine line, and near the apex by four longitudinal fine lines, all of these lines whitish; front sloping backward and downward. Thorax one-third shorter than vertex. Elytra surpassing the abdomen, minutely irrorate with fuscous, the costal margin marked with fuscous lines, and a minute whitish spot in the middle of the areoles. The pectus fuscous, on the border and the sutures faintly yellowish.'

This species is evidently a *Platymetopius*. It is near *P. loricatus* Van Duzee. A specimen from Bartica, British Guiana, in the collection of the author, is identified as undoubtedly being it.

19. ***Deltocephalus faminei*** Stål. (Plate LVI, fig. 2).

Jassus (Deltocephalus) faminei Stål, *Eugenies resa*, Ins. Hemipt., 1858, p. 293.

The original description by Stål is here reproduced:

"Pallide flavescens; verticis maculis 2 parvis posterioribus, linea utrimque media transversa lineisque apicalibus suboblique transversis, cum margine antico parallelis, fronte (lineolis lateralibus transversis mediaque longitudinali exceptis), macula clypei apicali, limbo lororum, pectore abdomineque (exceptis incisuris), maculis femorum punctisque tibiæ nigris; tegminibus sordidis, pallide subsordide flavescente-venosis, areolis fusco-marginatis. ♂, ♀. Long. 3.5-4.5; Lat. 1.25-1.66 millim.

Patria: Patagonia (Port Famine).

Variat tegminibus pallidioribus, areolis vix fusco-limbatis.

Statura fere *J. striatuli*, major. Caput obtuse triangulare, vertice medio quam utrimque ad oculos fere duplo longiore, thoraci æquilongio, oculo dimidio latiore; facie valde reclinato-decliva, fronte convexiuscula. Thorax longitudine fere plus duplo et dimidio latior. Tegmina abdomen paullulum superantia, venis distinctis, areolis apicalibus a commisura extrorsum sensim magnitudine decrescentibus."

The first part of the above description may be paraphrased as follows:

Pale yellowish; two small spots at the back of the vertex, a median transverse line on either side and somewhat oblique transverse apical lines parallel with the anterior margin, the front (transverse lateral fine lines and a longitudinal median line excepted), an apical spot on the clypeus, the margin of the loræ, the pectus and the abdomen (the sutures excepted) spots on the femora and dots on the tibiæ, black; the elytra sordid, the veins pale somewhat sordid yellowish, the areoles bordered with fuscous. Male and female. Length: 3.5-4.5; width, 1.25-1.66 mm.

Habitat: Patagonia (Port Famine).

A series of specimens in the collection of the author taken in the Canal Zone agrees well with the description of Stål and the figure of the type and is referred to this species. It evidently has a wide range from Patagonia northward.

Genus EUSCELIS Brullé.

Euscelis Brullé, Expédition Scientifique de Morée, Vol. III, pt. I, 1832, p. 109 (?).

20. *Euscelis obscurinervis* (Stål) (Plate LVII, fig. 3-4).

Jassus (*Thamnotettix*) *obscurinervis* Stål, Eugenies resa, Ins. Hemipt., 1858, p. 293.

Cicadula exitiosa Uhler, Am. Entom., Vol. III, 1880, p. 72.

Limotettix exitiosa Van Duzee, Psyche, Vol. V, 1892, p. 306.

Eutettix exitiosa Gillette and Baker, Hemip. Colorado, 1895, p. 100.

Athysanus exitiosa Osborn and Ball, Ohio Naturalist, Vol. II, 1902, p. 234.

Euscelis exitiosa Van Duzee, Catalog. Hemip. North of Mexico, 1916, p. 655.

The Latin description given by Stål may be repeated here for the benefit of those who do not have access to the original:

"Valde pallide griseo-flavescens; fascia sæpe obsoletissima media verticis, utrimque ramulum retrorsum et introrsum currentem semper distinctum emittente, maculis 2 basalibus, puncto interdum basali medio, lineola media longitudinali lineolisque transversis lateralibus frontis, vitta clypei, maculis lororum genarumque, maculis nonnullis anterioribus parvis distinctis, interdum etiam maculis 2 majoribus, transversis, obsoletis pone medium thoracis, maculis basalibus prope angulos interdum retrorsum ad vittulas subarcuatas extensis, sæpe etiam maculis 2 minutis mediis scutelli venisque tegminum, pectore fere toto (exceptis incisuris plus minus late) abdomine (limbo incisurisque exceptis) lineisque femorum fuscis aut nigro-fuscis. ♂, ♀. Long. 4-5.5, Lat. 1.5-1.66 millim.

Patria: Buenos Ayres, Rio Janeiro.

Caput inter oculos latiuscule rotundatum, vertice medio quam utrimque paullulum longiore, longitudine sua fere duplo, oculo singulo vix duplo latiore; fronte nonnihil reclinato-decliva. Thorax vertice fere duplo longior, longitudine duplo et dimidio latior. Tegmina valvata, venis mediocribus, areolis apicalibus 4, a commisura extrorsum longitudine decrescentibus, 2 exterioribus subæquilongis."

Head wider than pronotum; vertex broad, three times as wide as length at middle, scarcely longer at middle than next the eye, faintly subangulate; front broad, slightly longer than width; loræ short, not reaching margin of cheek; margin of cheek sinuate. Pronotum twice as wide as long and twice the length of the vertex, anterior border much curved, hind border slightly concave; scutellum nearly as long as pronotum; elytra mostly hyaline, with conspicuous venation. *Genitalia: female*, last ventral segment truncate; *male*, valve short, rounded behind; plates elongate, rather slender, tapering to acute upturned tips.

Light gray; the vertex with a transverse fuscous band, with two oblique dark fuscous spots, the inner ends nearly touching the hind border; base of front with two large roundish, blackish spots, almost touching the ocelli; the arcs and a central line in the apical portion

brownish fuscous; face otherwise whitish. Pronotum with a series of four black dots near the anterior border; the scutellum with two black triangles on the base; elytra with dark fuscous or blackish veins; the apex smoky.

Length: male, 4 to 4.5 mm.; female, 5 mm.

The species is represented in the Carnegie Museum by specimens from Chapada, Brazil, taken in May, C. M. Acc. No. 2966 (H. H. Smith *coll.*) and from Bahia, Brazil, taken in Nov., 1907, C. M. Acc. No. 3441 (Haseman *coll.*).

The species has a very wide distribution in the Western Hemisphere. Specimens have been examined from nearly all parts of the United States, Cuba, Porto Rico, Barbados (Stoner Collection), Central America, Brazil, and Argentina.

The drawings of the types of *J. obscurinervis* by Madame Ekblom reveal to our surprise, as has been already noted, that this species is the same as *E. exitiosa* Uhler, which therefore falls into the synonymy. It is not strange that the species has not hitherto been recognized from Stål's description, especially as the name seems to indicate that the venation is obscure, whereas it is very conspicuous. In the drawings reproduced upon the plate the vertex in the case of the female is more angulate than in the average run of specimens, and the plates of the male genitalia, while of the usual form, are shown as more divergent than in any specimens observed by me, but this may easily be explained as being due to an accidental slight pressure or displacement of these parts.

In the United States *E. obscurinervis* is especially destructive to grasses and cereal crops. It is probably a native of South or Central America and has migrated to the West Indies, the United States, and northward. *Euscelis capicola* Stål of South Africa suggests a common origin for these two species, with a separation of the African and South American forms at some remote time, possibly dating back to the supposed period of continental connexion between Africa and South America.

21. *Euscelis palliditarsis* (Stål) (Plate LVIII, fig. 3).

Jassus (Athysanus) palliditarsis Stål, Bidrag till Rio Janeiro-Traktens Hemipterfauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 52.

The brief description given by Stål may be translated as follows: 'Black, shining; many lines on vertex and base of front and minute marginal spots on scutellum, dull luteous. Elytra paler at apex, with

a white hyaline costal spot toward apex, areoles narrowly margined with dull pale. Anterior tarsi entirely, hind tarsi at base, pale. Male, length, 4.5 mm.; width, scarcely 2 mm.—(Stockholm Mus. and Collection of Stål).

Head short, vertex arcuate, middle and sides equally long, with base of front marked by alternating dark, testaceous, and dull pale lines. Cheeks and loræ with narrow yellow-testaceous margin. Thorax two and one-half times as long as vertex, with minute pale irrorations. Scutellum with seven marginal spots, one in each angle, two on front margin, and one on each side, also sometimes with small dull luteous or yellowish red spots in the middle. Elytra passing abdomen, apex pale, costal spot toward apex, and apical border, hyaline whitish; areoles narrowly pale-margined. . . . *Genitalia: male* (as shown by the figure received from Madame Ekblom) with narrow valves, rounded behind; plates with convex margin and acute tips.

This species has not been seen by me, but is evidently well marked, and the figure (Pl. LVIII, fig. 3) should make its recognition an easy matter.

Genus EUTETTIX Van Duzee.

Eutettix Van Duzee, Psyche, Vol. VI, 1892, p. 307.

22. *Eutettix mimicus* sp. nov.

Head wider than pronotum, distinctly produced; vertex one-half longer at middle than next the eye, scarcely one-half as long at middle as between the eyes at base, broadly sub-angulate, rounded to the front; front broad, somewhat tumid; clypeus short, scarcely longer than width at tip; loræ sub-quadrangle, as long as clypeus; cheeks rounded, margin reflexed. Pronotum strongly arched in front, nearly straight behind, about one-third longer than vertex; scutellum large, as long as pronotum; elytra broad, rounded at tips with rather broad appendix; a broad veinlet at base and tip of outer anteapical. *Genitalia: male*, valve very short, scarcely visible; plates short, broad at base, narrowed abruptly to rounded tips, about one-half the length of the pygofer, which is compressed, and bears a number of stiff hairs.

Ivory-whitish, marked with brown and fuscous; vertex ivory-white, the disk with a black double curved spot, two large dots close to the apex, a black dot next to the eye, just above the ocellus; a series of alternating black and white dots on the inner margin of the eye; the front olive-gray, with short whitish arcs and a whitish line at the center; clypeus and loræ yellowish, bordered with fuscous; cheeks fuscous, with a pale patch behind the border. Pronotum gray, irrorate with fuscous, merging into a rather indistinct band

near the front border; scutellum ivory-whitish with two basal brown spots bordered with fuscous; elytra gray, sub-hyaline; veins fuscous; discal cells with central fuscous spots; costa with a central fuscous spot, two broad veinlets from the outer-anteapical cell, the central apical cell, fuscous; inner cells small, somewhat smoky; legs light brownish; hind border of abdominal segments, margin of the connexivum, and larger part of the male plates, yellowish.

Length: 4 mm.

One male specimen, *holotype*, Province del Sara, Bolivia, Feb., 1913, C. M. Acc. No. 5064 (Steinbach *coll.*).

This species has a striking superficial resemblance to *Scaphoideus fasciatus*, Osborn, and to *Deltocephalus limicolus*, Osborn, but structurally it falls into the genus *Eutettix*. Moreover, the details of the color-pattern differ distinctly from the species just mentioned.

23. *Eutettix reticulatus* sp. nov.

Form of *E. irroratus*, but much smaller; head wider than pronotum, strongly arched, sub-angulate in front; vertex with a distinct transverse depression before the middle, more than twice as wide as length at middle, slightly longer at middle than next the eye, obtusely angular to front; front broad, short rather sharply narrowed below antennæ; clypeus broad, slightly elevated on the disk, tip truncate; loræ large, nearly reaching border of cheek; margin of cheek deeply sinuate beneath the eyes, lower border nearly straight. Pronotum twice as long as vertex, slightly concave behind; clavus and sub-claval areole with numerous cross-veins giving a reticulate appearance to the elytra. *Genitalia: female*, last ventral segment twice as long as preceding, lateral angles rounded; hind border slightly produced at middle.

Brownish, marked with fuscous; vertex pale brown with fulvous spots on the disk, two minute fulvous dots between the ocelli, a small fuscous dot over each ocellus. Pronotum light brown, irrorate with fuscous; scutellum yellowish with fulvous spots on each side at base and fuscous dots in basal angles on the disk and at the margins toward the apex; elytra sub-hyaline, veins and areolar spots fuscous, about four broad cross-veins on outer part of costa, apical margins fuscous; abdomen pale yellowish above, with basal bands of black. Beneath, dark fuscous or blackish; front brown with disk of lateral arcs fuscous; clypeus blackish; cheeks and loræ light yellowish with

fuscous areas; thorax blackish; femora, except at tips, dark fuscous; fore and middle tibiæ light brown; hind tibiæ fuscous, with light brown margins interrupted with black; hind tarsi at tips, tips of joints, and claws blackish; ventral segments blackish at base, with narrow yellowish border; the last ventral segment yellowish, tinged with fuscous; pygofer fuscous with yellowish margins and setæ.

Length: 5 mm.

Described from one female specimen, *holotype*, Bonda, Colombia, July, 1898, C. M. Acc. No. 1999 (H. H. Smith *coll.*).

This is a well marked species belonging in the group with *E. irroratus*, and distinguished by the numerous cross-veins and the small size.

Genus ACINOPTERUS Van Duzee.

Acinopterus Van Duzee, Psyche, Vol. VI, 1892, p. 308.

Recognized by the short rounded head, with the vertex short and rounded to front, and especially by the acutely pointed elytra, which narrow from the middle with the costal border curved, while the inner border is straight. The type of the genus is *Acinopterus acuminatus* Van Duzee.

24. *Acinopterus acuminatus* Van Duzee.

Acinopterus acuminatus Van Duzee, Psyche, Vol. VI, 1892, p. 308.

(For additional synonymic references consult Van Duzee, *Catalogue of the Hemiptera of America North of Mexico*, p. 675.)

Dark gray or brownish, often greenish, especially in fresh specimens; elytral veins more or less margined with fuscous.

Represented in the Carnegie Museum by specimens from Bonda, Colombia, July, 1898, C. M. Acc. No. 1999 (H. H. Smith *coll.*).

The South American specimens, which are referred to this species, reveal a range of variations similar to that shown by North American forms, two of which have been designated as varieties by Ball:

Var. *brunneus*, brown, or brownish, with veins distinctly infuscated;

Var. *viridis*, green, or greenish, with veins rather faintly infuscated.

From the general neotropic distribution of the species and the fact that its occurrence in the United States was not recorded until 1892, it is probably a tropical or sub-tropical form, which has spread northward, until now it covers most of the United States.

Genus THAMNOTETTIX Zetterstedt.

Thamnotettix Zetterstedt, Ins. Lapponica, 1840, Column 292.

25. *Thamnotettix altus* sp. nov.

Head as wide as pronotum; vertex broad, rounded in front, scarcely longer at middle than next the eye; front narrowing gradually from below the eye; clypeus nearly twice as long as wide, widening toward the apex; loræ narrow, not reaching border of cheek; outer border of cheek distinctly sinuate. Pronotum twice as long as vertex, slightly emarginate behind; elytral veins distinct; claval veins not connected by a cross-vein. *Genitalia: male*, valve small, sub-angulate or rounded behind; plates broad, tapering slightly toward broad upturned tips, sparsely set with short bristles.

Vertex light brown or fulvous, with curved band on the disk, connected at ends with a marginal fuscous border, extending slightly beyond the red ocelli; a fuscous picture on the face, including margins of the front, the short transverse arcs and the central patch, including a narrow yellowish line, inner border of cheeks, and loræ black; clypeus brown with tip blackish; outer portion of cheeks dull yellow. Pronotum brown, with the anterior border blackish; the hind portion of the disk irrorate with fuscous; scutellum with large basal triangles, two large dots on the disk, and a spot on each side within the border, fuscous; disk and middle part of apex fulvous; lateral borders yellowish; elytra sub-hyaline, with coppery metallic tints; the veins dark fuscous; thorax light-brown; legs brownish, the posterior pair striped with black; tibiæ with brown spines. Abdomen black; hind margins of segments and connexivum below, and the genital plates, dull yellowish.

Length: 5 to 6 mm.

Seven male specimens in author's collection; three from Coroico Yungas, Bolivia, April 16, 1899; and four specimens from Chulumani, Bolivia, Dec. 9, 1898. This is a very well marked species, apparently related to *Thamnotettix serius* Stål, but with a very different picture on the vertex and face, and it also is much smaller. *Type* and *paratype* in collection of author; *paratypes* in the Carnegie Museum and the United States National Museum.

26. *Thamnotettix serius* Stål. (Plate LVIII, fig. 2).

Jassus (Thamnotettix) serius Stål, Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 52.

Blackish; front with lines in each side; small spot below eyes on cheek; basal spots on vertex often transversely confluent; thorax in front, scutellum, four small basal spots, apical half, and also pectus,

pale dull reddish yellow. Thorax in front irrorate, or bimaculate with black. Elytra and feet fuscous-testaceous. Veins of elytra beyond the middle, and intra-costal stripes, and tibial spines, white. Length, 8 mm.; width, 2 mm.; Var. with feet paler.

Head obtuse, broadly rounded; vertex margined; parallel; nearly three times wider than long; thorax anteriorly rounded, transversely lightly rugulose, nearly three times longer than vertex; elytral veins toward apex obsolete. (From Stål's original description).

The male genitalia, as shown by the figure, have the valves angular behind, and the plates broad; outer margin rounded, the tips contracted.

No specimens, which can be referred to this species, have been seen in the collections of the Carnegie Museum, but the larger part of the material examined has been from the interior basin of the Amazon, while this species was described from Rio de Janeiro. The above description based upon Stål's Latin diagnosis, with the excellent figure by Madame Ekblom, should make the identification easy.

27. *Thamnotettix luctuosus* Stål. (Plate LVI, fig. 1).

Jassus (Thamnotettix) luctuosus Stål, *Eugenies resa*, Ins. Hemipt., 1858, p. 292.

The original description given by Stål, as cited above, is here reproduced:

"Nigricans, vel nigro-fuscus; margine basali verticis, vitta clypei, loris (macula excepta), genis extus, linea longitudinali media, maculis 2 anticis parvis lineolaque subcurvata utrimque antico-laterali thoracis, vitta clavi ad suturam, lineola longitudinali corii prope basin venaque ad suturam clavi, nec non fronte pallide flavescens, hujus maculis 3 basalibus, linea longitudinali media, vittaque utrimque (e lineolis transversis) supra medium cum opposita convergente et cum eadem maculaque basali media confluenta, nigro-fuscis; corii limbo costali ultra medium decolore, hyalino. ♂, ♀. Long. 4.66, Lat. 1.5 millim.

Patria: California, Punà, Taiti.

Variat colore nigro in capite thoraceque minus extenso, quare thorax tunc magis flavescens, maculis 2 anticis fasciaque indistincta posteriore nigro-fuscis; scutelli maculis 2 basalibus vittaque posteriore flavescens.

Caput obtuse rotundatum, vertice oculo singulo vix duplo latiore, ubique æquilongus. Thorax vertice duplo longior; longitudine plus duplo et dimidio latior. Tegmina abdomen nonnihil superantia, venis subtilibus, areolis apicalibus elongatis."

A rendering of the foregoing is as follows:

Blackish, or black-fuscous; the basal margin of the vertex, a band

on the clypeus, the loræ (a spot excepted) the outer parts of the cheeks, a median longitudinal line, two small spots in front, and a somewhat curved fine line on both sides of the front side of the thorax, a band on the clavus at the suture, a fine longitudinal line on the corium near the base, the veins as far as the suture of the clavus, and the front, pale yellowish; the front with three basal spots, a longitudinal median line and a band on either side (composed of fine transverse lines) converging above the middle with an opposite spot and with the above mentioned middle basal spot, black-fuscous; the costal margin of the corium beyond the middle without color, hyaline. ♂, ♀. Length, 4.66, width, 1.5 mm.

Habitat: California, Puna, Taiti.

It varies sometimes in having the black color of the head and the thorax reduced, in which case the thorax is then yellower, the two anterior spots and the indistinct posterior band of the scutellum black-fuscous; the two basal spots of the scutellum, and the posterior band yellowish.

Head obtusely rounded; vertex scarcely twice the width of a single eye, throughout of equal length. The thorax twice as long as the vertex, more than two and one-half times wider than it is long. The elytra slightly surpassing the abdomen, the veins fine, the apical areoles elongated.

Thamnotettix luctuosus Stål has not been recognized by me in any of the material submitted to me for examination, but the foregoing original description and the figure of the type by Madame Ekblom will, no doubt, easily enable students to recognize the species.

28. *Thamnotettix fuscipennis* sp. nov.

Small, slender, head wider than pronotum; vertex nearly as long as middle as next the eye, sub-angulate, rounded to front; ocelli close to the eyes; front broad, convex, narrowing rather abruptly to the clypeus; clypeus broad, sides nearly parallel; loræ small, not reaching margin of cheek; cheeks narrow, outer margin sinuate. Pronotum a little longer than vertex, hind margin scarcely concave; scutellum as long as vertex; elytra with venation distinct. *Genitalia: female*, last ventral segment truncate, or slightly emarginate.

Vertex yellow, with fulvous angular spots; four black dots on the anterior margin. Pronotum olive-green with two fulvous stripes on the disk, and traces of a fulvous stripe on each side; scutellum yellowish, marked with fulvous; elytra dark brown or fuscous; the veins and patches in the areoles black fuscous; the inner border of the clavus margined with yellowish; a rather broad blackish spot on the veinlets at each end of the outer antepical cell; beneath, face blackish; front dark fuscous with yellowish arcs and central line; clypeus, loræ, and cheeks, except the margin, blackish; thorax and abdomen

blackish; legs light yellow, except tip of tibiae and tarsal joints, which are faintly smoky.

Length: 3.75 mm.

Described from two female specimens, *type* and *paratype*, from Province del Sara, Bolivia, C. M. Acc. No. 5064, Feb. 1913 (Steinbach *coll.*). This species is most easily recognized by the light vertex and pronotum, the fulvous stripes, the dark elytra, and the blackish face.

29. *Thamnotettix clypeatus* sp. nov.

Robust; head scarcely wider than pronotum; vertex subangulate, one-third longer at middle than next the eye, obtusely angulate to front; front broad, narrowing from antennal pits to clypeus, merging into clypeus with indistinct sutures; clypeus long, slightly widened toward tip; loræ broad, distant from cheek border; border of cheek broadly sinuate. Pronotum nearly as long as vertex, strongly arched in front, truncate behind; elytral veins distinct; clavus with extra cross-veins, middle anteapical divided by a distinct cross-vein; a few cross-veinlets in inner anteapical and outer part of costal areoles. *Genitalia: male*, valve short, rounded behind; plates narrow, tapering to sharp upturned tips, margins with strong cilia.

Dull gray; vertex with four dots on anterior border, two slightly curved transverse bars on the disk. Pronotum with five whitish lines; elytral veins whitish, faintly margined with fuscous; front with light fuscous arcs; clypeus mostly fuscous; a dark dot on border of loræ; thorax, abdomen, and legs gray; femora and tibiae banded with fuscous; tarsal claws blackish.

Length: 5 mm.

One specimen, *type*, Province del Sara, Bolivia, C. M. Acc. No. 5064 (Steinbach *coll.*).

30. *Thamnotettix colonus* (Uhler).

Deltocephalus colonus Uhler, Proc. Zool. Soc. London, 1895, p. 80.

Athysanus villicus Crumb, Ann. Ent. Soc. Am., Vol. VIII, 1915, p. 194.

Thamnotettix colonus Van Duzee, Cat. Hem., 1917, p. 684.

Head slightly wider than pronotum, subangulate; vertex about as long as width between the eyes, more than half longer at middle than next the eye; front narrowing to clypeus, with which it is apparently fused, and continued with nearly straight margins to tip; clypeus narrow, slightly widening toward tip; cheeks sinuate. Pronotum about as long as vertex, strongly arched in front; margin nearly straight behind; elytra without second cross-vein. *Genitalia: female*, last ventral segment half longer than preceding, truncate; *male*, valve triangular; plates broad at base, tapering to narrow tips.

Light yellow; vertex with two large round black spots; face yellow, front and clypeus having brown borders, a blackish spot beneath antennæ, and two black dots bordering the eye. Pronotum yellow, with a brownish band near the hind border; scutellum yellow, with brownish triangles on the basal angles; elytra with brownish and yellow stripes, and a yellow costa; corium and apex transparent, or slightly smoky.

Length: 3.25 mm.

Five specimens from Bahia, Brazil, Jan. 7, 1908, C. M. Acc. Nos. 3765 and 4135 (Haseman *coll.*). One specimen from Lagoa Feia, Brazil, collected at night, June 29, 1908, by Haseman.

This species was originally described from the Island of St. Vincent, West Indies, and is a very common species in the southern United States. Evidently the above records carry it well into South America. As no records are at hand for Mexico and Central America it may be assumed as probable that the connection between North and South America has been by the way of the West Indies. In the southern states it occurs in enormous numbers in grass-lands, especially on Bermuda- and St. Augustine-grass, and may be considered as an economic pest, where these grasses have value as forage.

31. *Thamnotettix comatus* (Ball).

Deltocephalus comatus Ball, Canadian Entomologist, Vol. XXXII, 1900, p. 343.

Thamnotettix comatus Van Duzee, Cat. Hem. 1917, p. 684.

Closely resembling *T. colonus* (Uhler). Head wider than pronotum, subangulate; vertex a little wider than length at middle; one-fourth longer at middle than next the eye; front narrowed, scarcely separated from clypeus; clypeus with sides nearly parallel. Pronotum strongly arched in front, hind border nearly straight; elytral veins as in *T. colonus*. *Genitalia: female*, last ventral segment nearly twice as long as preceding, truncate or slightly concave; *male*, valve large, subangulate behind; plates short, triangular, tips bluntly angular.

Greenish yellow; vertex pale yellow, two large round black spots nearer the eye than to the center; two minute dots at apex of center, and in strongly marked specimens a pair of dots near the eye and a short oblique line on the disk, black. Pronotum olive-green, paler in front, with a pair of brownish spots on the front border, and in strongly marked specimens black dots on the disk and an oblique dash at the side, black; scutellum pale yellow, with black triangles on base; elytra pale green, nervures lighter yellowish; face light yellow with brownish borders on front and clypeus, a black spot under antennæ and two black dots next the eye; thorax and abdomen mostly black. *Genitalia: female* pygofers yellowish, marked with

black; *male*, valve and plates pale, the latter with an oblique fuscous mark near the border.

Dr. Ball described this species as from Orizaba and "other Mexican points." The author's collection contains specimens of his own collection from Orizaba, Mexico, and from Santa Lucia, Los Amates, and Gualan, Guatemala, collected by J. S. Hine. There are specimens in the Carnegie Museum from Santarem, Brazil, Acc. No. 2966 (H. H. Smith *coll.*) and Acc. No. 4043, Dec., 1909 (Haseman *coll.*). These Brazilian specimens are not as strongly marked, and in some cases lack the discal dots of the pronotum, but in other respects they seem definitely to belong to this species. It is quite similar to *T. colonus* Uhler, differing in the black markings of the pronotum, lacking the brown band of the pronotum, and perhaps differing in the details of the genitalia. Inasmuch as these differences appear to be emphasized in specimens from the more northern localities, it seems probable that the two species originated from a common stock, probably indigenous in the Amazonian basin.

32. *Thamnotettix acuminatus* (Uhler).

Deltocephalus acuminatus Uhler, Proc. Zool. Soc. London, 1895, p. 80.

Elongate; head scarcely wider than pronotum, distinctly angulate in front; vertex scarcely wider than length at middle, nearly half longer at middle than next the eye, rounded to front; front broad, sides nearly parallel, abruptly narrowed at apex; clypeus long, slightly widened at tip; loræ broad; cheeks broad, distinctly sinuate. Pronotum half longer than vertex, strongly arched in front, sinuate behind the eye, truncate behind; scutellum rather small; elytra reaching to tip of pygofer, but not to tip of ovipositor. *Genitalia: female*, last ventral segment with lateral angles rounded, hind borders slightly produced, feebly sinuate; ovipositor long, exceeding the pygofer by one-third its length.

Light green above, mostly black below; vertex yellowish green, two large black spots on anterior border, united at base of front and continued as a median stripe including a yellow line, frontal arcs light yellow; clypeus light yellow with a median black spot; borders of loræ black; cheeks beneath the eye to the border, black. Pronotum yellowish green, a black band between the eyes; scutellum yellowish, bordered with black at base; elytra greenish with a more or less hyaline disk and apex. Beneath, black; legs dull yellowish; hind tibiæ with dots and apex fuscous; hind tarsi bordered with fuscous; claws blackish.

Length: female, 3.75 mm.

Collected at Boqueirão, Rio Grande, Brazil, Jan. 8, 1908, C. M. Acc. No. 3533 (Haseman *coll.*).

This species was described from the island of St. Vincent, and evidently has a considerable distribution in South America, although it does not appear to have been recorded for this region.

33. ***Thamnotettix chapadensis* sp. nov.**

Head slightly wider than pronotum, obtusely angulate; vertex broad, nearly twice as wide as length at middle, nearly one-half longer at middle than next the eye; front convex; clypeus with a broad ridge on the disk; loræ nearly touching margin of cheek; margin of cheek nearly straight. Pronotum nearly twice as long as vertex, truncate behind; scutellum with an acute point at tip. *Genitalia: male*, valve obtusely angled; plates elongate; tapering gradually from base to the compressed, bluntly rounded tip.

Dull yellow; vertex with a distinct marginal line starting just behind the ocelli, disk faintly infuscated. Pronotum yellowish with fine brown irrorations, darker toward the posterior border; scutellum light yellowish, with a dark median line and becoming darker to the longitudinal white lines of the base; elytra suffused with metallic brown, the veins broadly dark brown or fuscous, apex smoky, beneath uniformly yellow.

Length: 4 mm.

One specimen, male, *type*, from Chapada, Brazil, C. M. Acc. No. 2966 (H. H. Smith *coll.*).

34. ***Thamnotettix hyalinipennis* Stål.** (Plate LVIII, fig. 1).

Jassus (Thamnotettix) hyalinipennis Stål, Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 52.

This species was described in Part 2 of this series of papers from females, identified by Stål's description. Since the publication of Part 2 we have received a careful drawing of the type, which is a male (See Pl. LVIII, fig. 1), and we have also had in hand a specimen of the male, which beautifully agrees with the type as figured, and also with the females, which have been described. The male valve is rather large, broadly rounded behind; the plates distinctly convex at the base; the outer margin faintly sinuate, the tips acute, and the margins minutely ciliate.

In the figure received from Madame Ekblom the cilia seem too long for normal, and have somewhat the appearance of bearing minute threads of mold. In every other respect the drawing fits

our specimens so closely as to make sure that we have correctly identified the male.

This male specimen is from Cachoeiro, Santos, Brazil, taken June, 1908, C. M. Acc. No. 3579 (Haseman *coll.*). This record adds another locality to those already given for the species.

35. *Thamnotettix magnificus* sp. nov.

Very large; head wider than pronotum, short, bluntly arched; vertex very broad, scarcely as long at middle as next the eye, disk minutely rugose, anterior margin rounded to front; front broad at base, narrowing rather uniformly to apex, somewhat flattened; clypeus widening toward the tip, apex truncate; loræ broad, outer margins strongly arched, approaching border of cheek; cheeks narrow, scarcely sinuate. Pronotum more than three times as long as vertex, strongly arched in front, lateral margins very short, faintly carinate, postero-lateral margin oblique, angles broadly rounded, hinder border sinuate; scutellum triangular; elytra long, narrow, considerably narrowed behind the middle, appendix large, outer antepical cell shorter. *Genitalia: female*, last ventral segment twice as long as preceding, hind border a little produced and with a broad notch reaching about one-fourth the distance to the base.

Light creamy-yellow; two bands on the head, one just before and one just behind the line joining the ocelli, orange; a faint orange band on the front in line with the antennæ; a stripe between the ocelli and on base of vertex, pale vitreous. Pronotum fulvous, the basal and lateral border and a transverse band parallel to the anterior border, vitreous, becoming yellow laterally; scutellum fulvous on basal half and at tip, with a cross-band of pale yellow behind the middle; elytra fulvous, with yellowish hyaline areas, one at base, a broad one at apex of scutellum, an oval one at middle, and an elongate one bordering the claval suture to the tip, a basal, four discal, and one sub-apical elongate, somewhat quadrangular, nearly in line from base to end of costa; a black broken stripe from base paralleling claval suture to the end of the middle antepical cell, a black spot covering the second apical cell; apical border of membrane smoky, interrupted with dull hyaline; wings black. Beneath uniformly light cream-yellow, tarsal claws fuscous; tergum and upper pygofer black; ovipositor light brown, darker at tip.

Length: 12 mm.

One female specimen, *type*, Quatro Ojos, Bolivia, C. M. Acc. No. 5065, Nov., 1913 (Steinbach *coll.*).

This is the largest species which I have so far seen in this genus, and it bears a striking resemblance to some of the ornate species of *Cicadella*.

36. *Thamnotettix luteus* sp. nov.

Head slightly wider than pronotum, rather strongly arched and faintly subangulate; vertex broad, three times as wide as length, scarcely wider at middle than next the eye, rounded to front; front broad, slightly convex, narrowing sharply from antennæ to clypeus; clypeus scarcely widened toward the tip; loræ large, almost reaching border of cheek; cheeks broad, sinuate. Pronotum twice as long as vertex, nearly truncate behind; elytra long, veins distinct, except those surrounding outer anteapical. *Genitalia: male*, valve one-half longer than last ventral segment, apex blunt; plate exceeding valve by more than twice its length, broad at base, gradually rounded to blunt, slightly rounded apices.

Pale straw-color; vertex with a light brown band, paralleling the margins; eyes brownish. Pronotum faintly marked along anterior border; scutellum with four whitish areas on the basal margin; elytra pale luteous, sub-hyaline; the veins of clavus and inner part of corium and tip, whitish; sub-costal indistinct. Beneath uniformly pale straw-color, tip of rostrum black.

Length: 5 mm.

One specimen, *type*, from St. Isabel, Uruguay, Nov. 12, 1909, C. M. Acc. No. 3793 (Haseman *coll.*).

37. *Thamnotettix venatus* sp. nov.

A slender species, head slightly broader than pronotum, angulate; vertex one-half longer in middle than next the eye, as long in middle as width between the eyes; front rather long; sides sinuate; apex rather narrow; clypeus elongate, nearly twice as long as width at base; loræ small, distant from border of cheek; margin of cheek slightly sinuate. Pronotum as long as vertex, twice as wide as long; hind border faintly concave; scutellum scarcely as long as pronotum; elytral venation conspicuous; the central anteapical cell closed at center by fusion of veins. *Genitalia: female*, last ventral segment slightly produced and thickened at the middle, lateral angles rounded.

Ivory-fulvous; vertex ivory-white, with two fulvous and four dark points on the anterior border, two close to the apex, and ocher stripes half-way to the eye on each side. Pronotum fulvous, with a central and lateral stripe in the hind border, ivory-white; scutellum mostly fulvous; elytra with the veins broadly ivory-white; the areoles fulvous, with fuscous borders; a darker fuscous spot at center of clavus, and another behind the middle of costa and the apical portion of the inner anteapical, the first and second apical areoles infuscated; front olive-gray with whitish arcs; elytra dusky; cheeks whitish with margins of loræ fuscous; legs whitish; anterior femora

annulate with fuscous; tarsal claws blackish; abdomen beneath whitish; apex of last ventral segment smoky.

Length: 3.50 to 3.75 mm.

Described from five specimens from Province del Sara, Bolivia: three taken in Nov., 1909, C. M. Acc. No. 4549, 450 M.; one in Dec., 1913, C. M. Acc. No. 5064; the fifth in Dec., 1918, C. M. Acc. No. 6443, 450 M. (Steinbach coll.).

Type and *paratypes* in Carnegie Museum. *Paratype* in Osborn Collection.

This species has much the appearance of the light form of *Deltocephalus inimicus*, but, aside from the difference in venation, the details of the color-pattern are distinct. It is similar to *Deltocephalus lepidellus* Stål, (See Plate LVII, fig. 1), differing from that species in the narrower body.

In venation these species resemble the group of *Thamnotettix shermani*, *T. crumbi*, etc.

Genus TERULIA Stål.

Terulia Stål, Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 50.

38. *Terulia ferruginea* Stål.

Terulia ferruginea Stål, Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II' K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 50.—Spångberg, Homoptera Americana, 1879, Pt. 6, p. 20.

Large ovate; head much narrower than pronotum, obtuse in front; vertex the width of the eyes, wider than long, scarcely longer at middle than next the eye; ocelli about twice as far from each other as from the eyes; front rather narrow, distinctly carinate; clypeus long, expanded at tip, carinate; loræ elongate; cheeks narrow, deeply sinuate under the eyes. Pronotum short, more than half longer than vertex, strongly carinate at sides, distinctly granulate; scutellum acuminate, rather minutely granulate on the disk; elytral veins raised. *Genitalia: female*, last ventral segment nearly three times longer than preceding; middle part produced, rounded; a distinct carina, diminishing to base.

Uniformly rusty brown, scarcely paler below.

Length: female, 12 mm.

A single specimen in the collection of the author from Bartica, British Guiana, Aug. 16, 1901, collected by H. S. Parish. This

specimen differs from Spångberg's description in lacking the yellow margins of the vertex and the middle line of front, and also in the greater length of the last ventral segment, but agrees so closely in all other respects that it can hardly be separated as a distinct species. Considering the frequent differences of coloration of the sexes and a very close agreement indicated by the figures it seems very probable that *T. nigriceps* Stål is the male of *ferruginea* Stål, in which case it would become a synonym, as *T. ferruginea* appears first on the page of Stål's paper.

Genus JASSUS Fabricius.

Jassus Fabricius, *Systema Rhyngotorum*, 1803, p. 85.

39. *Jassus venosus* (Germar).

Cælidia venosa Germar, *Mag. d. Ent.*, Vol. IV, 1821, p. 76.

Cælidia venosa Burmeister, *Handb. d. Ent.*, Vol. II, Pt. I, 1835, p. 114.

Cælidia venosa Walker, *Homoptera*, Pt. III, 1852, p. 852.

Head narrow; vertex about as long as wide, somewhat produced before the eyes, sub-angulate in front; front narrow, widening slightly below the eyes, distinctly carinate; clypeus long, more than twice as long as wide, with a central carina, tip expanded; loræ narrow; cheeks with outer border distinctly sinuate. Pronotum longer than vertex, widened behind; hind border slightly concave; scutellum acuminate, nearly as long as vertex and pronotum together; elytral veins conspicuous, elevated. *Genitalia: female*, last ventral segment elongate, much produced on the middle, and distinctly carinate; *male*, plates elongate, compressed, upturned at tips.

Dark brown; vertex and pronotum with fulvous lines, the latter with numerous minute dots; scutellum lineate, dotted on the disk; elytral veins with numerous yellowish or ivory dots, an irregular band of spots across the middle of clavus and a triangular spot toward the tip, opposite the transverse vein; beneath light brown, tips of tibiæ and tarsal claws darker.

Length: female, 10 mm.

Two females from Santarem, Brazil, July, 1919, C. M. Acc. No. 6324 (S. M. Klages *coll.*); one female, Minca, Colombia, June, C. M. Acc. No. 1999 (H. H. Smith *coll.*).

I have also a specimen in my own collection from Bartica, British Guiana, May 25, 1901, collected by H. S. Parish. This species is evidently common over a large area of northern South America, ranging from the Carribean to central Brazil.

40. *Jassus cingulatus* (Stål).

Cælidia cingulata Stål, Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 50.

Head broad, but not as wide as pronotum. Vertex quadrate, wider than long, slightly convex in front; front narrow, widening below the eyes, distinctly and rather sharply carinate; elytra long, twice as long as width at base, enlarged, and with the borders somewhat reflexed at tip; loræ narrow, angulate above and below; cheeks narrow, slightly sinuate. Pronotum longer than vertex, granulate; scutellum acuminate, faintly granulate on the disk; elytra with veins prominent and bearing numerous elevated yellowish dots. *Genitalia: female*, last ventral segment twice as long as preceding, middle portion somewhat produced, faintly carinate; *male*, valve represented by the membranous lobes extending upon the plates; plates elongate, flattened, appressed to the pygofer; tips acute, curved upward; the surface slightly ridged; pygofers broad, narrowing posteriorly to tip of plates.

Testaceous; vertex with a fulvous band back of the ocelli; ocelli black; front with fuscous spots and short arcs; elytra, loræ, and lower part of the cheeks with fuscous spots. Pronotum dark fuscous, with numerous fulvous or yellowish granular dots; scutellum black with sparsely dotted fulvous granules on the disk; tip brownish yellow; elytra dark brown to fuscous, with a sub-hyaline spot in the basal areas, a distinctly sub-hyaline band broken by the veins, crossing the elytra behind the scutellum, and another band somewhat less regular across the apex of clavus; apical cells dark brownish or fuscous with some lighter vitreous patches; thorax and abdomen beneath yellowish, with fuscous patches on pleural pieces and coxæ; the legs lineate with fuscous; tips of tibiæ and tarsal claws blackish.

Length: female, 9 to 10 mm.

Three female specimens are referred to this species: one from Chapada, Brazil, C. M. Acc. No. 2966, Sept. 1, (H. H. Smith *coll.*); one from Province del Sara, Bolivia, C. M. Acc. No. 5064 (Steinbach *coll.*); one from Pied Saut, Oyopok River, French Guiana, C. M. Acc. No. 6111 Nov., 1917 (S. M. Klages *coll.*).

Three male specimens from Province del Sara, Bolivia, bearing the same date and locality as the females mentioned above, are also referred here, and one male specimen from Santa Cruz de la Sierra, Bolivia, 450 M., Nov., 1910, C. M. Acc. No. 4549 (J. Steinbach *coll.*).

The four males, which must quite certainly be referred to this species, show variation in the coloration of the vertex in front, but agree in so many other details that there seems little question of their identity.

41. *Jassus limpidosparsus* (Stål).

Cælidia limpidosparsa Stål, Eugenies resa, Ins. Hemipt., 1858, p. 290; Bidrag till Rio Janeiro-Traktens Hemipter-fauna, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, No. 6, 1860, p. 51.

Head rounded in front; vertex nearly quadrate, scarcely as wide as long, with a median carina; front narrow, with a median carina; clypeus long, twice as long as width at base, apex expanded. Pronotum slightly longer than vertex, distinctly granulate; elytral veins raised, and with rather sparse swollen dots. *Genitalia: female*, last ventral segment twice as long as preceding; produced and rather deeply notched at middle.

Light brown; vertex immaculate. Pronotum mottled with fuscous; scutellum with two light spots near the base, behind which are two dark brown or fuscous spots. Elytra black or smoky, the elevations of the veins light yellow; irregular transverse broken bands, one crossing middle of clavus, the other just behind tip of clavus; the large spot on costa a little darker than the other spots. Beneath, face dull yellowish-brown; borders of front with reddish stripe; apex of clypeus black; legs light brown. Abdomen black; pygofer brown.

One specimen from Bartica, British Guiana, May 6, 1901, in collection of author (H. S. Parish coll.).

42. *Jassus adspersus* (Stål).

Cælidia nigrina Stål, Œfvers. Vet. Ak. Förh., Vol. XI, 1854, p. 254, ♂.

Cælidia adspersa Stål, Œfvers. Vet. Ak. Förh., Vol. XI, 1854, p. 254, ♀;—Eugenies resa, Ins. Hemipt., 1858, p. 290. ♂, ♀.

Jassus adspersus Spångberg, Œfvers. K. Vet. Ak. Förh., Vol. XXXV, No. 8, 1878, p. 21.

Head narrow and subangulate in front; vertex narrow at base, widened to tip, carinate; front narrow with numerous arcs, and central carina. Pronotum as long as vertex, granulate; elytral veins with numerous swollen dots. *Genitalia: female*, last ventral segment produced at middle; lateral angles prominent, not as long as the middle; *male*, plates rather broad, flat, slightly upturned, acute at tip.

Black; female lighter than male; vertex light grayish, with light fuscous spots. Pronotum black, with yellowish granules, scutellum black, with yellow dots; margin yellowish; elytral veins with numerous yellow raised dots; the costa pale. Beneath blackish; front with numerous transverse fuscous arcs. Legs brown, striped with black. In the female the legs entirely black, as also the lower part of the front and the costal border.

Length: female, 6 mm.; male, 5 mm.

Two specimens, male and female, Cruz Alta, Rio Grande do Sul, Brazil, in the author's collection. Originally described from Montevideo, Uruguay.

43. *Jassus nervosus* (Fabricius).

Jassus nervosus Fabricius, Systema Rhyngotorum, 1803, p. 85.

Cælidia pæcila Germar, Mag. d. Ent., Vol. IV, 1821, p. 77.—Walker, Homoptera, Pt. III, 1851, p. 852.

Jassus nervosus Stål, Hemiptera Fabriciana, 1869, p. 79.

Head narrow; vertex slightly longer than wide; margin slightly raised, scarcely produced before the eyes; front narrow, widening to beneath the eyes, contracted sharply to clypeus, with a prominent sharp central carina; clypeus twice as long as width at base, expanded at apex, distinctly carinate; loræ elongate, somewhat elevated near the anterior border; cheeks with outer border slightly sinuate. Pronotum short, a little longer than vertex; lateral angles prominent; scutellum acuminate; elytral vein somewhat elevated; inner vein of clavus obscure. *Genitalia: female*, last ventral segment long, twice as long as preceding; the middle part slightly produced, with central carina and a slight apical notch.

Brown; vertex anteriorly brown; posterior half yellowish; front brown; border between vertex and front with two dark spots enclosing ocelli; apex of front and base of clypeus whitish, forming part of the transverse band underneath the eye, extending to the propleuræ; apex of clavus, tips of loræ, and lower part of cheek, brownish, or dark fuscous. Pronotum and base of scutellum, brown; apex of scutellum yellowish; elytra brown, with sub-hyaline yellowish white patches on the costa, apical part of corium; and dark fuscous patches on the clavus at base of corium, and occupying the larger part of the apical part of corium; beneath, coxæ and bases of femora, blackish; the rest of legs dull yellowish with tips of tibiæ and tarsal joints and claws smoky.

A specimen referred to this species is from the Mana River, French Guiana, May, 1917, C. M. Acc. No. 6008 (Klages coll.).

44. *Jassus ruficosta* Jacobi.

Jassus ruficosta Jacobi, Sitzungsber. Ges. Naturf. Freunde, Berl., 1905, p. 187.

Head broad, moderately arched; vertex about as long as width between the eyes, widening forward; front widening to below the eyes, narrowed abruptly to clypeus, with a low sharp median carina; clypeus longer than wide, widening at tip. Pronotum slightly longer than vertex, minutely granulate; scutellum small, acuminate, minutely striate on the disk. *Genitalia: female*, last ventral segment long, lateral angles rounded, posterior margin with four sharp teeth, the inner ones separated by a deep notch; ovipositor long, extending beyond the tip of pygofer, and about one-fourth its length beyond the tip of elytra; *male*, valve hidden; plates elongate, bluntly rounded at tips.

Female uniformly black, with a pale band across the apex of vertex and base of front; vertex mostly yellowish, with black dots; minute yellowish dots on the elytral veins. Male with dull brown or reddish on costa, extending over the outer anteapical cell; beneath blackish, with narrow yellow margins on pleural pieces; middle and fore tibiæ pale, and hind tibiæ somewhat brownish; pleural pieces and abdominal segments narrowly margined.

Three specimens in the collection of the author, two females and one male, taken at Marcapata, Peru, the type-locality.

45. *Jassus bellus* Jacobi.

Jassus bellus Jacobi, Sitzungsber. Naturf. Freunde, Berl., 1905, p. 185.

Head broad, distinctly arched; vertex widening from base to front, longer than width at base of eyes; front widening to below the eyes, rounding to clypeus, without central carina; clypeus short, inflated; loræ very narrow, reaching tip of clypeus; cheeks with outer margins nearly straight. Pronotum slightly longer than vertex, strongly arched between the eyes; scutellum acuminate; margins at apex elevated; elytral nervures raised. *Genitalia: male*, plates narrow; margins raised; apex blunt.

Black, conspicuously marked with orange-yellow; vertex bordered with yellow; two stripes from inner angles of eye across pronotum and scutellum and a large lateral patch, apex of scutellum, outer part of clavus, especially at base, large patch occupying costal and discoidal areoles on the middle third, and a row of oblique dots and spots from tip of clavus to apex, orange; beneath black, tips of fore and middle femora, margins of pleural pieces, and narrow margin of abdominal segment orange-yellow.

Three specimens in the collection of the author, two from Calanga, Peru, a type-locality, and one from Yungas, Bolivia.

46. *Jassus montanus* Jacobi.

Jassus montanus Jacobi, Sitzungsber. Naturf. Freunde, Berl., 1905, p. 187.

Head broad and short; vertex slightly wider than long, rounded anteriorly; margins slightly elevated; front scarcely narrowing below, truncate at apex, sharply carinate; clypeus twice as long as width at base, widened at apex with a central elevated ridge; loræ narrow, acutely angular below; cheek margins sinuate. Pronotum short, scarcely longer than vertex, hind border sinuate; pronotum, scutellum, and elytral veins granulate. *Genitalia: female*, last ventral segment two and one-half times as long as preceding; hind border slightly produced, with a broad notch at the middle and a central carina.

Black, or dark fuscous; vertex and eyes pale; front blackish with short transverse light arcs; clypeus, loræ, and cheeks dirty white, with

some faint fuscous patches. Pronotum and scutellum black, with whitish granules; elytra black, smoky, with the veins bearing elevated ivory-white dots; a broken transverse band just behind scutellum, and another just at the tip of the clavus, expanded on the costa; beneath black; legs pale brownish, with femoral lines, tips of tibiæ, and tarsal claws, blackish.

Length: female, 7.25 mm.

One specimen from Quatro Ojos, Bolivia, Nov., 1913, C. M. Acc. No. 5065; one specimen from Province del Sara, Bolivia, April, 1913, C. M. Acc. No. 5064 (Steinbach *coll.*).

My collection includes three specimens from Callanga, Peru, the type-locality of the species. The species appears to vary considerably in the intensity of coloration, especially on the front, and in the extent of the transverse bands of the elytra.

47. *Jassus dissolutus* Jacobi.

Jassus dissolutus Jacobi, Sitzungsber. Naturf. Freunde, Berl., 1905, p. 186.

Head broad, obtusely rounded; vertex wider than long, widening slightly toward the apex; ocelli in slight depressions close to anterior border; front rather narrow, about equally broad at apex and at base of apex, with a distinct median carina; clypeus somewhat tumid, obtusely carinate; apex scarcely expanded; loræ narrow, sharply angular; cheeks narrow, outer margin nearly straight. Pronotum longer than vertex, distinctly granulate; scutellum acuminate, slightly granulate on the disk. *Genitalia: male*, plates narrow, strongly up-curved at middle, widening toward the tips, then narrowing to widely separated acute tips.

Black with numerous yellow or whitish dots; vertex yellowish with an oblique spot between the eyes and a discal dot below the base. Pronotum and scutellum black, closely dotted with yellow; tip of scutellum yellow; elytral veins with conspicuous yellow dots; a series of sub-hyaline spots near base, another forming a transverse band beyond apex of scutellum, and a third more broken band at apex of clavus; these appear as transverse bands and spots interrupted by the veins; face black with front marked with short arcs and irregular spots; disk of clypeus yellowish; borders of loræ and cheeks pale; pleural pieces and margins of abdominal segments black, with yellow margins; legs fuscous, or blackish; tibiæ paler.

Length: 8 to 10 mm.

Three specimens in the collection of the author, one from Marcapata, Peru, and two from Yungas, Bolivia, type-localities.

48. *Jassus lugubris* Spångberg.

Jassus lugubris Spångberg, Species Jassi generis Homopt., Æfvers. Ak. Förh., Vol. XXXV, 1878, p. 16.

Black or dark fuscous; head obtuse; vertex about as long as wide; sides divergent; ocelli in sunken areas between carinæ; front elliptic, distinctly carinate; clypeus twice as long as wide, carinate, expanded toward tip. Pronotum a little longer than vertex, granulate; elytra broad, rather short. *Genitalia: female*, last ventral segment twice as long as preceding; hind border faintly sinuate, shallowly notched at center.

Face, pronotum, scutellum, and most of elytra, black, or dull fuscous; vertex and base of front yellowish white, with fuscous patches on the middle of front and reddish suffusion at base of front; ocelli black; elytra with dull brown markings, forming an indistinct band behind middle of clavus, and the apical areoles mostly dull brown with the margins smoky; wings smoky; veins black. Beneath blackish; abdominal segments margined with yellowish; legs mostly dark fuscous; tips of femora and base of tarsal joints lighter.

Length: 7 mm.

One specimen from the Mana River, French Guiana, June, 1917, C. M. Acc. No. 6009 (Klages *coll.*) agrees very closely with Spångberg's description of the female from "Cayenne."

49. *Jassus atratus* Fabricius.

Jassus atratus Fabricius, Systema Rhyngotorum, 1803, p. 86.

Jassus atratus Stål, Hemiptera Fabriciana, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. III, 1869, p. 80.

Head obtuse; vertex as long as width between the eyes, slightly divergent anteriorly, scarcely depressed at ocelli; front elliptic, faintly carinate; clypeus sub-carinate, widened at tip, truncate, or slightly concave. Pronotum as long as vertex, granulate. *Genitalia: male*, plates narrow, elongate, somewhat twisted and compressed toward the acuminate tips.

Vertex and face pale olivaceous; borders of front reddish. Pronotum, except anterior border, scutellum, and a broad area of elytra widening to cover the apical part, black, or fuscous; clavus, costa, and most of anteapical cell, brownish-hyaline; veins black; wings smoky, with black veins; thorax and abdomen black, with pale brownish borders; fore and middle legs pale brown; hind legs blackish; apex of femora and of tibiæ and the tarsal joints, pale brown.

Length: male, 8 mm.

One male specimen from Las Juntas, Bolivia, Dec., 1913, C. M. Acc. No. 5066 (Steinbach *coll.*), answers very closely to Stål's description and more nearly represents this species than any specimens

I have seen. It is, however, near enough to *J. pruinus* or *J. auratus* to be the male of one of these species.

50. *Jassus pruinus* (Germar.)

Cælidia pruinosa Germar, Mag. d. Ent., Vol. IV, 1821, p. 78.—Walker, Homoptera, Pt. III, 1851, p. 853.

Jassus pruinus Spångberg, Öfvers. Vet. Ak. Förh., Vol. XXXV, 1878, p. 14.

Head broad and short, not as wide as pronotum; vertex broader than long, slightly rounded in front, borders scarcely raised; front long, ovate, faintly carinate; clypeus long, sides nearly parallel; apex slightly expanded; loræ elongate, narrowed below; cheeks sinuate. Pronotum broad, short, about one-fourth longer than vertex, minutely granulate; elytral veins raised, not pustulate. *Genitalia: female*, last ventral segment very long, two and one-half times as long as preceding, with a broad triangular tooth behind, and a rather prominent central carina.

Brown; some specimens distinctly pruinose; vertex and eyes above, greenish olive; vertex with two dark dots on the disk behind ocelli; face light olive-green; lateral borders of front and the central part of clypeus reddish. Pronotum brown; scutellum brown with a discal fuscous spot, wanting in some specimens; elytra brown with a central discoidal areole, an oblique patch on anteapical and apical areoles, fuscous; beneath greenish; the legs tinged with fuscous; tips of tibiæ and the tarsal claws blackish.

Length: female, 8.5 to 10 mm.; male, 8 to 9 mm.

One specimen, Hyatanahan, Rio Purús, Brazil, Mar., 1922, C. M. Acc. No. 6963 (S. M. Klages *coll.*); one specimen, Las Juntas, Bolivia, Dec., 1913, C. M. Acc. No. 5066 (Steinbach *coll.*).

51. *Jassus auratus* (Fabricius).

Cercopis aurata Fabricius, Mantissa Insectorum, Vol. II, 1787, p. 274.

Cercopis aurata Fabricius, Entomologia Systematica, Vol. IV, 1794, p. 52.

Cercopis aurata Fabricius, Systema Rhyngotorum, 1803, p. 95.

Jassus auratus Stål, Hemiptera Fabriciana, Pt. II, K. Svensk. Vet. Akad. Handl., Vol. VIII, 1864, p. 80.

Pale yellowish olive, tinged with brownish; head obtuse; vertex scarcely as long as width between eyes; ocelli prominent, scarcely farther from each other than from border of eye; front narrow with a distinct, but low, carina; clypeus twice as long as width at base, expanded at tip; apex concave. Pronotum a little longer than vertex, minutely granulate; scutellum granulate on base; elytral veins distinct. *Genitalia: female*, last ventral segment twice as long as preceding, produced on the middle, deeply sinuate at the sides, strongly carinate, notched at tip.

Olivaceous; ocelli red; margins of front red. Pronotum, scutellum, and elytra light brown; veins darker; apex sub-hyaline; wings smoky; veins distinctly blackish; proboscis, spines of hind tibiæ, and the tarsal claws, infuscate.

Length: 8 mm.

One female specimen from Quatro Ojos, Bolivia, Nov., 1913, C. M. Acc. No. 5065 (Steinbach *coll.*). This agrees closely with Stål's description of the Fabrician species, except that it is not quite as long. Stål says: "*J. pruinoso maxime affinis, dilutior, excepta differentia parva picturæ vix divergit nisi segmento ultimo ventrali apud feminam apice utrimque latius et minus profunde sinuato,*" and it appears quite possible, from the few specimens I have seen, that these species may be the same. In this case *J. auratus* has priority. Spångberg lists *J. pruinosus* from both Brazil and Cayenne, so that there is no basis of distribution, upon which to separate the two species, unless Spångberg's reference of the Cayenne specimens should have been to *J. auratus*.

52. *Jassus ensiger* sp. nov.

A large species with male plate slender, elongate, and slightly curved or sword-shaped at tip; head obtuse; vertex slightly produced before the eyes; wider than long, scarcely longer at middle than next the eye, with a faint carina at base; ocelli nearly twice as far from each other as from border of the eye; front with a small, but distinct, carina; clypeus tumid at base, subcarinate toward tip, expanded toward apex, deeply concave at apex. Pronotum a little longer than vertex, distinctly granulate; scutellum minutely, but sparsely, granulate at base. *Genitalia: male*, plates long, slender, widest about the middle with a strong carina near the margin, the apical part narrowed, gently curved, sword-shaped, and acute at tip.

Greenish yellow or pale olive, tinged with brown; ocelli brown; borders of front tinged with fulvous, or orange. Pronotum, scutellum, and elytra suffused with brown; the corium with a fuscous cloud on the disk, and the principal veins black; wings smoky, veins black; thorax and abdomen greenish yellow, with broad fuscous areas on the abdominal segments; male plates tinged with brown; legs pale brown; hind femora and tibiæ tinged with fuscous.

Length: 9 mm.

Described from one male specimen, type, Hyatanahan, Rio Purús, Brazil, Mar., 1922, C. M. Acc. No. 6963 (S. M. Klages *coll.*). This species belongs with the *pruinosus-auratus* group, but is different from any form which I have met. Except in size, the species might be considered as the male of *J. auratus*.

53. *Jassus maculipennis* Spångberg.

Jassus maculipennis Spångberg, *Æfvers. K. Vet. Ak. Förh.*, Vol. XXXV, 1878, p. 29.

Head broad, short; vertex about as long as width at base with faint carina; lateral margins slightly elevated; front margin between ocelli subangulate; front widening to below the eye, then narrowing to base of clypeus, faintly carinate; clypeus broad, elevated to beyond the middle; apex expanded; cheeks distinctly sinuate. Pronotum short, scarcely longer than vertex, minutely granulate; scutellum large, acuminate, very minutely granulate on disk, and striate on apex; claval veins parallel. *Genitalia: male*, valve hidden; plates elongate, tapering toward tip, curved upward; tips acute.

Vertex and face greenish yellow, with broad ferruginous stripes bordering the front and united on base and central apex of clypeus. Pronotum black, anterior border brown; scutellum black, narrowly margined with brown; elytra smoky black; the clavus from tip of scutellum to apex, and the costa and costal border, brown. Beneath black, fore and middle legs, and apical part of hind femora, pale.

Length: 8 mm.

This species was described from Bogotá, and I have four specimens in my collection from Marcapata, Peru. These are somewhat larger than Spångberg indicates, and differ slightly in the color-pattern.

54. *Jassus ferruginosus* sp. nov.

Head broad, short; vertex wider than long, rounded anteriorly; ocelli distinctly on the border between vertex and front; front narrow, widening to below the eyes, with a faint median carina; clypeus twice as long as width at base; apex expanded; cheeks narrow, sinuate. Pronotum scarcely as long as vertex, distinctly granulate; scutellum broad, disk depressed, lateral borders elevated, basal part minutely granulate. *Genitalia: female*, last ventral segment long, about four times as long as preceding segment, lateral angles rounded; posterior border sinuate, with a shallow notch at middle and a median carina.

Uniformly rusty brown; vertex and face paler, light brown; legs light brown; pectus and base of abdomen black; last ventral and preceding segment light brown; pygofer and ovipositor reddish brown, the latter tipped with black; scutellum with a narrow black line at base, close to the lateral margin; elytra sub-hyaline; veins a little darker; a smoky patch in the outer apical cell.

Length: 8 mm.

Described from one female specimen, *type*, from Chapada, Brazil, August, C. M. Acc. No. 2966 (H. H. Smith *coll.*).

This species appears to come near to *J. meditabunda* Spg., but,

aside from the much longer female ventral segment, it differs from the description in lacking the black markings on scutellum and elytra.

55. *Jassus brunneus* sp. nov.

Head scarcely wider than pronotum, rather strongly arched; vertex broad, obtusely angularly produced before the eyes; ocelli distinctly behind its anterior border; lateral margins nearly parallel; width a little longer than length at middle, about one-fourth longer at middle than next the eye; front broad at base, elevated below antennæ, narrowed to clypeus, with a distinct carina and transverse rugæ; clypeus broad at base, narrowing to near tip, then abruptly widened, obscurely carinate; loræ small; cheeks deeply sinuate below the eye. Pronotum about one-fourth longer than vertex, distinctly granulate; scutellum deeply depressed on disk; lateral margins elevated; disk minutely granulate. *Genitalia: female*, last ventral segment one-half longer than the preceding, hind border nearly truncate, faintly notched at middle.

Dark-brown, a little paler below; the costal margin and a small irregular band beginning in first outer apical cell and extending to tip of clavus, and the tips of the two middle apical veins, smoky; pleural pieces and margins of abdominal segments black, or fuscous.

Length: 8 mm.

Described from two female specimens, one, the *type*, from the Mana River, French Guiana, May, 1917, C. M. Acc. No. 6008 (S. M. Klages *coll.*); and another in the collection of the author, *paratype*, from Bartica, British Guiana, May 24, 1901 (H. S. Parish *coll.*).

The latter specimen differs from the type in lacking the black stripe of the front and the black color of the clypeus, and is less conspicuously marked with black on the thorax. The shape of the vertex is distinctly different from related forms of *Jassus* in the distinctly angular border and position of the ocelli, which might almost be considered as placing it in the Genus *Gypona*. However, in all essential structures it is distinctly a *Jassus*.

56. *Jassus fascifrons* sp. nov.

Pronotum distinctly wider than the head; head somewhat arched; vertex longer than wide, with a median carina and lateral elevated margins; ocelli close to the front margin; front long, rather narrow, distinctly carinate; clypeus long, slightly expanded at apex, distinctly carinate; loræ and cheeks narrow. Pronotum slightly longer than vertex, granulate; scutellum acuminate, sparsely granulate toward base; elytral veins with raised spots. *Genitalia: female*, last ventral

segment three times as long as preceding, carinate, and distinctly produced, with a shallow notch at apex; pygofer short, compressed toward the tip, exceeded by the ovipositor, which extends nearly to tip of elytra.

Light yellow; the vertex with fuscous patches in the depressions. Pronotum black with yellow granulations; scutellum black with lateral margins and apex yellow; elytra whitish hyaline, with veins blackish, distinctly marked with light yellow dots, a narrow smoky band near base, a broad band extending from costa and covering the clavus back of the scutellum; wings at apex smoky; face yellow, a broad stripe on each side of the front, enclosing a narrow brownish line extended on to the clypeus, the middle part of which is fuscous with a central yellowish line; the loræ bordered with black; pleural pieces crossed by black bands; legs light brownish, with fuscous annulations. Abdomen black above, yellowish at the margins. Beneath, yellowish, a broad smoky stripe on each side of last ventral segment; the pygofer brownish yellow with a black stripe; ovipositor brown, tipped with black.

Length: 9 mm.

Described from two female specimens, *type*, and *paratype*, from Santarem, Brazil, June and July, 1919, C. M. Acc. No. 6324 (S. M. Klages *coll.*).

This is a very well marked species, approaching *J. cingulatus* and *J. dissolutus* in size, but with a very different picture for elytra and face.

57. *Jassus spinosus* sp. nov.

Head almost as wide as pronotum, bluntly rounded; vertex about as wide as long, with lateral median carinæ; front with sides nearly parallel, a distinct median carina; clypeus expanded slightly at tip, elevated at base and carinated toward tip; loræ and cheeks narrow, border of cheek deeply sinuate below the eye. Pronotum as long as vertex, hind border sinuate; elytral veins slightly elevated; hind tibiæ with very strong spines. *Genitalia: female*, last ventral segment twice as long as preceding; hind border faintly sinuate, a slight notch at the center.

Rusty brown; beneath slightly paler; a faint fuscous patch at the end of the costal cell.

Length: ♀, 6.5 mm.

Described from a single specimen, *type*, in collection of author, from Bartica, British Guiana, Mar. 20-30, 1901 (H. S. Parish *coll.*).

58. *Jassus dentatus* sp. nov.

♀. Head broad, rounded in front; vertex quadrate, slightly produced before the eyes, with lateral and median carinæ, and shallow depressions between it and the front, including the ocelli; front with sides nearly parallel; apex expanded, sinuate, elevated at base and obtusely carinate toward tip. Pronotum scarcely longer than vertex, granulate; hind border sinuate; scutellum with a broad depression behind the middle, minutely granulate at base; elytral veins slightly raised. ♂, agreeing perfectly with the female in details of structure, but the pronotum, scutellum, front, cheeks and pleural pieces are somewhat darker fuscous. *Genitalia: female*, last ventral segment about three times as long as preceding; deeply incised at the middle, with a broad central tooth, as long as the lateral lobes; *male*, plates rather broad, elongate, strap-like, with longitudinal rugæ and bluntly rounded tips.

Uniformly rusty brown with very faint smoky patches at base of outer anteapical cell; scutellum with fuscous triangles at basal angles and two round fuscous spots on the disk.

Length: female, 7 mm.; male, 6 mm.

Described from one female, *type*, from Villa Bella, Bolivia, Oct. 6, 1907, C. M. Acc. No. 4043 (Haseman *coll.*); and a male, *paratype*, taken along the Guaporé below Rio S. Miguel, Brazil, Aug. 22, 1909, C. M. Acc. No. 4043 (Haseman *coll.*). This is very similar to *J. spinosus*, but the last ventral segment is so totally different, that they must be considered distinct.

There is a second male from Taperina, Brazil, C. M. Acc. No. 2966 (H. H. Smith *coll.*), which is very similar to the above, but with lighter sub-hyaline elytra, having a broad smoky band behind the clavus. It also probably belongs here.

59. *Jassus ater* (Walker.)

Cælidia atra Walker, Homoptera, Pt. III, 1851, p. 853.

Head narrower than pronotum, rather short; vertex scarcely as wide as pronotum, wider than long; vertex depressed, with lateral and median carinæ, a transverse carina behind the depressions, including the ocelli; front narrow, with a strong carina; clypeus widening from base toward tip, slightly expanded at tip, the base tumid and apical part carinate; loræ narrowed below; cheeks narrow, deeply sinuate. Pronotum densely granulate; scutellum faintly granulate at base. *Genitalia: male*, plates broad, widening to middle, then narrowing and compressed to blunt tips.

Black; vertex yellowish with fuscous, ocellate dots near base, and

a transverse broken fuscous band anteriorly; ocelli and median depression blackish; borders of the eye, short transverse arcs of front, and the base of clypeus, yellowish. Underside and abdomen black, with pleural pieces and borders of abdominal segments yellowish; fore and middle legs and hind femora, yellowish; hind tibiæ blackish.

Length: 7.5 mm.

Specimens from Chapada, Brazil, C. M. Acc. No. 2966, Jan. (H. H. Smith *coll.*), and San Antonio de Guaporé, Brazil, July 26, 1909; and Rio Guaporé below Rio S. Miguel, Aug. 22, 1901, C. M. Acc. No. 4043 (Haseman *coll.*).

60. *Jassus marginatus* (Stål).

Cælidia marginata Stål, Stett. Ent. Zeit., Vol. XXV, 1864, p. 85.

Jassus marginatus Spångberg, Species Jassi gen. Homopt., Æfvers. K. Vet. Ak. Förh., Vol. XXXV, No. 8, 1878, p. 20.

Head broad, almost equal to width at pronotum, broadly rounded in front; vertex a little wider than long, scarcely longer in middle than next the eye; ocelli well forward on border between vertex and front; front narrow, faintly carinate; clypeus expanded at tip, slightly elevated on basal half of median line; loræ and cheeks narrow; cheek border sinuate. Pronotum short, as long as vertex; minutely granulate; scutellum broad, acuminate at apex; elytral veins strong, not dotted. *Genitalia: female*, last ventral segment produced at middle, bi-sinuate, strongly carinate; *male*, plates narrow, upturned, compressed at tips.

Black; vertex and face greenish yellow with broad orange-red stripes bordering the front. Pronotum, scutellum, and elytra dark smoky, or blackish; the costal areole and an extension into outer antepical cell and outer apical areole yellowish; commissural border of clavus brownish. Beneath yellowish, with dark spots on pectus and coxæ. Abdomen above black on the disk, reddish brown on the sides, yellowish brown beneath. In the males the colors are generally darker, the thorax and abdomen beneath largely black; legs yellowish or light-brown; hind tibiæ and the tarsal joints somewhat marked with fuscous.

Length: ♀, 6.5 mm.; ♂, 5.5 mm.

One female specimen from Mana River, French Guiana, May, 1917, C. M. Acc. No. 6008 (Klages *coll.*) is referred to this species. The collection of the author includes a number of specimens from Pt. Barrios, Los Amates, and Mazatenango, Guatemala, collected during February and March, 1905, by Prof. J. S. Hine.

The description of the male is drawn from one of these specimens. The females are distinctly lighter colored, but otherwise apparently

identical, and it is possible that the lack of coloring indicates immaturity instead of variation.

Stål described this species from Mexico. These records carry the species through Central America and northern South America to the Guianas. The species resembles *J. melanotus* Spg., of the southern United States. The vertex appears shorter, but the genitalia are quite similar, and it is possible that, with collections in intermediate territory, it will be found that the species are one, with a continuous distribution from Ohio to South America, accompanied by variations in color.

61. *Jassus interruptus* sp. nov.

Head rather narrow, somewhat produced before the eyes; vertex widening from base to anterior border, slightly longer at middle than next the eyes, with lateral and median carinæ; ocelli in a depression between carina of vertex and base of front; front narrow, with transverse rugæ, and a scarcely visible median carina; clypeus long, twice as long as width at base, expanded at apex, tip truncate; loræ narrowed below; cheeks deeply sinuate below the eye. Pronotum a little longer than vertex, broadly sinuate behind, distinctly granulate; scutellum acuminate, sparsely granulate at base; elytral veins raised. *Genitalia: male*, plates narrow at base, widening and distinctly compressed toward the tip; apex rounded, reaching tip of pygofer.

Fuscous, or blackish; vertex dull yellowish with numerous fuscous dots, and three blackish patches across the disk; and a transverse bar behind the ocelli. Pronotum and scutellum black, with the granulations yellow; elytra dark brown, or fuscous; smoky toward the tip, an indistinct broken band across middle of clavus, and a more distinct broken band of fulvous spots crossing the tip of clavus; elytral veins and costal area with numerous yellow dots; front black, with broken transverse arcs yellowish; clypeus black, margin and lateral spots near apex yellowish; loræ and cheeks mostly black, with dull yellow borders; thorax and abdomen black; margins of the pleural pieces, the abdominal segments, and the legs mostly light brown or yellowish.

Length: 9 mm.

One male specimen, *type*, from Province del Sara, Bolivia, 450 M., C. M. Acc. No. 6443 (Steinbach *coll.*). This species approaches *J. cingulatus* Stål, but the carina of front is much smaller and the genital plates narrower than in the males of that species.

62. *Jassus pallidus* sp. nov.

Head narrower than pronotum, distinctly arched, rounded in front; vertex slightly longer than width at base, disk depressed, forming lateral and median carinæ; ocelli set between transverse ridges; front narrow, a distinct central carina; clypeus nearly twice as long as width at base, a little widened at tip; apex convex; loræ and cheeks narrow; cheek margins deeply sinuate under the eyes. Pronotum longer than vertex, minutely granulate; scutellum smooth, polished; elytral veins slightly raised. *Genitalia: male*, plates long, boat-shaped; widening to the middle, then narrowing to blunt points.

Almost uniformly light brown, below a little paler, tinged with yellow; male plates brown; elytral veins with faint elongate yellowish dots; ocelli, eyes, and tarsal claws, blackish.

Length: 7 mm.

Described from one male specimen taken on the Rio Guaporé, near Ft. Principe, Brazil, Aug. 25, 1909, C. M. Acc. No. 4043 (Hesman *coll.*).

This is a very light-colored species, possibly immature, although in all details of structure it appears fully matured.

63. *Jassus ampliatus* sp. nov.

Broad; head narrower than pronotum, broadly rounded; vertex about as long as wide, disk with two depressions on each side, a faint median carina; ocelli in slight depressions; front strongly carinate; clypeus narrow at base, widening to tip; a distinct median carina; tip truncate; loræ sharply angled below; cheek narrow. Pronotum short, scarcely longer than vertex, distinctly granulate; scutellum minutely granulate at base; elytra very broad; apex broadly rounded. *Genitalia: female*, last ventral segment twice as long as preceding; rather deeply excavated within the lateral angle, middle part somewhat produced and broadly notched and carinate; *male*, plates flat, rather narrow, at base, widening to center, then narrowed to acute tips, the outer part partially twisted, so as to form a keeled structure.

Dull black or deep fuscous; vertex ivory-white, faintly marked with fuscous in the depressions; ocelli black; front at base ivory-white, merging into red-brown; the disk black, with numerous sharp reddish arcs, base of clypeus ferruginous; rostrum yellowish. Pronotum, scutellum, and elytra dull black; elytra with obscure rusty-brown patches on clavus and disk; costal areole black, veins dotted with dull rusty brown; wings brownish smoky. Beneath, thorax and abdomen black, with pleural pieces and abdominal segments narrowly margined with yellow or brown. In the male, the plates are

dull brown; legs black; fore and middle tibiae, apex of hind tibiae, and tarsi, mostly brownish.

Length: female, 7 mm.; male, 7 mm.

Described from two specimens, one a female, *type*, from Las Juntas, Bolivia, Dec., 1913, C. M. Acc. No. 5066 (Steinbach *coll.*); and one male, *paratype*, from Province del Sara, Bolivia, 450 M., Nov., 1909, C. M. Acc. No. 4549 (Steinbach *coll.*).

These specimens agree so perfectly in every detail of structure and coloration, that it seems perfectly safe to connect them as the sexes of one species, although they were taken at different localities and at different times.

64. *Jassus foveatus* sp. nov.

Head narrower than pronotum; vertex as long as wide, contracted at base, widening at front of eyes; disk depressed; margins elevated, a median carina forked and becoming obsolete anteriorly, with two elevations near the eye, a strong anterior carina, forming distinct depressions for the ocelli, between which there is a double fovea; front elongate, ovate; margins slightly raised, median carina distinct; clypeus long, more than twice as wide as width at base, distinctly widened at tip; apex truncate; lorae elongate, sharply angular above and below, cheeks narrow, deeply sinuate beneath the eye. Pronotum as long as vertex, rather coarsely granulate; scutellum minutely granulate on the disk; base and angles polished, very minutely granulate; tip minutely rugose; elytra broad; apex rounded. *Genitalia*: *male*, plates long, nearly flat, each with a strong polished acute tubercle at base, rather thin, flattened, narrowed toward the tip to a bluntly rounded apex, reaching tip of pygofer.

Light brown; vertex with fuscous dots on the disk; ocelli whitish; front ferruginous with short lateral arcs, and antennal pits fuscous. Pronotum piceous, brownish at the sides; scutellum piceous-black; tip brownish; elytra brownish, with smoky, fuscous, somewhat iridescent border, extending as a band across the disk before the cross-veins, and reaching the costa on base of outer apical cell; veins with faint yellowish dots on clavus and within the smoky band.

Length: 4.5 mm.

Described from one male specimen, *type*, Taperina, Brazil, C. M. Acc. No. 2966 (H. H. Smith *coll.*).

65. *Jassus loricatus* sp. nov.

Head narrower than pronotum, moderately arched; vertex as long as wide, slightly divergent anteriorly, disk depressed, lateral and median carina distinct, and a low ridge anteriorly behind ocelli, and a shallow median depression between the ocelli; front with sides

almost parallel; a distinct median carina; clypeus nearly twice as long as wide, slightly expanded at tip; apex rounded or sub-truncate; loræ narrow below, margins of cheeks sinuate. Pronotum as long as vertex, distinctly granulate; scutellum acuminate, basal part granulate. *Genitalia: male*, plates large, longer than all preceding segments of abdomen taken together, widened to the middle, coarsely rugose, narrowed and somewhat compressed apically; tips bluntly angular, reaching tip of the pygofer.

Vertex pale fulvous or yellowish, with margins ivory-whitish; ocelli black; front ferruginous, with transverse arcs and central stripe, black; clypeus ferruginous, with discal patches toward the apex; loræ brown, with fuscous disks; cheeks at base somewhat infuscated. Pronotum and scutellum black; elytra brownish, subhyaline, more opaque and fuscous at base, and with a broad fuscous band beginning with outer apical cell and widening to the inner margin, where it covers from the end of the first claval vein to more than half of the appendix; veins with very faint yellowish spots, most evident in the dark band of the outer part. Beneath brownish; base of abdomen fuscous; genital plates brown; legs mostly brownish; tips of tibiæ and tarsal claws darker.

Length: 6.5 mm.

Described from one male specimen, *type*, San Antonio, Bolivia, July 26, 1909, C. M. Acc. No. 4043 (Haseman *coll.*).

66. *Jassus carinatus* sp. nov.

Head broad, not as wide as pronotum, bluntly rounded to front; vertex as long as wide, slightly widened at apex, disk depressed; carina conspicuous, an elevated spot near base and deep depressions on each side of ocelli, and a shallow depression between them; front flat, distinctly carinate; clypeus twice as long as basal width, expanded at tip, apex truncate, basal part with a slight elevation becoming carinate on center, and reaching two-thirds the length. Pronotum short, as long as vertex, rather coarsely granulate; scutellum acuminate, granulate at base; elytra broad, slightly passing the ovipositor. *Genitalia: female*, last ventral segment with lateral angles slightly produced, hind margin sinuate, a narrow deep notch and a prominent median carina; pygofers short, reaching about two-thirds length of the ovipositor.

Brownish fuscous; vertex pale brown, the carina lighter; ocelli whitish; front brown, median carina black, with two spots near center, transverse arcs dark fuscous; clypeus pale brown at base; disk and central apex brownish; lateral lobes dark fuscous; loræ black; cheeks brown. Pronotum piceous on the central part, pale brown laterally, with yellowish granules; scutellum brown, with fuscous patches at base and apex; elytra dark brown, nervures dark

fuscous, with numerous light brown or yellowish elongate dots; a paler spot on clavus at end of second nerve, and another at tip of clavus on base of membrane.

Length: 7 mm.

One female specimen, *type*, Rio de Janeiro, Brazil, August, C. M. Acc. No. 2966 (H. H. Smith *coll.*). A second specimen, taken on the Rio Guaporé, near Ft. Principe, Aug. 25, 1909, C. M. Acc. No. 4043 (Haseman *coll.*), agrees very closely with the type, but the costal area is darker and includes a lighter patch toward the end of the outer anteapical cell. It is also somewhat lighter colored, but the picture of face and elytra appear to be the same.

67. *Jassus dubius* sp. nov.

Similar to *J. carinatus*, but darker, and with two distinct bands on elytra; head broad, bluntly rounded; vertex with prominent carina, a basal elevation on the disk on each side; ocelli with depressions on each side and a shallow one between; front rather narrow, distinctly carinate; clypeus twice as long as wide, tip expanded, or truncate, a distinct elevation, or median carina, extending to the tip. Pronotum scarcely longer than vertex, distinctly granulate; scutellum acuminate, sparsely granulate, and minutely rugose at base; elytra broad, short, extending a little beyond the end of abdomen. *Genitalia: male*, plates narrow at base widening slightly to middle, then narrowed to blunt tips, the outer three-fourths somewhat inclined; tips slightly divergent, extending beyond tip of pygofer.

Mostly black; vertex pale; pronotum, scutellum, and elytra black, with yellowish granules and dots; the elytra with two sub-hyaline bands, one just beyond tip of scutellum, the other behind tip of clavus. Beneath black; margins of front and transverse arcs, and two or three dots on the carina, testaceous; base and carina of clypeus, brown; margins of pleural pieces and abdominal segments yellowish; legs black, fore and middle tibiæ and apical part of hind tibiæ paler.

Length: 6.25 mm.

One male specimen, Province del Sara, Bolivia, C. M. Acc. No. 5064 (Steinbach *coll.*); two male specimens from the same locality, 450 M., Nov., 1909, C. M. Acc. No. 4549 (Steinbach *coll.*).

This form agrees so closely with the female of *J. carinatus* that it seems quite likely to belong with that species, but, aside from the quite different locality, the difference in the carina of the clypeus, and the presence of two distinct transverse bands, suggest that it may be distinct; and, until definitely connected with that species, it had better be placed under a separate name.

68. *Jassus cinnamomeus* sp. nov.

Head narrower than pronotum, sub-angulate in front; vertex slightly produced, a little longer than wide, margins slightly divergent, feebly carinate, median carina obsolete in front, transverse carina including ocelli and a shallow depression at the middle; front narrow, flat, a distinct median carina; clypeus twice as long as wide, with a median elevation extending beyond the middle; tip expanded and truncate; loræ and cheeks narrow. Pronotum as long as vertex, rather sparsely granulate, hind border nearly truncate; elytra long, rather narrow. *Genitalia: male*, plates rugose at base, widening to the middle, distinctly carinate, compressed, and bluntly rounded at apex, which extends beyond tip of pygofer.

Dark fuscous or brown; the vertex, pronotum, and scutellum rather deep fulvous, tinged with cinnamon; front, loræ, and clypeus reddish brown; cheeks mostly fuscous; elytra dark fuscous, with two bands, one back of the scutellum, which is distinctly angulate, the other nearly transverse across tip of clavus; veins dotted with yellow, entire elytra tinged with cinnamon. Beneath, black; borders of pleural pieces and abdominal segments yellowish; legs brown; base of hind tibiæ and the tarsal claws fuscous.

Length: 7.5 mm. to 7.75 mm.

Two male specimens, one, *type*, Province del Sara, Bolivia, C. M. Acc. No. 5064, Oct., 1913; and one, *paratype*, Province del Sara, Bolivia, 450 M., C. M. Acc. No. 4549 (Steinbach *coll.*).

This species appears to be related to *J. conspersinervis*, but the genital plates and the color of the face are quite different. The cinnamon tinge, if constant, is a good diagnostic character.

69. *Jassus triangularis* sp. nov.

Head broad, moderately arched; vertex quadrate, scarcely exceeding the eyes; lateral and median carinæ distinct; anterior carina weak; ocellar fovæ shallow; front yellow, sides parallel; clypeus nearly twice as long as width at base, scarcely expanded at tip; front and clypeus both with median carina; cheeks narrow, margins slightly sinuate. Pronotum a little wider than vertex, rather sparsely and coarsely granulate; scutellum granulate at base; elytra passing beyond abdomen. *Genitalia: male*, plates narrow at base, strongly carinate, expanded toward tips, narrowing to blunt apex.

Dark above, pale below; vertex whitish, with depressed areas suffused with brown; face dull yellow, the frontal arcs brownish. Pronotum, scutellum, and elytra mostly dark fuscous or blackish, granulations yellow; a triangular hyaline spot on costa; the apical part smoky, subhyaline; veins dotted with yellow; a series of irregular sub-hyaline patches extend across the clavus, and there is a sub-

hyaline patch at base of membrane. Beneath uniformly dull straw-colored or yellowish; tarsal claws dark; male plates brownish.

Length: 5.75 mm.

Described from one male specimen, *holotype*, from the banks of the Rio Guaporé below Rio S. Miguel, Brazil, Aug. 22, 1909, C. M. Acc. No. 4043 (Haseman *coll.*).

This species is about the size and has the general appearance of *D. flavicosta* Stål, but is much paler below and the carinæ of head are less prominent.

70. *Jassus bisinuatus* sp. nov.

Small, broad; head broadly rounded; vertex short, wider than long; carina weak; front narrow, sides nearly parallel; median carina distinct; clypeus short, elevated on the middle; scarcely expanded at tip, truncate; loræ elongate; margin of cheek sinuate. Pronotum a little longer than vertex, granulate; elytra broad, short, broadly rounded at tips, reaching tip of ovipositor. *Genitalia: female*, last ventral segment long, hind border deeply sinuate on each side; lateral angles and central lobe equally produced; ovipositor extending beyond tip of pygofer about one-fourth of its length.

Dark brown, or blackish; vertex brown, carina darker. Pronotum and scutellum margined with brown; elytra dark fuscous; a large triangular area extending from costa nearly to clavus, light brown, subhyaline; apex smoky with subhyaline areas; veins spotted with yellowish; front brown at base, black at apex, with alternating reddish and black arcs; clypeus brown, with fuscous margins; face mostly fuscous; legs brown.

Length: 6 mm.

Described from one female specimen, *type*, collected at Santarem, July, 1919, C. M. Acc. No. 6324 (S. M. Klages *coll.*).

This may very probably be the female of *J. tubus*, with which it agrees closely in the color-pattern, but it cannot with certainty be referred to that species.

71. *Jassus tubus* sp. nov.

Small, robust; head nearly as wide as pronotum, broadly rounded in front; vertex about as long as wide, carina rather weak; ocellar pits shallow; front with sides nearly parallel; median carina distinct; clypeus twice as long as width at base, elevated on the middle, slightly expanded, truncate at tip; loræ narrow, cheeks moderately sinuate. Pronotum scarcely as long as vertex; hind border sinuate; elytra broadly rounded at tip, extending beyond the tip of abdomen. *Genitalia: male*, plates widening a little from the base, taken together, they are tubular in form, the tips blunt.

Black and brown; vertex light brown, with ivory-yellowish margins and carina; ocelli black, base of front reddish brown; disk and apical portion black; arcs light brown; clypeus reddish brown with blackish margins; loræ and cheeks black, narrowly margined with paler. Pronotum black, with reddish brown granules; scutellum black, margined with brown; elytra dark fuscous, with a large brown opaque area, extending from costa to near the clavus; apex brownish; veins spotted with reddish brown. Beneath, pleural pieces and coxæ black, with yellowish brown borders; abdomen reddish brown; legs with coxæ, most of femora, and hind tibiæ, blackish.

Length: 5.5 mm.

Described from one male specimen, *holotype*, Pied Saut, Oyapok River, French Guiana, Dec., 1917, C. M. Acc. No. 6111 (S. M. Klages coll.). This species resembles *J. bisinuatus* in the color-pattern, and may possibly be the male of that species.

72. *Jassus flavifrons* sp. nov.

Head short, vertex narrowed at base, broadly rounded at front; front long, narrowed below the eyes; truncate at tip, without carina; clypeus elevated at base, obtusely carinate toward tip; apex slightly expanded, truncate; loræ narrow; cheeks narrow, slightly sinuate. Pronotum nearly twice as long as vertex, strongly arched between the eyes, hind border nearly straight; scutellum acuminate. *Genitalia: male*, plates narrow, bent upward at middle, scarcely widened apically, tips obtuse.

Black, minutely dotted with yellow; vertex black, margined narrowly with yellowish next the eye; front, except at base, and basal half of clypeus, ivory-yellow; apex of clypeus testaceous, the borders black; loræ and cheeks black. Pronotum, scutellum, and basal half of elytra minutely dotted with dark yellow, elytra merging into fuscous brown on the apical half; beneath black, fore and middle legs with apex of femora, tibiæ, and tarsi, light brown; hind legs black; base of first tarsal joint brownish; tarsal claws blackish.

Length: male, 7.5 mm.

Described from numerous specimens from Coroico Yungas, among them the *type*, and Chulumani, Bolivia, *paratypes*, in the collection of the author and in the Carnegie Museum.

This well marked species seems distinct from any of the described forms, although occurring in a region from which a number of species have been described.

Genus NEOCÆLIDIA Gillette and Baker.

Neocælidia Gillette and Baker, Hemiptera of Colorado, 1895, p. 104.

73. *Neocœlidia ornata* sp. nov.

Head short, scarcely produced, narrower than pronotum; vertex wider than long, as long at middle as next the eye; ocelli considerably below the middle of the eye, three times their diameter from the eye; antennæ extremely long, longer than entire insect, the outer part of setæ very delicate and irregularly bent and twisted; front somewhat inflated, narrowed abruptly at tip; clypeus short, scarcely longer than wide, widening toward the tip, apex truncate; loræ broad, approaching border of cheek; cheeks broad. Pronotum short, one-half longer than vertex, lateral borders curved, hind border faintly sinuate; elytra long, narrowing to apex, appendix narrow. *Genitalia: male*, plates short, tumid; tips compressed, and bluntly rounded.

Light yellow, with the hinder border of pronotum and cheek, lateral and apical portion of scutellum, a broad discal and apical spot on clavus, an elongate basal spot on corium, a transverse discal spot from sub-costa to claval suture touching apical spot on clavus, two somewhat oblique spots on antepical cells, orange-red; a darker orange band bordered with fuscous on antepical cells; four blackish dots on apical veins; apical areoles smoky; wings milky subhyaline. Beneath, pale creamy; tarsal claws dusky.

Length: 6.75 mm.

This very ornate species is represented by a single specimen from Valparaiso (2500 ft.) Dept. of Magdalena, Colombia, July, 1898, C. M. Acc. No. 1999 (H. H. Smith *coll.*).

This species differs from any other of the genus in the short vertex and the position of the ocelli. The antennal setæ are even longer than is usual in this genus, and it is possible that with additional material at hand it may prove proper to set it apart as constituting a separate genus.

Genus EUGNATHODUS Baker.

Eugnathodus Baker, *Invertebrata Pacifica*, Vol. I, 1903, p. 1.

74. *Eugnathodus lineatus* sp. nov.

Head slightly wider than pronotum, strongly arched and sub-angulate; vertex a little produced, about one-third longer at middle than next the eye, more distinctly angulate with front than in other species; front narrowing uniformly to clypeus; clypeus nearly twice as long as wide, apex slightly rounded; loræ not reaching margin of cheek; cheeks broad, sub-angulate; propleura narrow. Pronotum strongly arched before, a little more than twice as long as vertex; hind border slightly concave; scutellum rather small. *Genitalia: female*, last ventral segment a little longer than preceding; hind border truncate; a transparent indentation gives the appearance of a central tooth.

Creamy white. Pronotum with three fulvous lines, the middle one extending through the scutellum; there are faint fulvous lines on the clavus and corium, and a dusky patch at tip of clavus and on the outer apical cell.

Length: 3 mm.

Described from four female specimens, *type* and *paratypes*, from Province del Sara, Bolivia, Nov., 1912, C. M. Acc. No. 5064 (Steinbach *coll.*).

The narrowness of the propleura would seem to relate this form to *E. flavescens*, but the head is much more depressed and the lines of the pronotum will readily distinguish it.

75. *Eugnathodus flavescens* Baker.

Eugnathodus flavescens Baker, Invertebrata Pacifica, 1903, Vol. I, p. 2.

Baker's description of this species reads:

"Propleura behind eye so narrow that hind margin almost touches eye; body small, short, and thick set; color opaque yellowish throughout; length 2.5 mm., Managua, Nicaragua."

Head scarcely wider than pronotum, rather distinctly arched; vertex a little longer at middle than next the eye; front broad, slightly elevated medially toward the tip; loræ rather short, not reaching apex of cheek; border of cheek sinuate; propleura excavated behind. Pronotum strongly arched in front, about three times as long as vertex. *Genitalia: female*, last ventral segment about twice as long as preceding; hind border sinuate.

Light yellow; eyes dark brown; elytra subhyaline.

Length: 2.6 mm.

One specimen Santarem, Brazil, Dec., 1909, C. M. Acc. No. 4043 (Haseman *coll.*).

76. *Eugnathodus lacteus* Baker.

Eugnathodus lacteus Baker, Invertebrata Pacifica, Vol. I, 1903, p. 2.

Head short, broad, scarcely wider than pronotum, broadly arched in front; vertex short, as long at center as at eye; front broad, obtusely carinate below; clypeus nearly twice as long as width at base; loræ broad, outer margin rounded, reaching border of cheek; cheeks broad. Pronotum moderately arched in front, about four times as long as vertex; hind border slightly convex. *Genitalia: female*, last ventral segment truncate, color-markings appearing like a tooth at center; *male*, valve short, triangular; plates broad at base, narrowed abruptly and extended in two long, slender, upcurved processes.

Dull milky white. Beneath, pale gray, somewhat tinged with yellow.

Length: 3.5 to 3.75 mm.

This description is drawn from a series of fifteen specimens from Province del Sara, Bolivia, Feb., 1913, C. M. Acc. No. 5064 (Steinbach *coll.*).

These specimens appear to fit the brief description by Baker which reads:

"Size medium; length 3.5 mm.; head and pronotum yellowish white; elytra translucent milky white, Managua, Nicaragua."

If our determination is correct, it gives this species a range from Central America to central South America.

Genus ALEBRA Fieber.

Alebra Fieber, Kat. Europ. Cicad., 1872, p. 14.

77. *Alebra terminalis* sp. nov.

Head scarcely as wide as pronotum, slightly produced; vertex a little wider than length at middle, slightly longer at middle than next the eye, rounded to front; ocelli near border of eye; front narrowed and tapering to clypeus; clypeus narrowed toward tip; loræ touching border of cheek; cheeks narrow. Pronotum twice as long as vertex, concave behind. *Genitalia: male*, last ventral segment a little longer than preceding, hind border concave; plates narrower than hind segment, with deep depressions on disk, narrowing at middle to compressed, slender, bluntly rounded tips.

Brilliant golden yellow above; vertex light yellow. Pronotum with three light yellow bars behind middle; elytra bright orange-yellow to end of clavus, with milky subhyaline yellowish areas on clavus and central part of corium; apex of elytra beyond tip of clavus glassy hyaline with black veins; three black cross-nervures toward tip, and a broad smoky apical band; face, thorax below, and legs, pale yellowish; venter sulphur-yellow; male plates brownish at tips.

Length: 3.75 mm.

Described from one male specimen, *type*, Province del Sara, Bolivia, Nov., 1912, C. M. Acc. No. 5064 (Steinbach *coll.*).

This is a very handsome species, the brilliant orange, or golden yellow, of the pronotum and elytra extending to tip of clavus, contrasting sharply with the hyaline apex.

Genus EMPOASCA Walsh.

Empoasca Walsh, Proc. Bost. Soc. Nat. Hist., Vol. IX, 1864, p. 315.

78. *Empoasca picta* sp. nov.

Head produced; vertex narrow, about one-half longer at middle than next the eye; front elongate, narrowing gradually to clypeus; clypeus broad, rounded at tip; loræ narrow; cheeks narrow, outer border nearly straight, reflexed. Pronotum short, half longer than vertex; hind border truncate; lateral margins concave. *Genitalia: male*, last ventral segment narrowed, about as long as preceding; plates narrow, triangular; tips acute.

Brilliant blue-green, with conspicuous orange-red markings. A broad band on base of vertex, a broad border on the front, merging on clypeus, which is lighter yellowish, two basal spots on pronotum; inner border of clavus and three elongate spots, one at base of clavus and one on basal disk of corium, and a third just beyond the middle, orange-red. Two lighter yellowish spots on base of scutellum; elytra beyond the clavus hyaline, somewhat suffused with smoky. Beneath yellowish green, bases of tibiæ tinged with orange-red.

Length: 3.25 mm.

Described from one male specimen, *type*, from Santarem, Brazil, Dec. 10, 1909, C. M. Acc. No. 4043 (Haseman *coll.*).

79. *Empoasca decorata* sp. nov.

Very similar to *E. picta*; head slightly wider than pronotum, strongly arched, somewhat produced, about one-third longer at middle than next the eye; front narrow, elongate; loræ and cheeks narrow; border of cheek nearly straight. Pronotum strongly arched in front, scarcely concave behind. *Genitalia: male*, last ventral segment narrowed, about as long as preceding; hind border lightly sinuate; plates narrow, elongate; triangular; tips upturned and acute, the disk with strong setæ.

Blue-green, pattern similar to that of *E. picta*, but the entire upper part of head, including eyes, bright red; lateral borders of front and the clypeus, base of pronotum, a broad stripe on the clavus interrupted at about the middle, an oval spot near base, and an elongate stripe opposite outer half of clavus, red; elytra beyond the clavus hyaline, faintly tinged with smoky, veins whitish; disk of abdomen black, margined with reddish. Beneath, pale green; tips of hind tibiæ and the tarsi blue-green.

Length: 3.5 mm.

Described from one male specimen, *holotype*, Ft. Principe, Rio Guaporé, Brazil, Aug. 26, 1909, C. M. Acc. No. 4043 (Haseman *coll.*).

This species is very much like *E. picta*, but the red border of the front is absent at the base, and the spots on the elytra are a little differently arranged; the male plates are more acute and spine-like;

these features, with the difference in locality, make it seem advisable to regard the two as separate species.

80. **Empoasca mali** LeBaron.

Tettigonia mali LeBaron, Prairie Farmer, 1853, XIII, p. 330.

Empoasca mali Osborn, Proc. Iowa Acad. Sci., I, Pt. 2, 1892, p. 126.

Empoasca mali, Gillette, Proc. U. S. Nat. Mus., XX, 1898, p. 744.

Bright green; elytra transparent; head a little wider than pronotum, somewhat produced, about one-third longer at middle than next the eye; vertex with greenish whitish dots on the disk. Pronotum with six whitish dots on the anterior border; elytra green, hyaline; below yellowish green; hind tibiæ and tarsi bluish green.

Length: 2.5 mm. to 3 mm.

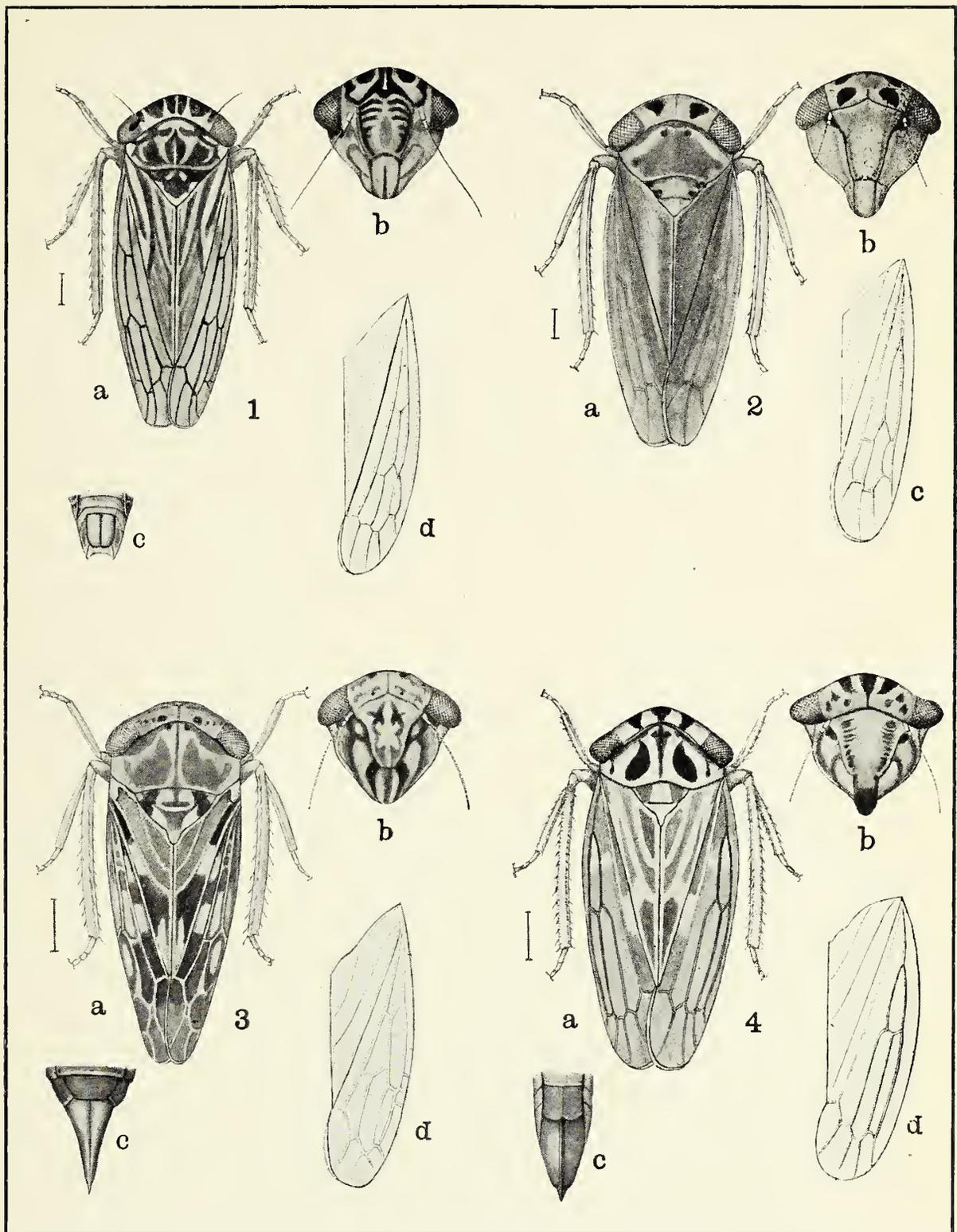
Several specimens from Province del Sara, Bolivia, C. M. Acc. No. 5064, Nov., 1912 (Steinbach *coll.*).

These specimens agree very well with some of the forms common throughout the United States and southward. The species is one of very wide range, and in the United States is of special importance as an economic pest, particularly as it serves as a carrier for the disease of potatoes, known as "hopper-burn."

EXPLANATION OF PLATE LV.

Figures reproduced from drawings by Madame Thérèse Ekblom of the types in the Naturhistoriska Riksmuseet at Stockholm.

- FIG. 1. *Agallia signata* (Stål). (See p. 385).
a, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.
- FIG. 2. *Agallia peregrinans* (Stål). (See p. 387).
a, dorsal view; *b*, face; *c*, elytron.
- FIG. 3. *Agallia punctaticollis* (Stål). (See p. 384).
a, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.
- FIG. 4. *Agallia assimilis* (Stål). (See p. 386).
a, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.

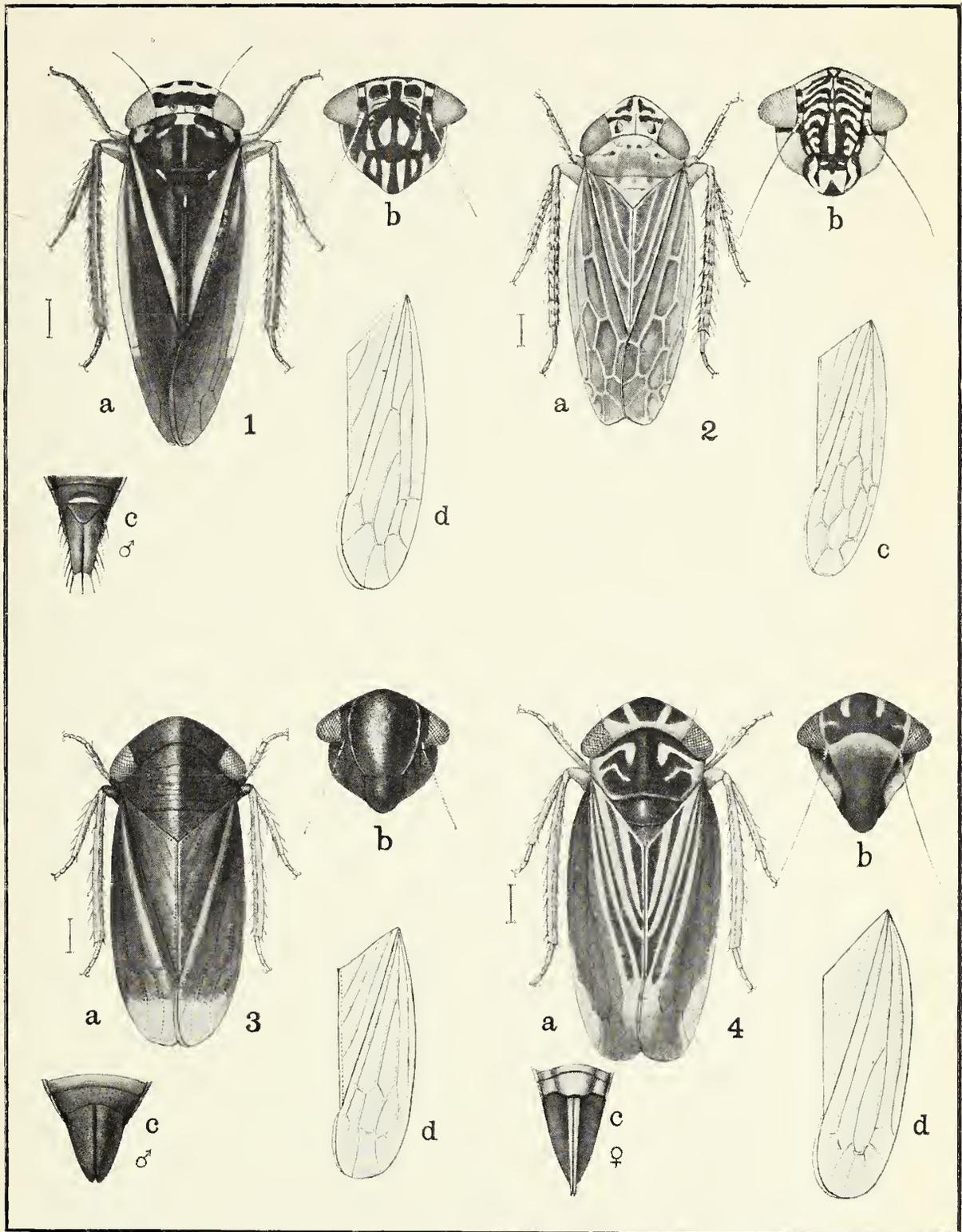


Agallia.

EXPLANATION OF PLATE LVI.

Figures reproduced from drawings by Madame Thérèse Ekblom of the types in the Naturhistoriska Riksmuseet at Stockholm.

- FIG. 1. *Thamnotettix luctuosus* Stål. (See p. 418).
a, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.
- FIG. 2. *Deltocephalus faminei* Stål. (See p. 411).
a, dorsal view; *b*, face; *c*, elytron.
- FIG. 3. *Nionia postica* (Stål). (See p. 403).
a, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.
- FIG. 4. *Agallia phalerata* (Stål). (See p. 386).
a, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.

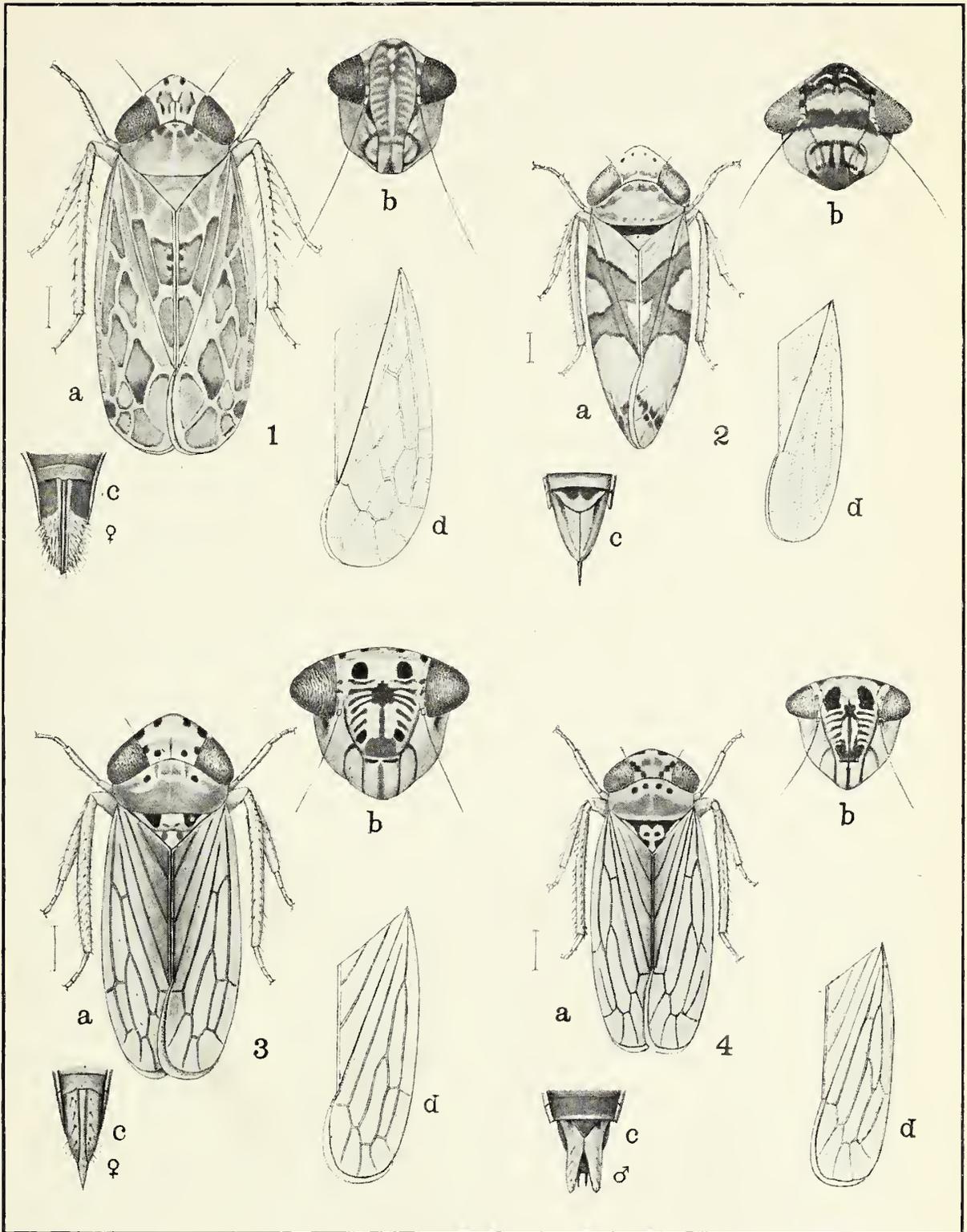


Thamnotettix, Deltocephalus, Nionia, Agallia.

EXPLANATION OF PLATE LVII.

Figures reproduced from drawings by Madame Thérèse Ekblom of the types in the Naturhistoriska Riksmuseet at Stockholm.

- FIG. 1. *Deltocephalus lepidellus* Stål. (See p. 408).
a, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.
- FIG. 2. *Scaphoideus ornatipennis* (Stål). (See p. 407).
a, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.
- FIG. 3. *Euscelis obscurinervis* (Stål). (See p. 412).
a, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.
- FIG. 4. *Euscelis obscurinervis* (Stål). (See p. 412).
a, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.



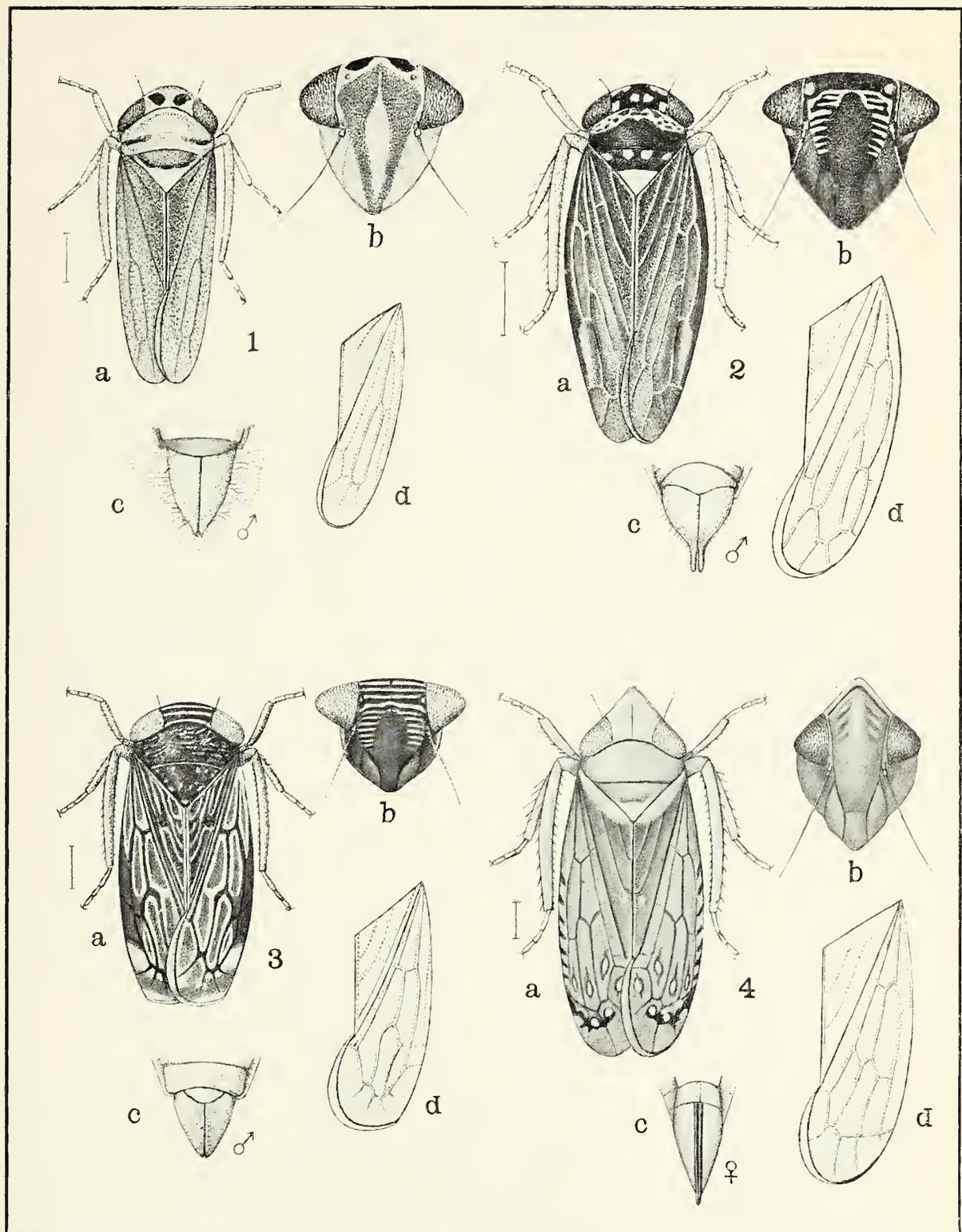
Deltocephalus, Scaphoideus, Euscelis.



EXPLANATION OF PLATE LVIII.

Figures reproduced from drawings by Madame Thérèse Ekblom of the types in the Naturhistoriska Riksmuseet at Stockholm.

- FIG. 1. *Thamnotettix hyalinipennis* Stål. (See p. 423).
a, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.
- FIG. 2. *Thamnotettix serius* Stål. (See p. 417).
a, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.
- FIG. 3. *Euscelis palliditarsis* (Stål). (See p. 413).
a, dorsal view; *b*, face; *c*, male genitalia; *d*, elytron.
- FIG. 4. *Deltocephalus anticus* Stål. (See p. 409).
a, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.

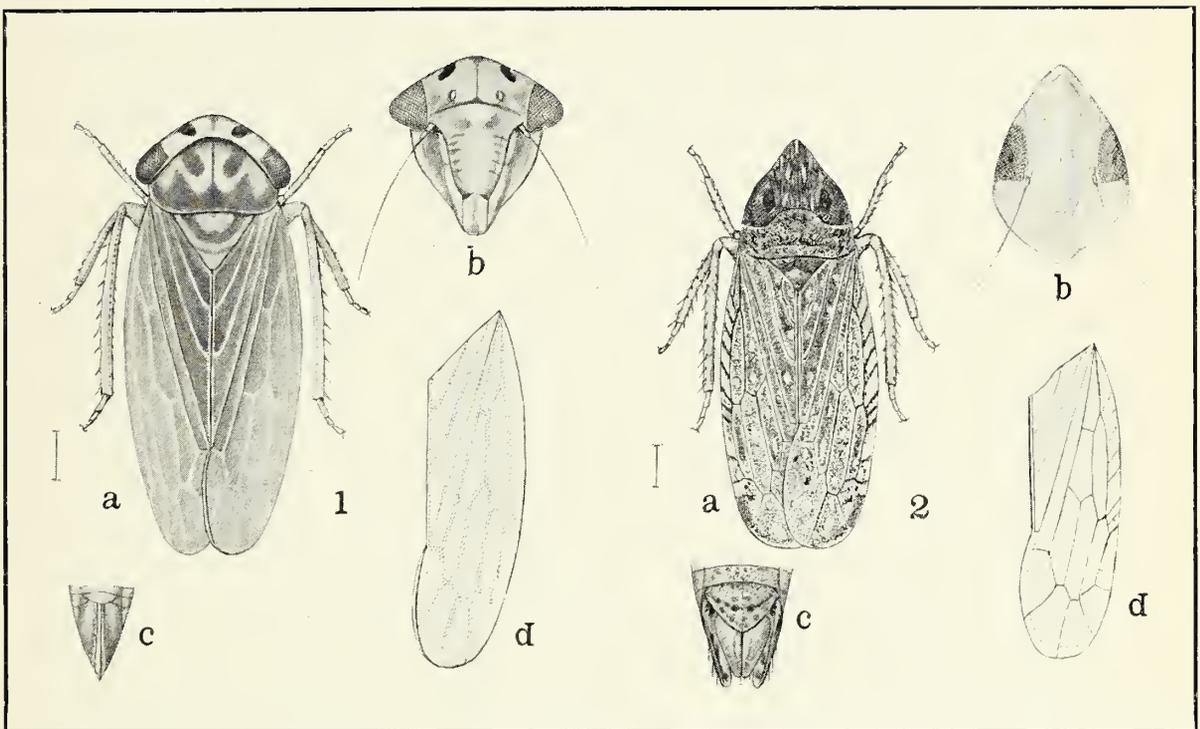


Thamnotettix, Euscelis, Deltocephalus.

EXPLANATION OF PLATE LIX.

Figures reproduced from drawings by Madame Thérèse Ekblom of the types in the Naturhistoriska Riksmuseet at Stockholm.

- FIG. 1. *Bythoscopus lautus* Stål. (See p. 389). (Referable to *Agallia*).
a, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.
- FIG. 2. *Deltocephalus marginelineatus* Stål. (See p. 410).
a, dorsal view; *b*, face; *c*, female genitalia; *d*, elytron.
(The species is referable to the genus *Platymetopius*).



1. *Agallia lautus* (Stål). 2. *Platymetopius marginineatus* (Stål).

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