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ADVERTISEMENT.

The publications of the National Museum consist of two series: Proceedings and Bulletins.

The Proceedings, the first volume of which was issued in 1878, are intended primarily as a medium of publication for newly acquired facts in biology, anthropology, and geology, descriptions of new forms of animals and plants acquired by the National Museum, discussions of nomenclature, etc. A volume is issued annually or oftener for distribution to libraries, while in view of the importance to science of the prompt publication of descriptions of new species, a limited edition of each paper is printed in pamphlet form in advance.

The present volume is the twenty-seventh of the series.

The Bulletin, publication of which was begun in 1875, is a series of more elaborate papers, issued separately and based for the most part upon collections in the National Museum. They are monographic in scope, and are devoted principally to the discussion of large zoological groups, bibliographies of eminent naturalists, reports of expeditions, etc.

A quarto form of the Bulletin, known as the "Special Bulletin," has been adopted in a few instances in which a larger page was deemed indispensable.

The Annual Report of the National Museum (being the second volume of the Smithsonian Report) contains papers chiefly of an ethnological character, describing collections in the National Museum.

Papers intended for publication by the National Museum are usually referred to an advisory committee, composed as follows: Frederick W. True (chairman), William H. Holmes, George P. Merrill, James E. Benedict, Otis T. Mason, Leonhard Stejneger, Lester F. Ward, and Marcus Benjamin (editor).

S. P. Langley,
Secretary of the Smithsonian Institution.

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CONTRIBUTIONS TO THE NATURAL HISTORY OF THE ISOPODA.

By Harriet Richardson,
Collaborator, Division of Marine Invertebrates.

PREFACE.

The difficulties which meet the systematist are but little understood or appreciated by those engaged in other fields of biological work. The morphologist, the embryologist, the physiologist give him but little encouragement and sympathy. Prof. Charles C. Nutting very adequately described the situation in his recent address before the American Association for the Advancement of Science and made an urgent appeal for cooperation with and leniency toward the man who toils over the "hard and often thankless task" of classification.

Those who have studied special groups of animals or plants realize the difficulties that have to be overcome and the problems that must be faced. The path is not always easy nor the way clear.

In the following pages the object has not been to give an exhaustive treatment of the Isopod group. The attempt is made to bring together by way of introduction facts of general interest, describing briefly the systematic position, structure, habitat, distribution, mode of life, development, and other points of interest in connection with the group, and to present, in detail, descriptions and figures of a number of new species and genera, which are the result of independent work on material collected by several different parties. These collections were made (1) by the U. S. Fish Commission steamer *Albatross* and by the U. S. S. *Palos* in Japan; (2) by Messrs. Jordan and Snyder in Japan; and (3) by Dr. C. H. Gilbert at Panama and Mazatlan. Lastly, a large number of Bopyridæ in the U. S. National Museum collection have been worked up and also included.

No bibliography is given with the general introduction. A bibliography accompanies each section of the work. The publications which

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have been of great service in preparing the general account of the group and freely used are those of T. R. R. Stebbing, G. O. Sars, F. Beddard, O. Harger, C. E. A. Gerstæcker, J. P. McMurrich, J. C. Schiœdte and F. Meinert, James D. Dana, A. Giard and J. Bonnier, and H. G. Hansen. A large number of other papers have also been consulted.

Finally, I wish to express my gratitude to Dr. Theodore Gill, the distinguished naturalist, for his kindness in looking over the work and for his many suggestions in connection with it.

INTRODUCTION.

1. CLASSIFICATION AND SYSTEMATIC POSITION.

The Isopoda are a group of Crustacea belonging to the large subclass Malacostraca, which, in contradistinction to the Entomostraca, includes all those forms having a gastric mill in the stomach; green glands, functioning as excretory organs, situated in the basal joint of the antennules; and not having a free nauplius larva, the nauplius stage being passed in the egg.

The order Arthrostraca includes both the Isopoda and the Amphipoda, which have in common the following characters: The first thoracic segment is permanently fused with the head, and bears maxillipeds; the seven remaining segments are usually free and bear legs, although the first free segment and sometimes even the second free segment may be united with the head to form a carapace; the eyes are usually sessile.

The Isopoda differ from the Amphipoda (1) in the general form of the body which is compressed dorso-ventrally, while in the Amphipoda, it is flattened or compressed laterally; (2) in the fact that respiration is carried on by the abdominal appendages or pleopoda, which are modified gills, while in the Amphipoda the gills are borne on the thoracic appendages; (3) in the difference in structure correlated with a difference in function in the pleopoda. The abdominal appendages in the Isopoda are usually broad plates or lamellæ, all five pairs more or less similar in shape and size. In the Amphipoda, the first three pairs are similar in shape and size, are long narrow appendages suitable for swimming, while the last three pairs are adapted for jumping.

Seven superfamilies[a] or tribes are usually recognized in the suborder Isopoda. The classification given by G. O. Sars is the one now generally adopted. He divides the Isopods into tribes according to the following characters:[b]

[a] The term tribe was originally used by Latreille for subdivision of family, and such was for a time the general usage. The history of the group has been indicated by Dr. Gill in his address on Some Questions of Nomenclature (Science, n. s. IV, p. 598, etc.).

[b] The table has been modified to include the tribe Phreatoicoidea. Other slight changes have been made also. See Sars, Crustacea of Norway, II, 1899, p. 3.

a Legs of the first pair cheliform. Uropoda terminal. Pleopoda, when present, exclusively natatory ..... I. CHELIFERA or TANAIOIDEA.

a' Legs of the first pair not cheliform.

b Uropoda lateral.

c Uropoda forming together with the terminal segment of the abdomen a caudal fan. Pleopoda for the most part natatory. II. FLABELLIFERA or CYMOTHOIDEA.

c' Uropoda valve-like, inflexed, arching over the pleopoda which to a great extent are branchial ..... III. VALVIFERA or IDOTEOIDEA.

b' Uropoda terminal or infero-lateral.

c Uropoda infero-lateral. Outer branch of the second and following pairs of pleopoda two-jointed ..... IV. PHREATOICOIDEA.

c' Uropoda terminal. Outer branch of the pleopoda never two-jointed.

d Free forms.

e Pleopoda exclusively branchial, generally covered by a thin opercular plate (the modified first pair) ..... V. ASELLOTA or ASELLOIDEA

e' Pleopoda fitted for air-breathing ..... VI. ONISCOIDEA.

d' Parasitic forms. Pleopoda and uropoda sometimes absent. When present exclusively branchial, and not covered by any operculum.

VII. EPICARIDEA or BOPYROIDEA.

The following list includes the numerous families which are comprised under these seven tribes:

I. CHELIFERA or TANAIOIDEA.[a]
1. Apseudidæ.
2. Tanaidæ.

II. FLABELLIFERA or CYMOTHOIDEA.[a]
1. Anthuridæ.
2. Gnathiidæ.
3. Cirolanidæ.
4. Corallanidæ.
5. Alcironidæ.
6. Barybrotidæ.
7. Ægidæ.
8. Bathynomidæ.
9. Cymothoidæ.
10. Serolidæ.
11. Sphæromidæ.
12. Limnoriidæ.

III. VALVIFERA or IDOTEOIDEA.[a]
1. Arcturidæ.
2. Idoteidæ.
3. Chætiliidæ.

IV. PHREATOICOIDEA.
1. Phreatoicidæ.

V. ASELLOTA or ASELLOIDEA.[a]
1. Asellidæ.
2. Janiridæ.
3. Munnidæ.
4. Desmosomidæ.
5. Munnopsidæ.

[a] The second name given above for the tribe or superfamily was suggested by Dr. Theodore Gill in order that the nomenclature might be more uniform.

VI. Oniscoidea.
1. Oniscidæ.
2. Armadillidiidæ.
3. Ligiidæ.
4. Trichoniscidæ.
5. Tylidæ.
6. Helleriidæ.

VII. Epicaridea or Bopyroidea.[a]
1. Bopyridæ.
2. Entoniscidæ.
3. Dajidæ.
4. Cryptoniscidæ.

Further subdivision into genera and species is not desirable, although the genera and species will be constantly referred to in the following pages.

2. EXTERNAL ANATOMY.

A. GENERAL FORM.

The body is generally flattened or compressed dorso-ventrally, differing in this respect from the Amphipoda, their nearest relatives, which have the body flattened or compressed laterally. The outline of the body varies considerably. Many forms are narrow and elongate, the extreme of this type being found among the Anthuridæ;[b] others are broadly oval, almost circular in outline (the Serolidæ). Bilateral symmetry prevails in the group as a whole. The adult females in the parasitic Isopoda deviate from the symmetry of the larval condition, owing to the parasitic mode of life, the parasitism being also accompanied in some of the Epicaridea by a degradation in structure of such an extent that the characters of the group are entirely lost, their relationship being known only through a study of the early larval stages and through the males which retain the characters of the group. Some of the Cymothoidæ, also parasites, are as symmetrical in the adult condition.

Sexual dimorphism occurs only in the parasitic tribe Epicaridea. The males in this superfamily are four or five times smaller than the females and are always found permanently attached to the body of the female.

In both sexes the body is segmented, the number of segments into which the thorax and abdomen is divided differing in the various subdivisions of the group. Fusion of the first and second segments with the head occurs sometimes, and often some or all of the abdominal segments are coalesced. The Dajidæ have the body very imperfectly

[a] The second name given above for the tribe or superfamily was suggested by Dr. Theodore Gill in order that the nomenclature might be more uniform.

[b] In *Hyssura vermiformis* Haswell, a member of this family, all the segments of the body are extremely narrow and elongated, giving the body an exceedingly long appearance.

segmented. In the Entoniscidæ alone there is no trace of segmentation whatever in the adult female, and in the Cryptoniscidæ but slight traces of segmentation.

Many of the terrestrial Isopoda, the pill bugs, and some of the Sphæromidæ, especially the genus *Sphæroma* Latreille, are able to roll the body completely into a ball.

B. HEAD.

The head may be considered as composed of seven coalesced segments, indicated by the number of paired appendages, the last coalesced segment, represented by the maxillipeds, being derived from the thorax. The eyes may be regarded as the appendages of a first or ocular segment; the antennæ and antennulæ, the appendages of a second and third segment; the mandibles and the two pairs of maxillæ representing the fourth, fifth, and sixth segments; the maxillipeds, as already stated, represent a first thoracic segment, which is permanently united with the head in all Isopods, the name foot-jaws indicating their origin and function. (Harger.)

A second thoracic segment, which is usually the first free segment, is also consolidated with the head to form a carapace in the Tanaidæ and the Serolidæ; in the latter family sutures may or may not be present. The Australian species *Crabyzos longicaudatus* Spence Bate, as well as *Arcturides cornutus* Studer, and *Stenasellus* Dollfus have the head and first free segment of the thorax united so as not to articulate, although they are separated by a suture in the first two mentioned. The males of the family Dajidæ also have the head fused with the first free segment of the thorax.

Still a third thoracic segment, or what is usually the second free segment, is united with the head in only one genus, the genus *Sphyrapus* Norman and Stebbing.

1. Eyes.—The eyes, when present, are always paired. They may be small and simple and situated some distance apart, or they may be large, composite eyes, formed of numerous ocelli and so close as to be contiguous. Except in the Tanaidæ, where the eyes are placed on stalks, which are, however, never movable, they are invariably sessile. The ocular lobes in the Apseudidæ are spine-like projections of the carapace upon which the eyes are situated.

Eyes are wanting in the following Isopod genera: *Typhlotanais* Sars, *Leptognathia* Sars, *Tanaella* Norman and Stebbing, *Strongylura* Sars, *Cryptocope* Sars, *Haplocope* Sars, *Anarthrura* Sars, *Cecidotea* Packard, *Cirolanides* Benedict, *Syscenus* Harger, *Platyarthrus* Brandt, *Titanethes* Schiœdte, *Tanaopsis* Sars, *Calathura* Norman and Stebbing (eyes imperfectly developed or wanting), *Leptanthura* Sars, *Alaotanais* Norman and Stebbing (there are minute ocular lobes but no eyes) *Pseudotanais* Sars (eyes are imperfect or absent), *Anuropus* Beddard,

Pleurogonium Sars, *Leptaspidia* Bate and Westwood, *Nannoniscus* Sars, *Dendrotion* Sars, *Ischnosoma* Sars, *Sphæromides* Dollfus, *Stenasellus* Dollfus, *Cœcosphæroma* Dollfus, *Hypsimetopus* Sayce, *Mesotanais* Dollfus, *Heterias* (new name for *Janirella* Sayce, preoccupied[a]), and *Phreatoicoides* Sayce.

In a number of species belonging to well-known genera eyes are also lacking. The list includes: *Trichoniscus cavernicola* Budde-Lund, *Astacilla cæca* Benedict, *Rocinela typhlops* Bonnier, *Munella danteci* Bonnier, *Brackenridgia cavernarum* Ulrich, *Trichoniscus stygius* Nemec, *Cirolana cubensis* Hay, *Monolistris cæca* Gerstæcker, *Asellus cavaticus* Schiœdte, *Pseudarmadillo carinulatus* Saussure, *Conilera stygia* Packard, *Phreatoicus typicus* Chilton, *Harponyx pranizoides* Sars, and *Serolis anartica* Beddard. None of the Munnopsidæ or Desmosomidæ have eyes. Eyes are likewise usually absent among the Epicaridea.

Stebbing says that the explanation for the fact that many of the genera of Tanaidæ are blind is to be found in their habit of living ensconced in the sand.

Many of the blind forms are deep-sea species, others are cave-dwellers, and some have been found in wells at great depths.

Structural degeneration of the eyes is found in some of the deep-sea Serolidæ, no retinula being present, although the vitreous body is represented (Beddard).

2. Antennæ.—There are two pairs of antennæ. The first pair are sometimes called antennules, superior or upper antennæ. These are rudimentary in the Oniscoidea, are inconspicuous, never more than three-jointed, and sometimes wholly wanting (Helleriidæ). Usually the antennules are composed of three peduncular joints and a many-jointed flagellum. The Valvifera, however, are without this multi-articulate flagellum, all the joints being consolidated to form a single clavate joint. The flagellum of the first pair of antennæ in the Tanaidæ is rudimentary or sometimes wanting in the female. This is also true of *Cyathura* Stebbing, females, *Leptanthura* Sars, females, *Janthopsis* Beddard, *Jæropsis* Koehler, *Macrostylis* Sars, and *Nannoniscus* Sars, all having a rudimentary flagellum to the antennules. In the genera *Anuropus* Beddard and *Nannoniscus* Sars, the first antennæ have but two joints. In *Plakarthrium*[b] Chilton, the antennules have but three joints, the first two of which are flattened and form plates surrounding the anterior margin of the head. The Apseudidæ are characterized by having two multi-articulate flagelli to the superior antennæ, the second flagellum being sometimes called the secondary filament.

The second pair of antennæ, inferior or lower antennæ, are usually composed of five peduncular joints and a multi-articulate flagellum.

[a] *Janirella* Bonnier, a new genus of *Asellida* is described, Ann. Univ. Lyon, XXVI, 1896.

[b] *Chelonidium* Pfeffer is a synonym of *Plakarthrium* Chilton.

Munnopsis M. Sars, *Paramunna* Sars, *Pleurogonium* Sars, *Nannoniscus* Sars, and *Eurycope* Sars are exceptions, having a six-jointed peduncle, and *Eurydice* Leach has only four joints to the peduncle of the second antennæ. In *Plakarthrium* Chilton the third and fourth joints of the peduncle of the second antennæ are flattened to form plates. Variations are found in the structure of the flagellum. The joints of the multi-articulate flagellum are all united in one tapering joint in the following genera: *Symmius* Richardson, *Erichsonella* Benedict, *Cleantis* Dana, and *Eusymmerus* Richardson. The flagellum of the lower antennæ is rudimentary in both sexes in the Tanaidæ, in the genus *Jæropsis* Koehler, *Edotea* Guérin-Méneville, *Epelys* Dana, *Leptanthura* Sars and *Cyathura* Norman and Stebbing; also in the males of *Paranthura* Bate and Westwood.

A few genera, *Apseudes* Leach, *Stenetrium* Haswell, *Janthe* Bovallius, *Janira* Leach, *Trichopleon* Beddard, *Janiropsis* Sars, and *Cruregens* Chilton are characterized by having an exopod or antennal scale, movable and ciliated, attached to the peduncle of the second pair of antennæ.

The inferior antennæ in the Epicaridea are greatly reduced. Both pairs in the females of the Entoniscidæ are transformed into lips. In the Cryptoniscidæ they are entirely wanting.

The antennæ are of great length in many Isopods. In the genera *Munnopsis* M. Sars, *Eurycope* G. O. Sars, and *Arcturus* Latreille they attain a great development, being many times longer than the body.

The greatly elongated second antennæ of the Arcturidæ are supposed to serve as a nursery for the young, which for some time after they have left the incubatory pouch are found clinging to the antennæ of the parent. In this way they are protected and are able to receive the nourishment which the parent secures for them and for herself.

3. Mouth parts.—"The upper lip usually forms a plate projecting from the top of the oral aperture over the cutting edges of the mandibles, and may have an inner plate lying parallel to the outer. The lower lip is bilobed, or forms two pairs of lobes, of which the inner pair is much the smaller."[a]

The maxillipeds are a pair of appendages, consisting of a basal part, the protopodite, usually composed of one segment; a palp or endopodite, with varying number of joints; an epignath or epipodite, which usually consists of one article, and is affixed to the protopodite at its external margin. In the Chelifera the epignath extends within the branchial cavity; in the Ægidæ it is fusel with the protopodite; in *Plakarthrium* Chilton it is wanting.

There are two pairs of maxillæ. The second, posterior or outer pair is three-lobed at the tip, the two outer lobes being articulated to the basal segment or protopodite. In the Oniscoidea the posterior maxillæ

[a] Stebbing, History of Crustacea, 1893.

are laminar, with only a slight indication of a division into lobes. The inner, anterior or first maxillæ are typically composed of two unequal lobes, the inner lobe being comparatively small, the outer lobe more robust. The Ægidæ have the anterior maxillæ composed of only a single lobe, the posterior maxillæ terminating in two lobes. The Tanaidæ also have but a single masticatory lobe to the anterior maxillæ; the posterior maxillæ are quite rudimentary, being simple rounded lobes. The posterior maxillæ are wanting in *Calathura* Norman and Stebbing; both pairs are wanting in both sexes of the Gnathiidæ. In the Chelifera there is a backward-directed palp attached to the anterior maxillæ. *Exosphæroma* Stebbing has a small exopod attached to the first maxillæ. The first maxillæ in *Valicora* Moore have the outer joint in the form of a strong, curved spine, the inner joint covered by a cap at its tip; the second maxillæ are four-jointed. *Plakarthrium* Chilton has both first and second maxillæ, consisting each of a single lobe.[a]

The mandibles are a pair of strongly calcified structures, often toothed along the inner margin or consisting of a single large tooth. Just below the cutting part is the molar expansion. A three-jointed palp is usually present. The palp is wanting in the Tanaidæ, the Oniscoidea, the Idoteidæ, the Arcturidæ, and in the following genera: *Mancasellus* Harger, *Cruregens* Chilton, *Pleurogonium* Sars, *Macrostylis* Sars, *Ischnosoma* Sars, *Echinopleura* Sars, *Echinozone* Sars, *Plakarthrium* Chilton, and in the following species: *Munnopsis* (?) *australis* Beddard.

The Cymothoidæ, the Limnoriidæ, the Armadillidiidæ, the Oniscidæ, the Corallanidæ, the Alcironidæ, the Ægidæ, and the Barybrotidæ have no molar expansion to the mandibles, as is also true of the following genera: *Ægа* Leach, *Tanaopsis* Sars, *Anarthura* Sars, and *Munnopsis* Sars.

In the females of the Gnathiidæ the mandibles are entirely wanting and the maxillipeds reduced. In the males the mandibles are powerful structures, extending some distance in front of the head.

The mouth parts of the Anthuridæ are suctorial. In some genera of this family the molar process of the mandibles is developed into a sort of semicircular saw.

With the exception of the maxillipeds all the mouth parts are lost in the males of the following genera: *Paratanais* Dana, *Typhlotanais* Sars, *Leptognathia* Sars, and *Alaotanais* Norman and Stebbing.

The oral parts in the Epicaridea are much reduced, only the mandibles and maxillipeds being distinctly developed.

c. THORAX.

The thorax, pereion or mesosome, is normally composed of seven free segments, articulating each with the other. Variation as to the

[a] According to Pfeffer.

number of segments is found; first, in the Tanaidæ, in the males of the Dajidæ and in the species *Crabyzos longicaudatus* and *Arcturides cornutus*, where the first free segment is fused with the head; secondly, in the Serolidæ, where the first free thoracic segment is united with the head, the five following segments being free, the seventh segment, however, differing in this respect that it is represented only on the ventral side by a short sternum, there being no indication of it on the dorsal surface; thirdly; in the genus *Sphyrapus* Norman and Stebbing, one of the Apseudidæ, where the first two free segments are fused with the head; fourthly, in the genus *Ischnosoma* Sars, where the fourth and fifth segments are united to form a columnar center; and finally in the females of the Gnathiidæ where consolidation occurs in the fourth, fifth, and sixth segments.

In many Isopods the lateral parts of the segments are produced as broad plates on either side of the body, these plates being often distinctly separated dorsally, with the exception of the first, from the segments. They are the epimeral plates or coxopodites. These epimera in many genera are firmly coalesced with the segments with no sutures evident as an indication of their union. The epimera of several segments may be fused with the segments, while those of the following segments may be quite distinct. In many species of *Nerocila* Leach the epimera are very long and greatly produced, as is also true of all the deep-sea species of the Serolidæ, especially in the males, with the exception of *S. antarctica* Beddard.

The segments of the thorax are more or less equal in length, the greatest deviation in this respect occurring in the genus *Astacilla* Cordinor and in the genus *Arcturus* Latreille, where the fourth thoracic segment attains great development, being elongated to such a degree in *Astacilla* that it becomes equal to all the other six segments in length. *Næsa* Leach has the sixth segment of the thorax larger than the others and produced backward in a bidentate process. *Haswellia* Miers, also a genus of the Sphæromidæ, has the last thoracic segment produced in a broad plate or shield over and beyond the pleon.

In *Colanthura* Richardson the last segment of the thorax is abruptly so small and short that it might easily be mistaken for the first abdominal segment. Not only the last segment, but also the first, in the Gnathiidæ is very small, the last segment being hardly distinguishable from the segments of the abdomen.

1. Legs.—The legs are usually fourteen in number, arranged in seven pairs, one pair for each of the seven thoracic segments. The Gnathiidæ have but six pairs of these appendages, those of the last segment being wanting. This is also true of the following genera of Anthuridæ; *Hyssura* Norman and Stebbing, *Curregens* Chilton, and *Colanthura* Richardson. The genus *Uropodias* Richardson is unique among the Armadilliidæ, and *Harponyx* Sars among the Cymothoidæ, in also lacking the appendages of the last thoracic segment. In all

these cases this embryonic or larval character is permanently retained in the adult condition.

Many of the parasitic Isopods, such as the Epicaridea, differ markedly in their structure from the free forms of other Isopods. For example, the females of the family Dajidæ have but five pairs of thoracic feet, crowded together around the oral area, and *Branchiophryxus* Caullery, a recently described genus of the family, has but four pairs of legs present in the adult female. *Phryxus abdominalis* Krøyer, an Epicarid species, has all the thoracic legs present on one side of the body in the female, while on the other side they have all disappeared with the exception of the first.

There is no trace of thoracic feet in the females of the Cryptoniscidæ, parasitic on the Amphipoda and other Isopoda, the Ostracoda and the Cirripedia, especially a parasitic family of Cirripedes, the Rhizocephala.

The males of the Entoniscidæ have the seventh thoracic segment without appendages, the other six segments sometimes with rudimentary feet; the female also has rudimentary feet.

The legs are composed of seven joints. Beginning at the proximal end, or their point of attachment with the thorax, these joints are: The coxa or coxopodite, the basis or basipodite, the ischium or ischiopodite, the merus or meropodite, the carpus or carpopodite, the propodus or propodite, and the dactylus or dactylopodite. The dactylus is sometimes furnished with an ungulus, which may be uni-, bi-, or tri-fid. The females in the genus *Kepon* Duvernoy have the feet ending in inflated joints without unguli.

Variation in the number of joints is found among the Gnathiidæ where the first gnathopods are only two-jointed with the males, are "opercular, the first joint being a large pyriform plate, fringed with setæ on the convex inner margin and containing three semitransparent calcareous plates, supposed to indicate the same number of original joints."[a] In *Eucognathia gigas* (Beddard) the first gnathopods in the male are only six-jointed. *Chætelia* Dana has the sixth and seventh pairs of legs terminating in an extremity composed of numerous joints.

In many Isopods (Oniscoidea) the legs or periopods are all similar in shape and size and are ambulatory in character. Difference of structure is to be found, however, in other groups. The Tanaidæ, for example, have the first pair of legs or gnathopods transformed into chelipeds. The chelæ of the males are much stronger and more robust than those of the females, and in some genera, as *Leptochelia* Dana, they are greatly elongated in many of the species. In the Apseudidæ the first and second gnathopods are modified, the first pair

[a] Stebbing, History of Crustacea, 1893, p. 336.

being chelate, the second pair, with the exception of *Pagurapseudes* Whitelegge, terminating in a broad flat joint surrounded with numerous flattened spines. The Arcturidæ have the four anterior pairs of legs differentiated from the other three pairs; they are slender, feeble, directed forward, and strongly ciliated on their inner margins with long slender hairs; the last three pairs are entirely different in structure, being ambulatory in character.

The Munnopsidæ have the first pair of legs shorter than the three following pairs and prehensile in structure; the three following pairs are ambulatory and greatly elongated; finally, the last three pairs are fitted for swimming, being natatory in character, and have the two distal joints flattened and provided with numerous hairs and spines. Among the Janiridæ there is more or less modification in the structure of the first pair of legs in several genera. *Stenetrium* Haswell and *Jamna* Bovallius have the first pair of legs chelate, these being the only genera of this group which are so characterized. The genus *Carpias* Richardson, belonging to the same family, is remarkable for the greatly elongated first pair of legs and the peculiar development and enlargement of the joints. In many genera and some families of Isopods the first pair, the first two pairs, the first three pairs, or all the legs are prehensile, the propodus being enlarged or dilated and the dactylus reflexed.

The Serolidæ have the last pair of legs small and feeble in proportion to the others, correlated with the rudimentary condition of the seventh thoracic segment. In *Tanais stanfordi* Richardson the second pair of legs are small and feeble, although similar in structure to those following.

Munna neozelandica Chilton from New Zealand is a species in which the first gnathopods of the adult male have a remarkable form, with the second joint small, the third "very thick and strong, hollowed anteriorly to receive the distal end of the limb when bent back; carpus expanded distally, mallet shaped; propodus small and rounded."

In certain genera of the Apseudidæ, *Apseudes* Leach, *Parapseudes* Sars, and *Sphyrapus* Norman and Stebbing, there is a minute and inconspicuous two-jointed exopod at the base of the first and second gnathopods. The exopod is absent on the first pair of legs in *Pagurapseudes* Whitelegge. The genus *Leiopus* Beddard, belonging to this family, has a three-jointed exopod at the base of both pairs of gnathopods. The supposed function of these exopods is to keep a constant current of water in the branchial chamber, and they are in rapid movement in the living animal (Stebbing).

Papillose adhesive processes, which are supposed to represent exopods, are developed on the coxal joint of all the legs of *Kepon* Duvernoy and *Leidya* Cornalia and Panceri, although they are in a rudimentary

condition on the last three pairs of legs in *Kepon*. In *Grapsicepon* Giard and Bonnier, the adhesive processes are oval, not warty. In *Cunericepon* Giard and Bonnier, these processes are rudimentary; in *Ergyne* Risso and *Portunicepon* Giard and Bonnier, they are strong and muscular.

2. Marsupium.—The marsupium or brood cavity of the female consists on its outer surface of lamellæ or plates affixed to the sides of the segments at the origin of the legs and overlapping on the ventral side in the median line. Sometimes the plates do not completely cover the eggs which are contained in the brood cavity, as in some of the parasitic Isopoda, the Bopyridæ, a large area being left which discloses the eggs. The lamellæ or oostegites, which are probably modified epipodites, are usually in pairs of four, one pair for each segment from the first to the fourth, inclusive, or from the second to the fifth, inclusive.

The Cymothoidæ differ in having five pairs of plates attached to the first five segments and small supplementary plates on the last two segments. The Cirolanidæ also have five pairs of lamellæ and supplementary ones issuing from the epignath of the maxillipeds.

In *Anthura* Leach the incubatory pouch extends over only three segments of the thorax—the third, fourth, and fifth. In *Astacilla* Cordiner, *Arcturella* Sars, *Tanais* Audouin and Milne Edwards, *Pseudotanais* G. O. Sars, *Cryptocope* Sars, and *Munnopsis australis* Beddard, it is confined to a single segment, being formed of only two plates attached to the fourth segment in *Astacilla* and *Arcturella* and to the fourth free segment, otherwise the fifth segment in the three genera of Tanaidæ mentioned. The Gnathiidæ have no true incubatory pouch.

The lamellæ in the Epicaridea are usually in pairs of five as in the Cymothoidæ. With some genera, as, for example, *Phryxus* Rathke, those of the two sides are very unequally developed, the plates on one side being much larger than those on the other side. In the Dajidæ the brood cavity extends as sacs along the sides of the body.

The young are retained in the marsupium for some time after they are hatched from the egg.

It has been pointed out that the structure of the incubatory lamellæ indicates that they have a respiratory function, and are, to a certain extent, branchial in character, assisting in the oxygenation of the blood.

D. ABDOMEN.

The abdomen, pleon or metasome, is typically composed of six segments, five short ones and a large terminal or caudal segment, which comprises the telson. The following modifications occur: The five anterior segments are coalesced with the caudal segment in the super-

family Asellota with the exception of the genus *Stenasellus* Dollfus, which has the first three segments free and well developed; in the following genera of Idoteidæ, *Stenosoma* Leach, *Synidotea* Harger, *Crabyzos* Spence Bate, *Glyptidotea* Stebbing, *Eusymmerus* Richardson, *Erichsonella* Benedict, *Epelys* Dana; in the Sphæromid genus *Cæcosphæroma* Dollfus; in the genus *Anarthrura* Sars, one of the Chelifera; and in the Cymothoid genus *Ourozeuktes* Milne Edwards. The pleon is also unsegmented in the males of the genera *Dajus* Krøyer and *Notophryxus* Sars, in the females of *Aspidophryxus* Sars, in the males and females of *Zonophryxus* Richardson, all belonging to the family Dajidæ. *Phryxus* Rathke has the pleon fused in the male, as is also the case with *Argeia* Dana, *Stegophryxus* Thompson, *Diplophryxus* Richardson, *Munnidion* Hansen, *Parargeia* Hansen, *Bathygyge* Hansen, *Pleurocrypta* Hesse, *Parapenæon* Richardson, and *Ergyne* Risso, all Epicarid genera. Segmentation is indicated at the sides of the pleon but not on the dorsal surface in the adult female of *Bopyrus* Latreille and *Bopyrina* Kossman. In the Arcturidæ the segments of the pleon are more or less coalesced.

The first five segments are united into one in the Sphæromidæ, which, together with the terminal segment, forms a biarticulate abdomen, the first segment of which usually bears suture lines at the sides indicating coalescence. There are two exceptions: *Sphæromides raymondi* Dollfus, supposed by Dollfus to be an archaic form, has all five segments anterior to the caudal segment free; *Cæcosphæroma* Dollfus also differs from the other Sphæromidæ in having all the pleonal segments fused to form a single segment. The fusion of the five anterior segments into one is characteristic of the Helleriidæ, two pairs of short lateral sutures marking off the third from the fourth, and the fourth from the fifth segments. The first five segments are also united in the females of *Anthura* Leach, and *Cyanthura* Norman and Stebbing, though in the male they are partially distinct. *Paridotea* Stebbing also has a biarticulate pleon.

The pleon in *Idotea* Fabricius, *Colidotea* Richardson, and *Symmius* Richardson is made up of two short segments and a large terminal segment.

The family Serolidæ, the genera *Edotea* Guérin-Méneville, *Zenobiana* Stebbing, *Chiridotea* Harger, and *Chætilia* Dana have the pleon composed of three short segments and a terminal segment. *Stenasellus* Dollfus also has three segments anterior to the caudal segment.

The following genera, *Cleantis* Dana and *Glyptonotus* Eights of the Idoteidæ, have a five-jointed abdomen, four short segments preceding the caudal segment. This is also true of *Tanais* Audouin and Milne Edwards, with the exception of *T. robustus* Moore.

In the Anthuridæ the sixth segment of the abdomen is usually distinct from the telson, as, for example, in *Anthura* Leach, *Anthelura*

Norman and Stebbing, at least in the type species, *Paranthura* Bate and Westwood, *Calathura* Norman and Stebbing, and *Cruregens* Chilton.

The members of the family Phrætoicidæ have the fifth segment of the abdomen longer than any of the four preceding segments, and the telson distinct from the sixth segment at the sides, but fused dorsally. The former character distinguishes the Cumacea, but is not found in any other of the Ispoda.

The lateral parts of the abdominal segments in the Bopyrid genus *Ione* Latreille are produced into branched appendages, which are jointed in some species.

1. Uropoda.—The uropoda are appendages of the last abdominal segment. In the Chelifera they occupy a terminal position and are multiarticulate. In this group there is usually a peduncular joint and either one or two jointed branches. The Oniscoidea and Asellota have terminal uropoda, but the branches in these tribes are usually not jointed but styliform. Of the last-named superfamily the uropoda are simple, consisting only of a single branch in the genera *Munna* Krøyer, *Leptaspidia* Bate and Westwood, *Munella* Bonnier, and *Janirella* Bonnier; they are single branched but two-jointed in *Desmosoma* Sars, *Munnopsis* Sars, *Echinopleura* Sars, *Macrostylis* Sars, *Ischnosoma* Sars, and *Ilyarachna* Sars; single-branched but from three to five-jointed in *Acanthocope* Beddard. The last-named genera of *Asellota* resemble the Chelifera in the jointed character of the uropoda.

Still more remarkable is the genus *Dendrotion* Sars, in which the uropoda issue from the dorsal surface of the caudal segment.

The Flabellifera or Cymothoidea have uropoda which occupy a lateral position, and consist of a basal joint and two more or less oval branches, an exopodite and an endopodite. One family in this tribe, the Anthuridæ, have one branch, the outer branch, occupying a superior position and arching over the telson. In the Sphæromidæ the inner branch or ramus is fixed and immovable, only the outer branch being free. *Cæcosphæroma* Dollfus differs from the other Sphæromidæ in having the uropoda united with or consolidated to the sides of the pleon on the under side, the union of both branches being sometimes complete or perhaps the exopodite may be visible but altogether rudimentary. *Scutuloidea* Chilton has the outer branch of the uropoda wanting; in *Cassidina* Milne Edwards the outer branch is rudimentary. *Codonophilus* Haswell, a Cymothoid genus, has but a single ramus to the uropoda. The genera *Anuropus* Beddard and *Branchuropus* Moore have submembranaceous branches which are concealed beneath the telson.

The uropoda in the Valvifera or Idoteoidea are transformed into opercular valves, which close like doors over the pleopoda, meeting in the median ventral line. These valves are affixed to the terminal seg-

ment only along the lateral margin, and when folded meet in the center.

The uropoda of the Tylidæ and Hellerïidæ, both families of the tribe Oniscoidea, are also transformed into opercular valves which fold over the terminal segment, below the pleopods, however, while in the Valvifera they inclose the pleopods.

Many of the Epicarid genera are without appendages to the terminal segment of the body, as, for example, *Dajus* Krøyer, males; *Aspidophryxus* Sars, females only; *Notophryxus* Sars, males and females; *Zonophryxus* Richardson, males and females; the Cryptoniscidæ, females only; the Entoniscidæ, males and females; and the following Bopyrid genera, *Athelges* Hesse, males and females; *Pleurocrypta* Hesse, males; *Pseudione* Kossman, males; *Ergyne* Risso, males; *Argeia* Dana, males; *Bopyrus* Latreille, males and females; *Probopyrus* Giard and Bonnier, males and females; *Bopyrina* Kossmann, males and females; *Stegophryxus* Thompson, males; *Parargeia* Hansen, males; *Munnidion* Hansen, males; *Branchiophryxus* Caullery, males and females; *Bathygyge* Hansen, males; *Bopyroides* Stimpson, males and females; *Portunicepon* Giard and Bonnier, males; *Cancricepon* Giard and Bonnier, males; *Gyge* Cornalia and Panceri, males; *Phryxus* Rathke, males and females; *Parapenæon* Richardson, males.

In a number of the Epicarid genera the uropoda are single branched appendages. This is true of *Dajus* Krøyer, females; *Pleurocrypta* Hesse, females; *Pseudione* Kossmann, females; *Leidya* Cornalia and Panceri, males and females; *Kepon* Duvernoy, females; *Grapsicepon* Giard and Bonnier, females; *Cancricepon* Giard and Bonnier, females; *Portunicepon* Giard and Bonnier, females; *Ergyne* Risso, females; *Gigantione* Kossmann, males and females; *Ione* Latreille, males and females; *Argeia* Dana, females; *Parargeia* Hansen, females; *Cryptione* Hansen, males; *Entophilus* Richardson, males; *Gyge* Cornalia and Panceri, females. With this tribe of Isopoda it is the exception for the uropoda to be biramous, although they are double-branched in some genera.

2. Pleopoda.—Respiration is effected by means of pleopoda, appendages of the abdominal segments, usually in pairs of five, one pair for each of the first five segments. The pleopoda in general consist on each side of a basal segment carrying two lamellæ or rami. In the male the inner lamellæ of the second pair bears a slender stylet.

The first three pairs of pleopoda in the Serolidæ are natatory, the two following pairs branchial; in the Arcturidæ, the two anterior pairs are natatory, the three posterior pairs exclusively branchial. The pleopoda are natatory or branchial in the Gnathiidæ; they are adapted for both swimming and respiration in the tribe Flabellifera, with the exception mentioned. In the Asellota and the Epicaridea and for the most part in the Idoteidæ the pleopoda are exclusively branchial.

Quite a different mode of respiration is effected in the tribe Chelifera from what is found in the other Isopoda. The pleopoda are used for swimming and are never branchial in character, the respiratory function being carried on by means of branchial chambers situated under the sides of the posterior part of the carapace (Stebbing).

The Oniscidæ, a terrestrial family, have air sacs developed in the pleopoda, sometimes the opercular branch of two or three pairs being provided with tracheæ, and sometimes the opercular branch of all the pairs containing tracheæ. This adaptation is probably due to their aerial mode of life.

Certain genera of Chelifera are remarkable for having no pleopoda, as, for example, *Tanaella* Norman and Stebbing, *Strongylura* G. O. Sars, and *Anarthrura* G. O. Sars. This character is usually correlated with a fusion of the abdominal segments. The genera *Cryptocope* G. O. Sars, and *Haplocope* G. O. Sars have rudimentary pleopoda in the female. There are but three pairs of pleopoda in *Tanais* Audouin and Milne Edwards and in the genus *Parapseudes* Sars there are but four pairs. The genera *Pseudotanais* G. O. Sars and *Leptognathia* G. O. Sars have pleopoda which are all developed and ciliated or altogether absent in the female, but always fully developed and ciliated in the male. *Pagurapseudes* Whitelegge has never more than three pairs of pleopoda, often only one pair, especially in the female.

The first pleopoda are wanting in both the Tylidæ and the Helleriidæ and in the females of the Asellidæ. *Leiopus* Beddard, a genus of the Apseudidæ, has one of the branches of all the pleopoda two-jointed, and the genera *Phreatoicus* Chilton, *Phreatoicopsis* Spencer and Hall, and *Hypsimetopus* Sayce have the outer branch of the second and following pairs of pleopoda also two-jointed, this jointed character of the pleopoda not being found elsewhere among the Isopoda, though a feature of the Amphipoda.

In *Bathynomus* Milne Edwards there are supplementary ramified branchiæ at the bases of the pleopoda.

As previously stated, the inner branch of the second pair of pleopoda carries a stylet in the males. In the Ligiidæ, the Oniscidæ, the Trichoniscidæ, and the Armadillididæ both first and second pairs of pleopoda are sexual in the males, the inner branches of which are modified into sexual organs, those of the first pair often being coalesced in the Oniscidæ; in the females these branches are rudimentary.

In the Asellidæ the pleon in both sexes has the first pair of pleopods quite small, while the outer lamellæ of the second pair are very large, forming a sort of operculum, the lamellæ of which are not fused together in either sex. The female has four pairs of pleopoda; the male has five pairs, with an additional pair of very small biramous appendages immediately behind the first pleopoda.

In the Janiridæ, the Desmosomidæ, and the Munnopsidæ the first pair of pleopoda in the female forms a subcircular operculum, while

in the male the first pair together with the second forms a compound operculum, consisting of a small oval plate on either side of a median elongated plate, divided by a central suture and terminating in two pointed lobes.

In the genus *Conilera* Leach the first pleopoda are opercular, with both branches hard.

Pleopoda are wanting in the following Epicarid genera: *Argeia* Dana, males only; *Bopyrus* Latreille, males; *Bopyroides* Stimpson, males; *Gyge* Cornalia and Panceri, males; *Bopyrina* Kossmann, males; *Pseudione* Kossmann, males; *Dajus* Krøyer, males; *Aspidophryxus* Sars, females and males; *Notophryxus* Sars, males and females; *Bathygyge* Hansen, males; *Athelges* Hesse, males; *Branchiophryxus* Caullery, males and females; *Zonophryxus* Richardson, males; *Stegophryxus* Thompson, males; *Diplophryxus* Richardson, males; *Portunicepon* Giard and Bonnier, males; *Parapenæon* Richardson, males; *Phryxus* Rathke, males; *Pleurocrypta* Hesse, males; *Ergyne* Risso, males; males of the Entoniscidæ. The pleopoda are represented by fleshy ridges in the females of *Bopyroides* Stimpson.

The pleopoda are rudimentary in the following genera: *Dajus* Krøyer, females (except the first pair); *Leidya* Cornalia and Panceri, males; *Bopyrus* Latreille, females; *Probopyrus* Giard and Bonnier, males; *Cancricepon* Giard and Bonnier, males; *Gigiantione* Kossmann, males.

In some Bopyrid genera the appendages of the pleon are three-branched, as for example: *Phyllodurus* Stimpson, females; *Stegophryxus* Thompson, females; *Cranericepon* Giard and Bonnier, females; *Grapsicepon* Giard and Bonnier, females, has the appendages of the first four segments three-branched, those of the fifth segment biramous; *Stegias* Richardson, females, has the pleopoda of the first three segments three-branched, those of the last two segments two-branched.

Diplophryxus Richardson, females, has the pleopoda four-branched, eight for each of the four abdominal segments.

The appendages of the pleon are coarsely pinnate or fringed in *Grapsicepon*[a] Giard and Bonnier, *Leidya* Cornalia and Panceri, *Portunicepon*[a] Giard and Bonnier, and *Ergyne* Risso. In *Cranericepon*[a] Giard and Bonnier, the dorsal branch of the pleopoda is tubercular.

In a number of Epicarid genera the pleopoda are single-branched in the adult female.

3. INTERNAL ANATOMY.

In the typical form the alimentary canal is a straight tube, without convolutions. It consists (1) of a short, muscular œsophagus lined

[a] The dorsal branch in these genera is not homologous with the epimeral lamellæ of the abdominal segments of *Ione* Latreille and *Kepon* Duvernoy.

with ectoderm; (2) a stomach also lined with ectoderm and provided with a "gastric mill," which is a chitinous apparatus consisting of nine plates, seven of which lie in the anterior part, two in the floor of the stomach; (3) an elongate intestine, more or less dilated at its anterior extremity, and lined for the most part with ectoderm, the endodermal portion extending but a short distance from its anterior connection with the liver lobes. There is no cæcal enlargement at its posterior extremity. The liver lobes or hepatic cæca consist of four elongate, more or less coiled, backwardly directed tubes, opening into the alimentary canal at the union of the stomach and the intestine.

The heart is an elongate tube, varying in length in the different groups, and situated in the pleon for the greater part, except with the Chelifera, where it occupies a position in the anterior part of the thorax. In the Asellidæ the heart is confined to the thorax, extending from the pleon forward. Surrounding the heart is a pericardium of connective tissue, a cavity or chamber intervening, in which the blood freely circulates. One, two, or three pairs of ostia place the heart into communication with the pericardial cavity. From the anterior extremity the dorsal aorta arises, sometimes being constricted off from the heart, and then again being simply an extension of the heart forward, with no differentiation of the two parts, the one vessel gradually becoming narrower from the posterior to the anterior extremity. Considerable variation exists in the manner in which the aorta subdivides. In some cases it extends forward to the lower lip without branching, arteries arising from the heart itself supplying the various parts of the body. It may divide very near the heart, each branch giving off arteries, or some little distance from the heart, or it may continue as a straight tube, giving off branches in each segment. Two valves open into the aorta from the heart. In position the main part of the circulatory system lies dorsal to the alimentary canal.

The nervous system consists of a brain or supra-œsophageal ganglion, composed of a number of more or less fused ganglia, connected by œsophageal commissures with an infra-œsophageal ganglion; from the infra-œsophageal ganglion there extends a double ventral nerve cord, connected by double ganglia more or less fused and inclosed in a single nerve sheath, one ganglionic mass being present in each segment of the thorax, the abdominal ganglia being more or less fused, so that from the fused mass it would be impossible to tell the number of corresponding abdominal segments. Commissural nerves are given off in each segment from the ventral nerve cord.

Lying in between and parallel to the commissures connecting the thoracic ganglia in the region of the thorax is a nerve which has been referred to the sympathetic system. It does not pass over the ganglia in each segment, but is fused with each anteriorly and starts again on the other side. At its union with the ganglia fibers extend to the commissures on either side.

From the anterior portion of the supra-œsophageal ganglionic mass two pairs of nerves are given off to the antennæ and antennules. They arise independently from the brain. Some little distance back of these is the place of origin of the optic nerves, which supply the eyes. From the central ganglionic masses of the ventral nerve cord branches go to two lateral ganglionic plexuses, lying under the hypodermis, which are the elements of the peripheral nervous system.

The visceral nervous system consists of an anterior and a posterior division. The anterior system starts from the circum-œsophageal commissure and innervates the œsophagus, stomach, and liver. There is a ganglion near the upper lip and one in front of the stomach. The posterior system has its origin in the fused abdominal ganglia and has no ganglionic differentiation.

The reproductive organs are paired organs lying on either side of the body in the region of the thorax and open by means of ducts at the base of the fifth pair of legs in the female, the male duct opening at the posterior margin of the seventh thoracic segment.

Respiration is effected by means of some or all of the branches of the pleopoda, these branches being thin and vascular in structure and acting as gills in aerating the blood.

4. DEVELOPMENT.

Within the last few years, Dr. J. P. McMurrich[a] has made a thorough and exact investigation of the development of some of the Isopods, having studied *Jæra*, *Asellus*, *Ligia*, *Cymothoa*, *Porcellio*, and *Armadillidium*.

He proved conclusively that the segmentation of the egg is centrolethical, the cells formed by the centrally situated segmentation cell gradually migrating to the surface and inclosing the yolk. The original centrally situated single cell is stellate in shape, with protoplasmic fibrils extending from it to the peripheral layer of protoplasm. The egg is inclosed in two membranes, the chorion, which surrounds it before the polar bodies are given off, and the vitelline membrane, which is formed by the activity of the protoplasm of the egg, during the period occupied by the maturation of the ovum.

The first plane of segmentation lies at right angles to the long axis of the egg, the division effecting only the centrally situated cell. The daughter cells thus formed remain connected by protoplasmic strands. The second division results in the formation of four stellate cells, the two pairs rotating through an angle of forty-five degrees; the cleavage in this stage bears most resemblance to the spiral form. The third division results in the formation of eight stellate cells. The next stage is the sixteen-celled stage. In the thirty-two-celled stage the cells

[a] Journal of Morphology, XI, 1895, pp. 63–155 from which this account is taken.

finally reach the periphery, when segmentation first begins to appear on the surface. The egg now becomes a syncytial blastula, the cavity being completely filled with yolk. At this stage the histological differentiation of cells is very complete, although it is indicated in the preceding stage. In *Jæra*, four cells, termed the vitellophags, occupy the posterior pole. Surrounding them is a circle of twelve cells, the mes-endoderm cells. The sixteen ectoderm cells are scattered over the remainder of the surface of the egg. In the next stage, the sixty-four-celled stage, the vitellophags have increased to eight in number, the mesoderm cells forming a double ring around them, each ring consisting of twelve cells, and the number of ectoderm cells is doubled. In the succeeding stage the vitellophag cells do not take part in the division. One cell of the posterior circle of mes-endoderm cells divides in a different plane from the others, and one of the daughter cells probably gives rise to the endoderm which forms the liver lobes. In *Asellus* the differentiation of vitellophags from the mes-endoderm is distinct at first but becomes inconspicuous later, and the differentiation of the liver endoderm is questionable. In *Armadillidium* and *Porcellio* no differentiation of the three parts of the mes-endoderm is recognizable, although the mes-endoderm in these forms is equivalent to the mesoderm, the liver endoderm, and the vitellophags as found in *Jæra*.

In the next stage the cells of the mesoderm, endoderm, and ectoderm increase in number and migrate to the ventral surface where the embryo is to be formed. The concentration of the mesoderm cells results in the formation of a mesoderm plug, which becomes gradually covered by ectoderm cells, the teloblasts, arising from the posterior row of ectoderm cells, and arranged in regular longitudinal and transverse rows. When the mesoderm plug is about half covered with ectodermal teloblasts, the vitellophags in *Jæra* begin to migrate into the interior of the yolk. The ectoderm cells of the anterior portion of the body, together with the mesoderm cells, contained in the mesodermal plug, which has gradually migrated and become distributed in that region, represent the naupliar part of the embryo. The liver endoderm migrates also to this region with the mesoderm. The posterior or metanaupliar region lies behind it and has resulted by the growth of the teloblasts.

The mesoderm cells in the naupliar region, lying beneath the ectoderm cells, become arranged in two divergent bands. In *Jæra* a transverse band joins the anterior ends of the two lateral bands, but this is not distinct in the other forms. As the appendages bud out the mesoderm cells migrate into their interior, forming a solid support for them. The liver lobes, formed from the liver endoderm, begin to appear about this time as hollow spheres, open toward the yolk, one on either side at the level of the first maxillæ.

The metanaupliar mesoderm is produced by teloblastic growth. The mesoblast cells become arranged in a very definite manner in transverse

rows. Each row of cells is equivalent to a segment. The mesoderm cells divide more rapidly in the anterior segments, resulting in the formation of masses of cells on either side of the median line corresponding to the limb buds, which appear on all the segments anterior to the last seven. The last seven represent the six abdominal segments and the telson, the sixth abdominal segment in the adult being fused with the telson in all Isopods.

The limb mesoderm and the mesoderm of the lateral masses, which lies on either side of the limb mesoderm, become converted into muscle and a certain amount of connective tissue.

The liver lobes unite eventually with the posterior end of the stomodeal invagination, or stomach, and the anterior end of the proctodeal invagination or intestine. The stomodeal invagination appears early and comes to lie between the antennules and the antennæ. As the invagination deepens into the yolk, the posterior extremity enlarges to form the stomach, the posterior extremity of the stomach uniting with the liver lobes. The proctodeal invagination occurs later than the stomodeal invagination. It appears first as a patch of cells lying behind the teloblasts.

The vitellophags take part in the formation of connective tissue, muscle tissue, blood corpuscles, and perhaps even the heart. The vitellophags are therefore mesoderm cells.

The cerebral ganglia, the antennary ganglia, and the antennular ganglia of the nauplius fuse to form the syncerebrum of the adult.

The young leave the brood pouch with the last pair of legs undeveloped. In most Isopoda there is no metamorphosis, the young being similar to the adult. A transformation occurs in the family Gnathiidæ; the young when they leave the incubatory pouch are very unlike the adult males, but bear some resemblance to the female, though more slender. Larval forms exist also in some of the parasitic Isopods. The Cymothoidæ have several different larval stages; the body of the young is more symmetrical than that of the adult, the animal apparently losing its symmetry on assuming a parasitic mode of life.

The early development and larval forms of the Epicaridea, a parasitic tribe, have been most earnestly investigated by Giard and Bonnier. These authors write that the mode of segmentation in the forms they have studied belonging to this tribe is holoblastic, the segmentation of the egg being complete and unequal, and resulting in the formation of an epibolic gastrula.[a] The first free larva, which they call

[a] Prof. L. Roule also makes this statement about the egg of *Asellus* and *Porcellio*, but Dr. McMurrich has pointed out that his observations are erroneous. Although Giard and Bonnier have figured an eight-cell stage of the egg of *Portunion*, in which the segmentation appears to be complete and unequal, there may have been some error of observation, and until more thorough work is done on this group it is not wise to accept the results so far obtained, which are so very different from what has been found to be true of the other Isopods.

the larva of the first stage, is a free-swimming form, resembling the nauplius stage of other Crustacea. Death occurred with all the larvæ of the first stage at the critical moment when the transformation into the Cryptoniscian larva, or larva of the second stage was expected to take place. Giard and Bonnier infer from this that it is highly probable that under this form (the Cryptoniscian larva) the parasite penetrates into the branchial cavity of its host, where it becomes transformed into the adult.

Sars has pointed out that there is an intermediate larval stage between these two stages, and that this stage is the Microniscus stage. He has shown that a true *Microniscus* develops from the first stage of a normal Bopyrid larva, and that another form of *Microniscus* after having attained its normal development is transformed into the well-known second larval stage or Cryptoniscian stage; that these two forms of *Microniscus*, though similar in appearance, belong to two different families of Epicaridea. Therefore he maintains that *Microniscus*, which has been thought heretofore to represent a distinct genus, the type of the family Microniscidæ, must in the future be regarded as a transitory stage of development common to all Epicaridea. He is inclined to think that this stage is always parasitic on Copepoda.

The Cryptoniscian larvæ develop into adult males and females, the females passing through a transitory stage of hermaphroditism. The larvæ of the first stage and of the Cryptoniscian stage have but six pairs of legs, except in the Epicaridea, where the Cryptoniscian larvæ have seven pairs. The adult male in the Entoniscidæ has but six pairs of legs, due to retrogressive development.

5. SIZE.

The largest known Isopod is *Bathynomus giganteus* A. Milne Edwards from the Gulf of Mexico. This form is 11 inches in length and belongs to the family Bathynomidæ. Other very large Isopods are *Chiridotea sabini* (Krøyer) and *Chiridotea entomon* (Linnæus).

Perhaps the smallest Isopods are found among the Tanaidæ, the Apseudidæ, the Janiridæ, and the Gnathiidæ. Some of these forms are only 2 mm. in length.

Between these two extremes, 2 mm. and 11 inches, Isopods of various intermediate sizes are known.

6. HABITAT.

According to their habitat the Isopods are classified as marine, fresh-water, and terrestrial.

The Oniscoidea are mostly land forms, having air sacs developed in their pleopoda, fitted for the respiration of air. As members of this tribe *Haplophthalmus puteus* Hay, from an old well at Bloomington, Indiana, *Trichoniscus cavernicola* Budde-Lund, from grottos in the

Pyrenees, and *Trichoniscus stygius* Nemec, from a Gabroviza grotto near Trieste, are exceptions.

The family Asellidæ includes only fresh-water forms. *Janirella* Bonnier, a recently described genus, containing a single species from the Gulf of Gascony, is the only marine member of this family. The tribe Phreatoicoidea, represented only in Australia and Tasmania, has until recently had assigned to it only fresh-water forms, *Phreatoicus typicus* Chilton being obtained from a pump at Eryeton, New Zealand, *Phreatoicus assimilis* Chilton from wells at Winchester, South Canterbury, New Zealand, *P. australis* Chilton coming from Mount Kosciusko, in Australia, at a place known as Pipers Creek, *Phreatoicus shephardi* Sayce, and *Phreatoicoides gracilis* Sayce, all being found in fresh water. Two terrestrial forms have recently been described, belonging to two different genera of this family having affinities to the previously known genera, *Phreatoicopsis terricola* Spencer and Hall, and *Hypsimetopus intrusor* Sayce, the last-named species being found in the burrows of the land crayfish *Engæus cuniculurus*, the former species leaving casts in the burrows and chambers in which it lives.

Other fresh-water species are: *Heterias*[a] *pusilla* (Sayce) and *Jæra guerneï* Dollfus, the only two fresh-water forms of the family Janiridæ; *Cirolanides texensis* Benedict from an artesian well at San Marcos, Texas; *Cruregens fontanus* Chilton, the only known species of *Anthuridæ* that is not marine, being found in an old well at Eryeton, New Zealand; *Idotea lacustris* Thompson from New Zealand; *Cleantis linearis* Dana from the Rio Negro River, Patagonia; *Alitropus* (?) *typus* (Von Martens) from the Kapaus River at Sintang, in Borneo; *Telotha henselii* (Martens) from the Rio Cadea, in Brazil; *Ichthyoxenos jellinghausi* Herklots from a fish in the river Tjikerang, in Java; *Livoneca daurica* Miers from a river in Dauria (region), Siberia; *Olencira prægustator* (Latrobe) from rivers in the eastern part of North America, especially the Potomac; *Cymothoa amurensis* Gerstæcker from a tributary of the Amur River, Asia; *Nerocila fluvialis* Schiœdte and Meinert from the Rio Plata River, near the city of Montevideo, Uruguay; *Lathræna insidiosa* Schiœdte and Meinert from a river near Santos, Brazil, at its exit into the sea; *Asotana formosa* Schiœdte and Meinert from the river Ica, in Peru; *Ceratothoa laticauda* Milne Edwards from the Continguiba River; *Ichthyoxenus montanus* Schiœdte and Meinert from streams in the Himalayan Mountains; *Artystone trysibia* Schiœdte from the La Plata River, in South America; *Chætilia ovata* Dana from the Rio Plata, Patagonia; *Pseudione* [*Palægyge*] *borrei* (Giard and Bonnier), a parasitic Bopyrid found on a fresh-water species *Palæmon dispar* Von Martens; *Pseudione* [*Palægyge*] *fluviatilis* Max Weber, and some forms belong-

[a] For the preoccupied *Janirella* Sayce.

ing to the genus *Probopyrus* Giard and Bonnier. The list of fresh-water Sphæromidæ is large for a marine family, and includes the following forms belonging to the genera *Sphæroma* Latreille, *Cæcosphæroma* Dollfus, and *Sphæromides* Dollfus: *Sphæroma dugesi* Dollfus from a warm spring in New Mexico; *S. thermophilum* Richardson from a warm spring in New Mexico; *S. destructor* Richardson from St. Johns River, Palatka, Florida; *S. fossarum* Von Martens from a swamp; *S. rugicauda* Leach from brackish waters in Europe; *Sphæromides raymondi* Dollfus from subterranean waters; *Cæcosphæroma virei* Dollfus and *C. burgundum* Dollfus from waters in grottos of the Jura; *C. faucheri* Dollfus from subterranean waters near the village of Sauve; and *Monolistris cæca* Gerstæcker.

With these exceptions all the forms belonging to the Chelifera, the Flabellifera, the Valvifera, the Asellota, and the Epicaridea are marine.

The Ligiidæ, a family of terrestrial Isopoda, are littoral forms, and are found around wharf piles and under rocks and stones along the shore. Prof. A. E. Verrill says of *Ligia baudiniana* Milne Edwards:

> At the Bermudas the *Ligia* occurs in great abundance on the ledges and cliffs along all the shores. It runs with surprising activity and quickly seeks refuge in the cracks and crevices of the ledges, so that it is not easy to capture without injury.

7. FOOD.

Mollusks, Annelids, Crustacea, and fish seem to be the chief food of the marine Isopods. The species *Cirolana concharum* (Stimpson) is known to feed on the blue crab. From a single crab as many as 108 specimens of this form have been taken. It is recorded that the dogfish *Squalus acanthias* has been reduced to a skeleton by *Conilera cylindracea* (Montagu). The Isopods feed not only on the dead animal, but the living animal is also their prey.

It is supposed that the food of the fresh-water Isopods consists mainly of Infusoria.

The stomachs of certain of the land Isopods have, on examination, been found to contain moss cells, algæ, etc., so that a vegetable diet is in some cases substituted for an animal diet. The Serolidæ are strongly suspected of cannibalism (Stebbing).

8. HABITS.

Very little is known about the habits of the Isopoda, except as they are destructive. It is a well-known fact that the Isopod, *Limnoria lignorum* (Rathke) commonly called the "gribble," attacks wood by boring small holes, causing much damage to bridges, piers, etc. It has also been seen attacking the gutta-percha of submarine telegraph cables.

There are two species of the genus *Sphæroma* which have this same

destructive habit. *Sphæroma vastator* S. Bate comes from the Indian Peninsula, where it was procured "from a piece of wood which had formed part of a railway bridge over one of the backwaters of the west coast." The wood is described as being "honeycombed with cylindrical holes, in many of which the animal was rolled up like a ball." *Sphæroma destructor* Richardson was found boring the piers on St. Johns River, at Palatka, Florida. Sections of the wood showed that the diameter had been reduced during a period of eight years from 16 inches to 7½ inches. The whole surface of the wood was bored with holes averaging in size about 5 mm. in diameter, and in an end section the holes were arranged in concentric rings between the rings of annual growth, showing the little animals' preference for the soft pine. Very strong mandibles, projecting beyond the labrum most conspicuously, provide a perfect equipment for this destructive work.

In decided contrast to the above-mentioned habits, Hallez has recently pointed out some of the beneficial work of these little creatures. He has found that *Eurydice pulchra* Leach is the principal agent in maintaining the healthfulness of the coast at Portal, France. Shark fishing is an important industry of the people of Portal, who consume a great many of these fish and export a large number of them to Paris. The heads of the fish are thrown on the beach, but they are instantly surrounded by the little crustacea which leave only the cartilaginous skeleton.

Hallez believes that each locality has a species especially adapted to the conditions of the place for carrying on this sanitary work along the coast.

9. MODE OF LIFE.

Many of the Isopods are ectoparasites. The Cymothoidæ and Ægidæ are found attached to the fins and gills and in the mouths of fishes. Some of the Cirolanidæ are also parasitic on fish. Dr. Goode said of *Olencira prægustator* that these forms are not parasites in the true sense of the word, drawing nourishment from the fish to which they attach themselves; they are commensal rather, stealing shelter and transportation, but not subsistence. When the fish to which they are attached die, they change their quarters and seek a new host. *Olencira prægustator* (Latrobe) is a very abundant parasite, infesting a large per cent of the menhaden from the Potomac.

Ægathoa loliginea Harger was obtained from the mouth of a squid. Other specimens, however, have been found parasitic on young mullet, showing that the species is not parasitic solely on the squid.

Parasitism is the mode of life chiefly with the Epicaridea. The family Bopyridæ infest the shrimps and crabs, and are found either attached to the abdomen of the host or within the branchial cavity, beneath the carapace. A crab or shrimp thus infested is readily

detected by the large swelling or protuberance at one side of the body. A new genus of Bopyridæ is described in the following pages, which occupies a position in the visceral chamber of a species of *Munida*, this position with reference to the host never having been heretofore recorded of a parasite of this family. The Entoniscidæ, parasitic on the Brachyura, always occupy the visceral cavity of the body of the host, entering through the branchial cavity.

The Dajidæ are found attached to Schizopoda, and usually occupy a position on the back of the host, but they may also attach themselves on the ventral side to the branchiæ of the gill chamber or to the abdomen on the dorsal side. The Cryptoniscidæ are parasitic on Amphipods, other Isopods, Ostracoda, Cirripedia (usually the parasitic Cirripedia known as the Rhizocephalia), and are sometimes found in the incubatory pouch of deep-water Mysidæ.

One host may carry as many as four parasites. Dr. Fraisse found a *Peltogaster*, a *Cryptoniscus*, an *Athelges*, and a *Pseudione* on one Pagurid. One branchial and one abdominal parasite, or two branchial parasites, one on either side of the body, is not uncommon.

Other abiding places for shelter and protection are found by other Isopods. The Anthurid *Eisothistos vermiformis* Haswell occupies the tube of a *Vermilia*, and in the elongated shape of the body and the smallness of the limbs resembles the original occupant. The posterior part of the body, with its expanded appendages, serves well to imitate the branchiæ of the head region of the *Serpula*, which issues from the free end of the tube, the Anthurid entering the tube in the reverse direction from its former occupant, with head foremost.

Ega spongiophila Semper lives in a silicious sponge. Species belonging to the genus *Titanethes* Schiœdte are found in caverns; species of *Platyarthrus* Brandt are myrmicophile forms, dwelling in ants' nests, and *Leptaspidia brevipes* Bate and Westwood was first found in the fibrous nest of a mollusk.

The species belonging to the genus *Cleantis* Dana are supposed to be tube dwellers.

Ichthyoxenus jellinghausii Herklots bores a hole in the body of the fish, *Puntius maculatus* Bleeker, just behind the fins, where it lives with its mate (Stebbing).

Many Isopods are confined to caves, and lead a subterranean life. *Cæcidotea stygius* Packard was first found in Mammoth Cave; it has been recorded from Wyandotte Cave also (it is not confined to caves); *Cæcidotea richardsonæ* Hay comes from Nickajack Cave, as well as *Cæcidotea nickajackensis* Packard; *Brackenridgia cavernum* Ulrich comes from Ezell's cave and Beaver Cave near San Marcos, Texas; species of the genus *Cæcosphæroma* Dollfus seem to be confined to grottos, being found in subterranean waters; *Sphæromides raymondi* Dollfus comes from subterranean waters in a Cevennes grotto; *Tricho-*

niscus cavernicola Budde-Lund from grottos in the Pyrenees; *Asellus cavaticus* Schiœdte from subterranean waters in Central Europe; *Trichoniscus stygius* Nemec from a Gabroviza grotto near Trieste (probably identical with *Typhloniscus stygius* Joseph, according to Nemec, who, however, considers the species a true *Trichoniscus*), and *Stenasellus virei* Dollfus from subterranean waters (wells) near Cevennes, at a depth of 150 meters.

10. BATHYMETRICAL DISTRIBUTION.

Many of the marine forms are found floating on algæ or swimming freely near the surface of the water. Below the surface they have been taken from depths ranging from 1 to 2,040 fathoms. Among the deep-sea forms, the species *Apseudes gracilis* Norman and Stebbing may be mentioned; it comes from a depth of 1,450 to 1,785 fathoms, and is confined to the deep waters of the North Atlantic. The families which are known to descend below 1,000 fathoms in the North Atlantic are—[a]

Apsendidæ	Genera *Apseudes, Sphyrapus.*
Tanaidæ	Many genera.
Anthuridæ	Many genera.
Gnathiidæ	Genus *Gnathia* (*Anceus*).
Cirolanidæ	Genus *Cirolana.*
Idoteidæ	Genus *Chiridotea.*
Asellidæ	Genus *Nannoniscus.*
Arcturidæ	Genus *Astacilla.*
Munnidæ	Genera *Ischnosoma, Macrostylis.*
Munnopsidæ	Genera *Munnopsis, Ilyarachna,* and *Eurycope.*

In the Southern Sea the Serolidæ have been found distributed over a wide area in very deep waters, descending to 2,040 fathoms.

Ægа maxima Hansen, from Cocos Island, comes from a depth of 1,175 fathoms; *Astacilla cæca* Benedict, from off Maryland, was taken at a depth of 1,825 fathoms, and *Pseudione tuberculata* Richardson, from Port Ortway, Patagonia, comes from a depth of 1,050 fathoms.

One of the characteristic features of the deep-sea forms, or "Bassalian animals," is their distribution over wide areas.

11. GEOGRAPHICAL DISTRIBUTION.

The influence of temperature has been considered of paramount importance in the distribution of life in the seas.

According to Prof. James D. Dana, the preponderance of species is in the Temperate Zone, or Pararctalian and Notalian Realms.[b] Species outside of the Tropical Zone or Tropicalian Realm[b] are of the highest rank and usually the largest of the order, the giant forms, such as

[a] For above list refer to Stebbing, Trans. Zool. Soc. London, XII, Pt. 4, 1886, p. 1.

[b] The above nomenclature was suggested by Dr. Theodore Gill for the primary marine regions or realms in place of the zones used by Dana. Proc. Biol. Soc. Washington, II, 1885, pp. 1–66.

Chiridotea sabina (Krøyer), *Chiridotea entomon* (Linnæus), and *Glyptonotus antarticus* Eights[a] being found in the Frigid Zone or Arctalian Realm.[b]

The Sphæromidæ are nearly all cold-water species, though not reaching into the Arctalian Realm. *Sphæroma thermophilum* Richardson, from a warm spring in New Mexico, and *S. dugesi* Dollfus, also from a warm spring in New Mexico, are exceptions.

The Idoteidæ are the most decidedly cold-water forms, the Cymothoidæ and the Corallanidæ the least so.

The following genera extend into the Arctalian Realm: *Idotea*, *Glyptonotus*, *Jæra*, *Janira*, *Munna*, *Ægа*, *Serolis*, *Gnathia*, *Arcturus*, *Tanais*, *Liriopsis*, *Phryxus*, *Dajus*, *Chiridotea*, *Cryptocope*, *Leptognathia*, *Sphyrapus*, *Synidotea*, *Astacilla*, *Munnopsis*, *Eurycope*, *Calathura*, and *Bopyroides*.

In the Pararctalian and Notalian realms there is a commingling of forms from the Arctalian, Antarctalian, and Tropicalian realms.

Some of the terrestrial Isopods are very widely distributed, such well-known species as *Armadillidium vulgare* (Latreille), *Porcellio lævis* (Latreille), *Porcellio scaber* (Latreille), *Oniscus asellus* Latreille, and *Metoponorthus pruinosus* (Brandt) being cosmopolitan and found all over the world.

Many of the marine forms from the coast of Norway, England, and the Atlantic coast of Europe, and from the Mediterranean are carried by the Gulf Stream along the Atlantic coast of North America and are found on the coast as far south as the West Indies and the Bermudas. Among the number on record from European waters found on the Atlantic coast of North America may be mentioned: *Idotea metallica* Bosc, *Rocinela maculata* Schiœdte and Meinert, *Ægа ventrosa* M. Sars, *Ægа arctica* Lütken, *Sphyrapus malleolus* Norman and Stebbing, *Ægа webbii* (Guérin), *Synidotea bicuspida* (Owen), *Calathura branchiata* (Stimpson), *Cyathura carinata* (Krøyer), *Ægа psora* (Linnæus), *Cirolana concharum* (Stimpson), *Idotea marina* (Linnæus), *Jæra marina* (Fabricius), *Arcturus baffini* (Sabine), *Cirolana borealis* Lilljeborg, *Gnathia elongata* (Krøyer), *Astacilla granulata* (Sars), *Ægа crenulata* Lütken, *Cryptocope arctica* Hansen, *Leptognathia longiremis* (Lilljeborg), *Conilera cylindracea* (Montagu), *Leptochelia savignyi* (Krøyer), *Eurycope cornuta* (Sars), *Munnopsis typica* M. Sars, *Janira maculosa* Leach, *Munna fabricii* Krøyer, *Munna kroyeri* Goodsir, *Limnoria lignorum* (Rathke), *Tanais carolinii* Milne Edwards, *Leptochelia dubia* (Krøyer), *Jæra albifrons* Leach, *Ægа incisa* Schiœdte and Meinert,

[a] *Bathynomus giganteus* Milne Edwards coming from the Caribbean Sea is not an exception, because it is found at great depths, where the temperature of the water is very low.

[b] The above nomenclature was suggested by Dr. Theodore Gill for the primary marine regions or realms in place of the zones used by Dana. Proc. Biol. Soc. Washington, II, 1855, pp. 1–66.

Syscenus infelix Harger, *Rocinela dumerili* (Lucas), and *Dajus mysidis* Krøyer.

Chiridotea sabini (Krøyer) is a circumpolar species, having been recorded from the Pacific coast of North America, Greenland, the Siberian Polar Sea, the Kara Sea, and Franz-Josef Land (Sars). *Synidotea nodulosa* (Krøyer) is also circumpolar and occurs along the west and east coasts of North America.

Some of the Bopyridæ have a wide distribution. *Phryxus abdominalis* (Krøyer) has been recorded from the coast of Norway, from Greenland, and from the Atlantic and Pacific coasts of North America, the various species of host which it infests being circumpolar. *Bopyroides hippolytes* (Krøyer) is found also on both coasts of North America, the form from the west coast having been described by Stimpson under the name *acutimarginata*.

It is interesting to note the similarity between several of the species found on the Atlantic coast of North America and those of the Pacific coast, the differences separating them being very slight. Hansen has pointed out the close resemblance of his two species *Æga maxima*, from Cocos Island, and *Æga acuminata*, from the Galapagos Islands, to *Æga psora* (Linnæus) from the Atlantic coast; of his species *Æga plebeia* from Cocos Island and the Galapagos Islands, to *Æga ventrosa* Sars from the coast of Greenland; of his species *Rocinela modesta*, from the Gulf of Panama to *Rocinela maculata* Schiœdte and Meinert, from Greenland, and of his species *Rocinela laticauda* from the coast of Mexico to *Rocinela australis* Schiœdte and Meinert from the Straits of Magellan. *Rocinela affinis* Richardson from Japan also presents striking resemblances to *Rocinela oculata* Harger from the Atlantic coast of North America. *Cilicæa caudata gilliana* Richardson and *Dynamene tuberculosa* Richardson from the Pacific coast are quite similar to forms from the Atlantic coast, *Cilicæa caudata* (Say) and *Dynamene bermudensis* (Ives) from the Gulf of Mexico, Yucatan, and the Bermudas.

A rather remarkable instance of a shallow-water organism coming from two very remote localities is that of *Leptochelia minuta* Dana. The type species of this form was obtained from the Fijis, at the island of Ovalau, from among seaweed and small corals. A few years ago this species was again recorded by Stebbing, but this time from the West Indies, at Long Island, where it was found in shallow water covered with algæ.

In the present paper record is made of a species *Æga deshaysiana* (Milne Edwards) known to West Indian waters, being obtained by the U. S. Fish Commission steamer *Albatross* at the Hawaiian Islands.

In explanation of these facts Dr. Gill has said:

> The inference is irresistible that such types have migrated from common ground, and may have originally developed either in the deep sea and thence dispersed in opposite directions, or at one of the extremes, and wandered thence over the bottom to their final resting places.

12. SECONDARY SEXUAL CHARACTERS.

In many cases the males and females are alike in general characters, although there may be slight differences in size and proportions. In some instances, however, differences occur of the following nature: the antennæ in the males may be longer than in the females; this is true of the Ligiidæ for example. The males of *Ligia baudiniana* Edwards also have a fringe of bristles or stiff hairs along the carpus and the merus of the first pair of legs, which character is entirely wanting in the females. *Ligia exotica* Roux is provided with a process extending from the propodus of the first pair of legs in the males, this process being absent in the females. The males of *Corallana tricornis* Hansen, *Corallana quadricornis* Hansen, and *Corallana sexicornis* Richardson have in the first species named three spines on the dorsal surface of the head, in the second species four spines on the head, and in the third species four spines on the head and two on the basal joints of the antennulæ, the head of the female in all these species being entirely unarmed.

Among the Tanaidæ and the Apseudidæ the first pair of legs of the males are much more robust and very much larger than those of the females, although they are usually similar in structure. The males of several species of the genus *Leptochelia* Dana have greatly elongated first gnathopods and antennæ while the same appendages in the females are greatly reduced.

The genera of the Janiridæ, in which the first pair of legs of the males is different in structure from the other pairs, show a similarity in structure in all seven pairs with the females. *Carpias bermudensis* Richardson, which presents this tendency in the extreme, being remarkable for the great size and peculiar structure of the first pair of legs, exhibits no peculiarities of this kind in the female. The legs of the first pair in the species, *Stenetrium stebbingi* Richardson, differ in form from those of the female, both, however, being chelate in character.

In the Sphæromidæ the genus *Cilicæa* Leach has the first abdominal segment in the male produced in a long spine or process, which, according to Haswell, is sometimes wanting in the female. The males of the genus *Isocladus* Miers have the seventh thoracic segment produced in a long spine, which is not developed in the female. *Cycloidura* Stebbing, an Australian genus of the Sphæromidæ, has the seventh segment of the thorax produced into a large dorsal spine, at least in the male. *Ceratocephalus* Woodward, also a Sphæromid genus, has the head of the male drawn out into three large processes, of which the middle one is much the longest; in the female faintly marked projections take the place of these processes. The sixth segment of the thorax in *Campecopea* Leach is produced in a long tooth in the male, but not in the female.

In this order, with the exception of the Epicaridea, perhaps there is no greater distinction between the males and the females than in the family Gnathiidæ. Owing to these differences, at one time the young and the females were included in a separate family from that to which the males were assigned. The relationship between the two forms was definitely established by Mr. Eugene Hesse, although suggestions were made by Leach as early as 1814 pointing to this conclusion. The adult males have powerful mandibles projecting in front of the large quadrangularly shaped head. In the female the mandibles are absent and the head is small and triangular. The first gnathopods in the male are two-jointed opercular appendages. In the female the first pair of legs lie in a membranous plate supposed to be marsupial in character (Stebbing).

With the Epicaridea not only is sexual dimorphism most marked, but the males also differ from the females in the shape of the body, which is elongate and always bilaterally symmetrical, while the body of the female is usually more or less asymmetrical, and has a tendency to be circular in outline, and in the fact that the segments of the abdomen may be distinct or fused irrespective of this condition in the female.

13. ALTERATION OF SEX AND HERMAPHRODITISM.

The peculiar phenomenon of the alteration of sex occurs among some of the Cymothoidæ. The young male at one period is protandrous, being provided with rudimentary female reproductive organs within the male reproductive organs. When the integument is shed the female reproductive organs develop at the expense of the male organs, the incubatory lamellæ arise at the base of the thoracic legs, and the copulatory organs are thrown off.

This alteration of sex and temporary hermaphroditism of the protandrous type has been observed in *Cymothoa*, *Nerocila*, *Anilocra*, and *Ichthyoxenos*.

The Cryptoniscian larvæ (males) of the Epicaridea develop into adult males and females, the larvæ which are to become females having at one period both male and female reproductive organs. In the family Cryptoniscidæ the males not transformed into females do not pass beyond the form of the Cryptoniscian larvæ. With the family Entoniscidæ certain males undergo, while retaining their sex, a metamorphosis less complete than that of the female, but sufficiently great to give a very different appearance to this second form. Thus the Entoniscidæ have larval males (complementary males) as well as degraded adult males, both fertile. It may be possible as Girard and Bonnier suggest, that, if the adult degraded male should disappear, one of these complementary males may take its place and continue its transformation into the adult form. The Cryptoniscidæ have only larval males. The Bopyridæ have only degraded adult males.

I.

ISOPODA COLLECTED IN JAPAN IN THE YEAR 1900 BY THE U. S. FISH COMMISSION STEAMER ALBATROSS, AND IN THE YEAR 1881 BY THE U. S. S. PALOS.

The collections made in Japan by the U. S. Fish Commission steamer *Albatross* and the U. S. S. *Palos* contained material that was interesting and, for the most part, new to science. In the present paper two new genera and several new species are added to the list of those already known.

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FLABELLIFERA or CYMOTHOIDEA.

Family ÆGIDÆ.

ROCINELA ANGUSTATA, new species.

Rocinela laticauda RICHARDSON (not Hansen), Proc. Am. Philos. Soc., XXXVII, 1898, No. 157, pp. 14–15, figs. 5–6; Proc. U. S. Nat. Museum, XXI, 1899, p. 828.

Locality.—Manazura, Japan. (Collected by the U. S. Fish Commission steamer *Albatross.*)

This species formerly identified by the author with *R. laticauda* Hansen[a] from Acapulco, Mexico, is now given a new specific name. It can be differentiated from *R. laticauda* Hansen by the difference in the width of the abdomen compared with the thorax, the abdomen being much broader in *R. laticauda* Hansen than in *R. angustata* Richardson; in having but four spines on the propodus of the prehensile legs, while in *R. laticauda* Hansen there are six; in having six spines (five are wrongly given in the earlier description) on the merus of the prehensile legs, while in *R. laticauda* Hansen there are four, and in the shorter antennæ. Four specimens of this species were obtained by the U. S. Fish Commission steamer *Albatross*, one from off San Luis Obispo Bay, California, another off Esteros Bay, California, a third at Puget Sound, and a fourth from Unimak Island, Alaska. All four specimens are alike in character; two are males, and two females. The specimen from Japan, a male, agrees with the specimens referred to *R. angustata* Richardson with this exception: There are four spines instead of six on the merus of the prehensile legs. It has the narrow abdomen, the shorter antennæ, and the four spines on the propodus of the prehensile legs, as stated in the description of *R.* (*laticauda*) *angustata* Richardson.

ROCINELA AFFINIS, new species.

Body ovate; color uniformly yellow.

Head large, triangular, and produced over the basal joints of the antennæ in a truncate process. Eyes large, occupying the greater portion of the head and contiguous along the median line. The ocular lobes do not project posteriorly. The ocelli are arranged in ten rows along the long axis of the eye. The first pair of antennæ extend to the end of the peduncle of the second pair of antennæ; the first joint of the peduncle is very short and is almost concealed by the frontal process; the flagellum consists of five joints. The second pair of antennæ extend but a short distance beyond the first thoracic segment;

[a] Bull. Mus. Comp. Zool., Harvard College, 1897, XXXI, No. 5, p. 108, pl. III, figs. 2, 3.

the first joint of the peduncle is entirely concealed by the frontal process; the flagellum consists of fourteen joints.

The first and second segments of the thorax are equal in length. The third is longer and the fourth the longest. The fifth segment is short and equal in length to the first or second segment. The sixth segment is very short in the median dorsal line, being about one-third the length of the preceding segment. The seventh segment is extremely short, being half as long in the median line as the sixth segment. The epimera of the second and third segments are not so acutely produced as in the following segments. Those of the fourth, fifth, and sixth segments are narrow and have acute posterior extremities. The epimera of the seventh segment are broad, but also acutely produced.

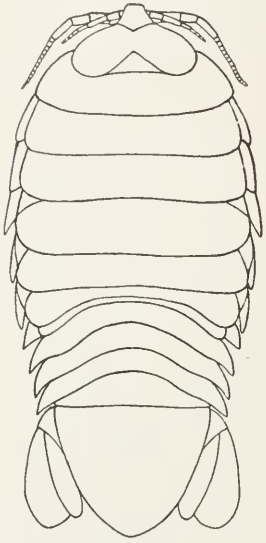

FIG. 1.—ROCINELA AFFINIS, NEW SPECIES. × 4.

The first abdominal segment is not evident in a dorsal view, being entirely concealed by the last thoracic segment. The second, third, and fourth segments are produced laterally in acute processes. The fifth segment is narrow, not as wide as the terminal segment, but is longer than the preceding segments in the median line. The terminal segment is roundly triangulate, with margins fringed with a few hairs. The outer branch of the uropoda is broadly expanded, rounded posteriorly, and is about twice as wide as the inner branch. The outer margin is crenulate, and beset with ten spines. The inner branch is narrow, and rounded posteriorly, and is equal in length to the outer branch.

The first three pairs of legs have long curved dactyli. The propodus of the first pair is armed with four spines, the carpus with one, and the merus with two. The second and third pairs have the propodus armed with only three spines. The other legs are long, slender, and somewhat spinulose.

FIG. 2.—LEG OF FIRST PAIR OF ROCINELA AFFINIS. × 10.

Only one specimen was taken by the U. S. Fish Commission steamer *Albatross*, at the entrance of Port Heda, Japan, at a depth of 167 fathoms.

Type.—Cat. No. 29083, U.S.N.M.

This species is very closely related to *R. oculata* Harger,[a] to which it bears a very striking resemblance. It differs from that species in the following points:

[a] Bull. Mus. Comp. Zool., Harvard College, XI, No. 4, 1883, pp. 97–98; pl. III, figs. 2–2a; pl. IV, fig. 1.

(1) In the entire concealment of the first abdominal segment on the dorsal side by the last thoracic segment; (2) in the much larger epimera of the seventh thoracic segment, which are quite as prominent as those of the sixth segment, and are somewhat broader, the posterior extremities not being on a level with those of the sixth segment, as is true of *R. oculata*, but extending some little distance behind; (3) in having the propodus of the legs of the first pair armed with only four stout spines, while in *R. oculata* there are eight, and in having two stout spines, also, on the merus, while in *R. oculata* there are none; the legs of the second and third pairs have three spines on the propodus, while in *R. oculata* they have six spines; and (4) in not having the eyes produced posteriorly into lobes as in *R. oculata*.

Family CIROLANIDÆ.

CIROLANA JAPONENSIS, new species.

Body about three times as long as wide, rather convex.

Head transverse. Eyes very small, round, and situated at the antero-lateral corners of the head. Color of eyes light brown. Frontal margin of head with small median point, on either side of which is a depression for the reception of the antennæ. First pair of antennæ very short, reaching only to the end of the fourth joint of the peduncle of the second pair of antennæ; flagellum with joints very short and difficult to distinguish; they number about ten. Second pair of antennæ extend a little beyond the posterior margin of the third thoracic segment; the flagellum contains about twenty-four joints. Frontal lamina or interantennal plate is narrow and elongate, this and the clypeus being unarmed and perfectly flat.

FIG. 3.—ANTENNÆ, FRONTAL LAMINA, CLYPEUS, AND LABRUM OF CIROLANA JAPONENSIS, NEW SPECIES. ×10.

The first segment of the thorax is not greatly longer than the second, although it is a little longer. The fourth, fifth, and sixth segments are equal in length to each other and to the first, being slightly longer than the second, third, and seventh. The epimera of the second and third segments are not produced posteriorly. Those of the following four segments are produced posteriorly, a gradual increase in this feature being noticeable. The posterior extremity of the epimera of the seventh segment reaches the posterior margin of the second abdominal segment. All the epimera are broad and smooth, with only a faint trace of arched carinæ.

The first four segments of the abdomen are of equal width and of nearly equal length. The third and fourth have the post-lateral extremities produced. The fifth segment is covered at the sides by the post-lateral prolongations of the fourth segment. The sixth seg-

ment is triangulate, with apex obtuse, the sides converging more rapidly to the posterior third portion of the segment. This posterior part of the last segment is crenulate, and armed with about ten spines and numerous hairs. The inner branch of the uropoda is about twice as broad as the outer. Both branches are equal in length, crenulate on both margins, and armed with spines and hairs.

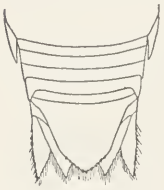

FIG. 4.—ABDOMEN OF CIROLANA JAPONENSIS. ×10.

The legs of the first pair have the ischium and merus distally produced, the process of the merus extending half the length of the propodus. The carpus is very small, almost inconspicuous. There are a few spines on the inferior margin of the merus, carpus, and propodus. In the second and third pairs of legs the carpus is larger, and the process of the merus extends to the end of this joint. The fourth and fifth pairs of legs are similar, with the exception that the basis in the fifth pair is more dilated and less slender than in the fourth pair. The sixth and seventh pairs have the basis much dilated, forming a high carina. All the legs are furnished with long, plumose hairs. Spines also are present along the margins of the legs.

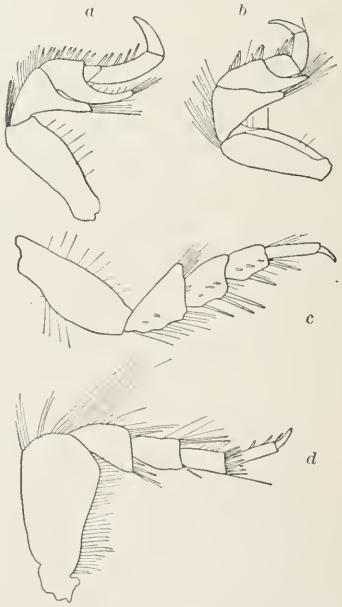

FIG. 5.—LEGS OF CIROLANA JAPONENSIS. *a*, OF FIRST PAIR; *b*, OF SECOND PAIR; *c*, OF FIFTH PAIR; *d*, OF SEVENTH PAIR. ×10.

Color, uniformly light yellow; eyes, light brown.

Only one specimen was taken by the U. S. Fish Commission steamer *Albatross*, at Yokkaichi Light, Japan.

Type.—Cat. No. 29085, U.S.N.M.

This species is closely related to *C. hirtipes* Milne Edwards,[a] but the following characters may serve to distinguish it from that species: Clypeus somewhat wider than labrum, being produced at the lateral angles; antennæ longer than in *C. hirtipes*, reaching the posterior margin of the third thoracic segment; eyes smaller than in *C. hirtipes* and round; epimera of thoracic segments not ornamented with arcuate carinæ ("furca"), only faint traces of these being evident; the legs of the first three pairs are not provided with a spine at the apex of the ischium and merus, as is true of *C. hirtipes;* the other four pairs of legs are provided with spines along the margins and a few spines on

[a] H. J. Hansen. Cirolanidæ, etc., Vidensk. Selsk. Skr., 6te R. Naturvidenskabelig og Mathematisk Afd. 5te Bd. 3, p. 326.

some of the joints, while in *C. hirtipes* the spines are more numerous on the margins and grouped together in rows on the ischium, merus, and carpus; and the posterior margin of the terminal segment of the abdomen is armed with ten rather than sixteen spines.

This species differs from *C. schiödtei* Miers[a] in the form of the frontal lamina (interantennal plate), which in the latter species bears a strong tooth at its anterior extremity.

It differs from *C. tenuistylis* Miers in not having the first thoracic segment greatly longer than the other segments.

From *C. rossii* Miers[b] it differs in the form of the eyes, which in that species are narrow-oblong, and extend "along the sides of the head from the front margin of the first segment of the body nearly to the bases of the antennæ."

Family CYMOTHOIDÆ.

LIVONECA PROPINQUA, new species.

Body broad, with sides subparallel, twisted either to right or left. Abdomen not narrower than thorax. Color, dark yellow.

Head small, triangular; front produced in an obtuse point; posterior margin straight. Eyes moderately large, oval, and situated at the lateral angles of the head. First pair of antennæ extend nearly to the antero-lateral angles of the first thoracic segment; each consists of seven joints. Second pair of antennæ reach the posterior margin of the head; each is composed of thirteen joints.

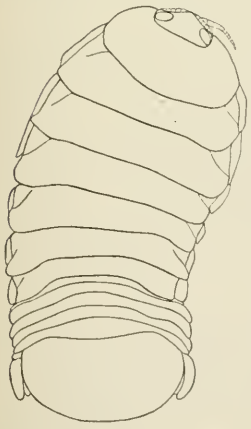

FIG. 6.—LIVONECA PROPINQUA, NEW SPECIES. ×3.

FIG. 7.—LIVONECA PROPINQUA. *a*, LEG OF FIFTH PAIR; *b*, LEG OF SIXTH PAIR; *c*, LEG OF SEVENTH PAIR. ×10.

First thoracic segment considerably longer than any of the others. The antero-lateral angles of this segment extend up around the head on either side; the posterior angles are widely rounded. The other thoracic segments are about equal in length, the seventh segment being somewhat shorter.

[a] Zoological Collections of H. M. S. *Alert*, 1884, pp. 302–304, pl. XXXIII, fig. A, and pl. XXXIII, fig. B.

[b] Catalogue of the Stalk and Sessile-eyed Crustacea of New Zealand, 1876, p. 109, pl. III, fig. 3.

The epimera of the second and third segments are long and narrow, and extend the whole length of the lateral margin of the segments. The epimera of the fourth and fifth segments are short and pointed posteriorly, and extend only half the length of their respective segments. The epimera of the sixth segment are pointed posteriorly and extend three-fourths the length of the segment; those of the seventh segment are rounded posteriorly and extend fully to the posterior margin of the seventh segment.

The abdominal segments are short but fully as wide as the thoracic segments. The terminal segment is transverse, about twice as wide as long, with the posterior margin widely rounded.

The uropoda are narrow oar-like appendages, somewhat tapering toward the extremity, which is rounded. The outer branch is a little longer than the inner branch and extends almost to the posterior margin of the terminal abdominal segment.

The legs are all similar, with the exception that the carina of the basis is very high on the four posterior pairs.

This species differs from *L. caudata* Schiœdte and Meinert[a] from Japan in the fact that the carina of the basis is much higher than in that species; in the longer uropoda, the outer branch being the longer one in *L. propinqua*, while the reverse is true in *L. caudata* Schiœdte and Meinert; and in the transverse terminal segment.

Three specimens were obtained by the U. S. Fish Commission steamer *Albatross* at Port Heda, Japan.

Type.—Cat. No. 29086, U.S.N.M.

Family SPHÆROMIDÆ.

CYMODOCEA ACUTA, new species.

Surface of body smooth; color white with numerous black dots. Head large, broader than long, with prominent median point. Eyes large, situated in the post-lateral angulations, the ocular lobes extending some distance beyond the posterior margin of the head. First pair of antennæ extend almost to the posterior margin of the first thoracic segment; first two joints of peduncle large, dilated, the first one long, the second very short; third joint long and slender; flagellum composed of about seventeen joints. Second pair of antennæ reach the posterior margin of the second thoracic segment; flagellum composed of about twenty joints.

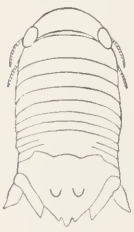

FIG. 8.—CYMODOCEA ACUTA, NEW SPECIES. ×3.

First segment of thorax is twice as long as any of the others. The following six segments are subequal in length. The lateral parts of all the segments are produced in narrow, acute angulations. The epimera are indicated by faint suture marks.

[a] Naturhistorisk Tidsskrift, (3) XIV, 1883–84, pp. 360–362, pl. xv, figs. 1–2.

The first segment of the abdomen is twice as long as the last thoracic segment. There are three suture lines on either side, the first pair being entirely concealed except in a lateral view. This segment is posteriorly produced in two small points, one on either side of the median line, and in two larger points, one on either side a little within the line of the epimeral sutures of the thoracic segments. The terminal abdominal segment has a large triangular lobe within the notch at the posterior extremity. The lobes on either side of the median lobe are smaller and shorter. About the middle of the segment are two elevations, one on either side of the median line, transversely situated. The uropoda are equal in length, and are shorter than the terminal segment. Both are pointed posteriorly. The outer one is more tapering than the inner one, which is equal in width throughout its length.

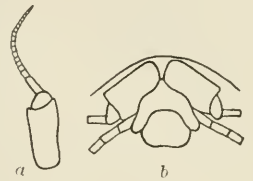

FIG. 9.—CYMODOCEA ACUTA. *a*, ANTENNÆ OF THE FIRST PAIR; *b*, LABRUM.

FIG. 10.—LATERAL VIEW OF BODY OF CYMODOCEA ACUTA. ×5.

The legs are all similar in shape and size and terminate in biunguiculate dactyli. They are ambulatory in character.

Only one specimen was collected by the U. S. Fish Commission steamer *Albatross* at Yeno-Ura, Japan. It was taken on the surface.

Type.—Cat. No. 29084, U.S.N.M.

This species differs from *C. mammifera* Haswell,[a] from Port Denison, Queensland, in having the uropoda shorter than the terminal segment, while in that species they are longer than the terminal segment; and in having the lateral angles of the thoracic segment drawn out in acute processes, while in *C. mammifera* they are "rather blunt."

VALVIFERA or IDOTEOIDEA.

Family IDOTEIDÆ.

SYMMIUS, new genus.

Head with lateral parts expanded; lateral margins entire, not cleft.

Eyes small and situated on the posterior part of the expanded lateral portions.

First pair of antennæ elongate, consisting of four joints, the last joint being clavate. Second pair of antennæ very short, not longer than the first pair, and consisting of six joints, five being peduncular, the sixth joint being the flagellar joint. Maxillipeds with a three-jointed palp.

Epimera present and developed on only the last three segments of the thorax, as in *Glyptonotus* Eights, the epimera of the three ante-

[a] Proc. Linn. Soc. New South Wales, V, 1880, pp. 474, 475.

rior segments being perfectly united with the segments and with no trace of suture lines.

The abdomen is composed of three segments, two short basal segments and one long, narrow terminal segment.

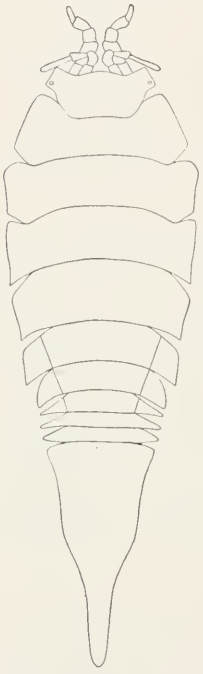

FIG. 11.—SYMMIUS CAUDATUS, NEW SPECIES. × 7.

The opercular valves consist of a single piece each, the basal and terminal plates not being distinct or separated by even a suture line.

This genus differs from both *Glyptonotus* Eights and *Chiridotea* Harger in having the lateral margins of the head entire and not cleft; in having the eyes situated on these lateral expansions of the head; in having all the joints of the flagellum of the second pair of antennæ consolidated and forming a single piece; in having the abdomen composed of only three segments; in having the valves of the operculum consisting of a single piece, and in having a three-jointed palp to the maxillipeds.

It differs also from *Chiridotea* Harger but agrees with *Glyptonotus* Eights in having the epimera distinct only on the last three segments of the thorax.

SYMMIUS CAUDATUS, new species.

Body elongate, broadest at second and third thoracic segment.

Head broader than long, with the anterior part expanded laterally. The margins of these lateral expansions are entire. The eyes are very small and situated in the posterior angles of the lateral lobes. There is no notch in the middle of the anterior margin, the margin being very slightly produced in a widely rounded lobe.

The first pair of antennæ consist of four joints and are somewhat elongate. The last joint is long and clavate. The second pair of antennæ consist of six joints and do not exceed in length the antennæ of the first pair. The joints of the flagellum are all consolidated into a single piece, the terminal or flagellar joint.

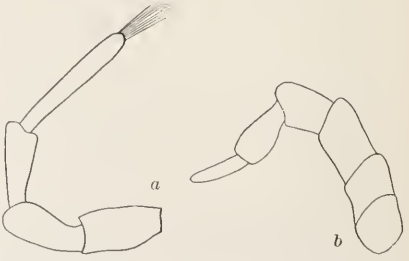

FIG. 12.—SYMMIUS CAUDATUS; *a*, ANTENNA OF FIRST PAIR; *b*, ANTENNA OF SECOND PAIR. *a* × 10; *b* × 7.

The first four segments of the thorax are about equal in length. The fifth, sixth, and seventh segments become successively shorter. The body is broadest at the second and thoracic third segments, the sides converging beyond that point to the narrow apex of the terminal abdominal segment. The epimera of

the four anterior thoracic segments are consolidated and perfectly united with the segments. Those of the fifth, sixth, and seventh segments are distinct and evident in a dorsal view.

The abdomen is composed of three distinct segments—two short segments preceding the long and narrow terminal segment. The lateral parts of the first two abdominal segments, as well as of the seventh thoracic segments, are produced into acute points. The terminal segment is entire, with no suture lines at the base. It is produced in a long and narrow extremity, rounded at the apex. About the middle of the segment there is a slight lateral expansion on either side. The opercular valves consist each of a single piece and are produced in a long and narrow extremity.

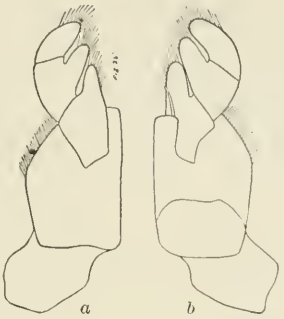

FIG. 13.—MAXILLIPED OF SYMMIUS CAUDATUS; *a*, ANTERIOR SIDE; *b*, POSTERIOR SIDE. × 10.

FIG. 14.—OPERCULAR VALVE OF SYMMIUS CAUDATUS. × 10.

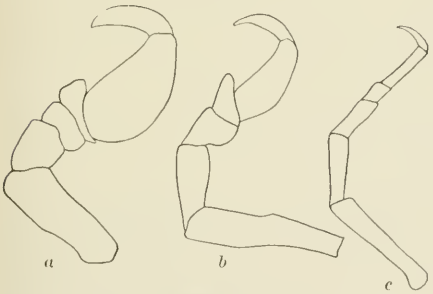

FIG. 15.—LEGS OF SYMMIUS CAUDATUS; *a*, FIRST PAIR; *b*, SECOND PAIR; *c*, SEVENTH PAIR. × 15.

The legs of the first pair are stouter and more robust than the others. Those of the last pair are very feeble and much smaller than the preceding pairs.

Color white, with markings of grayish brown.

Nine specimens were collected by the U. S. Fish Commission steamer *Albatross* at Ose Zaki, Japan, at a depth of 60 to 70 fathoms.

Type.—Cat. No. 29081, U.S.N.M.

Family ARCTURIDÆ.

ARCTURUS HIRSUTUS, new species.

Body densely covered and beset with spines, each of which at its distal end has a circle of fine hairs radiating from it in all directions in a plane at right angles to the axis of the spine, giving a very characteristic and unusually beautiful appearance to the body.

The head has a median excavation on the frontal margin. Between the eyes on the anterior portion are two long spines, the longest of any on the body except the two at the posterior extremity of the terminal segment of the abdomen. On the posterior portion of the head in the space between the eyes are four spines of equal length, two on either side of the median line. On the antero-lateral portion

of the head is a single small spine; on the post-lateral portion are two groups of small spines, having two or three spines in each group. The basal joints of the first pair of antennæ bear each a single long spine; the flagellum extends a short distance beyond the middle of the third joint of the peduncle of the second pair of antennæ. The second joint of the peduncle of the second pair of antennæ bears three long spines; the third joint bears four long spines in a longitudinal row about the middle of the segment, and a long spine at the distal extremity; the fourth joint bears a long spine at the distal extremity; the fifth joint is unarmed; the flagellum contains fifteen joints. The joints of the antennæ are thickly fringed with long hairs.

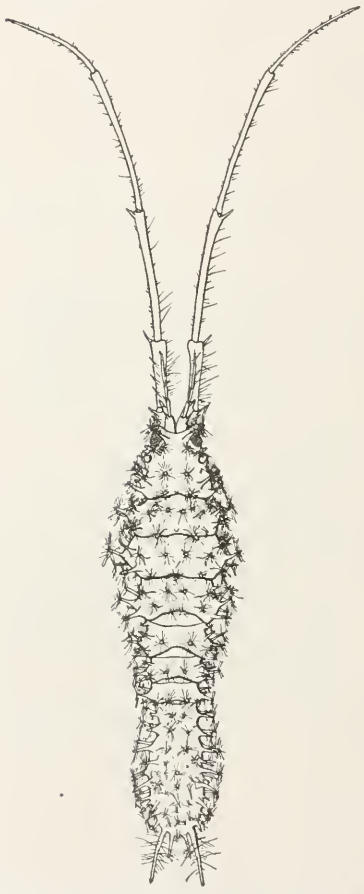

FIG. 16.—ARCTURUS HIRSUTUS, NEW SPECIES. ×2.

The first segment of the thorax has on the anterior portion two long spines on either side of the median line; on the posterior portion are three long spines on either side of the median line and one small median spine; four small spines are present on the lateral margin on either side. The second thoracic segment bears eight large spines and two small ones on either side of the median line; on the posterior portion is a small median spine; the epimeron of this segment is beset with four small spines. The third segment bears seven long spines and three small ones on either side of the median line, and one long spine on the posterior portion in the median line; the epimeron is beset with four small spines. The fourth segment bears eight long spines and two small ones on either side of the median line, and on the posterior portion in the median line two small spines close together; the epimeron is beset with two spines. The fifth and sixth segments bear each five long spines on either side of the median line; the epimeron of each segment is beset with three spines. The seventh segment bears three spines on either side of the median line; the epimeron is beset with three spines.

The first and second abdominal segments have each four spines on either side of the median line. The third segment has three spines on

either side of the median line. These segments are not separated from the terminal segment, but are coalesced with it. The terminal segment is rounded posteriorly. Bordering the lateral margins is a row of seven or eight spines on either side of the median line. The dorsal surface is irregularly covered with numerous long and short spines. At the posterior extremity of the terminal segment are two very long spines—the longest on the body—directed backward. Between them and a little back of them are two smaller spines, also directed backward.

The valves of the operculum are covered with numerous small spines.

Both the anterior and the posterior pairs of legs are armed with many long and short spines. The anterior pairs are also fringed with hairs.

Three specimens of this species were collected by the U. S. Fish Commission steamer *Albatross* at Rat Islands, the Aleutian Chain, at a depth of 270 fathoms.

Type.—Cat. No. 29082, U.S.N.M.

EPICARIDEA or BOPYROIDEA.

Family BOPYRIDÆ.

PARAPENÆON, new genus.

PARAPENÆON CONSOLIDATA, new species.

Body somewhat oval, about one and a half times longer than broad. Color uniformly yellow, without any markings.

Head with frontal border produced in a large quadrangular process, directed upward; posterior portion triangulate in shape. Eyes absent. The first pair of antennæ are composed of three joints, the terminal joint being minute. The second pair of antennæ consist of four joints.

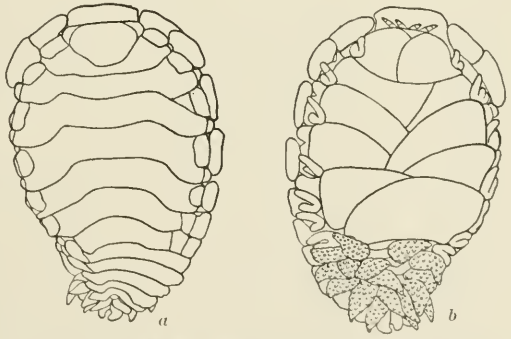

FIG. 17.—PARAPENÆON CONSOLIDATA, NEW SPECIES. *a*, DORSAL VIEW OF FEMALE *b*, VENTRAL VIEW OF SAME. ×8.

The first two segments of the thorax have the anterior portion of the pleural plates ("lames pleurales") very large and conspicuous, and, although developed from the anterior part of the segment, they extend some little distance in front of the segments. The posterior parts of these segments have each a small lobe constricted off, which may be regarded as the posterior portion of the

pleural plates of the segments. (Hansen so considers the posterior lobes of the corresponding thoracic segments in his genus *Cryptione*.)[a]

FIG. 18.—FIRST LAMELLA OF MARSUPIUM OF PARAPENÆON CONSOLIDATA. ×10.

In the two following segments the pleural plates are of this character, except that on one side of the body the anterior portion is greatly reduced and almost inconspicuous. The pleural plates in the three following segments are not divided by a furrow into anterior and posterior portions, but extend entire along the whole of the lateral margin of the segments. The ovarian bosses are prominent and well developed on the first four segments.

The segments of the abdomen are all distinct, with the lateral portions of the first five produced into plates, the first two of which on one side are turned upward. These plates are not distinctly separated from the segments. The sixth or terminal segment is minute and rounded and without pleural plates. The uropoda are a pair of small single-branched lamellæ attached to the terminal abdominal segment. The pleopoda consists of five pairs of double-branched lamellæ (ten on either side), the surfaces of which are closely and densely covered with small rounded knobs, supposed to indicate rudimentary ramification.

FIG. 19.—LEG OF SIXTH PAIR OF ADULT FEMALE OF PARAPENÆON CONSOLIDATA. ×39.

The marsupium consists of five pairs of large smooth plates, over-lapping in the ventral median line.

The basis of all the legs is furnished with a high carina.

Description of male.—Body elongate. Head large, rounded. Eyes absent. Seven thoracic segments distinct, with lateral margins rounded. Abdomen all in one piece, the six segments not indicated in any way on the dorsal side or lateral margins. Shape of abdomen triangular, with apex rounded. Pleopods neither developed nor in a rudimentary condition on the ventral side.

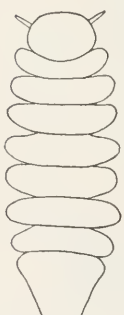

FIG. 20.—MALE OF PARAPENÆON CONSOLIDATA. ×41.

One female, with its male, was collected by Dr. F. C. Dale, U. S. Navy, on the U. S. S. *Palos*, at Mogi, Japan. It was found on *Parapenæus dalei* Rathbun.

The female of this species bears a great resemblance to the female of *Cryptione elongata* Hansen. The male differs, however, in having the segments of the abdomen all consolidated and forming a single piece, the male of Hansen's type species of the genus *Cryptione* having the abdomen distinctly segmented, each segment bearing a pair of rudimentary pleopoda, and the terminal segment provided with uropoda.

Type.—Cat. No. 29087, U.S.N.M.

[a] Bull. Mus. Comp. Zool. at Harvard College, XXXI, No. 5, Pt. 22, 1897, p. 113.

Young female of Phryxus sp.?—Body asymmetrical. Segments of thorax defined only on the one side; other side greatly swollen. All the legs of both sides present.

Segments of abdomen distinct. Terminal segment entire and produced in a long narrow process. Four pairs of double-branched pleopoda present. The outer lamellæ have the proximal portion greatly dilated, being constricted about the middle on one side and terminating in a narrow elongated process; the inner lamellæ are small, tapering processes directed toward the median line of the body.

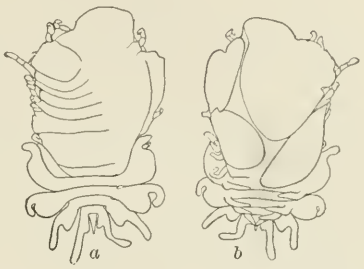

FIG. 21.—YOUNG FEMALE OF PHRYXUS, SPECIES.? *a*, DORSAL VIEW; *b*, VENTRAL VIEW. ×10.

The marsupium consists of four pairs of plates, four of these being large and conspicuous, the other four small and partly concealed by one of the larger plates.

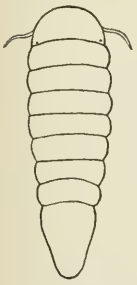

FIG. 22.—MALE OF PHRYXUS, SPECIES.? ×61.

Male.—Head large, broadly rounded in front; eyes very small, and situated at extreme post-lateral angulations; antennæ long. Segments of thorax distinct; those of the abdomen fused into one segment, whose extremity is broadly rounded.

Only one specimen, unattached, was obtained by the U. S. Fish Commission steamer *Albatross* at Omai Zaki Light, at a depth of 36 to 48 fathoms.

The young female described differs from the young female of *Phryxus abdominalis* (Krøyer)[a] in the shape of the terminal segment of the body, in the shape of the outer lamellæ of the pleopoda, and in having the inner branches of the pleopoda directed toward the median line.

The male differs from the male of *P. abdominalis* in the larger head, longer antennæ, and differently shaped abdomen.

ARGEIA PUGETTENSIS Dana.

Argeia pugettensis DANA, U. S. Expl. Exp. Crust., II, p. 804, pl. LIII, fig. 7.—STIMPSON, Bost. Journ. Nat. Hist., VI, 1857, p. 71.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 868.

Locality.—Tsuragi Saki Light, at a depth of 259 and 110 fathoms; Yokkaichi Light, at a depth of 13 and 16 fathoms; and Oboro Saki, Japan, at a depth of 14 and 18 fathoms. All parasitic on *Crangon propinquus* Stimpson, except those from the locality first named, which are parasitic on *Crangon* sp.

Another specimen was collected at Mogi, Japan, by Dr. F. C. Dale (U. S. S. *Pulos*), which was parasitic also on *Crangon propinquus*.

[a] Sars, Crustacea of Norway, II, 1899, pp. 214–217, pls. XC–XCI.

II.

ISOPODA COLLECTED IN JAPAN BY JORDAN AND SNYDER.

The material upon which this paper is based was collected in Japan by Dr. David S. Jordan and Mr. J. O. Snyder while investigating the fishes of that region for the Hopkins Laboratory of Stanford University. Three new species, one of which is the type of a new genus, are added to the fauna of that country. A list of the other species collected is included.

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FLABELLIFERA or CYMOTHOIDEA.

Family CYMOTHOIDÆ.

MEINERTIA TRIGONOCEPHALA (Leach).

Cymothoa trigonocephala Leach, Dict. Sc. Nat., XII, 1818, p. 353.—Milne Edwards, Hist. Nat. Crust., III, p. 272.—De Haan, Faun. Japon., L, p. 227, fig. 7a–b.

Ceratothoa trigonocephala Schiœdte and Meinert, Naturhist. Tidsskrift, (3) XIII, 1883, pp. 358–364, pl. xvi, figs. 1–7.

Meinertia trigonocephala Stebbing, Hist. Crust., 1893, p. 354.

Locality.—Nagasaki, Hizen, Misaki, Sagami, Japan. (Collected by Jordan and Snyder.)

Family SPHÆROMIDÆ.

SPHÆROMA RETROLÆVIS, new species.

Body somewhat convex. Head large with eyes post-laterally situated. Segments of thorax subequal with exception of last one, which is shorter than any of the others. The epimera are drawn out into narrow processes at the sides of the segments. The epimera, however, are not distinct from the segments, but are consolidated with them. The last two segments of the thorax are provided on the posterior margin with four low tubercles in a transverse row, the two on either side of the median line being more prominent than the others. The whole surface of the abdomen is rugose. The first segment has a transverse row of four tubercles. The terminal segment is posteriorly truncate; the posterior portion is rather flat on the dorsal surface and is unarmed; the more convex anterior portion is provided with two longitudinal rows of three low tubercles on either side of the median line, the middle tubercle in each row being the most prominent; on either side of these two median rows of tubercles are two small tubercles also in longitudinal series. The uropoda do not extend beyond the extremity of the terminal abdominal segment. The inner branch is smooth on both margins; in shape it is long and narrow, and pointed posteriorly. The outer branch is similar in size and shape to the inner branch, but is denticulate on the exterior margin, being armed with four teeth. The legs are in two series. The first three pairs are very slender and feeble and are directed forward. The last four are more robust. Only one specimen was found at Nagasaki, Hizen, Japan, collected by Jordan and Snyder.

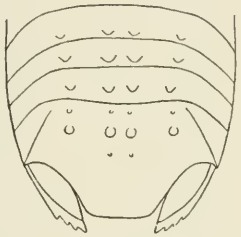

FIG. 23.—ABDOMEN AND LAST TWO THORACIC SEGMENTS OF SPHÆROMA RETROLÆVIS, NEW SPECIES. × 8.

Type.—Cat. No. 28965, U.S.N.M.

VALVIFERA or IDOTEOIDEA.

Family IDOTEIDÆ.

IDOTEA JAPONICA Richardson.

Idotea japonica RICHARDSON, Proc. U. S. Nat. Museum, XXII, 1900, pp. 131–134.

Locality.—Tokyo, Japan; Mororan, Hokkaida, Japan. Hakodate, Hokkaido, Japan. (Collected by Jordan and Snyder.)

PENTIAS, new genus.

PENTIAS HAYI, new species.

Body narrow elongate, four and a half times longer than wide; surface smooth; color in alcohol almost white.

Head twice as wide as long, slightly emarginate in front, with a small median point. Eyes situated at the extreme lateral margin, about the middle. First pair of antennæ have the basal joints greatly dilated, the three following joints slender and not reaching beyond the second peduncular joint of the second pair of antennæ. The second pair of antennæ are extremely short, reaching, when retracted, only to the posterior margin of the first thoracic segment; the first joint of the peduncle is short, the second about twice as long, the last three equal in length and not much longer than the third joint; the flagellum consists of six short joints. Maxilliped with a five-jointed palp.

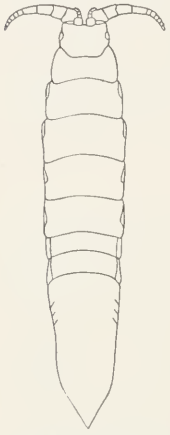

FIG. 24.—PENTIAS HAYI, NEW SPECIES. ×2.

The first thoracic segment is deeply excavate, the antero-lateral parts being produced on either side. In the median dorsal line the first segment is half as long as the second. The third and fourth segments are equal in length and are the longest. The last three segments are subequal and are about half as long as the two preceding ones. The epimera of the second, third, and fourth segments extend half the length of the segment, occupying only the anterior half of the lateral margin; those of the fifth segment extend two-thirds the length of the segment; the epimera of the last two segments occupy the whole of the lateral margin.

The abdomen consists of a single segment, very long, equal in length to the last five thoracic segments and with three suture lines on either side, near the base. The sides of the segment gradually converge to a point near the apex, where they form broadly rounded angles and meet some distance below in a long acute point.

The legs are very small and slender and terminate in bi-unguiculate dactyli; the two unguli are of equal length, and the character very distinctly marked.

One specimen, a female, was collected by Jordan and Snyder at Misaki, Sagami, Japan.

Type.—Cat. No. 28963, U.S.N.M.

FIG. 25.—MAXILLIPED OF PENTIAS HAYI.

This species differs from *Crabyzos* Spence Bate in having the head well separated and distinct from the first thoracic segment, while in Spence Bate's genus the head and first thoracic segment are fused and in having the epimera distinct. It differs from the type species *C. longicaudatus* in having the eyes placed in the middle of the lateral margin instead of at the antero-lateral angles; in having the basal joints of the first pair of antennæ dilated; in the much shorter first pair of antennæ; in the fewer number of joints in the flagellum of the second pair of

antennæ (Miers writes[a] that there are from twelve to fourteen joints in the flagellum of the second pair of antennæ in *C.* (*Idotea*) *longicaudatus*); in the much shorter second pair of antennæ; in having the body evenly convex, while in *C. longicaudatus* "the dorsal surface of the thoracic segments is nearly flat, while the margins with the epimera stand nearly perpendicular to them;" in having the first thoracic segment much shorter than the four following segments, which are about equal in length, while in *C. longicaudatus* the first segment is equal in length to the two following segments; in having the head broader than long, while the reverse is true of *C. longicaudatus*, and in the more tapering terminal abdominal segment, the sides being more nearly parallel from the base to about the middle of the segment in *C. longicaudatus*.

This genus differs from all the other known genera of Idoteidæ except *Glyptidotea* Stebbing[b] and *Crabyzos* in having the maxillipeds with a five-jointed palp. It is in agreement with *Glyptidotea* in having the epimera of all the thoracic segments, from the second to the seventh inclusive, distinct from the segments, and in having a uniarticulate abdomen. It differs, however, from Stebbing's genus in not having sculptured joints to both pairs of antennæ, and in not having the legs more or less subchelate in character. The abdomen of *Glyptidotea* has not the lateral rudiments of several coalesced segments.

The genus *Crabyzos* was formerly included in *Idotea* by Miers in his subdivision of the genus corresponding to *Stenosoma* Leach. The maxillipeds of *Stenosoma* have, however, four-jointed palps as in *Idotea* Fabricius,[c] while in *Crabyzos* they have five-jointed palps (Stebbing).

ONISCOIDEA.

Family LIGIIDÆ.

LIGIA EXOTICA Roux.

Ligia exotica Roux, Crust. Medit., 1828, p. 3, pl. XIII, fig. 9.

Ligia gaudichaudii Milne Edwards, Hist. Nat. des Crust., III, p. 157.—Dana, Expl. Exp., p. 741, pl. XLIX, figs. 6a-h.—Nicolet in Gay, Hist. Chile, III 1849, p. 265.

Ligia exotica Budde-Lund, Crust. Isop. Terrestria, 1885, pp. 266–268.

Locality.—Tokyo, Japan. (Collected by Jordan and Snyder.)
Misaki, Sagami, Japan. (Collected by Jordan and Snyder.)

[a] Journ. Linn. Soc. London, XVI, 1883, p. 63.

[b] Cape of Good Hope, Dept. of Agriculture: Marine Investigations in South Africa, No. 12, 1901, pp. 50–59.

[c] The information in regard to the number of joints to the palp of the maxillipeds in *Stenosoma* was kindly furnished me by Rev. T. R. R. Stebbing.

EPICARIDEA or BOPYROIDEA.

Family BOPYRIDÆ.

DIPLOPHRYXUS, new genus.

Body of female very asymmetrical, one side being much more swollen than the other side. All seven legs present on the smaller side. The first leg, only, present on the swollen side. Segments of thorax defined only on smaller side.

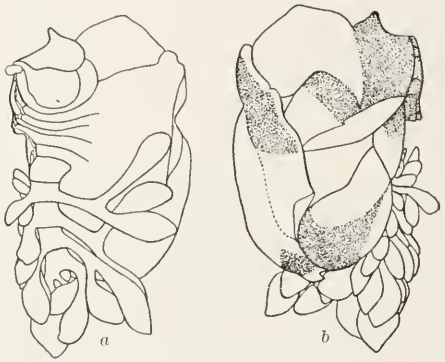

FIG. 26.—FEMALE OF DIPLOPHRYXUS JORDANI, NEW SPECIES. *a*, DORSAL VIEW; *b*, VENTRAL VIEW. ×8.

Abdomen composed of only five segments, the first four carrying each two pairs of double-branched appendages, a pair on either side. The incubatory lamellæ consist of four pairs of plates, those of the smaller side being greatly reduced and crowded together, the lamellæ of the swollen side sufficing to cover the marsupial pouch and extending as large plates over the whole ventral area.

This genus differs chiefly from *Phryxus* Rathke, in having the two pairs of pleopoda, one pair on either side of the body for each segment, double-branched instead of single-branched.

DIPLOPHRYXUS JORDANI, new species.

Body of female very asymmetrical, one side being very much more swollen than the other. Outline very irregular.

Head deeply sunk in thorax, and surrounded by first segment of the thorax; frontal margin covered by the projecting lobe of the first lamella of the incubatory pouch which folds over on the dorsal side. Antennæ small. Oral area wholly concealed on the ventral side.

FIG. 27.—HEAD AND FIRST PAIR OF ANTENNÆ OF DIPLOPHRYXUS JORDANI. ×14.

Segments of thorax defined on one side only, the smaller side. The first five are small and closely crowded together, the sixth somewhat longer, the seventh the longest. All seven legs are present on the smaller side, all, except the first one, being small and feeble. Only one leg is present on the other, the swollen side, this one belonging to the first thoracic segment.

Abdomen narrow, elongate, and composed of five well-defined seg-

ments, the last segment being small, rounded posteriorly, and without appendages. The four anterior segments are provided each with two pairs of double-branched appendages, a pair on either side, the outer appendages of the swollen side being much more developed and elongate than those of the smaller side, and extending as long leaf-like lamellæ over the incubatory pouch; the separation of each appendage into two branches occurs some distance from the segments.

FIG. 28.—MALE OF DIPLOPHRYXUS JORDANI. × 61.

Incubatory pouch extremely large, occupying the whole ventral side of the thorax and extending laterally on one side a considerable distance beyond the ill-defined outline of the body. The lamellæ of the narrow side of the body are small, and crowded together as four small plates. Those of the other side are developed and suffice to form the marsupium. Only four plates are present on this side also, the first lamella extending anteriorly over the dorsal surface of the head, concealing the antennæ of the first pair which are composed of two very much flattened joints.

Color of female white, with large areas of dark reddish brown on the marsupium and thorax.

Male.—Body narrow, elongate. Segments of thorax distinct. Abdomen composed of a single piece, with no trace of segmentation; outline rounded, or ovate. No rudiments of appendages. Eyes wanting.

Three specimens were found on the abdomen of *Palæmon serrifer* (Stimpson). They were collected by Jordan and Snyder at Misaki, Sagami, Japan, in 1900.

Type.—Cat. No. 28964, U.S.N.M.

III.

TWO NEW CYMOTHOIDS FROM THE WEST COAST OF CENTRAL AMERICA.

The two species new to science, herein described, were collected by Dr. C. H. Gilbert on the west coast of Central America from Panama and Mazatlan. Both were found in the mouth of *Mugil hospes.*

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———. Symbolæ ad Monographiam Cymothoarum, Crustaceorum Isopodum Familiæ.—III. Saophridæ. IV. Cymothoidæ, Trib. I. Ceratothoinæ. Naturhistorisk Tidsskrift (3), XIII, 1881–83, pp. 335–340, pl. XIII, figs. 11–15; pl. XIV, figs. 1–4, 5.

FLABELLIFERA, or CYMOTHOIDEA.

Family CYMOTHOIDÆ.

INDUSA[a] CARINATA, new species.

Body very convex, having a decidedly hunched appearance. Thorax large, rounded, almost as wide as long, the last two segments rapidly converging to the narrow abdomen. Abdomen nearly three times narrower than greatest width of thorax, with all the segments of equal width.

FIG. 29.—HEAD AND FIRST THORACIC SEGMENT OF INDUSA CARINATA. ×5.

Head about two and a half times narrower than first thoracic segment and four times narrower than fourth segment; front triangular in shape and produced into an acute point projecting between the basal joints of the antennæ. Eyes distinct and situated at the sides and about the middle of the head. First pair of antennæ, which are almost contiguous being separated only by the very acute median point, reach to the eyes; flagellum seven jointed. Second pair of antennæ extend to the posterior margin of the head; flagellum nine jointed.

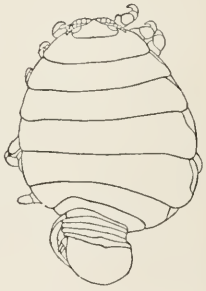

FIG. 30.—INDUSA CARINATA, NEW SPECIES. ×2⅔.

First thoracic segment rounded anteriorly and posteriorly, the sides of the segment surrounding the head, the lateral angles extending to the eyes. The first four segments gradually increase in width. The fourth and fifth are about equally wide. The sixth and seventh rapidly decrease in width, converging to the narrow abdomen. The epimera are well developed on all the segments with the exception of the first; they are narrow and elongate, rounded posteriorly and not reaching the posterior margin of their respective segments.

FIG. 31.—LEG OF SEVENTH PAIR OF INDUSA CARINATA. ×7.

The abdomen is likewise very convex and is nearly three times narrower than the thorax at its greatest width. The segments are of equal width. The terminal segment is rounded posteriorly or slightly triangular. The uropoda are very short, less than half the length of the terminal segment; the branches are equal in length.

There is a high carina on the four posterior pairs of legs, and a small one on the three anterior pairs. Color reddish brown.

Two specimens, a male and a female, were collected by Mr. C. H. Gilbert from the west coast of Panama. They were found in the mouth of *Mugil hospes*.

Type.—Cat. No. 28961, U.S.N.M.

[a] Schiœdte and Meinert.—Naturhistorisk Tidsskrift (3), XIV, pp. 334–335.

MEINERTIA GILBERTI, new species.

Head set in first segment of thorax, whose antero-lateral prolongations extend forward to about the middle of the eye. Shape of the head somewhat triangular; posterior margin straight; anterior margin produced somewhat at the middle, but quite rounded. Eyes very large, far apart, and situated at the sides of the head. First pair of antennæ consist of seven joints and extend to the middle of the eye; second pair contain eight joints and reach the posterior margin of the head.

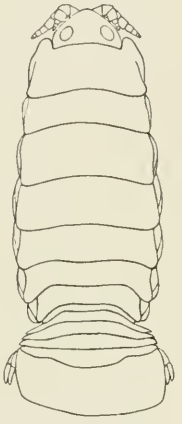

Fig. 32.—Meinertia gilberti, new species. × 2⅔.

The first four segments of the thorax are about equal in length, the second being somewhat shorter. The last three segments decrease gradually in length. The epimera are narrow pieces at the sides of the segments; in the first five segments they do not reach the posterior margin of the segments, although the fifth pair more nearly reach the posterior margin than the others; the epimera of the last two segments reach quite to the posterior margin.

The first segment of the abdomen is as wide as the last thoracic. The others are wider, increasing in width gradually to the terminal segment. The last segment is about three times as broad as long, and quadrangular in shape. The uropoda are short, reaching only a little beyond half the length of the abdomen; both branches are alike and of equal length.

The legs all terminate in long recurved unguli. There is no high carina developed on the basis of any of the legs.

Color reddish brown.

Fig. 33.—Leg of seventh pair of Meinertia gilberti. × 7.

Three specimens, two males and one female, were collected by C. H. Gilbert at Mazatlan. They were found in the mouth of *Mugil hospes*.

Type.—Cat. No. 29080, U.S.N.M.

This species differs chiefly from *M. gaudichaudii* (Milne Edwards)[a] from near locality, in the absence of high carinæ, which in *M. gaudichaudii* are strongly developed on the last four pairs of legs; in the much shorter uropoda, which in *M. gaudichaudii* extend beyond the terminal segment, both branches of which are narrowly pointed at their extremities; in the much larger eyes, and in the smaller size of the species, the adult female being only half the size of the adult female of *M. gaudichaudii*.

[a] Naturhistorisk Tidsskrift, XIV, pp. 335–340, pl. xiii, figs. 11–15.

IV.

AMERICAN EPICARIDEA.

American Epicaridea are represented in the following four families: Bopyridæ, Dajidæ, Cryptoniscidæ, and Entoniscidæ. At the present time no representatives of the Entoniscidæ are known to the North American fauna, and no representatives of the Dajidæ have been recorded from South American waters.

In the following pages the forms added to the list given of those already known are all representatives of the family Bopyridæ. The material studied belongs to the U. S. National Museum and was mostly collected by the U. S. Fish Commission steamer *Albatross*. Other collectors are Mr. Henry Hemphill, Mr. George M. Gray, Mr. W. C. Kendall, Dr. C. W. Richmond, Mr. J. B. Henderson, jr., Mr. C. T. Simpson, and Dr. G. Brown Goode. These collections were made at different times and in various localities. Some specimens were also sent from Union University to the U. S. National Museum; they were collected by Prof. H. E. Webster.

Following the classification of G. O. Sars,[a] who combines the three families of Giard and Bonnier, Cypronisciдæ, Cabiropsidæ, and Cryptoniscidæ, into one family, Cryptoniscidæ, the form *Clypeoniscus meinerti* Giard and Bonnier has been assigned to the family Cryptoniscidæ. Sars also cancels the family Microniscidæ, for he considers *Microniscus*, the only known genus, to represent not an adult condition, but only a transitory larval stage in different Epicaridea. The Microniscus stage Sars found to be intermediate between the two larval stages previously known, the larva of the first stage and the Cryptoniscus stage, and the Microniscus larvæ of two different Epicarid families was proved to be always parasitic on Copepoda. Giard and Bonnier do not accept Sars's conclusions, but assign to *Microniscus* the rank of a separate family, Microniscidæ, which they believe represents the ancestral form from which the other Epicaridea have descended.

Contrary, also, to the hypothesis of Giard and Bonnier, who write that one species of parasite can not be found on different species of host, Sars[b] has pointed out that for *Phryxus abdominalis* Krøyer ten different species of host have been recorded, representatives of two different genera, *Spirontocaris* and *Pandalus;* for *Bopyroides hippolytes* (Krøyer), three different species of *Spirontocaris;* for *Bopyrus squillarum* Latreille, three different species of *Leander;* for *Pseudione affinis* G. O. Sars, two different species of *Pandalus;* for *Pseudione hyndmanni* (Spence Bate and Westwood), two different species of *Eupagurus;* for *Pseudione crenulata* G. O. Sars, two species of

[a] Crustacea of Norway, II, 1899, pp. 193–195.

[b] Idem, pp. 198, 199.

Munida; for *Dajus mysidis* Krøyer, two different species of *Mysis;* for *Aspidophryxus peltatus* G. O. Sars, four different species of *Erythrops*, one species of *Parerythrops*, and also a species of *Mysidopsis;* for *Munnoniscus marsupialis* Sars, two different species of host belonging to the Isopod genera, *Eurycope* and *Hyarachna*.

In the present paper, ten species of host are added to Sars's list of those on which *Phryxus abdominalis* is found to be parasitic. The list now includes the following additional species: *Pandalus leptocerus*, *Spirontocaris grœnlandica*, *S. arcuata*, *S. townsendi*, *S. tridens*, *S. macrophthalma*, *S. suckleyi*, *S. gaimardii belcheri*, *S. fabricii*, and *S. bispinosa*. Spence Bate also records it from *Plesionika semilævis*.

Argeia puggettensis Dana is found parasitic on fifteen species of host representing two different genera of Crangonidæ, *Crangon* and *Nectocrangon*.

The list of hosts for *Bopyroides hippolytes* (Krøyer) is also enlarged and now includes the following additional species: *Spirontocaris suckleyi*, *S. bispinosa*, *S. arcuata*, *S. brevirostris*, *Pandalus borealis*, *P. montagui*, and *Pandalopsis dispar*.

Pseudione galacanthæ Hansen, is herein recorded from two additional species of host, *Munida subrugosa* and *Munida quadrispina*. A new species of *Probopyrus* described in the following pages, *P. bithynis*, is found on two different species of *Bithynis*, *B. ohionis*, and *B. acanthurus*.

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NORTH AMERICAN EPICARIDEA.

EPICARIDEA or BOPYROIDEA.

Family BOPYRIDÆ.

PHRYXUS ABDOMINALIS (Krøyer).

Bopyrus abdominalis KRØYER, Nat. Tidsskrift, R. 1, III, 1840, pp. 102–289, pls. I, II; Monog. Fremst. Skegten Hippolytes nordiske Arter, 1842, p. 263; Voy. en Scand., Crust., 1849, pl. XXIX, fig. 1.

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Phryxus abdominalis LILLJEBORG, Œfvers. Kongl. Vet. Akad. Forh., IX, 1852, p. 11.—STEENSTRUP and LÜTKEN, Vidensk. Meddelelser, 1861, p. 275 (9).—BATE and WESTWOOD, Brit. Sessil-eyed Crust., II, 1868, p. 234.—NORMAN, Rep. Brit. Assoc., 1869, p. 288; Proc. Royal Soc. Lond., XXV, 1876, p. 209.—BUCHHOLZ, Zweite deutsche Nordpolfahrt, 1874, p. 287.—METZGER, Nordseefahrt der Pomm., 1875, p. 286.—MIERS, Ann. Mag. Nat. Hist. (4), XX, 1877, p. 65 (15).—SMITH in Harger, Proc. U. S. Nat. Mus., II, 1879, p. 158.—HARGER, Rep. U. S. Fish Comm., 1880, Pt. 6.—AXEL OHLIN, Bidrag till Kannedomen on Malakostrakfaunan i Baffin Bay, och Smith Sound, 1895, pp. 18–19.—RICHARDSON, Proc. U. S. Nat. Mus., XXIII, 1901, p. 577.

Locality.—Circumpolar in distribution.

Atlantic coast localities: Massachusetts Bay on *Pandalus borealis*, *Spirontocaris spinus*, *S. securifrons*, and *Pandalus montagui;* Cashes Ledge, Gulf of Maine, on *Pandalus borealis* and *S. pusiola;* Georges Bank on *Pandalus leptocerus;* Halifax, Nova Scotia, on *S. pusiola*, *S. spinus*, and *S. securifrons;* northeastern part Grand Bank on *S. gaimardii*, and *S. gibba;* Cape Cod on *P. montagui*, *P. leptocerus*, *S. securifrons*, *S. pusiola*, and *S. polaris;* Grinnell Land, Discovery Bay, Greenland, Cape Dudley Digges on *S. phippsii* and *S. polaris;* Inglefield Gulf on *S. polaris;* 73° 48′ N. lat., 80° 30′ W. long., on *S. polaris;* 64° 56′ N. lat., 66° 18′ W. long., on *S. phippsii;* off Marthas Vineyard, on *Pandalus leptocerus* and *S. securifrons;* Casco Bay, Maine, on *P. borealis.*

Pacific coast localities: Admiralty Inlet, Puget Sound, Washington, on *Spirontocaris grœnlandica;* off N. Head, Akutan Island, Alaska, on *S. arcuata;* Straits of Fuca, between Washington and Vancouver Island,

on *S. townsendi;* Admiralty Inlet, Puget Sound, Washington, on *S. tridens;* Washington Sound, Straits of Fuca, Washington, on *S. tridens;* off Queen Charlotte Sound, British Columbia, on *S. macrophthalma;* off Yahwhit Head, Washington, on *S. macrophthalma;* Hinlink Harbor, Unalaska, on *S. suckleyi;* Arctic Ocean on *S. gaimardii beicheri* (Bell); Plover Bay, East Siberia, on *S. polaris* (Sabine); Alaska on *S. polaris* (Sabine); off Cape Strogonoff, Alaska, on *S. fabricii* (Krøyer); off Shumagin Bank, Alaska, on *S. bimguis* Rathbun; off Point Arena, California, on *S. macrophthalma;* Straits of Fuca on *S. townsendi* Rathbun; Philippine Islands on *Plesionika semilaevis* (according to Spence Bate).[a] Also recorded from British Isles; Scandinavian coast; Spitzbergen; Kara Sea; coast of Norway; depth, 5 to 204 fathoms.

STEGOPHRYXUS HYPTIUS Thompson.

Stegophryxus hyptius Thompson, Report U. S. Fish Comm., 1901, pp. 53–56, pls. IX, X.

Locality.—Great Harbor, Woods Hole; Hadley Harbor, Nashon; Edgartown and Warwick, Rhode Island, on *Pagurus longicarpus.*

STEGIAS, new genus.

STEGIAS CLIBANARII, new species.

Head deeply set in thorax, broader posteriorly than anteriorly, longer than broad, and with straight frontal margin. First pair of antennæ visible on dorsal surface, just anterior to front, as two small lobes, each antenna terminating in a minute joint. Second pair of antennæ also visible on dorsal surface, lying on either side of first pair of antennæ, each antenna terminating in a flagellum composed of several minute joints.

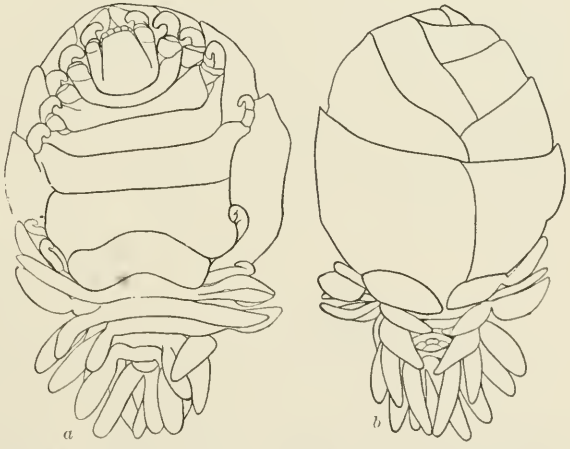

FIG. 34.—STEGIAS CLIBANARII. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF FEMALE. ×8.

Thorax divided into seven distinct segments. The first three surround the head and are closely crowded together. The other four are very much longer and are of nearly equal length, the fifth being much longer at the sides than the others. The first five segments at the sides are directed forward.

[a] Challenger Report, 1888; Crustacea Macrura, XXIV, pp. 645–646.

the five pairs of legs all extending in an anterior direction. A considerable space separates the fifth pair of legs from the sixth pair. The sixth pair of legs, as well as the seventh pair, are placed at the posterior extremity of the sixth and seventh segments, respectively. The epimera of the first four segments are distinct as narrow ridges on the lateral margins of each segment. The ovarian bosses are also present on these segments.

The abdomen is composed of six distinct segments, the first three of which are provided with a pair of triramous pleopods, two dorsal branches and one ventral branch to each pleopod; the next two segments, the fourth and fifth, are each provided with a pair of biramous pleopods, both branches of each pleopod being dorsal, the ventral branch, corresponding to that of the first three segments, not being represented; the sixth segment of the abdomen is furnished with a pair of simple, elongated uropoda, equaling in length the dorsal branches of the pleopoda of the other abdominal segments.

The marsupium is composed of five pairs of lamellæ, the lamellæ of the fifth pair being very large and occupying almost half of the ventral side of the thorax.

Male unknown.

Only one specimen was collected by Dr. G. Brown Goode at the Bermudas in 1876–77. The parasite was found attached to *Cibanarius tricolor*.

Type in the Peabody Museum, Yale University.

This genus differs chiefly from *Stegophryxus* Thompson, to which it is closely related in having the pleopoda of the fourth and fifth abdominal segments biramous instead of triramous; in having the uropoda long and leaf-like, similar in shape and size to the branches of the pleopoda, while in *Stegophryxus hyptius*, the type species of the genus, the uropoda are small, rounded, and knob-like, with a minute conical prominence between them; and in not having the sixth thoracic segment greatly longer than the others.

ARGEIA PUGETTENSIS Dana.

Argeia pugettensis Dana, U. S. Expl. Exp. Crust., II, p. 804, pl. liii, fig. 7.—Stimpson, Bost. Journ. Nat. Hist., VI, 1857, p. 71.

Argeia sp.? Calman, Ann. N. Y. Acad. Sci., XI, No. 13, 1898, p. 281.

Argeia pugettensis Richardson, Proc. U. S. Nat. Museum, XXI, 1899, p. 868.

Locality.—On *Crangon munita* Dana, at Puget Sound; off Cape Beale, Vancouver Island. On *Crangon alascensis* Lockington, off Cape Seniavin, Alaska; at Davidson Bank, Alaska; east of Amak Island, Alaska; off Cape Strogonoff, Alaska; northwest of Unimak Island, Alaska; Kouloulak Bay, Alaska; off Columbia River, Oregon; Gulf of Georgia, British Columbia. On *Crangon dalli* Rathbun, South of Amak Island, Alaska. On *Crangon alascensis elongata* Rathbun, off

Columbia River, Oregon. On *Nectocrangon orifer* Rathbun, off North Head, Akutan Island, Alaska; west of Pribilof Islands, Alaska. On *Crangon franciscorum angustimana* Rathbun, Straits of Fuca; Gulf of Georgia, British Columbia. On *Nectocrangon nigricauda* Stimpson, off Port Ano Nuevo, California. On *Nectocrangon crassa* Rathbun, off Cape Seniavin, Alaska; off Cape Newenham, Alaska; north of Bird Island, Shumagins, Alaska; Bering Sea, off the Pribilof Islands; Semidi Islands.

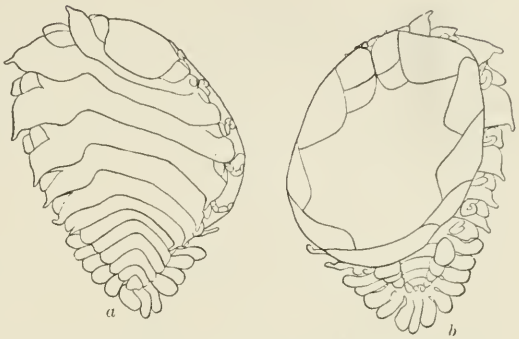

FIG. 35.—ARGEIA PUGETTENSIS. *a*, DORSAL VIEW OF ADULT FEMALE; *b*, VENTRAL VIEW OF ADULT FEMALE. × 1½.

On *Nectocrangon lar* (Owen), off Rakovaya Bay; Avatcha Bay; off Cape Strogonoff; off Kouloulak Bay and off Bristol Bay, Alaska; off Cape Menchikoff, Alaska; off Khoudoubine Islands, Alaska; off mouth of Yukon River. On *Nectocrangon alascensis* Kingsley, southwest of Hagemeister Island, Alaska; south and northwest of Unimak Island, Alaska; off Moorovskoy Bay, Alaska; Davidson Bank, Alaska; off North Head, Akutan Island, Alaska; south of San Diego Bay, California; off Rootook Island, Alaska; Petropaulski, Kamchatka; off Kouloulak Bay, Alaska; between Bird and Nagai Islands, Alaska; Unimak Pass; off Cape Johnson; southwest of Sannakh Islands, Alaska; off Grays Harbor, Washington; off Destruction Island; Bering Sea, off Akutan Pass. On *Crangon nigromaculata* Lockington, at San Diego Bay, California; off Tillamook Rock, Oregon; Monterey Bay, California; off Cape Johnson. On *Crangon communis* Rathbun, off Grays Harbor, Washington; off Columbia River, Oregon; San Luis Obispo Bay, California; Hinlink Harbor, Unalaska; Straits of Fuca; south of San Diego Bay, California; off Rootook Island, Alaska; off Falmouth Harbor, Shumagins, Alaska; Bering Sea, off Akutan Island; northwest of Unimak Island, Alaska; off Point Arena, California; Washington Sound, Straits of Fuca, Washington. On *Nectocrangon dentata* Rathbun, at Kyska Harbor; Unalaska; Mazan Bay, Atka; Port Etches, Alaska; Port Levasheff, Unalaska; Hinlink Harbor, Unalaska; off Round Island, Coal Harbor, Unga Island; off Sitkalidak Island, Alaska. On *Crangon alba* Holmes, south of San Diego Bay, California.

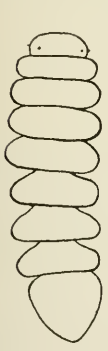

FIG. 36.—ARGEIA PUGETTENSIS, MALE. × 22.

FIG. 37.—ARGEIA PUGETTENSIS, FIRST LAMELLA OF MARSUPIUM. × 14½.

Immature specimens were found off Seal Islands, Alaska, on *Nectocrangon alascensis;* off Rootook Island, Alaska, on *Crangon communis;* north of Bird Islands, Shumagins, Alaska; Gulf of the Farallones, California, on *Crangon nigromaculata;* Coal Harbor, Unga Island, on *Nectocrangon dentata;* Captains Harbor, Unalaska, on *Nectocrangon dentata;* Sanborn Harbor, Nagai, Shumagins on *Nectocrangon lar;* Mazan Bay, Atka, on *Nectocrangon crassa;* southwest of Hagemeister Island, Alaska, on *Nectocrangon alascensis;* northwest and northeast of Unimak Island, Alaska, on *Nectocrangon alascensis;* Bering Sea, between Pribilof Islands and Cape Newenham, on *Nectocrangon lar;* Kouloulak Bay, Alaska, on *Nectocrangon lar;* between Bristol Bay and Pribilof Islands, Alaska, on *Nectocrangon lar;* Arctic Ocean, on *Nectocrangon lar;* Popoff Straits, on *Nectocrangon crassa;* between Bird and Nagai Islands, on *Nectocrangon alascensis.*

List of Crangonidæ on which *Argeia pugettensis* is found parasitic:

Nectocrangon orifer Rathbun.
Nectocrangon lar (Owen).
Nectocrangon alascensis Kingsley.
Nectocrangon crassa Rathbun.
Nectocrangon dentata Rathbun.
Crangon nigromaculata Lockington.
Crangon franciscorum angustimana Rathbun.
Crangon dalli Rathbun.
Crangon communis Rathbun.
Crangon propinqua Stimpson.
Crangon nigricauda Stimpson.
Crangon alascensis Lockington.
Crangon alascensis elongata Rathbun.
Crangon alba Holmes.
Crangon munita Dana.

Immature forms.—A female (probably in the first post-larval stage) has the thoracic processes well developed, sometimes only on one side. Inner pleopoda of the first pair usually present; all the outer pleopoda, the other four inner pleopoda and the uropoda are not developed at this stage. Marsupial plates are small and just developing. Male is similar to male found on adult female.

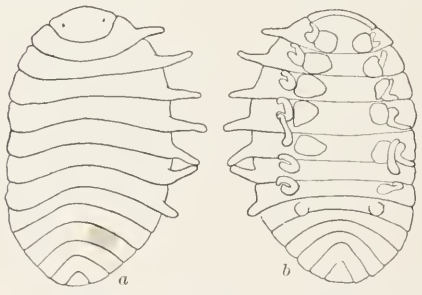

FIG. 38.—ARGEIA PUGETTENSIS. *a*, DORSAL VIEW OF IMMATURE FEMALE; *b*, VENTRAL VIEW OF SAME. × 10.

Immature female of a more advanced stage has thoracic processes well developed, although perhaps not quite as long as in the preceding stage. Outer pleopoda and uropoda small, but all developed. The first two inner pleopoda are present; the other three may or may not be present. When present they are usually smaller than the first two, decreasing in size to the fifth pair, and sometimes difficult to discern. The marsupial plates are larger than in the preceding stage, but not fully developed. The incubatory pouch never carries eggs in either of these stages. The male is similar to the male of the adult female.

Specimens of both immature stages were found on the same species and genera of host as the adult females.

A male in the cryptoniscan stage was found on one immature female (in first post-larval stage).

Thoracic processes of adult female.—In the adult female the thoracic processes may be quite reduced. In some specimens these processes are well developed, though never in all the specimens examined were they found as long as in the very young female or as in the figure given by Dana of the adult female. In other specimens these processes are very small, and yet in many they were not even present. Not only is this variation found in specimens taken from different

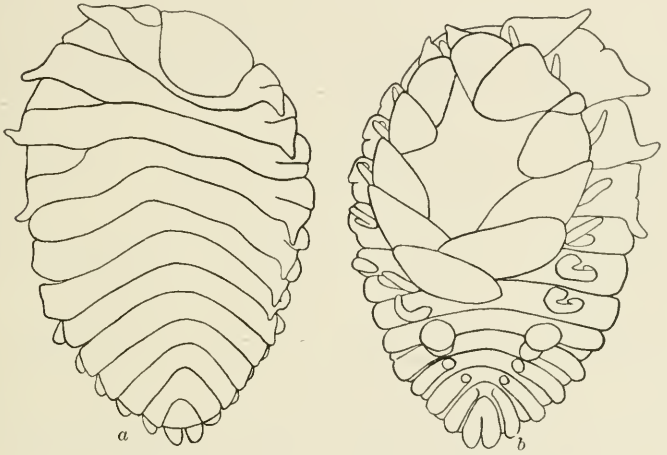

FIG. 39.—ARGEIA PUGETTENSIS. *a*, DORSAL VIEW OF IMMATURE FEMALE; *b*, VENTRAL VIEW OF SAME. $\times 14\frac{1}{2}$.

species and genera of host, but it was also true of those found on the same species and genus of host. As a result of this observation on a large number of these forms, the conclusion must be maintained that these thoracic processes, well developed in the young female, of varying size and shape and sometimes so reduced as to be practically absent in the adult female, have no specific value whatever. Giard and Bonnier[a] have described their function as organs of fixation, which seems a reasonable conclusion and one capable of explaining why so much variation occurs in this respect with each individual parasite.

The following paragraph is taken from the above quoted authors:

The "lames épimériènnes (nos lames pleurales)" have, as we have already said, but a very slight morphological importance. They are organs of fixation developed to assure the position of the parasite in the branchial cavity of the host and to protect it against the gill sweepers. Their form, their number, their dimensions are therefore only in accord with the peculiarities which the branchial cavity presents, and one knows nothing more variable in the decapod Crustacea than the organization of the branchiæ * * * the presence of pleural lamellæ in these animals is evidently simply a fact of adaptive convergence.

[a] Contributions à l'étude des Bopyriens. Travaux de l'Institut zoologique de Lille et du Laboratoire de Zoologie maritime de Wimereux, V, 1887, p. 61.

The thoracic processes are not, however, in *Argeia* of epimeral origin. They arise from the posterior portion of the segments, while the epimera are placed above on the anterior division of the segments. It is, therefore, incorrect to speak of them as "lames pleurales."

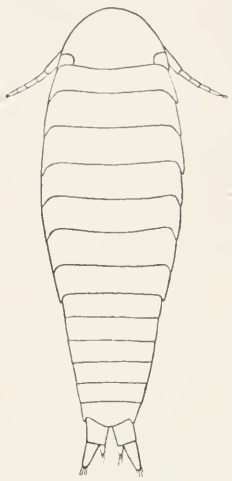

FIG. 40.—ARGEIA PUGETTENSIS, CRYPTONISCAN MALE. × 7$\frac{7}{8}$.

In the adult, the pleopoda consist of five pairs of double-branched appendages, the outer branches being elongate, lamellar, attached on the under side very near the edge of the segments, and extending as a border, together with the uropoda, around the abdomen. The inner branches are close together and more or less rounded plates or lobes. Giard and Bonnier's interpretation of these facts is different. They consider the outer branches of the pleopoda as the "lames pleurales" of the abdominal segments, but that this interpretation is untenable can be clearly demonstrated from an examination of specimens, when the manner of attachment and place of origin of these outer lamellæ can be seen.

The view taken in explanation of the abdominal appendages for *Argeia* is in accord with that held by Hansen for *Paargeia*.[a]

ARGEIA DEPAUPERATA Stimpson.

Argeia depauperata STIMPSON, Bost. Journ. Nat. Hist., VI, 1857, p. 71.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 868.

Locality.—San Francisco Bay, on *Crangon franciscorum*.

PARARGEIA ORNATA Hansen.

Paargeia ornata HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 120–122, pl. VI, figs. 1, 2.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 869.

Locality.—Off Acapulco, Mexico, in the branchial cavity of *Sclerocrangon procax* Faxon.

BOPYROIDES HIPPOLYTES (Krøyer).

Bopyrus hippolytes KRØYER, Grønlands Amfipoder, 1838, p. 306 (78), pl. IV, fig. 22; Monog. Fremst. Slægten Hippolytes Nordeske Arter, 1842, p. 262; Voy. en Scand., Crust., 1849, pl. XXVIII, fig. 2.—EDWARDS, Hist. Nat. des Crust., III, 1840, p. 283.—STIMPSON, Proc. Acad. Nat. Sci. Phila., 1863, p. 140.

Bopyroides acutimarginatus STIMPSON, Proc. Acad. Nat. Sci. Phila., 1864, p. 156.

[a] Bull. Mus. Comp. Zool. Harvard College, XXXI, No. 5, Pt. 22. The Isopoda, 1897, p. 121.

Gyge hippolytes Bate and Westwood, Brit. Sess. Crust., II, 1868, p. 230.—Buchholz, Zweite Deutsche Nordpolfahrt, 1874, p. 286.—Metzger, Nordseefahrt der Pomm., 1875, p. 286.—Miers, Ann. Mag. Nat. Hist., (4), XX, 1877, p. 64 (14).—Smith in Harger, Proc. U. S. Nat. Mus., II, 1879, p. 157.—Harger, Rep. U. S. Fish Comm., 1880, Pt. 6, p. 311.—Axel Ohlin, Bidrag till Kannedomen om Malakostrak-faunan in Baffin Bay och Smith Sound, 1895, p. 19.

Bopyroides hippolytes G. O. Sars, Crust. of Norway, II, Pts. 11, 12, 1898, pp. 199, 200, pl. LXXXIV, fig. 2.—Richardson Proc. U. S. Nat. Mus., XXIII, 1901, p. 578.

Locality.—Circumpolar in distribution.

Atlantic coast localities: Massachusetts, Bay of Salem, on *Spirontocaris spinus*, *S. fabricii*, and *S. securifrons;* Casco Bay on *S. polaris* and *S. pusiola;* Bay of Fundy, on *S. spinus* and *S. pusiola;* Halifax, Nova Scotia; Gulf of Maine, on *S. securifrons* and *S. spinus;* Eastport, Maine, on *S. spinus;* off Cape Cod, on *S. securifrons* and *S. liljeborgii;* 73° 48′ N. lat., 80° 30′ W. long., on *S. polaris;* 72° 33′ N. lat., 71° 30′ W. long., on *S. polaris;* 71° 42′ N. lat., 73° W. long., on *S. polaris;* 66° 33′ N. lat., 61° 50′ W. long., on *S. polaris;* 64° 56′ N. lat., 66° 18′ W. long., on *S. polaris.*

Pacific coast localities: Straits of Fuca, between Washington and Vancouver Island, on *Spirontocaris suckleyi;* Heceta Bank, Oregon, on *S. bispinosa;* off North Head, Akutan Island, Alaska, on *S. spinus;* Bay of Islands, Adakh, on *S. spinus;* Port Etches, Alaska, on *S. arcuata;* West of Amaknak Island, Unalaska, on *S. arcuata;* Bering Sea, north of Umnak Island, on *Pandalus borealis* Krøyer; off south entrance to Akutan Pass, Alaska, on *Pandalus montagui* Leach; between Bird and Nagai Islands, Shumagins, Alaska, on *P. montagui;* Bering Sea, south of Pribilof Islands, on *P. borealis* Krøyer; Straits of Fuca, on *Pandalopsis dispar* Rathbun; Unalaska, and Lituya Bay, Alaska, on *Spirontocaris brevirostris* (Dana); Puget Sound on *S. brevirostris;* Bering Sea, west of Pribilof Islands, on *S. polaris* (Sabine); Straits of Fuca, on *S. suckleyi;* Lituya Bay, Alaska, on *S. suckleyi.*

Also recorded from Greenland, Barents Sea, British Isles, coast of Norway; depth, 5 to 116 fathoms.

B. acutimarginatus Stimpson is undoubtedly identical with *B. hippolytes* (Krøyer), which is circumpolar in distribution, and infests the species and genera quoted above common to both coasts of North America.

BOPYROIDES LATREUTICOLA Gissler.

Bopyroides latreuticola Gissler, Am. Nat., XVI, 1882, pp. 591–594.
Bopyrus latreutes Spence Bate, Challenger Report, XXIV, 1888, p. 584.
Bopyroides latreuticola Richardson, Proc. U. S. Nat. Mus., XXIII, 1901, p. 579.

Locality.—Beaufort, North Carolina, on *Latreutes ensiferus* (Milne Edwards); lat. 28° 17′ 7″ N., long. 66° 17′ 37″ W.; lat. 31° 15′ 42″ N.,

long. 67° 39′ 10″ W., on *L. ensiferus;* lat. 31° 16′ N., long. 71° 50′ W., on *L. ensiferus;* 27° 38′ N. lat., 76° 23′ 24″ W. long., on *L. ensiferus;* Bahamas, between Nassau and Andros, on *L. ensiferus;* off South Carolina, on *L. ensiferus;* Bermuda, on *L. ensiferus.*

PROBOPYRUS PALÆMONETICOLA (Packard).

Bopyrus (?) LEIDY, Proc. Acad. Nat. Sci. Philad., 1879, Pt. 2, p. 198.—HARGER, Report U. S. Fish Comm., 1880, Pt. 6, p. 312.
Bopyrus palæmoneticola PACKARD, Zool. for High Schools and Colleges, 1881, p. 289.
Bopyrus manhattensis GISSLER, Scientific American, XLV, Sept. 3, 1881, p. 151.
Bopyrus palæmoneticola GISSLER, Am. Nat., XVI, 1882, pp. 6–12.
Probopyrus palæmoneticola STEBBING, Hist. Crust., 1893, p. 416.
Bopyrus palæmoneticola RICHARDSON, Proc. U. S. Nat. Mus., XXIII, 1901, p. 578.

Locality.—Atlantic City (Leidy), on *Palæmonetes vulgaris* (Say);

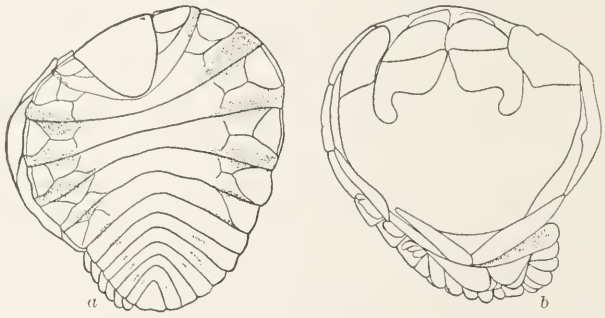

FIG. 41.—PROBOPYRUS PALÆMONETICOLA. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. × 4

from New Hampshire to Florida (Carl Gissler), on *P. vulgaris;* East Providence, Rhode Island, on *P. vulgaris;* Acushnet River, Massachusetts, on *P. vulgaris;* Baldwin Lodge, Mississippi, on *Palæmonetes* sp.; Lantana, Florida, on *Palæmonetes.*

Description.—Color of body white, with patches of black on the lateral margins of all the thoracic segments on both sides of the body. Head and abdomen also with a few scattered black markings. Legs of both sides white; patches of black on the ventral side of the lateral margins of both sides of the thorax. Incubatory lamellæ with patches of black on all the plates of both sides.

FIG. 42.—PROBOPYRUS PALÆMONETICOLA, LEG OF SIXTH PAIR OF ADULT FEMALE. × 39.

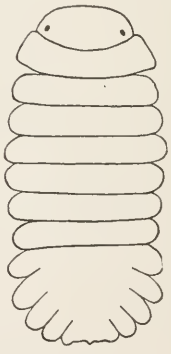

FIG. 43.—PROBOPYRUS PALÆMONETICOLA, MALE. × 41.

Head deeply set in thorax; anterior margin straight; posterior margin rounded. Eyes wanting. Ovarian bosses present on the first four segments of the thorax at the anterior part of the sublateral margin; epimera evident as narrow plates lateral to the ovarian bosses. The epimera occupy the entire lateral margins on the last three segments. The segments of the abdomen

are distinct. The terminal segment is broad, more or less bilobed. The pleopoda consist of five pairs of double-branched lamellar appendages, closely crowded together on the ventral side of the abdomen.

The five pairs of incubatory lamellæ surround a large open area normally filled with eggs. The first pair have the terminal lobe of the distal segment large, well defined, and incurved.

All the legs have a high quadrangularly shaped expansion or carina on the basis.

Male with all the segments of the thorax distinct, and with the lateral margins contiguous. First four segments of the abdomen well defined at the sides, but fused in the middle of the dorsal surface. The last two segments form a single large piece, the fused terminal segment being indicated only by a small median point on the posterior margin. The body is a little more than twice as long as wide. Eyes are present. The rudimentary pleopoda are pairs of small oval processes one pair on each abdominal segment. The abdomen is about one and a half times as broad as long.

PROBOPYRUS ALPHEI (Richardson).

Bopyrus sp. ? Fritz Müller, Jenaische Zeitschrift, VI, 1871, p. 68.
Bopyrus alphei Richardson, Proc. Wash. Acad. Sci., II, 1900, pp. 158–159.
Gype sp. ? H. V. Wilson, American Naturalist, XXXIV, 1900, p. 353.
Bopyrus alphei Richardson, Proc. U. S. Nat. Museum, XXIII, 1901, p. 578.

Locality.—Beaufort, North Carolina, on *Alpheus heterochælis;* mangroves, Rio Parahyba do Norte, Brazil, on *Alpheus heterochælis.*

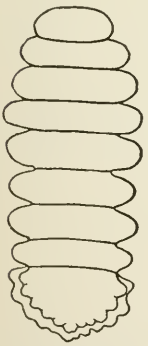

Fig. 44.—Probopyrus alphei, male.

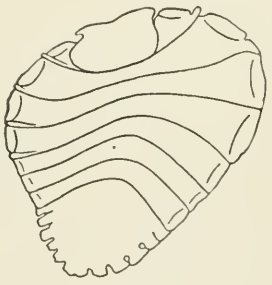

Fig. 45.—Probopyrus alphei dorsal view of female.

As previously said,[a] this species is probably identical with the *Bopyrus* mentioned by Fritz Müller as being found on a species of *Alpheus* on the coast of Brazil. Giard and Bonnier have referred their species *Grapsicepon fritzii* from the branchial cavity of a *Grapsus* (*Leptograpsus rugulosus*) to Fritz Müller's *Bopyrus* recorded from a species of *Alpheus.* A difference, not only in the species, but even in the genus of host, makes this conclusion rather inconsistent with a certain hypothesis which these authors maintain, namely, that one and the same species of parasite can not infest different species of Crustacea. The genus *Grapsicepon* Giard and Bonnier is characterized by the fact that there are four pairs of triramous appendages elongated and fringed to the first four segments of the abdomen, those of the fifth segment being biramous. It does not seem

[a] Proc. Wash. Acad. Sci., II, 1900, p. 158.

probable that Fritz Müller could have referred his species to the genus *Bopyrus* had there been any such appendages to the pleon.

PROBOPYRUS BITHYNIS, new species.

Body of female with dorsal surface perfectly white, having only three small patches of black on one side at the post-lateral parts of the

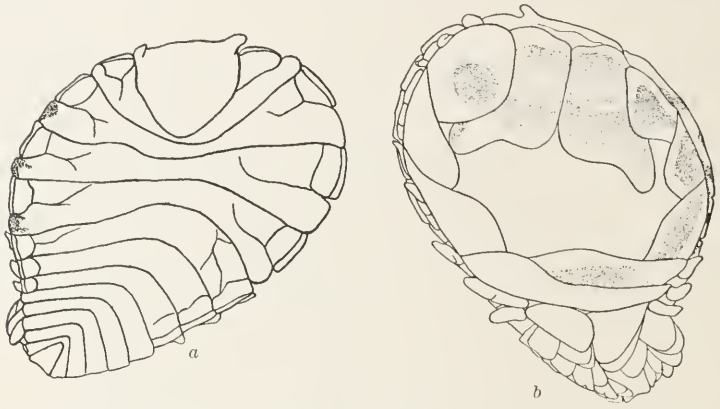

FIG. 46.—PROBOPYRUS BITHYNIS. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. + 16.

second, third, and fourth thoracic segments. Ventral side of the body with the first pair of incubatory lamellæ almost entirely covered with patches of black, and with all the other lamellæ of one side having patches of black, those of the other side being without these patches, with the exception in some specimens of the second lamella. Patches of black also on the ventral side of the lateral margins of the second, third, and fourth thoracic segments of one side—the same side on which these markings occur on the dorsal surface and to which the incubatory lamellæ, likewise marked with patches, are attached. Legs of both sides white and without any markings.

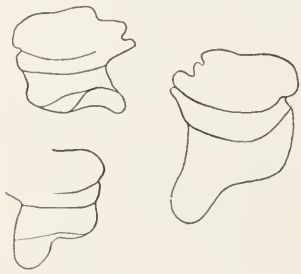

FIG. 47.—PROBOPYRIS BITHYNIS, FIRST LAMELLA OF MARSUPIUM, RIGHT SIDE. + 10.

FIG. 48.—PROBOPYRIS BITHYNIS, LEG OF SIXTH PAIR OF ADULT FEMALE. + 39.

Head with antero-lateral corners produced into prominent processes; anterior margin between these processes straight; posterior margin narrowly rounded. Length of head about equal to breadth. Eyes wanting.

The thoracic segments are distinctly defined. Ovarian bosses are present on all the segments, occupying only the anterior portion of the sublateral margin of the first four segments. The epimera are evident as narrow pieces lateral to the ovarian bosses on all the segments.

The segments of the abdomen are distinct on the dorsal side. The lateral margins of the first five segments are straight. The sixth or terminal segment is narrow, elongate, and has a slight emargination in the middle of the posterior margin.

The pleopoda are five pairs of double-branched appendages, the inner branches of the first pair being the largest and overlapping in the middle ventral line. The uropoda are wanting.

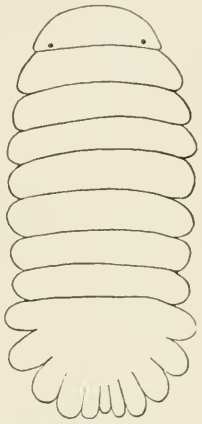

FIG. 49.—PROBOPYRUS BITHYNIS, MALE. × 41.

The first pair of incubatory lamellæ are large and extend about half the length of the ventral side of the thorax. In fact all the lamellæ are quite large, and encompass the marsupium, leaving only a comparatively small opening into the pouch.

All the legs have an extremely high expansion or carina on the basis.

The male has the thorax distinctly segmented, the segments not being widely separated at the sides. Body of male short and thickset, being only twice as long as wide.

The abdomen is a little more than one and a half times broader than long. The segments of the abdomen are only indicated at the sides, being fused in the middle of the dorsal surface; they gradually decrease in size to the sixth or last, which is a narrow piece situated between the two lobes of the fifth segment and which does not reach to the extremity of those lobes. Eyes present. Body with markings of brown.

Six specimens of this species were taken by the U. S. Fish Commission steamer *Albatross* from the Mississippi River near the Exposition Grounds in New Orleans, Louisiana. Parasitic on *Bithynis ohionis* (Smith).

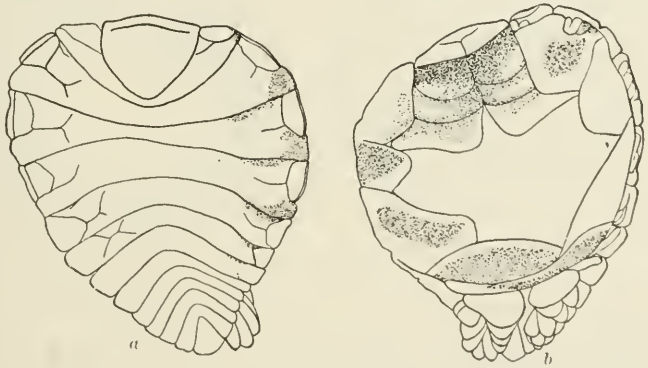

FIG. 50.—PROBOPYRUS BITHYNIS. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. × 8.

Type.—Cat. No. 29089, U.S.N.M.

About 6 specimens which should probably be referred to this

species were found in Escondido River, Nicaragua, 50 miles from Bluefields, by C. W. Richmond; they are parasitic in the branchial cavity of *Bithynis acanthurus* (Wiegmann).

They differ from the type as above described in having no anterolateral processes to the head of the female; in having patches of black on the lateral margins of all the segments of the thorax on one side of the body; and in having sometimes the third and also the fourth lamellæ of the incubatory pouch with patches of black.

In the male the terminal segment has in some specimens a tendency to be bilobed.

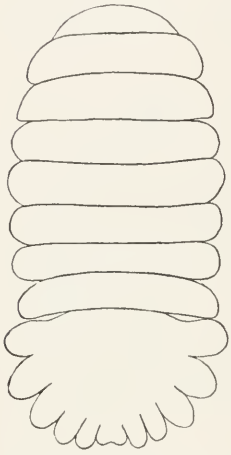

FIG. 51.—PROBOPYRUS BITHYNIS, MALE. ×41.

PROBOPYRUS FLORIDENSIS, new species.

Body of female light brown, with head, abdomen, ovarian bosses, and epimera light yellow, almost white. Markings of black are present all over thorax and a few black lines are present on the abdomen. The incubatory lamellæ are almost entirely covered with black markings, so that the color is uniformly dark. The lateral parts of the thorax on the ventral side have markings of black, those of one side being in patches with yellow areas separating them, all the legs of this side being yellow. The legs of the opposite side are dark.

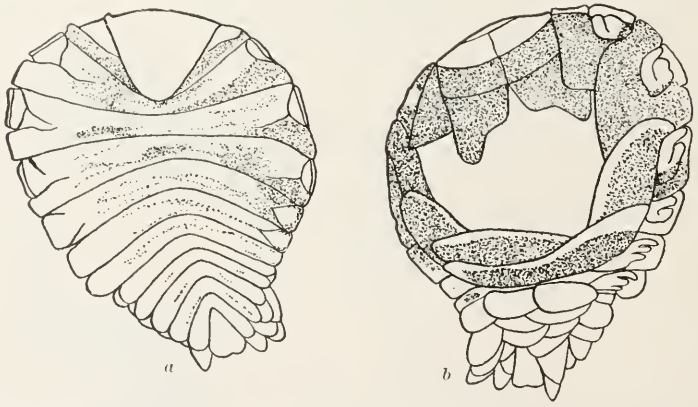

FIG. 52.—PROBOPYRUS FLORIDENSIS. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. ×12.

Head deeply set in thorax, broad anteriorly with frontal margin nearly straight; posterior margin narrowly rounded; eyes wanted.

The segments of the thorax are distinct. Ovarian bosses are prominent on the anterior portion of the sublateral margin of the first four

segments; the epimera are present as narrow plates lateral to the ovarian bosses. On the last three segments the epimera occupy the whole of the lateral margin.

The segments of the abdomen are distinctly separated on the dorsal side. The lateral margins are narrowly rounded. The terminal segment of the body is long and narrow, reaching beyond the lateral margins of the fifth segment, is rounded posteriorly, and with or without a minute excavation.

FIG. 53.—PROBOPYRUS FLORIDENSIS, FIRST LAMELLA OF MARSUPIUM. × 10.

The pleopoda consist of five pairs of double-branched lamellar appendages.

The incubatory lamellæ are large, encircling the incubatory pouch, leaving only a small opening into the interior. The first pair of plates have the terminal lobe of the distal segment straight.

FIG. 54.—PROBOPYRUS FLORIDENSIS, LEG OF SIXTH PAIR OF ADULT FEMALE. × 39.

All the legs have a well rounded expansion or carina about the middle of the basis.

Male with all the segments of the thorax well defined and widely separated at the sides. Body narrow, elongate, nearly three times as long as wide.

The abdomen has all the segments well defined at the sides, but fused in the middle of the dorsal surface. Length almost equal to the breadth. Terminal segment well defined, rounded posteriorly, and extending beyond the lobes of the preceding segment. The lateral margins of all the segments are rounded. Pleopoda are present in the form of pairs of small rounded processes, a pair on each segment of the abdomen. Eyes present.

One specimen was collected by Mr. W. C. Kendall at Satsuma Island, above St. Johns River, Florida; parasitic on *Palæmonetes exilipes* Stimpson. Two other specimens were obtained by the U. S. Fish Commission steamer *Albatross* at Little River, Miami, Florida, parasitic also on *Palæmonetes exilipes* Stimpson.

Type.—Cat. No. 29090, U.S.N.M.

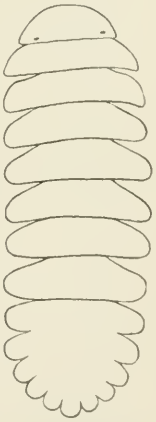

FIG. 55.—PROBOPYRUS FLORIDENSIS, MALE. × 41.

BOPYRINA ABBREVIATA, new species.

Body of adult female very asymmetrical, the one side being very much longer than the other. Color entirely white with a few black dots scattered irregularly over the dorsal surface.

Head large, turned to the shorter side; frontal boarder produced in a rounded lobe in the middle. Antero-lateral angles produced in narrow lobes or processes. Eyes small, distinct.

The segments of the thorax are distinctly defined. The epimera are distinct on the first three segments, where they occupy the anterior portion of the lateral margin; they are quite distinct on the longer side of the body, but it is impossible to distinguish them on the shorter side. Ovarian bosses are not present on any of the segments. The epimera of the last four segments are not separated off from the segments; they occupy the entire lateral margin.

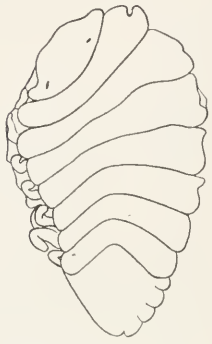

FIG. 56.—BOPYRINA ABBREVIATA, DORSAL VIEW OF FEMALE. × 23.

The abdominal segments are completely fused in the middle of the abdomen. On the lateral margin of the shorter side of the body there is no indication whatever of the coalesced segments. The first four abdominal segments are represented on the longer side of the body by four rounded lobes. The last two segments are completely fused, and are not indicated on either side.

FIG. 57.—BOPYRINA ABBREVIATA, FIRST LAMELLA OF MARSUPIUM. ×27.

The pleopoda, as far as could be made out, consist of four pairs of single branched lamellæ. Three pairs were distinctly seen; the last pair are very indistinct.

FIG. 58.—BOPYRINA ABBREVIATA, MAXILLIPED. ×41.

The first lamella of the marsupium on the shorter side extends about one-third the length of the body; on the longer side, the first lamella extends to the posterior margin of the second thoracic segment.

Male with head large, rounded in front. Eyes large, irregularly shaped. All seven segments of thorax distinct. Abdomen narrower than thorax, and tapering to a narrow extremity. In one specimen all six segments were more or less defined at the sides; in the other specimen only the first three. Length of abdomen about equal to one-third the length of the body.

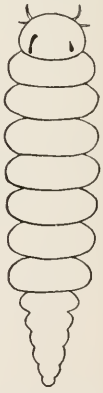

FIG. 59.—BOPYRINA ABBREVIATA, MALE. ×77½.

Color white with markings of black or brown.

Nine specimens were collected by Mr. Henry Hemphill at Puntarasa, Florida, on *Hippolyte zostericola* (Smith).

This species differs from *Bopyrina virbii* (Waltz),[a] in the much smaller first lamellæ in the female, the lamella of the shorter side of the marsupium extending but one-third the length of the body, while in *B. virbii* it extends nearly to the abdomen, that of the longer side reaching only the posterior margin of the second thoracic segment, while in *B. virbii* it

[a] Kossman, Zeitschrift für Wissenschaftliche Zoologie, XXXV, 1881, p. 666–679, pls. XXXIV–XXXV.

extends to the posterior margin of the fourth segment; in not having any indication of segmentation on the shorter side of the abdomen, while in *B. virbii* there is some indication; and in having the abdomen of the male rounded posteriorly with indications of segmentation at the sides more or less during its entire length, while in *B. virbii* the abdomen is truncate posteriorly, with only the first two segments indicated.

The specific name refers to the abbreviated first lamellæ of the marsupium.

Type.—Cat. No. 29097, U.S.N.M.

BOPYRINA UROCARIDIS, new species.

Body of female twice as long as wide

Head with frontal margin produced in a broadly rounded process. Eyes present about the middle of the head as small black spots.

The segments of the thorax are distinct. The epimera are marked off by faint lines or impressions. The abdomen is composed of six segments, which are distinct at the sides but fused in the middle. The posterior margin of the terminal segment is broad, with a slight median excavation.

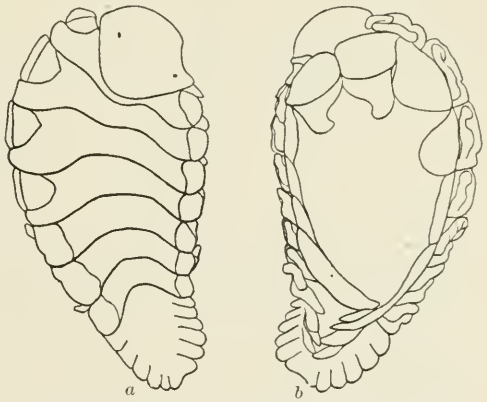

FIG. 60.—BOPYRINA UROCARIDIS. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. × 23.

The pleopoda consist of four pairs of single branched plates or lamellæ, each pair directed toward the median line. There are no uropoda.

FIG. 61.—BOPYRINA UROCARIDIS, MAXILLIPED. × 39.

The incubatory pouch is a large area on the ventral side of the body, which is not closed over by the incubatory lamellæ. These lamellæ consist of five pairs of plates, the first pair of which have the second segment produced distally in a linguiform process.

FIG. 62.—BOPYRINA UROCARIDIS, FIRST LAMELLA OF MARSUPIUM, RIGHT SIDE. × 52.

Color uniformly light yellow with small black dots on the incubatorylamellæ.

Male unknown.

Four specimens were found—three at Puntarasa, Florida, collected by Henry Hemphill, and one from west Florida, collected by Mr. J. B. Henderson and Mr. C. T. Simpson, all parasitic on *Urocaris longicaudata* Stimpson.

Type.—Cat. No. 29088, U.S.N.M.

BOPYRINA THORII, new species.

Body of adult female asymmetrical, turned very much to one side. Color yellow with a few markings of black on one side of the thorax and in the center of the first three segments of the abdomen.

Head large with frontal margin produced in a rounded lobe, which is turned upward in the specimen; the antero-lateral angles are produced into small processes. The eyes are black and distinct.

The segments of the thorax are all distinctly separated from each other. The epimera are distinct on the longer side of the body as long, narrow plates on the anterior portion of the lateral margin of the first four segments. Ovarian bosses are not present on any of the segments.

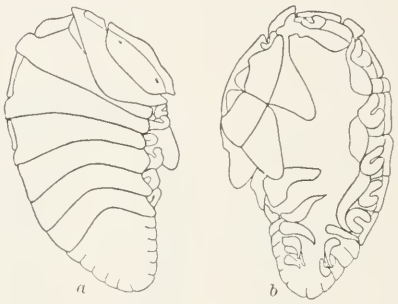

FIG. 63.—BOPYRINA THORII. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. ×15.

The abdomen is composed of six segments, completely fused in the middle, but indicated on both lateral margins. The terminal segment is rounded posteriorly.

There are four pairs of single branched pleopoda. The marsupium is a large open area, normally filled with eggs, and inclosed by five pairs of lamellæ. The first lamellæ have the distal lobe rounded. The fifth lamellæ are narrow elongated plates.

Male unknown.

Only one specimen was obtained by the U. S. Fish Commission steamer *Albatross* at Key West, Florida. The species is parasitic on *Thor floridanus* Kingsley.

This species differs from the preceding species chiefly in the form of the distal segment of the first lamellæ of the marsupium.

Type.—Cat. No. 29099, U.S.N.M.

BATHYGYGE GRANDIS Hansen.

Bathygyge grandis HANSEN, Bull. Mus. Comp. Zool., Harvard College, XXXI, 1897, pp. 122, 124, pl. VI, figs. 2, 2*c*.—RICHARDSON, Proc. U. S. Nat. Mus. XXI, 1899, p. 869.

Locality.—Off Acapulco, in the branchial cavity of *Glyphocrangon spinulosa* Faxon.

LEIDYA DISTORTA (Leidy).

Cepon distortus LEIDY, Journ. Acad. Nat. Sci., Phila., (2), III, 1855, p. 150, pl. XI, figs. 26–32.

Leidya distorta CORNALIA and PANCERI, Mem. R. Acad. Sci., Torino, (2), XIX, 1861, p. 114.

Cepon distortus HARGER, Rep. U. S. Fish Comm., Pt. 1, 1874, p. 573 (279); Proc. U. S. Nat. Museum, II, 1879, p. 157; Rep. U. S. Fish Comm., 1879, p. 157;

Pt. 6, p. 311.—KOSSMAN, Zool. Ergb. einer Reise in die Küst. des Rothen Meeres, III, Malacostraca, p. 122; Mittheil, aus der Zool. Station zu Neapel, III, 1881, first half, p. 182.

Phryxus distortus WALZ, Arbeit. aus d. Zoolog. Insti. d. Univers. Wien, IV, 1882, p. 59.

Cepon distortus RICHARDSON, Am. Nat., XXXIV, 1900, p. 309.

Leidya distorta RICHARDSON, Proc. U. S. Nat. Museum, XXIII, 1901, p. 579.

Locality.—Atlantic City, New Jersey, in the branchial cavity of *Uca pugilator.*

IONE CORNUTA Spence Bate.

Ione cornuta SPENCE BATE, Proc. Zool. Soc. London, 1864, p. 668; Lord's Naturalist in British Columbia, II, 1866, p. 282.

Ione cornuta BATE and WESTWOOD, Brit. Sessile-eyed Crust., II, p. 253.—GIARD and BONNIER, Travaux de l'Institut zoologique de Lille et du Laboratoire Maritime de Wimereux, V, 1887, p. 77.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 869.

Locality.—Esquimault Harbor, British Columbia, in the branchial cavity of *Callianassa longimana;* Vancouver Island.

IONE THOMPSONI, new species.

Body of female longer than broad.

Head deeply set in thorax, its anterior margin produced in a crenulated border. The antero-lateral lobes of the frontal border extend some distance beyond the sides of the head. The posterior portion of the head is evenly rounded. The first antennæ are three jointed: the second pair are five jointed.

All the thoracic segments are distinct, with distinct epimera ("lames pleurales" of Giard and Bonnier), in the form of large rounded lobes, not elongated. In the first two segments these epimeral lobes occupy the anterior portions of the lateral parts of the segments; in the third segment they are placed about the center of the lateral margin; in the fourth and fifth segments they occupy more of a posterior position; in the sixth and seventh segments they occupy the entire lateral margin. Ovarian bosses are present on the first four segments, along the anterior portion of the segment.

The six segments of the pleon are distinct, and are produced laterally, each in a pair of elongated and jointed appendages, furnished with numerous mammilliform, branching appendages, originating from the posterior margin and extending downward. Thus there are six pairs of appendages corresponding to the "lames epimeriennes du pleon" of Giard and Bonnier.

The pleopoda consist of four pairs of double-branched appendages and one pair of single-branched appendages.[a] The inner branches of

[a] The young female of *Ione thompsoni* has the last pair of pleopoda double-branched, the two branches similar, however. The inner branches of the first four segments are quite different from those of the outer branches, as is true of the adult female, and lie folded over the abdomen as in the adult described.

the first four pairs fold over the ventral side, meeting in the median line. These branches are all large and of nearly equal size and thickly tuberculate, the first two pairs being somewhat larger than the last two pairs. The outer branches of the first four pairs and the fifth pair of pleopoda consist of narrow, elongated appendages crenulated on their outer margins and thickly tuberculate. The appendages of

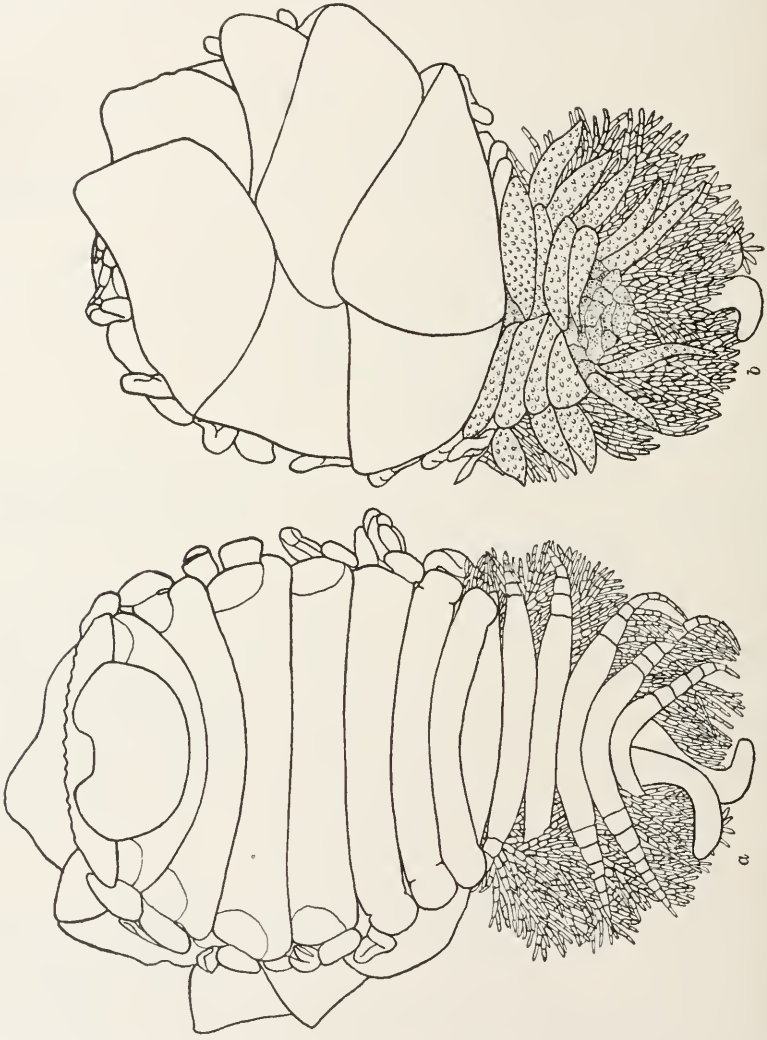

FIG. 64.—IONE THOMPSONI. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. ×6.

the sixth abdominal segment, the uropoda, are a pair of simple, cylindrical, elongated lobes, recurved at their extremities, and not reaching beyond the mass of epimeral appendages.

The incubatory pouch is formed of five pairs of lamellæ, five issuing from one side and five from the other. The first pair are much smaller than the others, and are entirely concealed by the second pair.

The seven pairs of legs are all similar, and terminate in a prehensile hand. There are two expansions or carinæ on the basis of all the legs, the anterior one being only half as long as the other.

FIG. 65.—IONE THOMPSONI, MAXILLIPED.

Male with all the segments of the thorax distinct. Eyes wanting. Antennæ conspicuous, six jointed. Antennulæ, three jointed. The segments of the abdomen are distinct, all six furnished each with a pair of elongated leaf-like tapering appendages.

Two specimens were collected by Mr. G. M. Gray at North Falmouth, Massachusetts. They were found on *Callianassa stimpsoni*.

The species is named for Mr. Millett T. Thompson, from whom the specimens were received.

Type.—Cat. No. 29091, U.S.N.M.

FIG. 66.—IONE THOMPSONI, FIRST LAMELLA OF MARSUPIUM. ×10.

This species is apparently very close to *I. cornuta*, Spence Bate, from Vancouver Island. It agrees with *I. cornuta* in the absence of the elongated epimeral lobes (lames pleurales), in which both species differ from *I. thoracica* (Montagu). *Ione thompsoni* and *I. cornuta* are both much larger species than *I. thoracica*. In the description of *I. cornuta*,[a] the author says that the coxæ of the three posterior segments of the thorax are larger than the four anterior, and are produced posteriorly to a point. This is not true of *I. thompsoni*, in which the epimera of the three posterior thoracic segments are smaller than those of the anterior segments, although they occupy the entire lateral margin, and they are rounded posteriorly and not produced to a point. Spence Bate also speaks, in reference to *I. cornuta*, of the antero-lateral "horn-like process of the cephalon[b] curving posteriorly." In *I. thompsoni*, these lateral processes or lobes extend out straight at the sides. Bate and Westwood, in describing *I. cornuta*, state that the last pair of inner saccular branches of the pleopoda are almost obsolete. There are but four pairs of inner branches in *I. thompsoni*. The above quoted authors also describe the inner branches of the pleopoda as

FIG. 67.—IONE THOMPSONI, LEG OF SIXTH PAIR OF ADULT FEMALE. ×11½.

FIG. 68.—IONE THOMPSONI, MALE. ×8.

[a] Proc. Zool. Soc. London, 1864, p. 668.

[b] British Sessile-eyed Crustacea, II, 1867, p. 254.

gradually diminishing in size to the last pair, whereas the outer branches gradually increase in size. This is not true of *I. thompsoni*.[a]

PHYLLODURUS ABDOMINALIS Stimpson.

Phyllodurus abdominalis STIMPSON, Journ. Bost. Soc. Nat. Hist., VI, 1857, p. 71.—LOCKINGTON, Proc. Cal. Acad. Sci., VII, 1877, Pt. 1, p. 57; Ann. Mag. Nat. Hist., 1878, pp. 299, 300.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 868.

Locality.—Puget Sound; Tomales Bay, California, "on *Upogebia pugettensis;*" San Francisco Bay on *Upogebia pugettensis.*

PSEUDIONE GIARDI Calman.

Pseudione giardi CALMAN, Ann. N. Y. Acad. Sci., XI, 1898, No. 13, pp. 274–281, pl. XXXIV, fig. 5.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 869.

Locality.—Puget Sound, on *Pagurus ochotensis* (Brandt).

PSEUDIONE GALACANTHÆ Hansen.

Pseudione galacanthæ HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 118–120, pl. v, fig. 22*i*.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 869.

Locality.—Gulf of California, in the branchial cavity of *Galacantha diomedeæ* var. *parvispina* Faxon; near Flattery Rocks, Washington, parasitic on *Munida quadrispina* Benedict. (Collected by U. S. Fish Commission steamer *Albatross.*)

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[a] The descriptions of the type species, *Ione thoracica* (Montagu), are so unsatisfactory and inadequate and so much at variance when compared that the only action to take, under the circumstances, is to place the form described above tentatively in the genus *Ione* Latreille and to give it a new specific name.

Montagu and Kossman describe the pleon of *Ione thoracica* as composed of six segments, all of which are produced laterally into arborescent, branching lamellæ. Montagu in his figure, however, represents but four segments, with five pairs of branching lamellæ. Milne Edwards, Bate and Westwood, and Giard and Bonnier describe six segments, with only the first five produced into ramified appendages. The appendages of the last segment are described as simple, recurved.

Montagu mentions also six simple, recurved appendages, of which the last two are larger than the rest. Kossman describes six pairs of double-branched pleopods (pleopodoiden) and also a single pair of simple, cylindrical uropoda (pleopoden). Milne Edwards says that the first (appendages of the first five segments?) carry at their base a little "écaille" folded beneath, under the abdomen. Bate and Westwood refer to the pleopoda in the following way: "Several of the basal appendages are, moreover, furnished at the base beneath with a small scale, lying beneath the tail." Finally, Giard and Bonnier, characterize these appendages in this way: "Rames des Pléopodes composés de six articles."

The species herein described as new seems close to *Ione cornuta* Spence Bate. In the original description of *Ione cornuta* the pleopoda are simply described as "long and fringed with arborescent branchiæ." Bate and Westwood mention the jointed character of these appendages (pleural lamellæ), and give a much fuller description of the species.

PSEUDIONE FURCATA, new species.

Body of female longer than broad, more or less ovate.

Head with frontal border; anterior margin nearly straight; posterior portion narrowly rounded. Head small and deeply immersed in thorax. Mouth parts and antennæ concealed by first lamellæ of marsupium. The first antennæ are composed of three, the second of four joints.

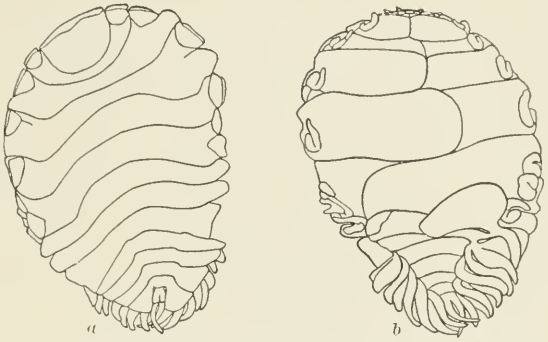


Fig. 69.—Pseudione furcata. *a*, dorsal view of female; *b*, ventral view of same. × 4.

The thorax has all the segments distinct. Ovarian bosses are large and prominent on the first four segments. The epimera on these segments are represented by narrow ridges lateral to the ovarian bosses; those of the three last segments occupy all of the lateral margin.

The segments of the abdomen are all distinct with the epimera produced in wide plates on either side of the narrow middle portion of the segment. The sixth or terminal segment is without epimera, and terminates posteriorly in two small, rounded lobes. The pleopoda are five pairs of smooth, narrow, elongated biramous appendages, all similar and equal in size, with the exception of the inner branch of the first pair, which is exceedingly large and is inwardly directed, meeting the corresponding branch of the opposite side in the median ventral line, just below the incubatory pouch. All the remaining branches are directed, post-laterally. The surfaces of all the lamellæ are quite smooth. The uropoda consist of a single pair of simple appendages, similar in shape and size to the pleopoda.

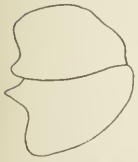


Fig. 70.—Pseudione furcata, first lamella of marsupium.

The incubatory pouch consists of five pairs of large lamellæ, overlapping in the median line. First pair of plates with the terminal lobe not defined.

There is a high and widely rounded expansion or carina on the basis of all the legs.

Male unknown.

Fig. 71.—Pseudione furcata, leg of sixth pair of adult female. × 20½.

Four specimens were collected on the eastern shore of Virginia by Prof. H. E. Webster. Host unknown. They were sent from Union College to the Smithsonian Institution.

Type.—Cat. No. 29093, U.S.N.M.

PSEUDIONE CURTATA, new species.

Head very large, with wide anterior margin, almost straight; no frontal border. Antero-lateral portion produced in a small process on either side. Posterior portion widely rounded. Eyes wanting.

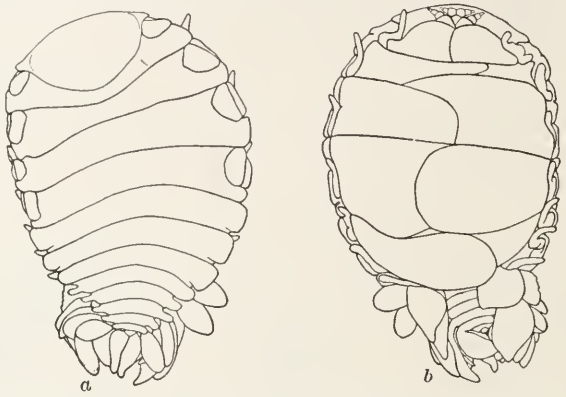


FIG. 72.—PSEUDIONE CURTATA. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. ×8.

The segments of the thorax are distinct. The epimera are distinct as narrow plates on the extreme lateral margin of the anterior portion of the first four segments. Ovarian bosses are prominent on the anterior portion of the first four segments. The epimera occupy almost all of the lateral margin of the three posterior segments.

FIG. 73.—PSEUDIONE CURTATA, FIRST LAMELLA OF MARSUPIUM. ×14½.

The abdomen has the six segments distinct. All are produced laterally in small rounded epimera with the exception of the last; or terminal segment which is very small and rounded posteriorly.

The pleopoda are five pairs of large, broad, smooth, leaf-like, double-branched appendages not concealed on the dorsal side by the small epimeral plates of the abdominal segments, from which they project in full view. The uropoda are a pair of single-branched, simple appendages, similar in shape to the branches of the pleopoda.

The marsupium is formed of five pairs of incubatory lamellæ, which overlap so as to completely encompass the ventral surface of the body; the first pair have the terminal lobe of the distal segment small, but well defined.

FIG. 74.—PSEUDIONE CURTATA, LEG OF SIXTH PAIR OF ADULT FEMALE. ×39.

There are seven pairs of small legs, all similar in size and structure; a high triangularly shaped expansion or carina is present on the basis.

Color uniformly light yellow.

Male, two and one-third times longer than broad, with all seven segments of the thorax and all six segments of the abdomen distinct.

Eyes present. Abdomen occupies one-fourth of the entire length of the body.

Only one specimen was found at Key West by Henry Hemphill. Parasitic on *Petrolisthes serspinosus* (Gibbes).

Type.—Cat. No. 29094, U.S.N.M.

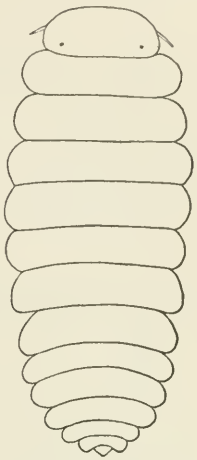


FIG. 75.—PSEUDIONE CURTATA, MALE. ×23.

MUNIDION PARVA, new species.

Head large, broader anteriorly than posteriorly, with wide frontal border. Eyes wanting. Anterior margin nearly straight, posterior margin narrowly rounded.

The segments of the thorax are distinct, the first two of which are short in the dorsal median line. The other five segments are about equal in length. Ovarian bosses present on all the segments and occupying the posterior portion of the sublateral part of the segment. On all the segments they are in the form of petiolated processes. The epimera are large plates which occupy the whole of the lateral margin of the segments. These plates are larger on the posterior segments than on the anterior ones.

The abdominal segments are all distinct. The first five are produced laterally in epimeral lobes, elongated and leaf-shaped, decreasing in size gradually from the first to the fifth segments. These lobes do not cover the dorsal surface of the abdomen, or obscure the small terminal segment, which is visible dorsally as a small rounded petiolated process.

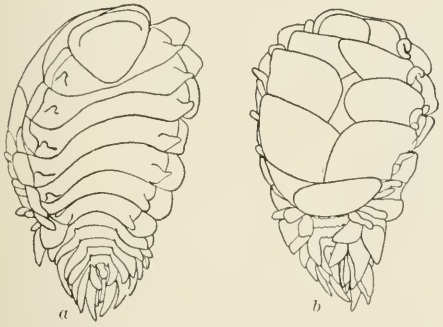


FIG. 76.—MUNIDION PARVA. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. ×8.

The pleopoda are five pairs of double-branched elongated leaf-like appendages; the inner branches are smaller than the outer. The uropoda consist of a pair of biramous appendages, each with one large outer and one small inner branch, similar in shape to the branches of the pleopoda.

The ventral side of the abdominal segments is keeled on the posterior margin. The pleopoda and abdominal epimera are somewhat carinated on both surfaces.

The marsupium is bounded by five pairs of incubatory lamellæ, the third pair of which do not overlap in the median ventral line, so that a small opening is left into the incubatory pouch. The terminal lobe of the distal segment of the first pair is very small, but well defined.

The seven pairs of legs are all similar; the basis is furnished with

an extremely high expansion, the anterior end of which is twice as high as the other end.

FIG. 77.—MUNIDION PARVA, FIRST LAMELLA OF MARSUPIUM. ×14½.

The male has all the segments of the thorax distinct. The segments of the abdomen are fused into a single piece. There are no indications of the coalesced segments on the lateral margins of the abdomen, these margins being entire. The posterior portion of this segment is narrower than the anterior portion, its apex, however, being widely rounded. Its length is about one and one-half times its greatest breadth. Eyes are present.

Only one specimen comes from the Straits of Fuca, taken by the U. S. Fish Commission steamer *Albatross* at a depth of 152 fathoms. Parasitic on *Munida quadrispina* Benedict.

Type.—Cat. No. 29095, U.S.N.M.

FIG. 78.—MUNIDION PARVA, LEG OF SIXTH PAIR OF ADULT FEMALE. × 20½.

This species is a very much smaller one than the type species of the genus described by Dr. Hansen,[a] being less than half the size of *Munidion princeps*. The present species differs from the type species in its much smaller size; in the relatively larger and differently shaped head; in the larger thoracic epimera (pleural plates); in the differently shaped ovarian bosses; in the smaller and differently shaped abdominal epimera, which do not conceal the abdominal segments dorsally as in that species; in the differently shaped carina on the basis of all the legs; in the absence of the sinuous lateral margins of the abdomen of the male; and in the broader apex and greater length compared with the width of the abdomen of the male.

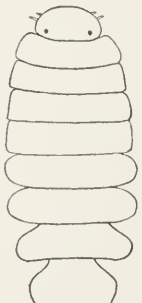


FIG. 79.—MUNIDION PARVA, MALE. ×23.

Family DAJIDÆ.

DAJUS MYSIDIS Krøyer.

Dajus mysidis KRØYER, Voy. en. Scand., Crust., 1849, pl. XXVIII, fig. 1.

Bopyrus mysidium PACKARD, Mem. Bost. Soc. Nat. Hist., I, 1867, p. 295, pl. VIII, fig. 3.

Leptophryxus mysidis BUCHHOLZ, Zweite Deutsche Nordpolfahrt, 1874, p. 288, pl. XI, fig. 2.

Dajus mysidis LÜTKEN, Crustacea of Greenland, 1875, p. 150.—G. O. SARS, Arch., Math. Nat., II, 1877, p. 354 (254).—SMITH in Harger, Proc. U. S. Nat. Museum, II, 1879, p. 158.—HARGER, Rep. U. S. Fish Comm., 1880, Pt. 6, p. 312.—G. O. SARS, Crustacea of Norway, II, Pts. 11, 12, 1898, p. 223–225, pl. XXVIII, fig. 1.—RICHARDSON, Proc. U. S. Nat. Museum, XXIII, 1901, p. 579.

Locality.—Labrador; Greenland; Kingigtok; Duck Island; Murchison Sound; 73° 48′ N. lat., 80° 30′ W. long.; 72° 33′ N. lat., 71° 30′ W. long; 71° 57′ N. lat., 73° 56′ W. long.; 66° 33′ N. lat., 61° 50′ W. long.;

[a] Bull. Mus. Comp. Zool. Harvard College, XXXI, No. 5, Pt. 22, The Isopoda, 1897, pp. 115–117, pl. IV, figs. 2–2*c*; pl. V, figs. 1–1*d*.

64° 56′ N. lat., 66° 18′ W. long.; also recorded from west coast of Norway, Kara Sea, Sabine Island, Spitzberg, Jan Mayen, Murman coast.

Depth.—3 to 20 fathoms.

Family CRYPTONISCIDÆ.

CLYPEONISCUS MEINERTI Giard and Bonnier.

Clypeoniscus meinerti GIARD and BONNIER, Bull. Scientifique de la France et de la Belgique, (4) XXV, 1893, pp. 421–436, 444.

Locality.—Greenland (Godhavn), 8 to 10 fathoms; Nova Zembla (Jugor Schar), 6 fathoms, (Giard and Bonnier). Parasitic in the incubatory pouch of *Synidotea nodulosa* (Krøyer).

SOUTH AMERICAN EPICARIDEA.

EPICARIDEA or BOPYROIDEA.

Family BOPYRIDÆ.

STEGOPHRYXUS RESUPINATUS (Müller).

Bopyrus resupinatus MÜLLER, Jen. Zeitschrift Nat., VI, 1871, pp. 57–60.
Phryxus resupinatus STEBBING, Hist. Crust., 1893, p. 409.
Stegophryxus resupinatus THOMPSON, Report U. S. Fish Comm., 1901, p. 56.

Locality.—Brazil, on a Pagurid.

PSEUDIONE GALACANTHÆ Hansen. [a]

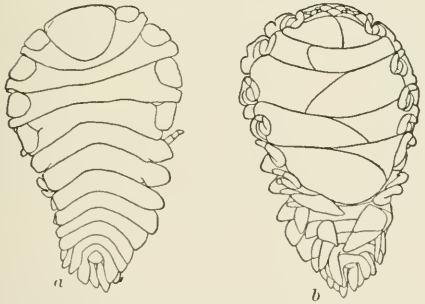


FIG. 80.—PSEUDIONE GALACANTHÆ. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. × 8.

FIG. 81.—PSEUDIONE GALACANTHÆ. *a*, MAXILLIPED. × 11½; *b*, FIRST LAMELLA OF MARSUPIUM, RIGHT SIDE. × 15.

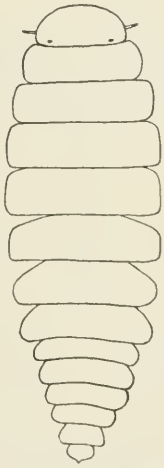


FIG. 82.—PSEUDIONE GALACANTHÆ, MALE. × 23.

Pseudione galacanthæ HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 118–120, pl. v, fig. 22*i*.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 869.

[a] This species is again figured, for the reason that it is found parasitic on a different species of host, and is from a different locality from that of the type specimen.

Locality.—Off east coast of Patagonia, two specimens parasitic on *Munida subrugosa*. Collected by U. S. Fish Commission steamer *Albatross*.

PSEUDIONE TUBERCULATA, new species.

Head small, with frontal border; anterior margin straight; posterior portion narrowly rounded.

Segments of thorax distinct. Ovarian bosses present on antero-

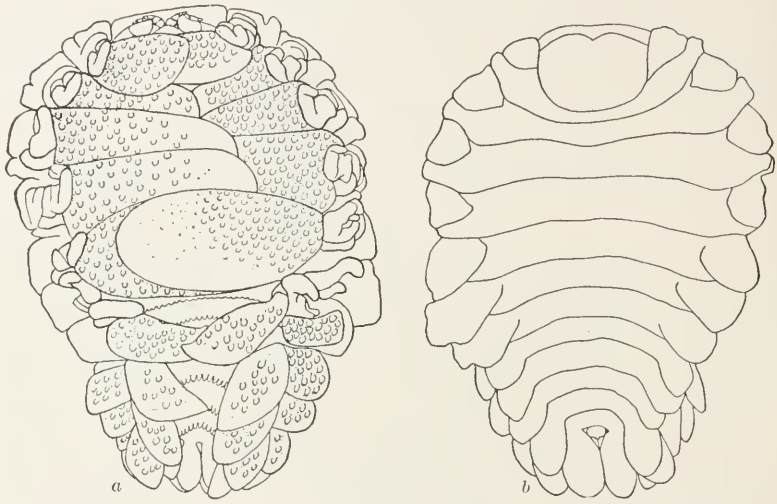


FIG. 83.—PSEUDIONE TUBERCULATA. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. ×4.

lateral part of first four segments. Last three segments without bosses. The epimera occupy only the small posterior part of the lateral margin of the first four segments, and are not distinctly separated from the segments on the dorsal side; they occupy the whole of

FIG. 84.—PSEUDIONE TUBERCULATA, MAXILLIPED. ×5.

FIG. 85.—PSEUDIONE TUBERCULATA, DISTAL SEGMENT OF FIRST LAMELLA OF MARSUPIUM. ×10.

FIG. 86.—PSEUDIONE TUBERCULATA, LEG OF SIXTH PAIR OF ADULT FEMALE. ×11½.

FIG. 87.—PSEUDIONE TUBERCULATA, MALE. ×8.

the lateral margin of the last three segments, and are in the form of large plates, extending somewhat backward.

The segments of the abdomen are distinct. The epimera of the abdominal segments form large plates on either side of the segments. They are present on all but the last or terminal segment, and are not distinctly separated from the segments. The epimera almost entirely conceal, on the dorsal side, the underlying pleopoda. The terminal segment is bilobate posteri-

orly, with a small median point. The posterior edge of the ventral side of all the abdominal segments is strongly keeled. The pleopoda are five pairs of double-branched, broad, leaf-like appendages, distinctly tuberculate. The inner branches of the first pair overlap in the median ventral line.

The marsupium is composed of five pairs of strongly tuberculate lamellæ, overlapping in the median ventral line of the thorax, and entirely inclosing the incubatory pouch.

There are seven pairs of legs similar in shape and structure. A wide expansion extends the entire length of the basis.

Color, uniformly light yellow.

Males, three and a half times longer than broad, with all seven segments of thorax and all six of abdomen distinct. Eyes wanting. Abdomen occupies more than one-third of the entire length of the body.

About thirteen specimens were obtained by the U. S. Fish Commission steamer *Albatross*, from off Port Ortway, Patagonia, at a depth of 1,050 fathoms. Parasitic on *Lithodes diomedeæ* Benedict.

Type.—Cat. No. 29092, U.S.N.M.

PSEUDIONE PAUCISECTA, new species

Body of female ovate, twice as long as wide, twisted somewhat to one side. Color, uniformly light yellow.

Head very large, triangular in shape, with frontal margin widely

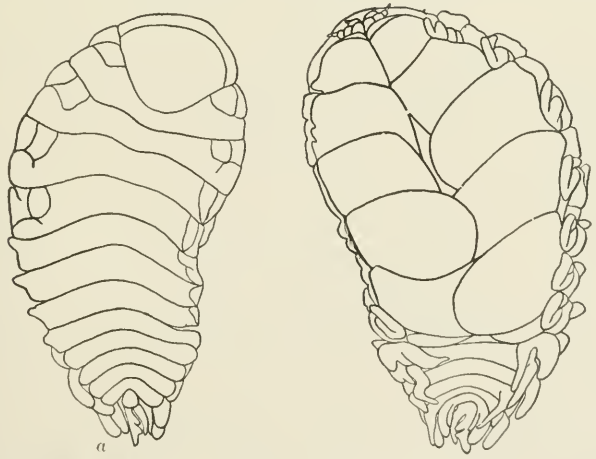


FIG. 88.—PSEUDIONE PAUCISECTA. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. ×8.

rounded or arcuate. A wide frontal border, somewhat irregular in outline, surrounds the anterior portion. Eyes absent. First pair of antennæ consist of three joints; second pair of five joints.

Ovarian bosses present on the anterior portion of the first four thoracic segments; lateral to these, on the anterior portion of the segments, are the wide epimeral plates, which have a tendency to be irregular along the lateral margin. The epimera occupy the whole of

the lateral margin of the three posterior segments, and are produced laterally into irregular processes.

The segments of the abdomen are distinct with the epimera extending as narrow, elongated plates on either side of the first five segments. Terminal segment knoblike in appearance with well-rounded margins.

FIG. 89.—PSEUDIONE PAUCISECTA, FIRST LAMELLA OF MARSUPIUM. ×10.

Pleopoda consist of five pairs of double-branched, narrow, elongated tapering lamellæ directed backward, the inner branches being smaller than the outer branches in the last two segments. The uropoda are a single pair of lamellæ, both lamellæ being irregular in outline.

The five pairs of incubatory plates completely inclose the incubatory pouch, meeting in the median ventral line. The terminal lobe of the distal segment of the first pair is not defined. All the legs have a high and narrowly rounded expansion or carina about the middle of the basis.

FIG. 90.—PSEUDIONE PAUCISECTA, LEG OF SIXTH PAIR OF ADULT FEMALE. ×20½.

The male is twice as long as broad. Head transverse; eyes absent. Segments of thorax of equal length. Abdomen short, occupying less than one-sixth of the entire length and composed of only five segments, all distinct, with terminal segment small, rounded.

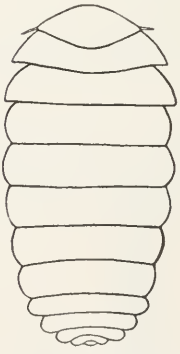


FIG. 91.—PSEUDIONE PAUCISECTA, MALE. ×14½.

Only one specimen was taken by the U. S. Fish Commission steamer *Albatross* off Port Ortway, Patagonia. Parasitic on *Munida curvipes* Benedict.

Type.—Cat. No. 29096, U.S.N.M.

UROBOPYRUS, new genus.

UROBOPYRUS PROCESSÆ, new species.

Body of adult female somewhat asymmetrical, and a little broader than long. Color, uniformly white.

Head with frontal margin produced and upturned; posterior margin widely rounded. Markings of black, which may represent eyes, present on the antero-lateral angles of the head.

All the segments of the thorax are distinct. Ovarian bosses are present on the anterior portion of the first four segments. The epimera of these segments are represented by narrow plates on the outer margin of the segments, lateral to the ovarian bosses. On the three posterior segments the epimera are produced as large plates, larger on one side than on the other, beyond the margin of the segments.

All six segments of the abdomen distinct. The lateral margins are rounded, the lateral parts not being produced. The terminal segment is bi-lobed.

The uropoda are a pair of double-branched appendages attached to the terminal abdominal segment; the inner branches are smaller and more slender than the outer branches.

The pleopoda consist of five pairs of double-branched, elongated lamellæ, the inner branches being smaller than the outer and directed inward, the outer branches extending beyond the margins of the abdomen.

The incubatory lamellæ consist of five pairs of plates affixed to the sides of the thorax, five on either side. They do not completely cover

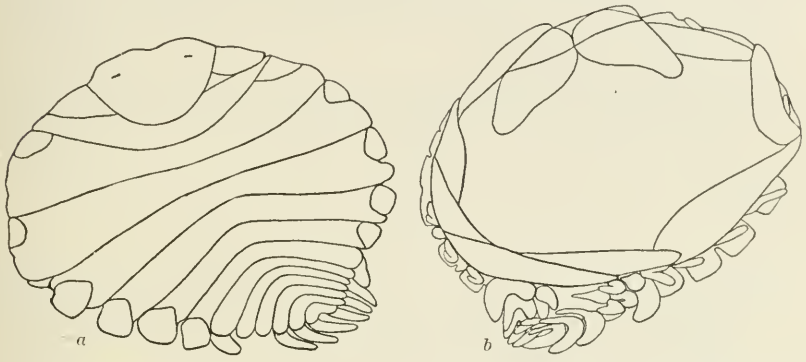


FIG. 92.—UROBOPYRUS PROCESSI. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. × 14⅓.

the incubatory pouch, but a large area remains open, which is normally filled with eggs.

All seven pairs of legs present.

Male unknown.

A single specimen was obtained by the U. S. Fish Commission steamer *Albatross* off the east coast of South America, lat. N. 6° 59′ 30″, long. W. 34° 47′. Parasitic on *Processa canaliculata* Leach.

This genus is very close to *Probopyrus* Giard and Bonnier, but differs in having uropoda, which are altogether wanting in that genus.

Type.—Cat. No. 29098, U.S.N.M.

CRYPTIONE ELONGATA Hansen.

Cryptione elongata HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 112–115, pl. III, figs. 5, 5ª; pl. IV, figs. 1–1ᵉ.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 869.

Locality.—Near the Galapagos Islands, in the branchial cavity of *Nematocarcinus agassizii* Faxon, which occurs as far north as Acapulco, Mexico.

MUNIDION PRINCEPS Hansen.

Munidion princeps HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 115–117, pl. IV, figs. 2–2ᶜ; pl. V, fig. 1–1ª.

Locality.—Cocos Island, lat. 3° 58′ 20″ N., long. 81° 36′ W., on *Munida refulgens;* off the coast of Ecuador, on *M. refulgens* Faxon. *Depth*, 112 fathoms.

GRAPSICEPON FRITZII Giard and Bonnier.

Grapsicepon fritzii[a] Giard and Bonnier, Travaux de l'Institut zoologique de Lille et du Laboratoire de Zoologie maritime de Wimereux, V, 1887, p. 70.

Locality.—Branchial cavity of a *Grapsus* (*Leptograpsus rugulosus?*) found on the coast of Brazil, at Desterro.

Family ENTONISCIDÆ.

CANCRION CANCRORUM (Müller).

Entoniscus cancrorum Müller, Für Darwin, figs. 16, 41. (Translated in Bull. Sci. du Nord, XIV, 1882, pp. 422 and 449); Jen. Zeitschrift Nat., VI, 1871, pp. 53–56, pl. III, figs. 1–3.

Cancrion cancrorum Giard and Bonnier, Comptes rendus de l'Acad. des. Sci., 1886; Travaux de l'Institut zool. de Lille et du Laboratoire de Zool. maritime de Wimereux, 1887, pp. 239–240. —Stebbing, Hist. Crust., 1893, p. 407.

Locality.—Brazil, on several species of *Xantho*, at Desterro.

ENTONISCUS PORCELLANÆ Müller.

Entoniscus porcellanæ Müller, Archiv für Naturgeschichte, Jahrg. XXVIII, 1862, pp. 10–17, pl. II; Jen. Zeitschrift Nat., VI, 1871, pp. 53–56.—Giard and Bonnier, Trav. de l'Institut Zool. de Lille et du Laboratoire de Zool. maritime de Wimereux, 1887, p. 232.

Locality.—Brazil, on *Porcellana* sp. ?, at Desterro.

ENTONISCUS BRASILIENSIS Giard and Bonnier.

Entoniscus No. 2, Fritz Müller, Jenaische Zeitschrift für Naturwissenschaft, VI, 1871, p. 53.

Entoniscus brasiliensis Giard and Bonnier, Trav. de l'Institut zool. de Lille et du Laboratoire de Zool. maritime de Wimereux, 1887, p. 235.

Locality.—Desterro, Brazil, parasitic on *Porcellana* sp.?

This species may be identical with the preceding species.

ENTONISCUS CREPLINII Giard and Bonnier.

Entoniscus No. 3, Fritz Müller, Jenaische Zeitschrift für Naturwissenschaft, VI, p. 54, 1871.

Entoniscus creplinii Giard and Bonnier, Travaux de l'Institut zool. de Lille et du Laboratoire de Zool. maritime de Wimereux, 1887, p. 236.

Locality.—Desterro, Brazil, parasitic on *Porcellana creplinii*, F. Müller.

ENTIONE ACHÆI Giard and Bonnier.

Entoniscus No. 4, Fritz Müller, Jenaische Zeitschrift für Naturwissenschaft, VI, p. 53, 1871.

Entione achæi Giard and Bonnier, Travaux de l'Institut zool. de Lille et du Laboratoire de Zool. maritime de Wimereux, 1887, p. 237.

Locality.—Desterro, Brazil, parasitic on *Achæus* sp.?

[a] See note under *Probopyrus alphei* (Richardson), p. 67.

Family CRYPTONISCIDÆ.

CRYPTONISCUS PLANARIOIDES Müller.

Cryptoniscus planarioides MÜLLER, Jen. Zeitschrift Nat., VI, 1871, pp. 61–64.—STEBBING, Hist. Crust., 1893, p. 402.

Locality.—Brazil, on *Peltogaster purpureus.*

MICRONISCUS FUSCUS Fritz Müller.

Microniscus fuscus MÜLLER, Jen. Zeitschrift Nat., VI, 1871, p. 65.

This form is probably the Microniscus stage in the development of some Epicarid.[a]

[a] See Sars, Crust. of Norway, II, Pts. 11, 12, pp. 218–220.

A REVIEW OF THE SCORPÆNOID FISHES OF JAPAN.

By David Starr Jordan and Edwin Chapin Starks,
Of the Leland Stanford Junior University.

In this paper is given a review of the species of *Scorpænidæ* known to inhabit the waters of Japan. The specimens examined are in the museum of Leland Stanford Junior University and in the United States National Museum, most of them having been collected by Messrs. Jordan and Starks in 1900 and a few by the United States Fish Commission steamer *Albatross*.

Family SCORPÆNIDÆ.

Body oblong, more or less compressed, the head large, and with one or more pairs of ridges above, which usually terminate in spines; sometimes very irregular in form. Opercle usually with 2 spinous processes; preopercle with 4 or 5. Mouth terminal, usually large, with villiform teeth on jaws and vomer, and usually on the palatines. Premaxillaries protractile; maxillary broad, without supplemental bone, not slipping under preorbital. Gill openings wide, extending forward below; the gill membranes separate and free from the isthmus; usually no slit behind the fourth gill. Scales etenoid, or sometimes cycloid, usually well developed, sometimes obsolete. Lateral line single, continuous, concurrent with the back; a narrow bony stay extending backward from the suborbital toward the preopercle. Ventral fins thoracic, usually of the normal percoid form, I, 2, to I, 5, the rays branched; dorsal fin continuous, sometimes so deeply notched as to divide it into two parts, or even three parts, with 8 to 16 rather strong spines and about as many soft rays; anal rather short, usually with 3 spines and 5 to 10 soft rays; soft rays in all the fins usually branched, except some or all of rays of the pectorals; pyloric cæca in moderate or small number (less than 12). Pseudobranchiæ large. Air bladder present or absent. Actinosts moderate, inserted on the posterior edges of hypercoracoid and hypocoracoid; ribs borne on enlarged pleuraphyses. Post-temporal bifurcate, normally connected; myodome more or less developed. Genera and species numerous,

inhabiting all seas, but especially abundant in the temperate parts of the Pacific Ocean, where they form a large proportion of the fish fauna. They are nonmigratory fishes, living about rocks. Most of them are of large size, and all are used as food. Many of them are viviparous, the young being produced in great numbers when about one-fourth inch in length. Many of them have a venom sac at the base of the dorsal spines. In Japan the olivaceous species are known as *Mebaru* (pop eye), the others as *Soi* or *Aka-uuo* (red fish). Numerous species with venomous spines are known as *Okoze*.

a. Dorsal fin beginning well backward at the nape, far behind the eye.
b. Body scaly, sometimes with fleshy flaps; no free rays on the pectoral; ventral rays always I, 5.
c. Pectoral fin with its lowermost ray not detached as a separate feeler.
d. Dorsal spines not greatly produced with slender free tips; pectoral fins moderate.
e. SEBASTINÆ. Dorsal spines more than 12; vertebræ more than 10 + 14.
f. Dorsal spines 15 or 16; vertebræ about 11 + 18 = 29; palatine teeth present; scales ctenoid; top of head scaly.
g. Pectoral with the lower rays produced in a distinct lobe; anal rays III, 5 ..... *Sebastolobus*, 1.
ff. Dorsal spines 13 (rarely 14); vertebræ usually 12 + 15 = 27; palatine teeth present.
h. Head and lateral line without series of filaments.
i. Preorbital stay without series of hooked spines.
j. Base of skull strongly curved; interorbital space broad, flat, or convex; cranial spines relatively low; gill-rakers relatively long ..... *Sebastodes*, 2.
jj. Base of skull nearly straight; interorbital space narrow, mostly concave; cranial spines relatively sharp and high; gill-rakers short and thick ..... *Sebastichthys*, 3.
ii. Suborbital stay and preopercle with a row of strong hooked spines; dorsal spines very strong and long.. *Neosebastes*, 4.
hh. Head and lateral line with many dermal filaments; preorbital stay without enlarged spines ..... *Thysanichthys*, 5.
ee. SCORPÆNINÆ. Dorsal spines normally 12; vertebræ 10 + 14 = 24.
l. Bones of head scarcely cavernous; occiput with two pairs of spines; scales ctenoid, or else provided with dermal flaps; some of the pectoral rays branched.
m. Scales on top of head ctenoid; cranium essentially as in *Sebastodes;* the armature moderate, and no deep pits; palatine teeth present.
n. Air bladder well developed ..... *Sebastiscus*, 6.
nn. Air bladder obsolete ..... *Helicolenus*, 7.
mm. Scales on top of head cycloid or wanting; no air bladder; cranium irregular above, with many spines.
o. Palatine teeth present ..... *Scorpæna*, 8.
oo. Palatine teeth none ..... *Scorpænopsis*, 9.
ll. Bones of head with large muciferous cavities; scales cycloid; pectoral rays usually 20 or more, some of them branched; head scaleless above; no groove at occiput; palatine teeth present; scales deciduous.
p. Dorsal spines 12; interorbital space wide and convex; gill-rakers short and slender.. *Setarches*, 10.

pp. Dorsal spines 11; interorbital space concave; gill-rakers slender, rather long; dorsal very deeply notched..... *Lythrichthys*, 11.

dd. Pteroinæ. Dorsal spines 12 or 13 in number, greatly produced, venomous; pectoral fins more or less elongate; top of head with spinous crests; three anal spines; no palatine teeth.

q. Pectoral greatly elongate, all the rays simple, largely free at tips, and extending to or beyond the caudal; no bony crests at the nape. *Pterois*, 12.

qq. Pectoral moderately produced, the rays united by membrane nearly to the tips.

r. Each side of occiput with an elevated bony crest ..... *Ebosia*, 13.

cc. Apistinæ. Pectoral fin elongate, its lowermost ray detached; chin with barbels; dorsal with 15 spines; anal spines, 3; ventral rays I, 5 .. *Apistus*, 14.

bb. Body scaleless, sometimes with dermal flaps.

s. Minoinæ. Dorsal spines, 10 or 11; the fin undivided; pectoral moderate, with the lower ray free; ventral rays I, 5; anal with 2 slender spines; top of head with spinous crests.

t. Dorsal spines stiff and sharp.. *Minous*, 15.

tt. Dorsal spines slender and flexible. *Decterias*, 16.

ss. Dorsal spines 15 to 18 in number; head irregularly formed, with deep pits or depressions above.

u. Synanceinæ. Pectoral without free rays; body robust.

v. Skin smooth; no pit on the cheek ventrals I, 4..... *Erosa*, 17.

uu. Pelorinæ. Pectoral with the two lower rays almost free; first 3 spines of dorsal separated; head depressed, fantastically formed.

w. Pectoral fin without produced filaments above..... *Inimicus*, 18.

aa. Aploactinæ. Dorsal fin beginning farther forward, the first spines inserted above the eye; the spines provided with venom glands; pectoral fin without free rays; scales small or wanting.

x. Ventral rays I, 5; preorbital with a strong spine; skin smooth.

y. Mouth small; palatine teeth present; dorsal fin with 16 spines..... *Ocosia*, 19.

yy. Mouth large; palatine teeth obsolete; dorsal fin with spines; no slit behind last gill; chin without barbels. *Snyderina*, 20.

xx. Ventral rays I, 2, to I, 4.

z. Preorbital with a strong spine.

a'. Skin with small scales, or almost naked; dorsal fin not notched; no barbels; no slit behind last gill; palatine teeth present; anal with 3 spines; ventral rays I, 4..... *Paracentropogon*, 21.

a'a'. Skin scaleless, covered with velvety prickles; no barbels; no slit behind last gill; palatine teeth absent; ventral rays I, 2, or I, 3.

b'. Dorsal fin undivided; anal with two spines ..... *Erisphex*, 22.

zz. Preorbital without spine; spinous dorsal deeply notched, the first three spines separated; no palatine teeth; no anal spine; ventral rays I, 2.

Aploactis, 23.

1. SEBASTOLOBUS Gill.

Sebastolobus GILL, Report, Smithsonian Institution, 1880, p. 375 (1881), (*macrochir*).

Pectorals with a wide base, produced backward near the upper margin and not medially, lower rays thickened, extending much beyond rays next above in a linguiform lobe; ventrals directly under axils of pectorals, with the outer rays produced, thick, branched; anal III, 5; vertebræ 11+18=29; otherwise as in *Sebastes*. Pacific Ocean in deep water.

(σεβαστός, *Sebastes;* λοβός, lobe.)

1. SEBASTOLOBUS MACROCHIR (Günther).

BALA MENUKE (THORNY POP-EYES).

Sebastes macrochir GÜNTHER, Shore fishes Challenger, 1880, p. 65, pl. XXVII; off Enoshima in 345 fathoms.

Sebastolobus macrochir JORDAN and EVERMANN, Fish. North and Middle Am., II, 1898, p. 1763.

Head 2½ in length; depth 3¼. D. XV, 6; A. III, 5; P. 22 (1,7/5). Lat. line, about 45. Scales rather regular. Eye very large, much longer than snout, 3 in head. Mouth wide, maxillary reaching beyond middle of eye. Teeth on mandibles, vomer, and palatines in very narrow bands, those on premaxillaries in somewhat broader bands. Interorbital space flattish, narrow, scaleless, about 2½ in orbit. Occipital region flat, with some rudimentary scales. Preocular, supraocular, postocular, tympanic, parietal, and nuchal spines present. Interorbital stay with strong spines. Preopercle with 5 pointed spines. Each ramus of mandible with 3 large pores. Dorsal spines rather feeble, third to sixth longest, 2½ in head. Anal spines stronger, but shorter than longest dorsal spines. Caudal truncate. Pectoral extremely broad, 5 or 6 lower rays elongated beyond those above them, their extremities somewhat thickened, and used like the similar outer ventral rays, as an organ of locomotion. Pectorals reaching vent, ventrals beyond vent. Red, a large black spot on posterior half of spinous dorsal, another between anal spines. Length about a foot.

Coast of Japan at moderate depths; often taken on the long lines (dabonawa) at 200 to 400 fathoms. Our specimens from Miyako and Misaki, and Nemuro in Hokkaido. It was also dredged by the U. S. Fish Commission steamer *Albatross* in Station 3697, off Manazura Point, Sagami Bay, in 265 to 120 fathoms, these figures representing the depths at the beginning and end of the dredge-haul.

(*μακρός*, long; *χεῖρ*, hand.)

2. SEBASTODES Gill.

ROCK-FISHES.

Sebastodes Gill, Proc. Ac. Nat. Sci. Phila., 1861, p. 165 (*paucispinis*).
Sebastosomus Gill, Proc. Ac. Nat. Sci. Phila., 1864, p. 147 (*melanops*).
Acutomentum Eigenmann and Beeson, American Naturalist, 1893, p. 669 (*ovalis*).
Primospina Eigenmann and Beeson, American Naturalist, 1893, p. 669 (*mystinus*).
Rosicola Jordan and Evermann, Check-List Fishes North and Middle Amer., 1896, p. 429 (*pinniger*).
Eosebastes Jordan and Evermann, Check-List Fishes North and Middle Amer., 1896, p. 430 (*aurora*).
Emmelas Jordan and Evermann, Fish. N. and M. Am., 1898, p. 1777 (*glaucus*).

Body and head somewhat compressed; head large, $2\frac{2}{5}$ to $3\frac{2}{3}$ in length of body; depth $2\frac{1}{4}$ to $3\frac{3}{4}$ in length of body; mouth moderate or large, with the jaws equal or the lower more or less projecting; the maxillary reaching middle of eye or beyond, sometimes beyond posterior edge of orbit, its length from $1\frac{2}{3}$ to 3 in head; teeth in villiform bands on jaws, vomer, and palatines. Head more or less evenly scaled, without dermal flaps; interorbital space broad, convex, widening markedly with age; base of skull strongly curved; cranial ridges more or less developed, one or more of the following pairs always present, usually ending in spines: Preocular, supraocular, postocular, tympanic, coronal, parietal, and nuchal. Five preopercular and 2 opercular spines; 1 to 3 spines on the suprascapula. Suborbital stay moderate, usually not reaching preopercle. Gill rakers always long and slender. Scales moderate or small, mostly ctenoid, 35 to 100 transverse series. Dorsal fin continuous, emarginate, its formula XIII, 12 to 16, the number of spines rarely 14, never 12; anal fin III, 5 to 9. Pectorals well developed, the base broad or narrow, the lower rays undivided. Caudal slightly rounded, truncate, or slightly forked; soft parts of vertical fins more or less scaly. Pyloric cæca 6 to 11. Vertebræ 12 + 15. Species of varied, often brilliant colors, mostly red. Sexes colored alike. Air bladder present in all species so far as known. The group inhabits the two shores of the northern Pacific Ocean; some of the species are extremely localized; exceedingly abundant in rocky places along the west coast of the United States and Japan. They seem to disappear rather abruptly to the southward on both coasts; the number of species dwindles northward; none are Arctic

and none tropical, the bulk of the group inhabiting temperate waters. The vertical range of most of the species is rather limited; some live in and near tide water, and a few species have been taken at a depth of 1,600 feet. All are ovoviviparous, bringing forth great numbers of young, which are nearly one-half inch in length when born. The species differ greatly in form and armature, and in the extension of the bones of the cranium, but the genera based on these differences intergrade too closely to admit of definition, notwithstanding the great differences which appear on comparison of extreme forms.

(*sebastes*, εἶδως, resemblance; *Sebastes* is from σεβαστός, magnificent.)

a. Emmelas. Dorsal spines 14; skull thick, with small spines; color dull brownish; peritoneum black ..... *glaucus*, 2.

aa. Dorsal spines always 13.

b. Cranial ridges, except parietal, all obsolete, or very slightly developed; lower jaw much projecting.

c. Scales moderate, 40 to 55 pores in lateral line. Parietal bones usually meeting.

d. Primospina. Peritoneum black; lower jaw projecting with a symphyseal knob; anal rays III, 7.

e. Body moderately elongate, compressed; the depth 3 to $3\frac{1}{4}$ in length.

f. Tubes in lateral line 45; mandible naked; maxillary scaly, $2\frac{1}{3}$ in head. Color warm brown, shaded and mottled with darker; all the fins, except pectoral and caudal, distally black ..... *taczanowskii*, 3.

ff. Tubes in lateral line, 54; mandible scaled; maxillary scaled, $2\frac{1}{10}$ in head; pectorals scarcely reaching vent; color creamy brown; lateral line in a pale streak; opercle with a black blotch ..... *itinus*, 4.

ee. Body ovate, compressed, the depth $2\frac{2}{3}$ in length; scales large, 30 pores in lateral line; mandible not scaled; maxillary scaly, reaching posterior border of eye; pectorals reaching front of anal. Color creamy olive green, orange-tinged below; orange streaks about eye; back in a pale streak; clouded with dusky; lateral line a dark, opercular blotch; fins blackish edged ..... *steindachneri*, 5.

dd. Sebastosomus. Peritoneum white, color blackish or bronze-greenish.

g. Anal rays III, 8.

h. Pores of lateral line 50; mouth moderate, the maxillary $2\frac{1}{2}$ in head; eye $3\frac{1}{2}$ in head; pectoral reaching tips of ventrals; not to front of anal; color blackish with dark cross-bands; fins all black; depth $2\frac{3}{4}$ in length ..... *güntheri*, 6.

hh. Pores of lateral line 45; mouth larger, the maxillary $2\frac{1}{6}$ in head; eye 3 in head; pectoral reaching front of anal; color dull brassy green; maxillary usually with a dark stripe; depth $2\frac{3}{5}$ in lengthe ..... *inermis*, 7.

gg. Anal rays III, 7; pores 45; body slender; the depth $2\frac{5}{6}$ in length; pectoral very long, reaching beyond ventrals to front of anal; mouth moderate; eye 3 in head. Color dusky, white below; fins edged with dusky, the pectorals colorless ..... *tokionis*, 8.

bb. Cranial ridges somewhat developed, most of them present and ending in a slender spine; lower jaw projecting; parietals usually not meeting.

i. Acutomentum. Lower jaw much projecting, with a symphyseal knob.

j. Second anal spines not much if any longer than third.

k. Peritoneum white. Scales small, about 48 pores in lateral lines; depth $2\frac{2}{3}$ in length; pectorals about as long as head, about reaching anal; maxillary not reaching middle of eye. Color red, with 5 blackish cross-bands ..... *joyneri*, 9.

kk. Peritoneum black; scales large, the pores about 30; color deep red, inside of gill cavity black.

l. Teeth in narrow bands on jaws and on palatines; jaws scaly.

m. Pectoral reaching base of third anal spine; ventrals reaching vent; a dusky shade on opercle.... *matsubaræ*, 10.

mm. Pectoral not reaching anal fin; ventrals not to vent, a dusky spot on side of body..... *iracundus*, 11.

ll. Teeth in single series on sides of jaws and on palatines; maxillary $2\frac{1}{2}$ in head; pectoral reaching front of anal. *flammeus*, 12.

jj. Second anal spine longer than third; scales large, 28 pores in lateral line; depth $2\frac{1}{2}$ in length, pectorals shorter than head; maxillary reaching just past middle of eye. Peritoneum dusky. Color red, with brownish clouds or cross shades. *scythropus*, 13.

ii. ROSICOLA. Lower jaw little projecting; scales not large; maxillary reaching hinder margin of orbit.

n. Supraocular spine wanting; nasal, preocular, postocular, tympanic and parietal spines present; jaws scaleless; pectoral about $1\frac{1}{2}$ in head. Color dusky, with irregular darker cross blotches and spots; fins broadly edged with blackish; dark shades across cheeks; pores about 46 (60 to 70 series of scales above lateral line) ..... *fuscescens*, 14.

2. SEBASTODES GLAUCUS (Hilgendorf.)

Sebastes glaucus HILGENDORF, S. B. Ges. Naturf. Freunde, 1880, p. 170; Yezo.
Sebastodes glaucus JORDAN and GILBERT, Rept. U. S. Fur Seal Comm., III, 1898, p. 447; Bering Island.—JORDAN and EVERMANN, Fish. North and Middle Amer., II, 1898, p. 1777; Bering Island.

Head $3\frac{1}{3}$ in length; depth $2\frac{3}{4}$; eye $4\frac{2}{3}$ in head, $1\frac{1}{5}$ in snout; interorbital width $3\frac{2}{5}$ in head. D., XIV, 16; A., III, 8. Lateral line with 56 pores. Highest dorsal spine $2\frac{1}{3}$ in head, thirteenth spine $4\frac{2}{5}$, fourteenth spine $3\frac{2}{3}$; second anal spine $3\frac{1}{5}$, third anal spine $3\frac{1}{5}$, longest soft ray of dorsal $1\frac{9}{10}$. Crown and occiput very broad, more convexly arched than in any other species known to us. Nasal spines low, but strong. Ocular ridge low, evident only above front of eye; occipital ridges barely evident, evenly scaled over; top of head otherwise without spines, ridges, or furrows, the even convex curve unbroken. Vertical distance from middle of interorbital space to upper edge of orbit equaling one-half vertical diameter of orbit. Anterior margin of preorbital with 2 rounded lobes which do not bear spinous points; preopercular spines very strong, the upper 2 closely approximate, the others widely separated, all the spines sharp pointed, the uppermost very wide at base, the second much narrower, the others short and

wide; upper 2 spines directed backward, the 3 lower downward and backward; opercular spines strong, flat, often bifid or trifid; spines on adjacent angles of subopercle and interopercle sometimes bifid; behind these on margin of subopercle a few short spinous points. Gill rakers very long and slender, 11 + 29 in number, the anterior 1 or 2 of lower arch tubercular, the longest (22 mm.) more than two-thirds diameter of orbit. Mandible very heavy, the symphysis not produced, the 2 jaws subequal. Vomerine and palatine patches of teeth extremely narrow. Fins high, the third to seventh dorsal spines subequal; caudal very slightly emarginate; anal spines graduated; pectorals scarcely reaching vertical from vent, the lower 9 simple, the 10 upper forked; ventral not reaching vent, two-thirds length of head. Caudal scaled to tip on membranes and rays; soft dorsal and anal with narrow bands of scales following the rays to or nearly to their tips, the membranes of the first 3 or 4 rays in each fin wholly scaled on basal third; spinous dorsal naked; pectorals scaled on basal half; ventrals naked; head, the maxillary and mandible, the branchiostegal rays, the anterior and upper half of interopercle, and all of preorbital except a minute area along its posterior margin, naked. The body is covered with small weakly ctenoid scales, largely covered over by the extraordinarily developed accessory scales; scales on breast; belly, and prepectoral area smooth. The naked skin covering bones of head is minutely wrinkled or papillose. Color in spirits, light brownish on body and fins, with darker shades on lips, gill membranes, opercles, and top of head; it may have been reddish in life; mouth and gill cavity white; peritoneum jet-black. Here described, after Jordan and Gilbert, from one specimen 49 cm. long, from Bering Island. The identification is made with some doubt, owing to lack of any detailed description of the type, a dried specimen from Yezo, and to some minor discrepancies between the two. Our specimen has 56 (not 49) tubes in the lateral line, the nasal spine is small but not properly to be called rudimentary, the dorsal notch seems somewhat deeper, and the second anal spine somewhat shorter. North Pacific; two specimens known, the one from Hokkaido, in the museum of Berlin, the other from Bering Island, in the United States National Museum.

(*γλαυκός*, hoary blue.)

3. SEBASTODES TACZANOWSKII (Steindachner).

Sebastodes taczanowskii Steindachner, Sitzb. Akad. Wiss. Wien, 1880, p. 256, pl. II, fig. 1 (dorsal XIV, 13); Bays of the Gulf of Strielok, near Vladivostok, Japan Sea.—Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, 1898; Shana Bay, Iturup Island.—Jordan and Evermann, Fishes N. M. Amer., II, 1898, p. 1831; after Steindachner and Jordan and Gilbert.

Head $2\frac{5}{6}$ in length; depth 3. Dorsal XIII, 13; anal III, 7. Tubes of lateral line 45. Body not much elevated. Mouth moderate; maxillary nearly reaching vertical from posterior edge of pupil, $2\frac{1}{5}$ in head.

Lower jaw projecting. Teeth in rather narrow bands, developed in a slight knob at tip of lower jaw. Eye a little longer than snout, 3¾ in head. Interorbital space rather wide and slightly convex, its width scarcely less than diameter of eye. Nasal and preocular spines present, supraocular ridge very slightly developed, sometimes ending in a tiny spine on one or both sides, usually absent. Crown and occiput evenly convex, and without spines or ridges. Preopercular spines diverging, the lowest pointing downward, the highest backward. Preorbital with 2 rounded lobes, no spines. Gill rakers long and slender, the longest, half the diameter of the eye. Caudal truncate or very slightly emarginate.

Scales rough ctenoid. Maxillary and preorbital with tiny embedded scales. Mandible naked.

Color warm brown above and on sides, paler brown below; obscure shadings of darker brown on upper part of sides; many scales with basal or central area darker; opercles with a dusky shade; no dark streaks on head; fins brown, all except the pectorals and caudal becoming distinctly black on distal portion; lining of buccal and gill cavities white, but with a narrow dark streak along each side of floor of mouth anteriorly; peritoneum brownish black, uniformly and densely pigmented.

This species, a near ally of the Aleutian *Sebastodes ciliatus* and of the American *S. mystinus*, is very abundant in northern Japan. Our many specimens are from Otaru, Mororan, Iwanai, Aomori, and Same.

(Named for Professor Taczanowsky).

4. SEBASTODES ITINUS Jordan and Starks, new species.

YANAGI-NO-MAI (MAID OF THE WILLOWS).

Head 3⅙ in length; depth 3¼; eye 4 in head; snout 4; maxillary $2\frac{1}{10}$; interorbital 4. Dorsal XIV, 13; anal III, 7; pores of lateral line, 54.

Mouth rather large, the maxillary reaching a little past posterior margin of pupil. Lower jaw strongly projecting. Symphyseal knob prominent. Teeth coarse and sharp, in narrow bands on jaws, vomer and palatines. A knob of teeth developed on front of mandible, which shuts outside of maxillary teeth. Interorbital evenly convex, the superorbital rim not raised. Nasal spines very small, but sharp. Preocular spines represented by very blind, inconspicuous lobes; other spines absent. Occipital ridges scaled over and scarcely discernible. Edge of preorbital slightly scalloped, but without spines. Preopercular spines evenly spaced, the next to the uppermost the largest, the two lowest directed downward. Gill rakers very slender, the longest ⅔ eye, 26 on outer limb of arch.

Pectoral rays 19, the lower 10 unbranched. They reach slightly past tips of ventrals, but scarcely to vent. Dorsals low, the longer spines equal to the anterior or longest rays. The longest spine 2½ in

head, the next to the last $\frac{3}{4}$ eye; the last equals eye. When fin is depressed, the next to the last spine reaches along the basal third of the last. Tips of last dorsal rays reach to within half the diameter of the eye of the base of upper axillary caudal rays. Second anal spine not nearly so long as third, its length equal to eye. First spine one-third eye. Caudal concave.

Scales strongly ctenoid on body and top of head, less strongly on cheeks. Fine scales on mandible, preorbital, and maxillary. Pectoral, ventrals, soft dorsals, and caudal, with fine scales nearly to tips of rays, basal half of anal with scales. Peritoneum black.

Color creamy brown; top of head and upper part of sides clouded

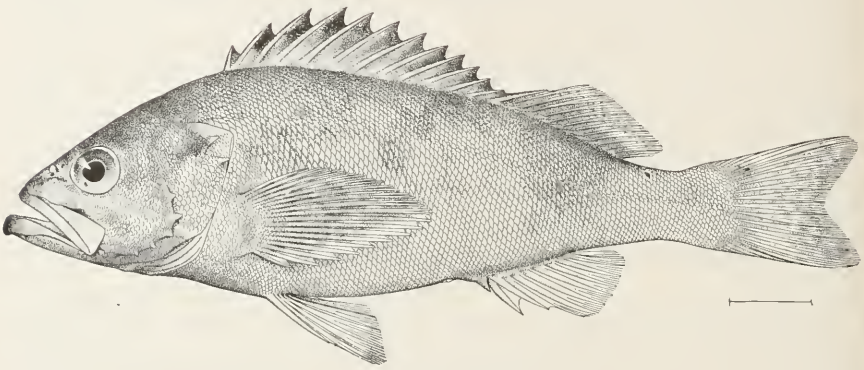


FIG. 1.—SEBASTODES ITINUS.

with dusky; lateral line running in a conspicuous light streak. Upper part of opercles with a black spot.

This species is known from a single example taken at Hakodate, 27 cm. in length. It much resembles the "Willow-maiden," *Sebastodes steindachneri*, differing from it in having smaller scales, a more slender body, a smaller mouth, scales on mandible, and many minor characters. It is an ally of *Sebastodes entomelas*.

Type.—No. 7368, Ichthyological collections, Leland Stanford Junior University Museum.

(*ιτείνος*, of the willow, in allusion to the common name Yanagi-no-mai.)

5. SEBASTODES STEINDACHNERI (Hilgendorf).

AKA SOI (RED ROCK-FISH); YANAGI-NO-MAI (WILLOW-MAIDEN).

Sebastes steindachneri HILGENDORF, S. B. Ges. Natur. Freunde, Berlin, 1880, p. 172, with plate; Yezo.—JORDAN and EVERMANN, Fish. N. M. Am., II, 1898; p. 1830, copied.

Head $2\frac{5}{6}$ in length; depth $2\frac{2}{3}$. Dorsal XIII, 14; anal III, 7. Eye 4 in head; snout 4; interorbital $4\frac{1}{2}$. Lateral line with 30 pores.

Mouth large, the maxillary reaching to posterior edge of orbit. Lower jaw strongly projecting, a knob developed at symphysis. Teeth

rather coarse, in narrow bands, developed in a knob at front of mandible. Interorbital space slightly and evenly convex, superorbital rim not raised. No spines on head except nasal. Ridges absent except at occiput, where they are but very slightly evident. Spines of preopercle all pointing backward, the next to the upper one the largest. Preorbital with 2 obtuse spines. Gill rakers long and slender, three-fifths in diameter of eye.

Pectoral rather broad and rounded, reaching past tips of ventrals to vent or to front of anal; 18 rays, the lower 9 unbranched. Ventrals not reaching vent; ventral spine three-fifths of length of soft rays. Dorsal spines rather low, a little lower than soft rays; the fourth to eighth subequal, $2\frac{2}{5}$ in head, next to last spine $3\frac{1}{2}$; last spine 3; when fin is declined, the next to last spine reaches about two-thirds the distance to tip of last spine. Dorsal rays reach well past tips of anal rays (when fins are declined) and nearly to base of auxiliary caudal rays. Caudal slightly concave. Second anal spine stouter and as long or a little longer than third, length $2\frac{1}{3}$ to $2\frac{1}{2}$ in head; first spine 5 in head, scarcely reaching to middle of second. Scales everywhere strongly ctenoid; mandible naked; maxillary and preorbital with fine scales. Peritoneum black.

Color of fresh specimen: Light olive green, verging on golden below and orange-tinged on breast. Dull orange stripes radiate from eye. Jaws fleshy pink, the lips golden, the maxillary with a yellow streak. Dark olive clouds on body, the lateral line pink. Dorsal clouded olive, pinkish at tip with blackish edging. Pectoral pink, yellow olive at base. Ventral yellow olive with pink on first rays and blackish at tip. Anal spines pink, the rays bright yellow olive. Caudal bright olive, pinkish above and below. In the preserved specimens the color has almost entirely disappeared; the back is clouded with dusky; the opercular spot is conspicuous, but with blended edges, and the lateral line is in a conspicuous light streak cutting through the dusky pigment of black.

We identify our specimens with those of Dr. Hilgendorf, with some doubt. Hilgendorf describes orbit $3\frac{1}{2}$ in head, three-fourths in snout (4 in head in our specimens, and equal to snout). The ocular and tympanic spines rudimentary (entirely absent in our specimens), and mandible and preorbital naked (preorbital with scales in our specimens). Here described from two specimens 20 and 24 cm. in length.

This very handsome species, known as Yanagi-no-mai or willow-maiden, is rather rare in the markets of Japan. Our two specimens are from Hakodate. This species very much resembles *Sebastodes oralis* of California, having, however, larger scales. Its black peritoneum, long gill rakers and smooth head show its relationship to *Sebastodes taczanowskii* and *Sebastodes glaucus*.

(Named for Dr. Franz Steindachner.)

6. SEBASTODES GÜNTHERI Jordan and Starks, new species.

Head $3\frac{1}{5}$ in length; depth $2\frac{3}{4}$. Dorsal XIII, 14; anal III, 8. Pores of lateral line, 50; 17 scales in a vertical series running upward and backward between anal spine and lateral line; 12 between lateral line and last dorsal spines; mouth not large, the maxillary reaching a little past a vertical line passing through middle of pupil $2\frac{1}{2}$ in head; chin strongly projecting and entering into profile of head, its lip with a knob of teeth; teeth in narrow bands; orbit longer than snout—$3\frac{1}{2}$ in head. Interorbital convex, of moderate width, almost equal to diameter of eye. Ridges of head low and ending in small but sharp spines. Nasal, preocular, supraocular, and parietal spines present. Preopercular spines all directed backward, the upper one very small, the next

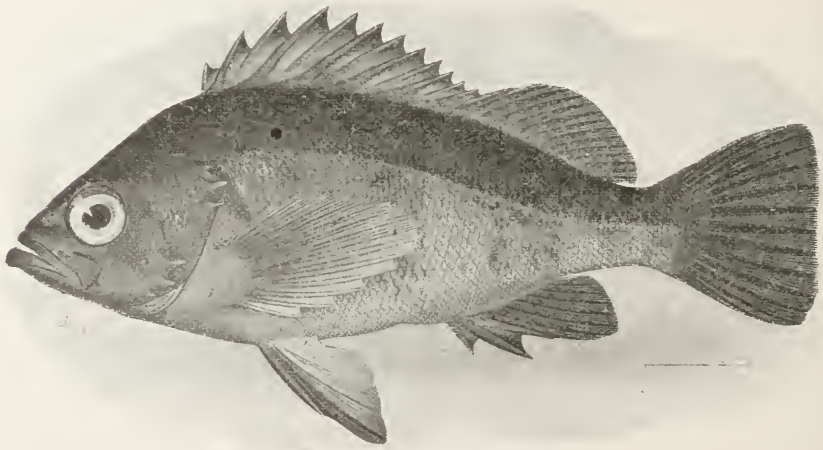


FIG. 2.—SEBASTODES GÜNTHERI.

by far the largest. Gill rakers slender, the largest slightly exceeding half the diameter of eye, 26 on anterior limb of arch.

Pectoral reaching to tips of ventrals, or scarcely to front of anal. Ventrals rather long, ventral spine reaching two-thirds of length of longest rays. Anal not nearly reaching to base of auxilary caudal rays when depressed. Second anal spine stronger and a little shorter than third—$2\frac{1}{2}$ times longer than first. Dorsal spines moderate, the fourth 2 in head, the last two-fifths longer than the one preceding it. Soft dorsal rays about equal to spines in length. Peritoneum white. Color black on back and sides, dusky silvery below. Sides with 4 broken irregular cross-bars. Fins all black.

Here described from the type, from Wakanoura, $7\frac{1}{2}$ inches in length.

This species is closely related to *Sebastodes inermis*, differing from it in having smaller scales and eye, shorter maxillary, wider interorbital and longer ventral spine, as compared with ventral rays.

Other specimens were taken at Misaki, Wakanoura, and Hakodate.

Type.—No. 7372, Ichthyological collections, Leland Stanford University Junior Museum. Cotypes are No. 50904, U.S.N.M.

(Named for Albert Günther.)

7. SEBASTODES INERMIS (Cuvier and Valenciennes).

KURO-SOI (BLACK ROCK-FISH).

Sebastodes inermis Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 346; Japan.—Günther, Cat., II, 1860, p. 97.—Hilgendorf, Sitzungb. Bericht. Gesell. naturf. Freunde, Berlin, 1880, p. 172.—Steindachner and Döderlein, Fische Japans, III, 1884, p. 205; Tokyo.—Jordan and Evermann, Fish. N. M. Am., II, 1898, p. 1829 (after Steindachner).

Sebastes ventricosus Schlegel, Fauna Japonica, Poiss., 1845, p. 48, pl. xx, figs. 1, 2; Nagasaki.—Bleeker, Verh. Bat. Gen., XXVI, p. 80; Nagasaki.—Günther, Cat. Fish, II, 1860, p. 87.—Nystrom, Kong. ver. Handl., 1887, p. 20; Nagasaki.

Sebastodes ventricosus Jordan and Evermann, Fish. N. M. Am., II, 1898, p. 1829 (copied).

Sebastodes fuscescens Jordan and Snyder, Proc. U. S. Nat. Mus., 1900, pp. 745–756; Tsushima (not of Houttuyn).

Head $2\frac{5}{6}$ in length; depth $2\frac{3}{5}$. Dorsal XIII, 14; anal III, 8. Pores of lateral line 43; 14 scales in series, running upward and slightly backward, between anal spines and lateral line, between last dorsal spines and lateral line.

Body deepest at first dorsal spines. Head pointed. Tip of lower jaw strongly projecting and entering into upper profile. Mouth moderate, maxillary nearly reaching vertical from posterior edge of pupil; $2\frac{1}{6}$ in head. Teeth in narrow bands, developed in a knob at tip of lower jaw. Orbit much longer than snout, 3 in head. Interorbital convex, rather narrow, two-thirds of diameter of orbit. Ridges on head low and little developed, ending in small, sharp spines lying close against the skin; nasal, preocular, supraocular, and parietal spines present. Two spines on shoulder and 2 on opercle. Preopercle spines all directed backward. Preorbital with 2 spines directed downward and backward. Gill rakers long and slender, the longest a little less than half orbit; 24 on anterior limb of arch.

Pectoral $1\frac{1}{4}$ in head, reaching to tips of long ventrals, nearly to above front of anal. Ventrals long and slender, the spine reaching little more than halfway to tip of first ray. Anal, when depressed, reaching to, or nearly to, auxiliary caudal rays, the third spine a little longer and weaker than second; the first half length of second. Dorsal spines moderate, the fourth about 2 in head; the last one-third longer than the one preceding it, which scarcely reaches the middle of last when fin is depressed. Soft dorsal rays as long or longer than the spine. Peritoneum white. Color, brassy green, pale or dusky. Maxillary usually with a stripe.

Here described from specimens from Tokyo, 20 to 23 cm. in length.

This species is very abundant in southern Japan, by far the most common representative of the genus. It is the only one often seen in the markets of Nagasaki and it is abundant even so far north as Tokyo. It is well figured by Schlegel as *Sebastes ventricosus*. Our specimens are from Hakodate, Matsushima, Tokyo, Misaki, Enoshima, Kobe, Onomichi, Hiroshima, Wakanoura, Nagasaki, and Tsushima.

The nearest American ally of this species is *Sebastodes flavidus*.

(*inermis*, unarmed.)

8. SEBASTODES TOKIONIS Jordan and Starks, new species.

Head $2\frac{5}{6}$ in length; depth $2\frac{5}{6}$. Dorsal XIII, 14; anal III, 7. Pores of lateral line 45; 14 scales in a series, running upward and backward between anal spines and lateral line; 9 between lateral line and posterior dorsal spines.

Mouth moderate, maxillary extending to below middle of eye, tip of lower jaw strongly projecting and entering into upper profile of

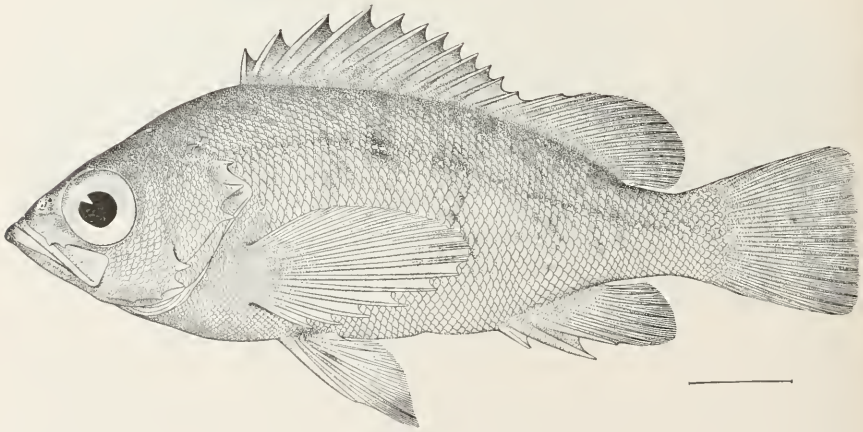


FIG. 3.—SEBASTODES TOKIONIS.

head. Teeth in narrow bands, developed in a knob at tip of mandible. Eye large, its diameter 3 in head. Interorbital slightly convex, three-fourths diameter of eye. Ridges of head low; nasal, preocular, supraocular, and parietal present. Preorbital with two spines, the anterior one triangular, the posterior one rather sharp and directed downward and backward. Gill rakers slender, two-fifths of eye, 26 on anterior limb of arch.

Pectoral long and slender, reaching well past tips of ventrals to above front of anal. Ventral spine three-fifths the length of soft rays. Ventrals not reaching to anal. Dorsal spines not high, equal to height of soft rays, the fourth spine $2\frac{1}{4}$ in head. Anal scarcely reaching to auxillary caudal rays when depressed, the third spine a little longer and more slender than the second. Peritoneum white.

Color silvery below, dusky on back. Dorsals, anal, and tips of ventrals dusky; pectoral colorless.

This species is known to us from numerous specimens taken at Tokyo, Wakanoura, Tsuruga, and Misaki. It is very close to *Sebastodes inermis*, differing in the longer pectoral, more slender form, and longer ventral spines. Here described from the type from Misaki.

Type.—No. 7369, Ichthyological Collections, Leland Stanford Junior University Museum. Cotypes, No. 50905, U.S.N.M.

(Tokyo, at the capital.)

9. SEBASTODES JOYNERI (Günther).

TOKENOKO MEBARU (BAMBOO-SPROUT ROCK-FISH).[a]

Sebastes joyneri Günther, Ann. and Mag. Nat. Hist., I, 1878, p. 485; Japan; Challenger Report, Shore Fishes, 1880, p. 64, pl. xxix, fig. A.

Sebastodes joyneri Jordan and Evermann, Fish N. M. Am., II, 1898, p. 1829, after Döderlein.—Jordan and Snyder, Check List, 1901.

Sebastes inermis Hilgendorf, S. B. Gesell. Naturf. Freunde, Berlin, 1880, p. 172, with plate.—Steindachner and Döderlein, Denksch. Akad. Wiss. Wien, 1884, p. 206 (not of Cuvier and Valenciennes).

Head 3 to $3\frac{1}{6}$; depth $2\frac{2}{3}$; D. XIII, 14 or 15; A. III, 7; P. 16 (10–6); lateral line 45 to 49 (pores); orbit 3; snout $4\frac{1}{4}$; interorbital width, flat, unbroken by ridges, 4 in head. Mouth moderate, oblique; projecting lower jaw with symphyseal knob. Teeth delicate, sharp, in narrow bands, tip of mandible developed in a knob, which fits in a notch in upper jaw and projects above maxillary teeth. Maxillary not quite reaching middle of eye. Preorbital broad, with 2 strong spines directed downward and backward. First (uppermost) spine of preopercle a little weaker than the fifth; second longest, the others decreasing rapidly in length. Opercular spines parallel, the upper stronger. Maxillary, under side of lower jaw. Preorbital and greater part of snout (nearly whole head except lips) scaled. Pores of lower jaw inconspicuous. Ridges of head very low, ending in acute spines. Nasal preocular, supraocular, and occipital spines present. Gill rakers, half eye in length, 25 on anterior limb of arch. Fourth to sixth dorsal spines longest, $2\frac{1}{3}$ in head; second anal spine stronger but equal to third in length, $2\frac{1}{3}$ in head. Pectoral somewhat pointed toward tip, as long as or only a little shorter than head, reaching beyond vent or even to origin of anal. Ventral and caudal $1\frac{1}{2}$ in head, the latter slightly concave; basal half of spinous dorsal with minute scales; whole of soft dorsal, anal, and caudal completely scaled. Color in life (Döderlein), red, darker on the back; 5 blackish cross bands running upon dorsal fin and ending below (except second and third) at lateral line; last 2 bands short, rounded; the longest 2, middle bands somewhat interrupted, each sometimes forming 2 spots.

[a] This fish is reputed delicious when boiled with bamboo sprouts.

Peritoneum white. Here described from a specimen 9 inches in length from Tokyo.

This handsome species is known to us by several specimens from Aomori, Miyako, and Tokyo. It is rather rare, living in water of some depth, its nearest American ally being *Sebastodes proriger*.

(Named for Mr. Joyner, who collected for the British Museum in Japan.)

10. SEBASTODES MATSUBARÆ (Hilgendorf).

Sebastes matsubarae Hilgendorf,[a] Sitzb. Gesell. Naturf., Freunde, 1880, p. 170; Hondo.

Sebastodes matsubarae Jordan and Evermann, Fish. N. M. Amer., II, 1898, p. 1833, after Hilgendorf.

Head $2\frac{3}{5}$ in length; depth $2\frac{1}{2}$. Dorsal XIII, 13; anal III, 7. Pores of lateral line 32. Eye $2\frac{3}{4}$ in head; maxillary $2\frac{1}{6}$. Interorbital width $4\frac{4}{5}$.

Lower jaw slightly projecting. Symphyseal knob prominent. Teeth fine and sharp, in very narrow bands, developed in a knob at tip of mandible which fits in a notch in premaxillaries. Maxillary reaching to below middle of eye. Snout two-thirds eye. interorbital rather wide, three-fifths the diameter of eye, deeply concave, the supraorbital edges not abruptly raised as ridges; along its middle are a pair of weak ridges with a shallow rather wide channel between them. Cranial ridges scarcely developed except parietal ridges, which are very high and sharp. Cranial spines moderate in size and sharp. Preocular, supraocular, postocular, tympanic, parietal, and nuchal spines present. Preorbital with an anterior broad rounded lobe and 2 spines. Preopercle spines sharp and the 2 upper ones rather slender; the lowest are directed downward, the next 2 downward and backward, and the 2 uppermost backward. Two opercular spines, the upper one long, sharp, and slender. Gill rakers long and slender, one-third eye, 22 on anterior limb of arch.

Pectoral rather slender, reaching to above base of third anal spine; number of rays 19, the lower 10 simple and not much thickened. Ventrals covering vent, not reaching anal. Fifth dorsal spine equal to length of soft dorsal rays, which are equal or very slightly exceed diameter of orbit. Next to the last dorsal spine $4\frac{1}{4}$ in head; last $3\frac{1}{2}$. Second anal spine stronger, slightly shorter and more curved than third, its length $2\frac{4}{5}$ in head; first spine half as long. Caudal slightly concave.

Scales strongly ctenoid. Mandible, preorbital, and maxillary with fine scales. Fine scales cover soft fin rays nearly to their tips. Peritoneum jet black, inside of gill covers dusky.

[a] The specimens from the Aleutian Islands in Pallas's collection (No. 8145, Mus. Berlin) referred by Dr. Hilgendorf to *S. matsubarae*, belong to *Sebastodes aleutianus* Jordan and Gilbert, an allied species with smaller scales and lower spines.

Color in life bright red; in spirits colorless or flesh color; the fins without markings; the upper part of opercle shows traces of a diffuse dusky blotch.

This species is known to us only from specimen 28 cm. in length taken with the long lines at Misaki. It is an ally of *Sebastichthys aleutianus*.

(Named for Shinnosuke Matsubara, director of the Imperial Fisheries Institute in Tokyo.)

11. SEBASTODES IRACUNDUS Jordan and Starks, new species.

Head $2\frac{2}{5}$ in length; depth $2\frac{4}{5}$. Dorsal XIII, 13; anal III, 8. Pores of lateral line 30. Eye $3\frac{5}{6}$ in head; maxillary $2\frac{1}{4}$; interorbital width 5.

Snout blunt. Lower jaw projecting and with a large symphyseal knob. Mouth large; maxillary not quite reaching to below posterior

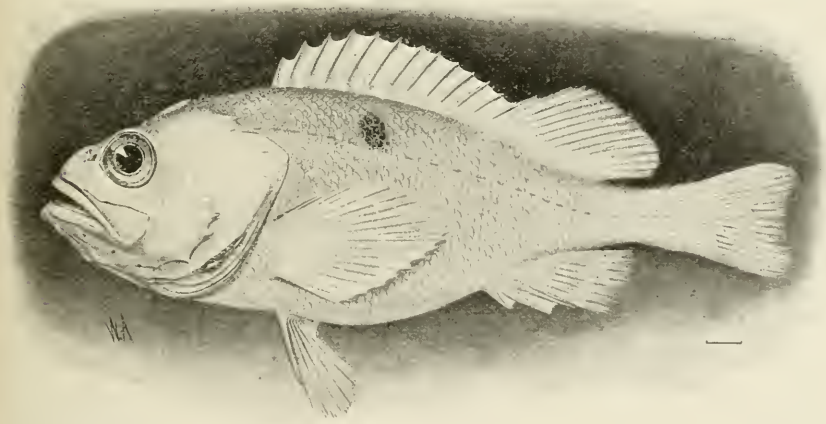


FIG. 4.—SEBASTODES IRACUNDUS.

orbital rim. Teeth rather sharp, set in narrow bands at sides of jaws, and becoming much wider anteriorly; tip of mandible with a small knob of teeth which fits in a notch in premaxillaries; vomer with a narrow V-shaped patch; palatines with a short narrow patch. Cranial spines without ridges except at occiput, where they are sharp, but rather low. Spines very slender, but sharp. Nasal, preocular, postocular, tympanic, parietal, and (on one side) nuchal spines present. Preorbital with 3 lobes, the anterior one broadly rounded, the other 2 angulated, but without spines. The 3 upper preopercular spines closer together than the others; the next to the uppermost the largest; all directed backward. The 2 lower ones directed downward and backward. Gill rakers two-fifths diameter of orbit; 21 on anterior limb of arch.

Pectoral reaching just past vent, but not to anal fin; its lower 9 rays simple, 11 branched rays. Ventrals not reaching to vent by a distance

equal to three-fourths diameter of eye. Fifth dorsal spine $3\frac{1}{2}$ in head; not as long as the longest soft rays; twelfth spine $5\frac{1}{4}$ in head; thirteenth $4\frac{3}{5}$. Third anal spine longer and much slenderer than second, $3\frac{1}{2}$ in head; second 4; first barely half second. Caudal probably concave.

Scales rough ctenoid. Head entirely scaled to tip of snout, small scales on branchiostegal rays, isthmus, and hyoid bones above branchiostegals. Small scales on lower two-thirds of spinous dorsal, on three-fourths of pectoral, on ventrals including ventral spine, and on basal half of anal, soft dorsal, and caudal. Peritoneum dusky, inside of gill covers black.

Color bright red; in spirits colorless, with no markings except a jet-black spot just above lateral line below the base of the sixth or seventh dorsal spine, its diameter on one side about half that of eye, on the other side about a fourth this size.

The type is a large specimen 55 cm. in length, numbered 12716, Ichthyological Collections Leland Stanford Junior University Museum.

This species is known from this specimen, taken at Kushiro in Hokkaido, and presented to us by Professor Mitsukuri.

It is nearer *Sebastodes alutus* and *Sebastodes aleutianus* than to any other of the American species.

(*iracundus*, red with wrath.)

12. SEBASTODES FLAMMEUS[a] Jordan and Starks, new species.

Head $2\frac{2}{5}$ in length; depth $3\frac{1}{4}$. Dorsal XIII, 14; anal III, 8. Eye $3\frac{3}{5}$ in head; maxillary $2\frac{1}{5}$; interorbital width $4\frac{2}{3}$.

Body not much elevated. Lower jaw strongly projecting and with a large knob at symphysis. Teeth sharp and curved, set in a single irregular row at sides of lower jaw, in a narrow band at front, and in a large knob at tip which shuts entirely outside of premaxillaries; premaxillaries with wide toothless space at front, a narrow band of teeth at sides, which grows slightly under anteriorly, and inside of other teeth on each side of toothless area is a conspicuous knob of large curved teeth pointing irregularly but inward. Vomerine teeth in a narrow band; palatine teeth in a single row. Maxillary reaching to below posterior margin of pupil. Interorbital space flat with 2 median ridges, between which is a shallow rather narrow channel. Cranial spines small and except occiput not preceded by ridges. Preocular, supraocular, postocular (on one side), tympanic, and parietal spines present; the last preceded by very sharp moderately high ridges. Preorbital with 3 lobes without spines. Preopercle spines sharp and slender, the upper 3 directed backward. Gill rakers long and slender, the longest two-fifths diameter of eye, 21 on anterior limb of arch.

Pectoral long and slender, reaching to front of anal, number of

[a] See illustration on p. 175.

rays 19, the lower 8 simple. Fifth dorsal spine $2\frac{3}{4}$ in head, thirteenth $3\frac{1}{4}$. Third anal spine much longer than second, and but little slenderer, 3 in head; second spine $3\frac{1}{2}$; first spine one-half second.

Inside of gill covers and peritoneum dusky; body and fins entirely red.

The type is a badly preserved specimen 33 cm. in length. No scales remain and the length of the soft rays can not be ascertained. It is numbered 7365, Ichthyological Collections Leland Stanford Junior University Museum. It is very close to *Sebastodes iracundus*, but may be known at once by the character of the teeth.

This deep-red species is known to us from a single example taken in deep water at Misaki by Kumakichi Aoki.

(*flammeus*, flame-red.)

13. SEBASTODES SCYTHROPUS Jordan and Snyder.

Sebastodes scythropus JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1901, p. 360, pl. xv; Misaki (No. 49406, U.S.N.M. Coll. K. Otaki).

Head, measured to end of opercular flap, $2\frac{3}{5}$ in length; depth, $2\frac{1}{2}$; depth of caudal peduncle, $3\frac{1}{2}$ in head; eye, $2\frac{3}{5}$; snout, 5; maxillary, $2\frac{1}{2}$; interorbital space, $4\frac{1}{3}$; height of longest dorsal spine, $2\frac{1}{5}$; longest ray, $2\frac{2}{3}$; anal spine, $2\frac{2}{5}$; ray, $2\frac{1}{5}$; pectoral, $3\frac{1}{6}$ in length; ventrals, $4\frac{1}{2}$; caudal, $4\frac{3}{4}$; D. XIII, 13; A. III, 6; pectoral rays, 8 + 8; scales in lateral line, 31; pores, 28.

Eye very large; round; high in head; nearer tip of snout than to posterior edge of opercle, a distance equal to interorbital width. Interorbital area convex; with a median longitudinal groove, deepest anteriorly, growing shallower and wider posteriorly; the groove bounded laterally by a pair of low, rounded ridges. Mouth, oblique; maxillary extending to a vertical through a point a little posterior to center of pupil; lower jaw with a slender, symphyseal knob which projects in a line with upper contour of head. Teeth on vomer and palatines; symphyseal patch of teeth of lower jaw elevated, fitting into a median toothless notch of the upper jaw; palatine bands narrow. Gill-rakers long and slender; 10 + 24 on first arch. Head strongly armed; preocular, postocular, and occipital spines large and sharp; preceded by prominent ridges; tympanic spine acute; smaller than postocular; nasal spines well developed; preorbital with 2 strong spines directed downward; above these an indistinct lobe; preopercle with 5 large spines; the upper 3, of which the second is longest, project backward; the lower 2 project downward and backward; a subopercular and an interopercular spine closely approximated; 2 large, flat, acute spines on upper part of opercle; 2 small, humeral spines. Head, completely scaled; lower jaw, maxillary, and preorbital area with very small scales; dorsal, anal, caudal, and ventral fins with small scales extending almost to tips of spines and rays; pectorals less extensively scaled; all the scales except those on fins and branchiostegals ctenoid. First dorsal

spine shortest; equal in length to width of interorbital space; second equal in length to ninth and tenth; third to sixth twice as long as first; interspinal membranes deeply incised. Longest dorsal rays as long as third spine. First anal spine a little less than half as long as second, somewhat more than half as long as third; second spine strong. Edge of caudal concave; 8 lowermost rays of pectoral simple; uppermost simple ray, in middle of fin, longest, extending to a vertical through insertion of anal. Ventrals extending to vent. Color, in alcohol, light red, with brownish, cloud-like blotches of irregular shape, a blotch equal in width to half the diameter of orbit extending from insertion of dorsal downward to lower edge of interopercle, the brownish color darker on upper part of opercle; a patch of dark color on upper median part of body, spreading over posterior two-thirds of spinous dorsal, extending posteriorly below base of soft dorsal, and reaching upward on anterior part of the latter fin; a dark band on posterior dorsal part of caudal peduncle.

This species is known only from the original types taken at the mouth of the bay of Tokyo, and a third specimen taken with long lines off Misaki. It is related to *Sebastodes hopkinsi* of the California coast. (σκύθροπος, pouting, having a protruding lower lip.)

14. SEBASTODES FUSCESCENS (Houttuyn).

KURO SOI (BLACK ROCK FISH.)

Sparus fuscescens Houttuyn, Verh. Holl. Maats. Wet. Harlem., XX, Pt. 2, 1872, p. 340; Nagasaki.

Sebastes inermis Schlegel, Fauna Japonica Poiss., plate; not of Cuvier and Valenciennes.

Sebastes schlegelii Hilgendorf, S. B. Gesell. Naturf. Freunde, 1880, p. 171, with plate; Tokyo, Hakodate.—Steindachner and Döderlein, Fische Japans, II, Wien, 1884, p. 202; Tokyo, Strielok, Hakodate.

Sebastodes schlegeli Jordan and Evermann, Fish. N. and M. Am., II, 1898, p. 1834; after Steindachner.

Sebastodes nigromaculatus[a] Günther, Ann. Mag. Nat. Hist., 1873, p. 377; Chi-fu, China, coll. Mr. Swinhoe.

Sebastodes hakodatis Jordan and Snyder, Proc. U. S. Nat. Mus., 1901, p. 361, pl. xiv; Hakodate (No. 49394, U. S. Nat. Mus., Coll. *Albatross*).

[a] Dorsal XIII, 12; anal III, 8; lateral line 75 (pores doubtless much fewer).

Height of body a little less than length of head, and one-third total (without caudal). Scales rather irregular. Upper surface of head scaly, flat, with very low, plain ridges, without prominent spines. Superciliary edge not elevated; width of interorbital one-fifth length of head. Lower edge of preorbital and preoperculum with acute spines. Maxillary reaching nearly to vertical from hind margin of orbit. The fifth, sixth, seventh (or the fourth, fifth, sixth) dorsal spines longest, longer than anal spines and not half length of head. A deep notch between dorsal fins.

Brownish or greenish brown, with numerous irregular, black spots about as large as pupil; an oblique brown streak from lower part of eye toward the angle of the perculum; fins black, 7⅛ inches long. (Günther.)

This species described, from the Chinese side of the Sea of Japan, seems to be identical with *Sebastodes fuscescens*.

Head $2\frac{2}{3}$ in length; depth $2\frac{4}{5}$; depth of caudal peduncle $3\frac{2}{5}$ in head; eye $4\frac{2}{5}$; snout 4; maxillary $2\frac{2}{5}$; interorbital space $4\frac{1}{2}$; height of longest dorsal spine $2\frac{2}{3}$; longest ray $2\frac{2}{5}$; anal spine $3\frac{1}{5}$; ray $2\frac{1}{6}$; length of pectorals 4 in length; ventrals 5; caudal $4\frac{1}{2}$; D. XIII, 12; A. III, 7; pectoral rays 10–8; scales in lateral line 54; pores 46.

Eye moderate in size; nearer tip of snout than to posterior edge of opercle, a distance equal to its diameter. Snout equal in length to diameter of eye. Lower jaw projecting; symphysial knob scarcely noticeable. Maxillary extending to a vertical through posterior edge of orbit. Bands of teeth on jaws, palatines, and vomer; palatine bands as wide as those on lower jaws. Gill-rakers, 6-17; those on upper part of arch short and blunt; others long and slender. Interorbital space a little convex; interorbital ridges very low, rounded. Head not strongly armed, the spines all lying close to the surface; nasal, preocular, postocular, and tympanic spines minute, sharp; occipital ridges low, rounded, terminating in small, acute spines; preorbital with three flat, sharp spines which project downward; preopercle with five flat, rather blunt spines; two opercular and two humeral spines present. Preorbital area, maxillary, lower jaw, and branchiostegals naked; subopercle and lower and posterior edges of preopercle with cycloid scales; other parts of head with small ctenoid scales; those of the interorbital area extending forward to nasal spines; breast and belly with cycloid scales; other parts of body with ctenoid scales, the edges of which have minute bristles; most of body with minute accessory scales wedged in between the larger ones; spinous dorsal, except a small space on posterior ventral part, naked; other fins with minute scales, which are closely packed at the bases, extending outward along the membranes. Dorsal fins continuous, though having a dividing notch; interspinous membranes deeply incised; first and twelfth spines contained three and one-third times in length of maxillary; fourth to seventh spines longest; tenth and thirteenth spines of equal length; second and third dorsal rays longest. Anal fin rounded, first spine a little less than one-half the length of second; second and third spines of equal length, the second much stronger. Pectoral rounded, the lower eight rays simple. Ventrals pointed when depressed. Edge of caudal slightly convex. Color, in alcohol, dark, with scarcely noticeable irregular blotches on upper parts; fins broadly edged with darker color; an indistinct light band on pectoral.

A number of smaller specimens (co-types No. 6274, Leland Stanford Junior University Museum), from the same locality as the type, are much lighter in color, with small, irregular brown spots scattered over the body. In many individuals the spots are collected together, forming four or five indistinct lateral bands; all have three or four dark lateral bands radiating downward and backward from the orbit. The fins show more or less dark color, the pectoral and caudal often being distinctly barred.

One specimen has well-developed coronal spines, but is otherwise indistinguishable from the others.

This species is extremely common in northern Japan, its range coinciding with that of *Sebastodes taczanowskii*. Our numerous specimens are from Otaru, Iwanai, Aomori, Same, Mororan, and Hakodate, where it is especially abundant.

But one species of this type is represented in our collections, *hakodatis* and *schlegelii* being the same, and apparently identical with the *Sparus fuscescens* of Houttuyn. If the scales in the type of *S. hakodatis* are counted so as to give the subvertical series above lateral line, there would be 60 to 68 as described for *S. schlegelii*.

Of the California species, this most resembles *Sebastodes atrovirens*. (*fuscescens*, growing dusky.)

3. SEBASTICHTHYS Gill.

Sebastichthys Gill, Proc. Ac. Nat. Sci. Phila., 1862, p. 329 (*nigrocinctus*).
Sebastomus Gill, Proc. Ac. Nat. Sci. Phila., 1864, p. 147 (*rosaceus*).
Pteropodus Eigenmann and Beeson, Amer. Nat., 1893, p. 670 (*maliger*).
Auctospina Eigenmann and Beeson, Amer. Nat., 1893, p. 670 (*auriculatus*).
Hispaniscus Jordan and Evermann, Check List Fish. N. M. Amer., 1896, p. 431 (*rubrivinctus*).

This genus is closely allied to *Sebastodes*, being connected with it by an almost continuous series of species. As a whole it differs in the nearly straight base of the skull, the convex interorbital space, and the short, thick, gill-rakers. All these characters are subject to large variation, and while the Japanese species are well defined, there are some American species intermediate between the two groups. Species of this type are found also on the coasts of Chile and of Cape Colony. (σεβαστός, magnificent; ἰχθύς, fish.)

a. Pteropodus. Supraocular spine wanting; scales large; pores 30 to 40; jaws scaleless or nearly so; peritoneum white.
b. Gill rakers relatively long and slender, 2½ to 3 in diameter of eye; 14 to 16 on lower part of arch. Lower jaw not projecting.
c. Color brown, with marblings and spots of darker brown and white; usually a darker cross shade under each half of dorsal ..... *vulpes*, 15.
cc. Color dusky brown, nearly uniform, covered by snowy spots; second anal spine enlarged ..... *nivosus*, 16.
ccc. Color bright greenish yellow, with an irregular dark shade above and below, leaving lateral line in a dark streak; a dark shade along base of dorsal; dark shades across cheek ..... *tricittatus*, 17.
bb. Gill rakers relatively short and thick, 4 to 5 in diameter of eye, 10 to 14 on lower part of arch; fins usually much spotted.
d. Interorbital area flat, rather wide and scaly.
e. Cranial ridges rather low; scales small; 40 to 65 pores in lateral line; body rather elongate, little compressed, its depth 3 in length; eye small, 5 in head. Color gray, clouded, or barred and spotted with dark; soft fins with small spots; cheek with dark bars.
f. Scales 59 to 65; over 50 pores in lateral line ..... *oblongus*, 18.
ff. Scales 45 to 50; about 40 pores in lateral line ..... *mitsukurii*, 19.

ee. Cranial ridges high and rather blunt; body stout, the depth 2½ in length; pectoral broad, reaching front of anal. Color blackish, usually with yellow areas, one under each dorsal; lower parts and fins usually but not always profusely spotted with dark ..... *pachycephalus*, 20.

dd. Interorbital area narrow, deeply concave, with a deep channel between two raised ridges; dorsal spines often 14; cranial spines rather high. Color gray, much mottled and barred with reddish, fins all barred and mottled; anal spines scarlet in life. Color more variegated than any other species, the size smaller ..... *elegans*, 21.

15. SEBASTICHTHYS VULPES (Steindachner and Döderlein).

Sebastes vulpes Steindachner and Döderlein, Fische Japans, III, 1884, p. 203, pl. II; Tokyo.

Sebastodes vulpes Jordan and Evermann, Fish. N. and M. Amer., II, 1898, p. 1835; after Steindachner.

Head 2⅔ to 2½ in length; depth 2¾. Dorsal XIII, 13; anal III, 7; lateral line with 32 pores. Nasal, preocular, postocular, tympanic, and parietal spines moderately developed; eye 4 to 4⅔; snout 4; interorbital space 5 in head. Maxillary reaching posterior margin of orbit; lower jaw scarcely projecting, without distinct symphyseal knob. Lower border of broad preorbital with 3 blunt lobes; the 2 lower opercle spines broad, blunt, the 3 upper more slender, sharp, the 2 opercular spines strongly diverging; upper end of interopercle, especially in older individuals, with a spine; lower end of subopercle with a weaker spine which sometimes divides into several. Snout, anterior part of preorbital, and lower jaw scaleless; a few very small scales on maxillary behind and under preorbital (sometimes absent); rest of head thickly covered with rough scales. Several pores on each side under lower jaw. Interorbital space nearly flat, with very weak interorbital ridges. Gill rakers rather long and slender, the longest two-fifths of eye; 21 on anterior of arch. Upper profile rises moderately, slightly curved at the snout. Fifth dorsal spine longest, 2⅔ in head. Second anal spine stronger, but sometimes a little shorter than third, 2½ in head in small individuals, nearly 3 in larger ones. Pectoral equals head without snout, reaching vent in adults, a little beyond in young; ventral 1⅔ to 1¾ in head; caudal equaling ventrals, slightly convex. Scales moderately large, with some accessory scales. Peritoneum white.

Body, dorsal, anal, and caudal fins mingled reddish brown and whitish; pectoral and ventral grayish; upper half of head reddish brown, strewn with small dark-brown spots which posteriorly almost unite in wavy stripes, or marked like body; lower side of head and body whitish yellow. Sometimes a distinct broad ½ bar of dark brown under middle of spinous dorsal and a less distinct one under soft dorsal.

This large and strongly marked species is rather rare in Japan. Our specimens are from Hakodate, Same, and Miyako in Rikuchu. It is an ally of *Sebastichthys maliger*.

(*vulpes*, fox.)

16. SEBASTICHTHYS NIVOSUS (Hilgendorf).

GOMA SOI (SPECKLED ROCKFISH), KESHIMUYO.[a]

Sebastes nivosus STEINDACHNER and DÖDERLEIN, Fische Japans, III, 1884, p. 202, pl. VII; Tokyo, Hakodate.

Sebastodes nivosus JORDAN and EVERMANN, Fish. N. and M. Amer., II., 1898, p. 1834, after Steindachner.

Head $2\frac{3}{5}$ in length; depth $2\frac{3}{4}$. Dorsal XIII, 12; anal III, 7; lateral line pores, 36; cranial edges and spines well developed. Nasal, preocular, postocular, tympanic, and parietal spines present. Upper profile slightly convex to beginning of dorsal. Eye and snout $4\frac{2}{5}$, interorbital space $5\frac{1}{2}$ in head. Maxillary reaching to posterior rim of orbit, in older individuals somewhat farther. Inferior border of preorbital with 3 more or less rounded lobes, the last angulated, but without a spine. Interorbital space between the elevated supraocular ridges weakly convex. Head entirely scaled, except jaws, snout (in front of nostrils), preorbital, and nearly the whole of interopercle; scales of head small, firm, rough, with accessory scales like those on body. Preopercular spines short, broad, and blunt. Gill rakers moderate in length, one-third of eye, 16 in number on anterior limb of arch. Pectoral rays 18, the lower 10 unbranched, its length $1\frac{1}{2}$ in head, its tips reaching past tips of ventrals; ventral more than $1\frac{3}{5}$ in head; caudal equaling ventral, slightly convex; 36 pores on body, 2 to 3 on base of tail. Peritoneum white. Blackish brown, with innumerable small white dots on body and fins. In some individuals the uniform dark brown of body is interrupted by lighter shades.

This beautifully marked species is not very common in Japan. Our specimens are from Same and Misaki. It is somewhat related to *Sebastichthys nebulosus*, but is well distinguished by the profuse starry spots.

(*nivosus*, snowy.)

17. SEBASTICHTHYS TRIVITTATUS (Hilgendorf).

SHIMA SOI (STRIPED ROCKFISH).

Sebastes trivittatus HILGENDORF, S. B. Gesell. naturf. Freunde, Berlin, 1880, p. 171, with plate; Yezo, Japan.

Sebastodes trivittatus JORDAN and EVERMANN, Fish. N. and M. Amer., II, 1898, p. 1834, after Hilgendorf.

Head $2\frac{3}{5}$ in length; depth $2\frac{5}{6}$; eye 5 in head; snout 4; maxillary $2\frac{1}{6}$; interorbital width $5\frac{1}{2}$. Dorsal XIII, 14; anal III 7. Pores of lateral line 39.

Mouth large, the maxillary reaching to posterior border of eye. Lower jaw slightly shorter. Symphyseal knob very small. Teeth in rather broad bands. Interorbital slightly concave. A pair of ridges run longitudinally near middle of interorbital space, between which is

[a] Marked with unshaven tufts, as on a child's head.

a narrow channel. Cranial ridges and spines strong. Nasal, preocular, postocular, tympanic, and parietal spines present. Edge of preorbital with 2 rounded and an angulated lobe, but without spines. Preopercle spines well developed, the next to the uppermost the largest. Gill rakers of moderate length, 16 of them on anterior limb of arch, the longest two-fifths of eye.

Dorsal spines a little lower than soft rays, the longest $2\frac{3}{4}$ in head; the next to the last $4\frac{1}{5}$; the last $3\frac{1}{2}$. Notch between dorsals rather deep. Pectoral broad, reaching past ventrals to above front of anal, 17 rays, the lower 8 simple. Ventrals usually reaching vent. Second anal spine stronger and as long, or sometimes a little shorter, than third; length of first spine half second. Inclined anal rays reach base of auxiliary caudal rays; dorsal rays reach slightly past. Caudal rounded.

Scales strongly ctenoid on sides below lateral line, less strongly

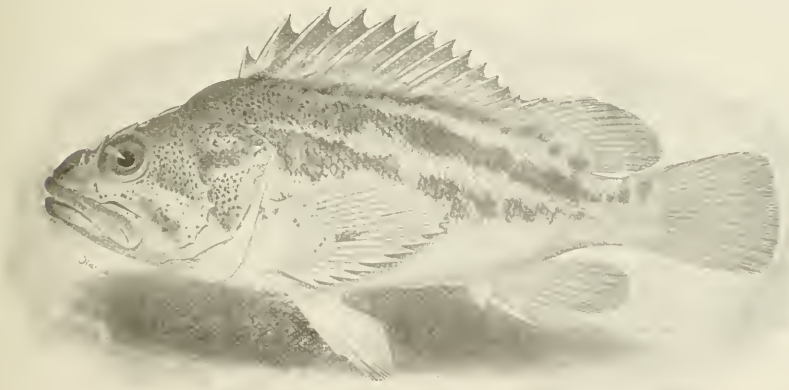


FIG. 5.—SEBASTICHTHYS TRIVITTATUS.

above; scales on head cycloid. Maxillary, mandible, and preorbital naked. Upper pectoral, dorsal, and caudal rays with very small scales nearly to their ends. Peritoneum white.

Color in spirits light gray with an irregular longitudinal dark brown or black bar above and below lateral line leaving lateral line in a light streak. Another dark bar along base of spinous dorsal. Dark bars radiating from eye across cheek. Each scale on head with a black spot. Fins dark.

In life bright yellow with slightly greenish cast everywhere, the blackish parts dark olive, the same yellow wash being over them.

Here described from a specimen from Hakodate. In length 36 cm.

This very beautiful species seems to be rare in Japan. Our specimens are from Aomori and Kushiro. It has no near ally among American species, *Sebastichthys vexillaris* being as near as any.

(*trivittatus*, three-striped.)

18. SEBASTICHTHYS OBLONGUS (Günther).

Sebastes oblongus GÜNTHER, Challenger Report Shore Fishes,[a] 1880, p. 64, pl. XXVIII; Inland Sea, Japan, Yokohama.—HILGENDORF, S. B. Gesell. naturf. Freunde, Berlin, 1880, p. 171, with plate; Tokyo.

Sebastodes oblongus JORDAN and EVERMANN, Fish. North and Middle Am., II, 1898, p. 1830; after Günther.

Head $3\frac{3}{5}$ in length; depth $3\frac{1}{2}$. D. XIII, 12; A. III, 5; scales 59 to 65. Scales rather irregular, much smaller above than below lateral line. Head scaly above as far forward as nostrils; very minute scales on preorbital. Snout pointed, longer than eye. Interorbital space flat, equal to eye, 6 in head. None of spines on upper side of head projecting, those on preopercle obtuse. Teeth in broad bands on jaws, vomer, and palatines. Maxillary reaching posterior margin of eye. Dorsal spines strong, fourth to seventh longest, $2\frac{1}{2}$ in head; anal spines stronger, much shorter than longest dorsal. Brownish, marbled with darker; lower parts and all fins with brown spots; an oblique brown streak from preorbital toward angle of preopercle.

Recorded from the Inland Sea of Japan and the market of Yokohama. Not seen by us. All our specimens of this type belong to *Sebastichthys mitsukurii* and it may be that *S. oblongus* is merely an extreme example of the same species.

This species was not taken by us. Were it not that Dr. Boulenger has verified for us Dr. Günther's count of scales, which agrees with that shown in his figure, we should believe that *Sebastichthys oblongus* is the same as *Sebastichthys mitsukurii*. Except for the larger scales of the latter, we know of no difference.

(*oblongus*, oblong.)

19. SEBASTICHTHYS MITSUKURII (Cramer).

Sebastes oblongus (var.?) STEINDACHNER and DÖDERLEIN, Denkschr. Akad. Wiss. Wien, 1884, p. 204; Tokyo.—NYSTROM, Kong. Vet. Ak., 1887, p. 20; Nagasaki.

Sebastodes mitsukurii CRAMER, in Jordan and Evermann, Fish. North and Middle Am., II, 1898, p. 1831; Tokyo, based on the description given by Steindachner and Döderlein.

Head $2\frac{1}{2}$ in length; depth 3. Eye 5 in head; snout $4\frac{2}{5}$; maxillary $2\frac{1}{10}$; interorbital $5\frac{1}{3}$. Dorsal XIII, 12 to 14 (usually 12); anal III, 7. Pores of lateral line 40 to 42.

Mouth large, maxillary reaching to behind eye. Jaws subequal or the lower very slightly projecting. Symphyseal knob scarcely developed. Teeth in broad bands on vomer and palatines. Teeth on front

[a] Dr. Boulenger has kindly reexamined the types of *Sebastodes oblongus*. He finds that they agree with Dr. Günther's plate in showing about 60 scales, counting oblique series below the lateral line. Scales 58, 59, 60, in 4 examples. In our specimens of *Sebastodes mitsukurii* a species otherwise very similar to *S. oblongus*, the scales counted in the same way, number from 42 to 46.

of mandible somewhat raised and fitting in a notch in maxillaries, not, however, developed in a knob. Eye small, a little shorter than snout. Interorbital flat sometimes slightly concaved usually unbroken by ridges, sometimes with slight nearly parallel ridges running backward from nasal spines. Cranial ridges all low, the occipital ridges best developed. Spines sharp but lying close to the skin and not prominent. Nasal, postocular, tympanic, and parietal spines present. Preorbital with slight rounded lobes, no spines present. Preopercle spines subequally spaced or the two upper sometimes closer together than others. Gill-rakers very short and blunt, one-fourth or one-fifth diameter of eye, 12 or 13 developed on anterior limb of arch.

Dorsal spines longer than soft rays, the fifth $2\frac{1}{3}$ in head; next to last equals snout; last 4 in head. Notch between dorsals rather deep. Pectoral rounded the lower 10 rays unbranched, its tip reaching slightly past ventrals to above vent. The second anal spine stronger and as long as third 3 in head; first spine half as long. Tips of last dorsal rays reach to base of auxiliary caudal rays, and slightly farther back than those of anal. Caudal rounded. Peritoneum white.

Scales ctenoid. Soft fins except ventrals with a few small scales at base. Preorbital scaled. Mandible and maxillary naked. Body clouded and spotted with dark brown, these spots forming 4 or 5 more or less conspicuous broken crossbars. Dark bars radiating from eye, especially conspicuous in small specimens. Rays of soft fins with dark spots which do not involve the membrane. All fins rather dark.

This species, which must be extremely close to *Sebastichthys oblongus*, we found abundant about the Inland Sea of Japan, and northward even to Hakodate. Our specimens are from Hakodate, Aomori, Matsushima, Tokyo, Yokohama, Onomichi, Kobe, and Nagasaki. It may be known from *Sebastichthys oblongus* by the presence of but 45 cross rows of scales instead of 55 to 65. It is perhaps not really a distinct species.

(Named for Kakichi Mitsukuri.)

20. SEBASTICHTHYS PACHYCEPHALUS (Schlegel).

MURA SOI (BLOTCHED ROCK-FISH).

Sebastes pachycephalus SCHLEGEL, Fauna Japonica, Poiss., 1843, p. 47, pl. XX, fig. 3, Nagasaki.—? RICHARDSON, Ichth., China, 1846, p. 214; Canton.—GÜNTHER, Cat. Fish., II, 1860, p. 97.—STEINDACHNER, Reise Aurora, 1897, p. 202, Kobe.

Head $2\frac{1}{2}$ in length; depth $2\frac{1}{2}$; eye $4\frac{1}{5}$ in head; maxillary $2\frac{1}{5}$; snout $4\frac{1}{5}$. Dorsal XIII, 13; anal III, 7; pores of lateral line, 30.

Body rather deep, deepest under first spine of dorsal. Mouth large, maxillary reaching nearly to below posterior orbital margin. Lower jaw included. Teeth in moderate bands, wide on front of premaxillaries, not developed in a knob at front of mandible. Narrowest part of interorbital space just behind preocular spine three-fifths eye.

Interorbital deeply concave, the median area between supraocular ridges flat and covered with small scales. Cranial ridges and spines well developed. Nasal, preocular, postocular, tympanic, and parietal spines present. Upper 2 preopercle spines the largest; all except the lower one, which is inclined downward, are directed backward. Gill-rakers one-fourth eye in length; 12 developed on anterior limb of arch.

Pectoral very broad and rounded, composed of 17 rays, the lower 10 very much swollen and unbranched; its tip reaches past tips of ventrals to above front of anal. Dorsal spines rather low, a little lower than soft rays, the fifth spine $2\frac{1}{2}$ in head, the last spine 3, next to last $3\frac{1}{2}$. Second anal spine a little longer and much stronger than third, twice as long as first. Caudal rounded.

Scales everywhere coarsely ctenoid. Preorbital, maxillary, and mandible naked. Small scales only on the base of soft fins. Peritoneum white.

Black or dark brown, with or without areas of gray. Usually a pale area under spinous dorsal, which in the fresh state is with golden-yellow reticulations and spots; a second light-yellowish area under front of soft dorsal. Fins and lower parts of body sometimes profusely covered with dark round spots. Spots on breast and base of pectorals sometimes round and distinct, sometimes diffused, sometimes running together, leaving this region dusky, or sometimes entirely absent, leaving this region cream color. Entire body sometimes uniform dark brown, lighter on breast and in front of pectoral, without markings of any kind.

This species is generally common in southern Japan, our specimens being from Wakanoura, Kobe, Hiroshima, and Shimonoseki. It is related to *Sebastodes chrysomelas* of the American coast.

Our various specimens, though differing much in coloration in the extremes, run together so that it is impossible to separate them. None of them differ in anything except coloration.

($\pi\alpha\chi\acute{\upsilon}\varsigma$, thick; $\kappa\epsilon\phi\alpha\lambda\acute{\eta}$, head.)

21. SEBASTICHTHYS ELEGANS (Steindachner and Döderlein).

Sebastes elegans STEINDACHNER and DÖDERLEIN, Fische Japans., III, 1884, p. 205; Tagawa, in the Inland Sea of Japan.

Sebastodes elegans JORDAN and EVERMANN, Fish. N. and M. A., II, 1898, p. 1830 (after Steindachner).

Head $2\frac{1}{2}$ in length; depth $2\frac{3}{4}$; eye $4\frac{1}{2}$ in head; snout $4\frac{2}{3}$; maxillary $2\frac{1}{4}$; interorbital width $6\frac{2}{3}$; dorsal XIII, 12, often XIV, 12; anal III, 7; pores of lateral line 30.

Mouth rather large, the maxillary reaching nearly to below posterior border of eye. Jaws equal. No knob at symphysis. Teeth in moderate bands. Interorbital deeply concave, the supraorbital edges raised. Near middle of interorbital are 2 curved longitudinal ridges,

between which runs a very narrow deep canal. Cranial ridges and spines well developed. Nasal, preocular, postocular, tympanic, and parietal spines present. Preorbital with 2 sharp angles, but without spines. Gill-rakers very short and blunt, 14 on anterior limb of arch.

Dorsal spines variable in number, 13 to 14, a character very unusual in this group, lower than dorsal rays, the longest 3 in the head; the next to the last $3\frac{3}{4}$; the last $3\frac{1}{3}$. Notch between dorsals not very deep. Pectoral rounded, the lower 10 rays not branched, reaching past ventrals and slightly past vent. Ventrals reaching to vent. Second anal spine stronger and longer than third, $2\frac{1}{2}$ in head; first spine one-half length of second. Tips of last anal rays scarcely reaching base of auxiliary caudal rays, not extending so far back as dorsal rays. Caudal rounded.

Scales weakly ctenoid. Few auxiliary scales present. Mandible

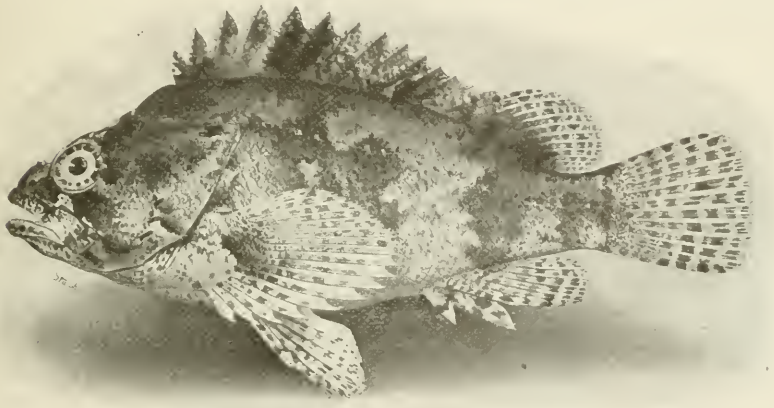


Fig. 6.—Sebastichthys elegans.

and preorbital naked. Maxillary with a few embedded scales near anterior end only (these not always evident, never evident without the aid of the lens, and after specimen has been out of alcohol a few minutes and has become slightly dry). Median rays of pectoral with fine scales nearly to their tips. Peritoneum white.

The following color description was taken from a fresh specimen: Gray much mottled with darker and with flesh color. Body with 4 diffuse dark cross bands, first at shoulder, second behind pectoral, third narrower; more distinct under soft dorsal; fourth at base of caudal. A black band covering top of head; extending on cheeks. A pale preorbital band from eye, and a pale band on preopercle behind eye. Lower jaw with dark spots. Large black spot at angle of mouth, another on maxillary. Belly mottled with black. Dorsal olive and a dusky shade corresponding with body bands; first 2 spines black. Tips of fins flesh color. Caudal flesh color at base, the termi-

nal half reddish, with broad dark base made of 3 or 4 bars. Anal spines scarlet, barred with black. Soft dorsal dusky at base with pale streaks, tipped with flesh color. Ventral colored like anal; first spine reddish, the thin flesh color at tip blackish, paler at base. Pectoral flesh color barred with blackish; lower rays tinged with orange. Pale shades on lower fins somewhat tinged with golden.

Here described from specimens from Misaki 15 to 17 cm. in length.

The species may be separated from *Sebastichthys pachycephalus* (which it somewhat resembles) at a glance by the narrow, deep channel along middle of interorbital. The area between raised supraorbital rims in *S. pachycephalus* is wide and scaled over.

This small and handsome species, like the preceding, has no homologue on the American coast. Our specimens are from rocky shores about Misaki, Onomichi, and Miyajima. About the famous sacred island of Miyajima it is especially abundant.

Table of dorsal spines.

Number of specimens.	Locality.	Number of dorsal spines.
2	Tokyo	14
24	Misaki	14
3	Kobe	14
4	Miyajima	14
8	....do	13
3	Onomichi	13

4. NEOSEBASTES Guichenot.

Neosebastes GUICHENOT, Mém. Soc. Nat. Sci., Cherbourg, XVI, 1868, p. 83 (*panda.*)

This genus is closely allied to *Sebastichthys*, having 13 dorsal spines, which are very long and strong; a series of strong spines in a line from edge of preorbital across suborbital stay and preopercle; a long band of palatine teeth; armature of upper parts of head much as in *Sebastichthys*; vertical fins, scaleless.

Indian seas.

In Guichenot's arrangement *Neosebastes* differs from *Sebastes* in having the vertical fins scaleless and the lower rays of the pectorals branched like the upper and not exserted. This latter character is not found in the Japanese species, *N. entaxis*, which may represent a distinct genus.

(νεός, new; Sebastes.)

22. NEOSEBASTES ENTAXIS Jordan and Starks, new species.

Head $2\frac{2}{5}$ in length; depth $2\frac{2}{5}$. Dorsal XIII, 9; anal III, 5 (or 6, counting the last very fine ray). Pores in lateral line 31. Eye $3\frac{1}{2}$ in head; interorbital $5\frac{1}{2}$; maxillary $2\frac{3}{4}$.

Body not greatly compressed, the back slightly elevated. Mouth not very oblique, the front of premaxillary well below level of lower

part of orbit. Maxillary extending to below middle of eye, lower jaw not projecting, a knob developed at symphysis. Teeth in a moderate band on lower jaw, in a broader band on premaxillary, becoming very broad anteriorly. Tip of mandible fitting into a toothless notch in front of premaxillaries, but without a knob of teeth. Bands of teeth on vomer and palatines a little narrower than on mandible. Anterior nasal with a large backward-extending flap. Interorbital deeply concave, the supraorbital region on each side closely scaled and sloping inward and downward to a naked median channel, which runs to a point anteriorly. Eye elliptical, its long diameter considerably longer than snout. Nasal spines small and sharp. Preocular margin with a pair of small spines on each side. Supraocular margin with 5 or 6 small, very sharp spines, growing larger posteriorly. Parietals with

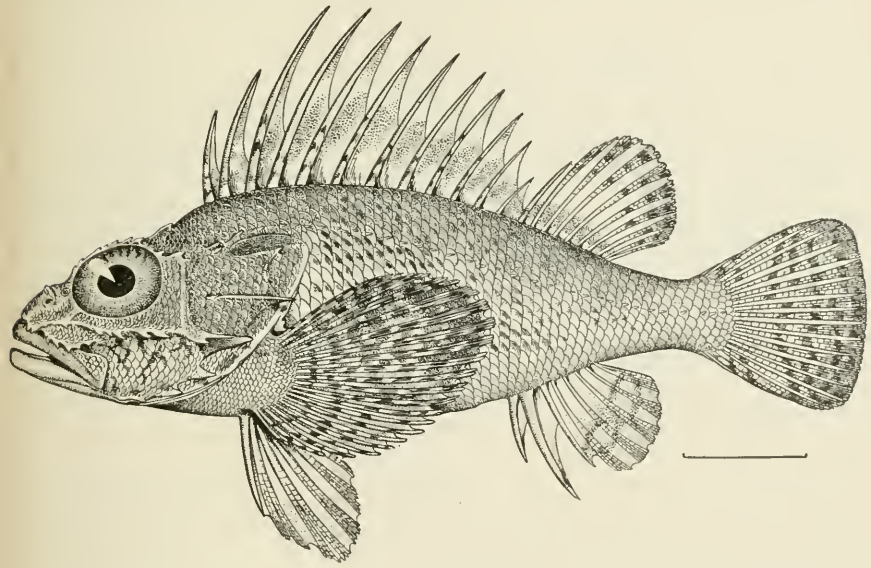


FIG. 7.—NEOSEBASTES ENTAXIS.

a pair of very sharp, widely diverged, naked ridges, ending in spines. A couples of spines are present behind the upper fourth of eye, and farther back, slightly above them, is a similar spine on post-temporal. Preorbital with a bunch of 2 or 3 spines on its anterior edge, pointing forward, and 3 sharp, hooked spines pointing backward along the rest of its lower edge. A row of sharp spines inclined backward from preorbital to preopercle, the first large one on center of preorbital preceded by 1 or 2 tiny ones; 2 or 3 under anterior half of eye, one recumbent upon another; a similar group under posterior part of eye, having an interval between; a very long, sharp spine on preopercle, its point nearly reaching edge of opercle, a secondary ridge and spine developed on its base. Edge of preopercle with 3 smaller spines below, growing smaller downward. Opercle with 2 spines; the upper

one moderate in size, inclined somewhat upward, not preceded by a ridge; the lower one is long and sharp, pointing straight backward and preceded by a sharp, naked ridge, which runs nearly across the whole length of opercle. Eight gill rakers developed on anterior limb of arch, the longest one-third the long diameter of eye.

Scales ctenoid, though not roughly. Lateral line anteriorly raised in a low ridge. Head with scales to tip of snout; preorbital, interorbital, suborbital regions and nape with fine, crowded, irregular scales; scales more regular and larger on cheek and opercle; interopercle and maxillary with scales; branchiostegal region and mandible naked; the latter with a great many pores scattered irregularly over it; opercle with a naked flap above; upper opercle spine. Fins naked.

Pectoral scarcely reaching front of anal (slightly past in cotype); it has 13 branched rays and 8 simple ones; the fourth or fifth ray from the uppermost the longest. Ventrals rather wide apart, not reaching to vent. Dorsal and anal spines each with a channel along its side, reaching its entire length. Third dorsal spine the longest, $3\frac{1}{3}$ in entire length without caudal; the first scarcely half as long, equal to the thirteenth; the twelfth three-fifths eye. Longest dorsal rays $2\frac{1}{3}$ in head. Second anal spine much stronger and longer than third, $2\frac{1}{3}$ in head; the first $1\frac{3}{4}$ in second. Caudal truncate. Peritoneum white. Color, light below, mottled with fine lines and spots on sides and back. Pectoral dark, the color solid above, with white spots below. Anal with white spots on a dusky ground. Soft dorsal and anal rays crossed with dark lines. Spinous dorsal mottled. This species is known to us from two fine specimens, the one from Chosu, in Shimosa, the other from Misaki. From the first the drawing is taken. The species is known locally as Kasago.

The type is from Misaki. It is 17 cm. in length and is numbered 7367, Ichthyological collections, Leland Stanford Junior University Museum. The cotype from Chosu is numbered 50906 in the United States National Museum.

(*ἐντάξις*, in array, from the rank of spines.)

5. THYSANICHTHYS Jordan and Starks.

Thysanichthys JORDAN and STARKS, new genus (*crossotus*).

This genus differs from *Sebastodes* chiefly in having dermal filaments on head and along lateral line; no enlarged spine on edge of preopercle or ridge on opercle. It has teeth on the palatines; 13 dorsal spines; well-developed spines on top of head, along suborbitals, and edge of preopercle.

Species of small size and bright colors.

(*θυσάνος*, a fringe; *ἰχθύς*, fish.)

23. THYSANICHTHYS CROSSOTUS Jordan and Starks, new species.

Head $2\frac{4}{5}$ in length without caudal; depth $2\frac{3}{5}$. Dorsal XIII, 11; anal III, 5. Pores of lateral line 23. Eye $3\frac{2}{5}$ in head; maxillary $2\frac{1}{2}$; interorbital $5\frac{1}{2}$.

Lower jaw not projecting. Symphysis with a knob. Maxillary reaching to below middle of eye. Anterior end of premaxillaries on a level with or slightly above lower margin of orbit. Teeth in rather broad bands on jaws; in narrower bands on palatines and vomer; teeth developed in a knob at tip of mandible, which fits in a toothless notch at front of premaxillaries. Interorbital deeply concave and covered with scales, and with a pair of interorbital ridges with a moderate channel between them. Cranial spines large and more erect than in

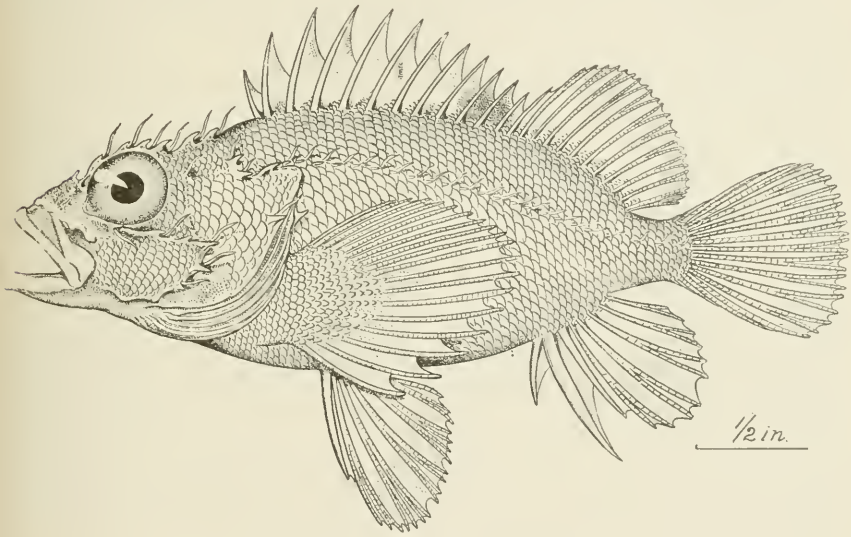


FIG. 8.—THYSANICHTHYS CROSSOTUS.

the genus *Sebastichthys*, not preceded by ridges even at occiput. Nasal, preocular, supraocular, postocular, tympanic, parietal, and nuchal spines present. Preorbital with 3 lobes, the anterior one broadly rounded, the others angulated, but without spines. A ridge of 3 low spines extends along suborbitals. Preopercle with 5 spines, the upper 3 sharp, the others blunt, the uppermost one hooked upward. Two hundred spines present, rather close together. Opercle with 2 spines of equal size, the upper one inclined slightly upward. Spines on top of head each with a long filament behind; the longest ones half eye in length. Similar filaments behind the preorbital lobes, the spines on suborbitals, the three upper spines on preopercle, and a fringe of them along lateral line. Gill rakers very short, about one-fourth diameter of pupil, 7 of them developed on anterior limb of arch.

Scales roughly ctenoid. Lateral line running in a crooked line.

Upper parts of head with scales to tip of snout. Maxillary and preorbital with scales. Suborbital and mandible naked, the latter with three large pores on its lower side. Base of pectoral caudal and soft dorsal with scales; other fins naked. Pectoral reaching to above base of third anal spine; it has 10 simple rays and 7 branched ones. Ventrals barely reaching to front of anal. Dorsal and anal spines each with a longitudinal channel, as in the genus *Neosebastes*. The anterior dorsal spines strongly curved. Third, fourth, and fifth dorsal spines of about equal length, $2\frac{1}{2}$ in head; the thirteenth higher than the twelfth by half the diameter of the pupil. Second anal spine much stronger and larger than third, nearly as long as soft rays, $1\frac{5}{6}$ in head; the third $2\frac{3}{4}$; the first $2\frac{1}{4}$ in the second. Peritoneum white.

Color in spirits: Body and fins with little color remaining. Indications of a dusky blotch under first dorsal spine, one under middle of spinous dorsal and one under last spine. A black spot on spinous dorsal from ninth to twelfth spine; fins otherwise colorless.

This species is known to us from a single example, 85 mm. long, dredged by the U. S. Fish Commission steamer *Albatross* at Station 3720, in Suruga Bay, off Ose Point, in 63 fathoms. It is numbered in the U. S. National Museum 50907.

(κροσσωτός, fringed.)

6. SEBASTISCUS Jordan and Starks, new genus.

Sebastiscus Jordan and Starks, new genus (*marmoratus*).

This genus is based on species having the external appearance of *Sebastodes* and much resemblance to the subgeneric group called *Pteropodus*, but having but 12 spines in the dorsal fin and the vertebræ 10+14=24, agreeing in these regards with *Scorpæna*. From *Helicolenus*, *Sebastiscus* differs, solely, perhaps, in the presence of a well-developed air bladder. Peritoneum pale. The two known species are very much alike and both very abundant in Japan.

(σεβαστίσκος, a diminutive form, from Sebastes.)

a. Color olivaceous, mottled with darker; no spine below eye; shore species. *marmoratus*, 24.

aa. Color rose red, marbled with golden and violet; a small spine close below lower margin of eye; species inhabiting deeper water ..... *albofasciatus*, 25.

24. SEBASTISCUS MARMORATUS (Cuvier and Valenciennes).

KASAGO.

Sebastes marmoratus Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 345; Japan, Coll. Langsdorf.—Schlegel, Fauna Japonica, 1843, p. 46, pl. xxi, fig. 1, 2; Nagasaki.—Günther, Cat. Fish, II, 1860, p. 104; Japan, China.—Steindachner, Fische Japans, III, 1884, p. 32; Tokyo.—Nystrom, Kong. Vet. Handl., 1887, p. 20; Nagasaki.—Ishikawa, Prel. Cat., 1897, p. 51; Fukushima, Tokyo, Kii.

Helicolenus marmoratus Jordan and Snyder, Check List, 1901, p. 98; Hakodate.

Sebastes crassispinis Döderlein, Fische Japans, III, 1884, p. 32; Tokyo.

? Sebastes sinensis McClelland, Calcutta Journ. Nat. Hist., IV, 1843, p. 397, pl. xxi, fig. 3; Chusan, China.

Head $2\frac{2}{5}$ in length without caudal; depth $2\frac{5}{6}$. Dorsal XII, 12; anal III, 5. Pores in lateral line 46. Eye $4\frac{1}{4}$ in head; maxillary $2\frac{1}{4}$; interorbital half orbit.

Jaws equal, or the lower slightly included. Symphyseal knob slight. Maxillary nearly reaching to below posterior margin of eye. Teeth in rather wide bands, very wide at front of premaxillaries, narrower on vomer and palatines; in a V-shaped band on vomer. Cranial spines high and sharp; nasal, preocular, superocular, postocular, tympanic, coronal, parietal, and nuchal spines present; coronal spines ending just anterior to a line between tips of tympanic spines. Occipital ridges high. A small dermal filament usually present behind each of the parietal, nuchal, and superocular spines. Interorbital deeply concave; the interobital ridges end behind in the coronal spines and have a deep channel between them, which is narrow between eyes and grows wider between coronal spines. Preorbital with a spine on its posterior lower edge and 2 very low lobes anteriorly. Preopercle spines moderately sharp, the upper 3 directed backward, the lower 2 downward and backward; the next to the upper the largest. Opercle with 2 flat spines, the upper one directed slightly upward. Gill-rakers short, in length about one-fourth eye, 13 to 15 on anterior limb of arch, counting 3 or 4 anterior tubercles.

Scales everywhere etenoid, except on breast. Pectoral with scales extending about half the length of median rays; other fins except ventrals with fine scales at the base. Maxillary, preorbital, mandible, and branchiostegals naked; subopercle naked except at its posterior end.

Pectoral with 18 rays, an equal number simple and branched, the former projecting beyond the others; the upper posterior edge of the fin usually concave, sometimes obliquely truncate; pectoral reaching past tips of ventrals, usually but slightly, sometimes nearly to front of anal. Fourth dorsal spine 3 in head; the eleventh $3\frac{3}{4}$; the twelfth $4\frac{1}{2}$. Dorsal spines a little lower than the soft rays. Anal spines all stout, the second stronger and a little longer than third, which is $2\frac{1}{3}$ in head and twice as long as first spine; the spines considerably shorter than the soft rays. Caudal truncate, or very slightly rounded. Peritoneum white.

Color in spirits: Dark brown on back, belly white or light brown; 5 light spots along back at base of dorsals, one below fourth and fifth spines, one below seventh and eighth, one below last spines and first rays, one below middle rays, and one on caudal peduncle behind last ray; the dark-brown area between the spots with its edges usually darker and sometimes extending up on the dorsal; below, marbled with brown; soft fins brown, and with white spots, giving fins the appearance of having crossbars of white and brown; fins in some specimens nearly colorless. Other specimens have acellated light spots scattered over the sides.

The following color note was taken from a specimen in a fresh state: Head and body above brassy, changing to light carmine below; spots on body light olive green (bluish in life); spots at base of dorsal reddish yellow; fins all suffused with carmine; spots on dorsal and anal same as on body; caudal spots whitish.

This species is one of the most abundant of the shore fishes of Japan, and varies widely in color, according to depth and condition. The whitish spots along the base of the dorsal and the dark dots or bars on the pectoral are very constant.

Sebastiscus albofasciatus, closely resembles it, but may be known by the bright red coloration and the presence of the small spine below the eye, which is wanting in *Sebastiscus marmoratus*.

This species is known everywhere as Kasago. Our specimens are from Hakodate, Same, Tokyo, Misaki, Sagami Bay, Enoshima, Suruga Bay, Kobe, Hiroshima, Wakanoura, and Nagasaki It was dredged by the U. S. Fish Commission steamer *Albatross* in Suruga Bay, at station 3718, off Ose Point, in 65 fathoms.

(*marmoratus*, marbled.)

25. SEBASTISCUS ALBOFASCIATUS (Lacépède).

AKAKASAGO (RED ROCK-FISH).

Holocentrus albofasciatus LACÉPÈDE, Hist. Nat. Poiss., IV, 1802, p. 372; Japan; from a specimen in Mus. Berlin; coll. Langdorf.

Sebastes albofasciatus CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 344; after same specimen.

Head $2\frac{1}{2}$ in length without caudal; depth 3. Dorsal XII, 12; anal III, 5. Pores in lateral line, 48. Eye $3\frac{4}{5}$ in head; interorbital width 7; maxillary $2\frac{1}{5}$.

This species differs but little from *Sebastiscus marmoratus*. The cranial spines are usually sharper, and the ridges a little more acute; at the lower rim of the orbit on the upper edge of the suborbital stay, is a sharp spine, directed backward and slightly upward, which is entirely absent in *S. marmoratus;* the eye is larger and the upper simple rays of the pectoral slightly more produced, their tips always extending well past tips of ventrals.

The alcoholic specimens are more nearly colorless; they have a few dusky spots on upper pectoral rays, and the brown color on back between light spots, extends slightly on dorsals; fins otherwise colorless; the slight spots on back instead of being yellowish, like an alcoholic fish without pigment, as in *S. marmoratus*, are with dead white pigment.

The following colors are shown by fresh specimens:

Bright scarlet with dark olive shades on back; the pale blotches on sides of back violet or lilac; membrane of ventrals, anal and caudal lobes above and below bright lilac violet; fins otherwise orange; the membrane of the dorsal tipped with violet; pectorals pale, with dark olive dots, toward the tip.

This specimen is from station 3715, off Ose Point, Suruga Bay, 68 to 65 fathoms.

Body and head above vermilion red with reticulations of bright lemon yellow. Below whitish, clouded with red. Soft dorsal, caudal and anal with yellow; pectoral with some dark spots toward the tip, the fin shaded with bright violet. This specimen is from Nagasaki.

This species lives in deeper water than *Sebastiscus marmoratus*, and is almost equally common, though not nearly so often seen in the markets. Through the kindness of Dr. Hilgendorf we have received a description of Lacépède's original type, which is evidently identical with this species. Our specimens are from Tokyo, Misaki, Awa, Wakanoura, Nagasaki, and from the following dredging stations of the U. S. Fish Commission steamer *Albatross:* 3707, Ose Point, Suruga Bay, 63 to 75 fathoms; 3714, same locality, 48 to 60 fathoms; 3715, same locality, 68 to 65 fathoms; 3720, same locality, 63 fathoms; 3730, Owai Point, Totomi Bay, 34 fathoms; 3734, same locality, 48 to 36 fathoms.

This species can be almost always known at sight by the blackish dots or bars on the pectoral, wanting in all species of *Helicolenus*, and by the little spine under the eye, wanting in *S. marmoratus*. Like *Sebastiscus marmoratus*, and unlike the species of *Helicolenus*, it possesses a large air bladder.

(*albus*, white; *fasciatus* banded, but the markings are pink and golden.)

7. HELICOLENUS Goode and Bean.

Helicolenus Goode and Bean, Oceanic Ichth., 1896, p. 248 (*dactylopterus*).

Body oblong, somewhat compressed; head large, ctenoid scales on its tip, and on cheeks and opercles; several series of spinous ridges on head, but no occipital pit; mouth large with bands of villiform teeth on jaws, vomer, and palatines. Dorsal fin continuous, not deeply notched, with stout spines and 10 to 12 rays; anal with 3 spines and 6 rays; pectoral broad, fan-shaped, with rays arranged in three groups, the first of 2 simple rays, the second of 8 or 9 branched rays, the third of 8 simple rays, sometimes prolonged, with their tips more or less free from membrane; soft dorsal with tips free from membrane; suborbital keel smooth, or nearly so; preorbital with spines small and hidden beneath the skin. Vertebræ 10 + 14 = 24; no air bladder. Peritoneum black. Atlantic. Very close to *Scorpæna*, differing only in the *Sebastes*-like cranium. From *Sebastichthys* it is distinguished by the smaller number of vertebræ, by the presence of but 12 dorsal spines, as also by the entire absence of the air bladder.

(ἡλίκος, strong; ὠλένη, elbow, arm.)

a. Posterior edge of eye without spine; mouth black; body with 3 wide diffuse green or red bands ..... *dactylopterus*, 26.

aa. Posterior edge of eye with a spine; two spines under the eye... *emblemarius*, 27.

26. HELICOLENUS DACTYLOPTERUS (De La Roche).

Scorpæna dactyloptera De La Roche, Ann. Mus., XIII, 1809, pl. XXII, fig. 2; Ivica, Barcelona.—Risso, Ichthyol. de Nice, 1810, p. 186.—Günther, Challenger Report, 1, 1880, Pt. 6, p. 6.—Jordan and Gilbert, Synopsis, 1883, p. 679.

Sebastes dactylopterus Günther, Cat., III, 1860, p. 99.

Sebastopolus dactylopterus, Goode and Bean, Bull. Mus. Comp. Zool., X, 1883, No. 5, p. 214.

Helicolenus dactylopterus Goode and Bean, Oceanic Ichthyology, 1896, p. 249, pl. LXVIII, fig. 244.

Sebastes imperialis Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 336; Nice.

Sebastes hilgendorfi Döderlein, Fische Japans, IV, 1884, p. 34; Tokyo.

Head $2\frac{1}{2}$ to $2\frac{4}{5}$ in length without caudal; depth $2\frac{3}{4}$ to 3. Dorsal XII, 12; anal, III, 5. Pores of lateral line 26; oblique series of scales below lateral line running downward and backward, 41. Eye $2\frac{4}{5}$ to $3\frac{1}{5}$ in head; maxillary 2 to $2\frac{1}{5}$; interorbital width, 8.

Mouth large, the maxillary nearly or quite reaching to below posterior margin of eye. Lower jaw but slightly projecting; symphyseal knob small and sharp; tip of lower jaw fits in a vostral notch. Bands of teeth of moderate width, rather wide at tip of premaxillaries. Interorbital space very narrow and deeply concave, not narrowest just behind preoculars, but nearly parallel for nearly half its anterior length. A pair of ridges running very close to edge of superorbital edge, between them a wide, deep channel. Cranial spines small and sharp, scarcely elevated; nasal, preocular, superocular, postocular, tympanic, parietal, and nuchal spines present; supraocular, postocular, and tympanic in line with each other and with supraorbital ridge. Suborbital ridge rather narrow and sharp, and with scarcely perceptible spines. Preopercle spines divergent, the next to the upper one the largest. Preorbital with 2 or 3 very low lobes, but without angles or spines. Gill-rakers small, 16 on anterior limb of arch, the longest three-fourths of interorbital width.

Scales weakly ctenoid; maxillary, mandible, preorbital, and interopercle naked.

Fourth dorsal spine $2\frac{3}{5}$ to $2\frac{4}{5}$ in head; the twelfth, 4; the eleventh, 5. Second anal spine stronger, but of equal length to third; in the declined fin, the latter projects slightly beyond the second; the second 3 to $3\frac{1}{6}$ in head; the first one-third of second; the anal rays one-third or one-fourth of second spine longer than spines. Pectoral reaches just past tips of ventrals; the first 2 upper rays simple, the next 9 branched, and the lower 8 simple, the longest ones projecting slightly beyond the branched rays; the posterior outline of the branched rays, when fin is spread, obliquely truncated. Peritoneum black.

A few dusky markings on back usually outlining light spots just below base of dorsals, placed as in species of *Sebastiscus;* a dark

shade sometimes present on opercle, caused by dusky lining, showing through. No other color on alcoholic specimens. The following color was taken from a fresh specimen: Bright crimson with vague paler shades on back and red shades from eye. Pectoral blood red; other fins red, but paler.

Here described from specimens from 16 to 22 cm. in length from Misaki.

It is with much doubt that we identify this species with the Mediterranean form, but having no specimens from the Atlantic side, and being unable to find sufficient characters in current descriptions, we can not do otherwise.

It is common in the deeper waters off Misaki and Awa. We have many specimens from Misaki, Tokyo market, Sagami Bay, Suruga Bay, these last dredged by the U. S. Fish Commission steamer *Albatross*. The stations are: 3698, Manazuru Point, Sagami Bay, 501 to 749 fathoms; 3717, Ose Point, Suruga Bay, 68 to 65 fathoms, and 3719, same locality, 90 to 70 fathoms.

(*δάκτυλος*, finger; *πτερόν*, fin.)

27. HELICOLENUS EMBLEMARIUS Jordan and Starks, new species.

Head $2\frac{1}{3}$ in length without caudal; depth, $2\frac{1}{2}$. Dorsal XII, 12 or 13; anal III, 7 counting last slender one. Pores of lateral line, 28; oblique series of scales below lateral line, 40. Eye, $2\frac{2}{3}$ to 3 in head; least interorbital width, 7; maxillary, $2\frac{1}{6}$.

Tip of mandible not projecting; symphyseal knob but little developed. Mouth moderate, the maxillary scarcely reaching to below posterior edge of pupil. Teeth in rather narrow bands on jaws, very narrow on palatines and vomer; front of premaxillaries with scarcely a notch, the bands of teeth of each side nearly touching; palatine bands toward anterior ends turned rather sharply inward to vomer. Cranial spines strong and erect. Nasal, preocular, supraocular, postocular, tympanic, coronal, parietal, and nuchal spines present; coronal spines rather small, blunt in the largest specimens; all of the spines growing blunter and less erect with age; in the larger specimens a spine or tubercle of bone developed laterally on supraorbital margin between pre and super ocular spines. Suborbital margin a sharp ridge, broken up into 2 sharp, backward directed spines. Posterior, upper margin of orbit with a blunt tubercle developed, sometimes paired on one or both sides. Preopercle with 5 spines, the second and third from the lowest the largest, the lowest hooked forward. Opercle with 2 flat spines not preceded by ridges. Preorbital with an anterior, very low, rounded lobe, behind it a large double spine, and at the posterior end either a similar one, or a single spine, sometimes double on one side and single on the other of the same specimen. Interobital concave; narrowest just behind preocular spines; growing rapidly wider pos-

teriorly, the sides nowhere parallel; a pair of interocular ridges with a moderately wide channel between them. Gill-rakers, 17; the longest $4\frac{1}{2}$ in postocular part of head.

Pectoral reaching to front of anal or slightly past; lower 9 rays simple, the other 9 rays branched, except the upper 1 or 2, which are simple. Ventrals not reaching anal. Third dorsal spine $2\frac{1}{3}$ in head; fourth $2\frac{1}{7}$; last $3\frac{3}{4}$; next to last 5; spines much longer than rays. Longest anal spines but little shorter than soft rays; the second much stronger and as long, or sometimes longer, than third; second spine $2\frac{1}{4}$ in head; first spine half as long. Caudal slightly rounded. Peritoneum black. Color in life bright red, with broad cross-bands of deep crimson extending on the fins, the color almost exactly that of the "Spanish

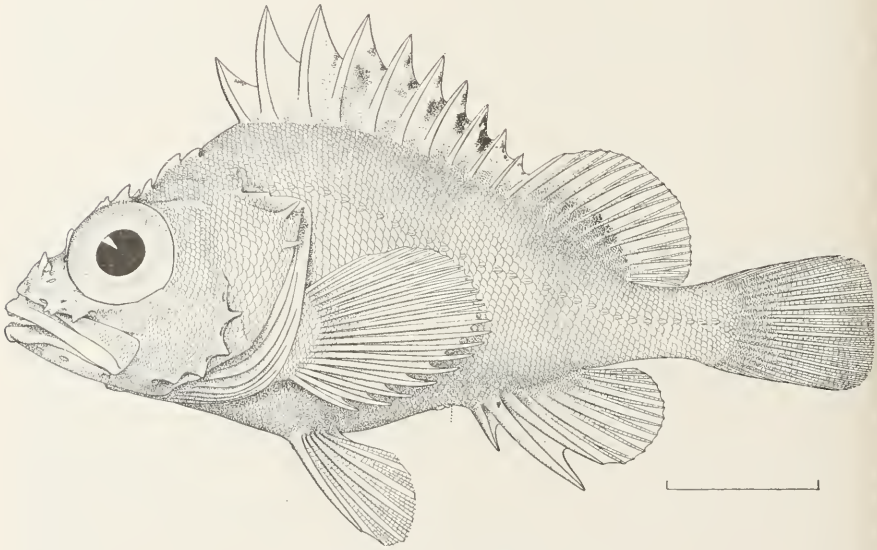


FIG. 9.—HELICOLENUS EMBLEMARIUS.

flag," *Sebastichthys rubrivinctus* of the California coast. Alcoholic specimens colorless, except sometimes margin of membrane between dorsal spines is dusky.

This species may be at once known from *Helicolenus dactylopterus* by the large erect cranial spines; the spines on orbital rim below and behind; the large preorbital spines; the presence of coronal spines; the wider interorbital space, which is narrowest just behind preocular spines and grows rapidly wider behind; and by the anal spines being but little shorter than the soft rays.

Unfortunately, the specimen here figured has but 11 dorsal spines, the first being obsolete, the first developed spine higher than usual, and the blunt spine at upper posterior orbital margin is not developed.

The type 18 cm. long from Okinose near Misaki. It is numbered

7364, Ichthyological collections, Leland Stanford Junior University Museum. Cotypes bear the number 50908, U. S. National Museum.

Several other specimens, all with 12 dorsal spines, were taken for us by Kumakichi Aoki off Misaki with long lines. The largest specimen is 25 cm. in length.

(*ἐμβλέμα*, flag.)

8. SCORPÆNA (Artedi) Linnæus.

Scorpæna Artedi, Genera, 17, XX, 1738, p. 47.

Scorpæna Linnæus, Syst. Nat., 10th ed., 1758, p. 266, (*porcus*) (breast almost naked).

Parascorpæna Bleeker, Versl. Ak. Amst., (2), IX, 1876, Pt. 3, p. 296 (*picta*) (species with the breast scaly).

Body oblong, somewhat compressed. Head large, not much compressed, naked above, and more or less uneven with spinous ridges, often with dermal flaps. Mouth large, with bands of villiform teeth on jaws, vomer, and palatines. Scales mostly ctenoid, of moderate size, often with skinny flaps. Dorsal fin with 12 stout spines; anal with 3 spines, the second commonly the longest; pectorals large, rounded, the base usually procurrent; some or all of the upper rays divided, the lower simple; ventrals inserted behind pectorals. No air bladder. Vertebræ $10 + 14 = 24$. Species numerous in the tropical seas; fishes of singular forms and bright colors; the variation in squamation and armature very great, but, as in most similar cases, it is not easy to find definite characters for subdivision.

(*σκόρπαινα*, the ancient (generic) name of *Scorpæna scrofa*, from *σκορπίος*, scorpion, in allusion to the dorsal spines, which inflict a very painful, sting-like wound.)

a. Interorbital space relatively narrow and deeply concave; no flap on inner base of pectoral.

b. Head about $2\frac{1}{3}$ in length.

c. Maxillary reaching a little past posterior edge of pupil. Scales 40.....*fimbriata*, 28.

cc. Maxillary not reaching as far as middle of eye. Scales 45.....*miostoma*, 29.

bb. Head about $2\frac{1}{5}$ in length; maxillary reaching nearly to posterior margin of eye.....*onaria*, 30.

aa. Interorbital space wide and shallow; a flat flap on inner base of pectoral. Scales 41.....*izensis*, 31.

28. SCORPÆNA FIMBRIATA Döderlein.

Scorpæna fimbriata Steindachner and Döderlein, Fische Japans, III, 1884, p. 195; off Tokyo.

Head $2\frac{1}{3}$ in length without caudal; depth $2\frac{1}{2}$. Dorsal XII, 10; anal III, 6. Pores in lateral line 22; scales 40, counting subvertical series above lateral line. Eye 4 in head; maxillary $2\frac{1}{3}$; interorbital space 7.

Head rather short. Mouth moderate, the maxillary reaching but little past posterior edge of pupil. Jaws equal. Knob at symphysis moderate. Teeth in narrow bands on jaws, narrower on palatines and

vomer. Cranial spines sharp, nasal, preocular, supraocular, postocular, coronal, parietal, and nuchal spines present; the coronal spines at the end of the low interorbital ridges, just behind the eye on a level with upper edge of pupil, are a pair of spines set close together, and a sharp ridge ending in a spine behind them. A pair of supraocular spines set close together; a backward hooked spine at center of preorbital in a line with suborbital ridge; suborbital ridge with 3 spines and a double preopercle spine in the same series; preopercle with 4 short, blunt spines below double spine at angle; opercle with 2 spines at the ends of ridges, diverging from a point near its anterior part, the lower ridge the larger; preorbital with a sharp spine pointing forward at its anterior end, a pair of spines pointing downward and forward near the middle lower edge, and the largest spine pointing backward and downward near its posterior edge. Pit at occiput evident, but not large. Interorbital narrow and deeply concave, the interorbital ridges close together and with a narrow channel between. A large tentacle behind supraocular spine on superorbital ridge; one on posterior margin of anterior nasal, one large one on preorbital behind last spine, extending over maxillary, and several smaller ones anteriorly; several on cheek below suborbital ridge; and several scattered over body. Gill-rakers very short and blunt, about 6 developed, and 3 or 4 rudimentary scales. Fins naked. Peritoneum white. Fourth dorsal spine $2\frac{1}{2}$ in head; the eleventh 5; the twelfth $3\frac{1}{2}$. Pectorals usually not reaching past ventrals, which just cover vent; 9 lower pectoral rays simple; 8 upper rays branched. Second anal spine stronger and longer than third, its length $2\frac{3}{5}$ in head.

Color, dark brown, irregular markings on back, surrounding lighter areas; the markings usually with sharp, cut edges, though sometimes shading into each other; markings continued on dorsal fins; a light area on base of spinous behind third dorsal spine, running down on back; a similar, more diffused area behind base of sixth or seventh spine; a light area under last spines and first soft rays; the surrounding dark area running up on middle rays of soft dorsal, and continued downward, forming an irregular crossbar; an irregular brown crossbar at base of caudal; brown bars radiating from eye more or less distinct; upper lip with or without brown markings; axil light dusky, mottled with white spots, which are variable in size, number, and position on different individuals; sometimes axil is faded and colorless. Young examples with fine brown and white mottling, which in the adult are faded and indistinct; a distinct wide crossbar of brown across caudal rays and sometimes a dark, conspicuous dark spot toward tips of posterior dorsal spines.

The following color note was taken from a fresh specimen: Olive above, much mottled; lower marks and bands bright red, those above rather brown.

This species may be known from *Scorpæna onaria*, which it most resembles, by the shorter head, smaller eye, smaller mouth, and lower cranial spines. In *S. fimbriata* the opercular flap is distant from the outline of back above it one diameter of eye; in *S. onaria* it is distant half the diameter of eye.

This species is known to us from several specimens taken at Wakanoura, Kobe, and Misaki, or found in the Tokyo market.

(*fimbriatus*, fringed.)

29. SCORPÆNA MIOSTOMA Günther.

Scorpæna miostoma GÜNTHER, Shore fishes of the Challenger, 1880, p. 65; Yokohama.

Dorsal XII, 10; anal III, 5. Lateral line 45. Palatine teeth; the vomerine teeth form a simple open V-shaped band. The height of the body is less than the length of the head, which is contained twice and one-third in the total length (without caudal). Head nearly entirely scaleless. Upper jaw slightly overlapping the lower. Orbital tentacles broad, fringed, shorter than the eye, which equals the length of the snout. Interorbital space deeply concave, with a pair of slight ridges within its concavity. Vertex with a quadrate depression, which is rather broader than long, and surrounded by spines. The maxillary does not extend backward to below the middle of the eye. All the cutaneous appendages on the head, body, and fins are well developed. The fourth and fifth dorsal spines are longest, two-fifths of the length of the head, and equal to the second of the anal fin, which, however, is stronger. Eight of the pectoral rays are branched. Body and fins marbled with the usual colors of this genus, but without any peculiar markings. The axil of the pectoral is scarcely spotted, and the lower part of the head is white. Length of specimen, 5⅓ inches. Market of Yokohama (Günther).

This species is not represented in our collection. According to the description given by Günther, it may be known from the other Japanese species of *Scorpæna* by the maxillary not reaching to below the middle of the eye.

(μείος, reduced; στόμα mouth.)

30. SCORPÆNA ONARIA Jordan and Snyder.

ONARI (TABU).

Scorpæna neglecta, SCHLEGEL Fauna Japonica, Poiss., 1848, p. 43, pl. LXXVII, fig. 4; Nagasaki (not *Scorpæna neglecta* of Heckel, 1840).

Scorpæna fimbriata NYSTROM, Kong. Vet. Handl., 1887, p. 18; Nagasaki (not of Steindachner).

Scorpæna onaria JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 365; with plate; Tokyo.

Of this species a good figure and description have been already given in these Proceedings.[a]

This species is occasionally taken on the coast of Japan. It is known to us only by the types of *Scorpæna onaria* which were taken by Professor Otaki in the market of Tokyo.

(*onari*. an Emperor's journey; a fish tabu, or set aside, for the Emperor.)

31. SCORPÆNA IZENSIS Jordan and Starks, new species.

Head $2\frac{1}{5}$ to $2\frac{1}{3}$ in length without caudal; depth $2\frac{5}{6}$ to $3\frac{1}{6}$. Dorsal XII, 10; anal III, 6. Pores of lateral line 23; suborbital series of scales above lateral line, 41. Eye $4\frac{1}{4}$ to $4\frac{1}{2}$ in head; maxillary $2\frac{1}{10}$; interorbital 6 to $6\frac{1}{2}$.

Lower jaw usually slightly projecting (scarcely projecting in type). Symphyseal knob large. Mouth large, the maxillary scarcely reaching to below posterior rim of orbit. Teeth rather coarse, in moderate bands on mandible and sides of premaxillaries, becoming very wide on front of the latter, in very narrow bands on vomer and palatines. Interorbital space wide and concave; as compared with its width much more shallow than *S. fimbriata* and *S. onaria*. The interorbital ridges are rather high and have a channel between them. Cranial spines high, but not very sharp. Nasal, preocular, superocular, postocular, coronal, parietal, and nuchal spines present; behind upper posterior margin of eye is a small bunch of 2 or 3 small spines, and behind it are 2 low spines preceded by ridges; suborbital ridge with the spines not set directly in line, terminating in a double spine at edge of preopercle, below which are 4 small preopercle spines, the upper 2 sharp, the lower 2 blunt; no spine at center of preorbital; 2 opercle spines at the ends of diverging ridges, the lower ridge many times the

FIG. 10.—SCORPÆNA IZENSIS.

[a] Proc. U. S. Nat. Mus., XXIII, 1900, p. 365.

stronger; preorbital with a large spine at its lower posterior edge, a pair of smaller spines near the middle of its lower edge and an anterior rounded lobe. A tentacle behind each of the ocular spines, that behind superocular much the largest, and multifid; a small one behind the parietal and nuchal spines; a multifid one on posterior margin of anterior nostril; a few flat tentacles on soft part of eye above iris; one behind each suborbital spine; a large, flat, thin flap behind posterior preorbital spine, extending over maxillary, and similar ones along lower edge of preopercle; a long, simple tentacle at anterior end of preorbital, extending down to a level with teeth, a large flat flap on inner base of pectoral just behind upper rays, a series of thin flat ones along lateral line and similar ones variously scattered over the body. Gill rakers very short and blunt, 6 or 7 developed on anterior limb or arch, 3 or 4 rudimentary ones in front of them. Peritoneum white.

Pectorals extending a little past ventrals, which usually do not reach to vent; 10 pectoral rays branched, 9 simple. Third dorsal spine $2\frac{1}{5}$ in head, the first half as long; the eleventh $5\frac{1}{3}$; the twelfth $3\frac{1}{5}$. Second anal spine a little stronger and slightly longer than first (?), its length $3\frac{1}{10}$ in head. Caudal slightly rounded.

Color in spirits greyish, with large irregular blotches of brownish slate color on back and sides, with light areas between; a dark blotch above opercle flap involving base of front of dorsal back to third spine; a similar one on base of middle dorsal spines, running obliquely backward and downward, but very much broken up and irregular; a dark patch on posterior dorsal spines, and another under middle of soft dorsal; the light areas between running out on spines and rays of dorsal to their tips; a dark band across snout and another between eyes, leaving a light band between; dark spots on pectoral rays, forming irregular cross lines; soft dorsal, anal and caudal with scattered small black spots; ventrals colorless. Axil colorless, or with diffused black spots variable in number and position.

The color of a specimen from Suruga Bay when first examined was as follows: Deep maroon purple, variegated with olive above and shaded with pinkish, below pinkish with golden shades; flaps flesh color, sides and top of head maroon purple, cheeks golden below; lower jaw and belly white. Dorsal pale with crimson edge and a few dusky mottlings, the soft dorsal pale, reddish edged, axil plain yellowish. Pectoral pale, centrally flesh color, spotted with round dots of maroon crimson. Caudal pale, violet at tip.

This species may be distinguished from *Scorpæna onaria* and *S. fimbriata* by the wide interorbital space and by the flap on inner part of pectoral base. Of this species we have several large specimens dredged by the U. S. Fish Commission steamer *Albatross* in Suruga Bay, and smaller ones in Sagami Bay and Totomi Bay. The localities are: 3708, Ose Point, Suruga Bay, 60 to 70 fathoms; 3713, same local-

ity, 45 to 48 fathoms; 3715, same locality, 68 to 65 fathoms; 3717, same locality, 63 to 100 fathoms; 3720, same locality, 63 fathoms; 3729, Omai Point, Totomi, 34 fathoms; 3754, Sune Point, Sagami Bay, 48 to 52 fathoms; 3755, same locality, 57 to 77 fathoms; 3763, same locality, 49 to 52 fathoms; 3765, same locality, 68 to 45 fathoms.

The type is the largest specimen, 245 mm. in length; it is numbered 50909 in the U. S. National Museum. Cotypes are No. 7366, Leland Stanford Junior Ichthyological Collection.

(Izu, a province of Japan, occupying the promontory between Sagami and Suruga bays.)

9. SCORPÆNOPSIS Heckel.

Scorpænopsis Heckel, Ann. Wien. Mus., II, 1840, p. 159.
Scorpænodes Bleeker, Ind. Ned. Pisc., IV, about 1860, p. 452 (*diabolus*).
Scorpænichthys Bleeker, Bijdr. Ichth. Boero, Nat. Tijds. Ned. Ind., XI, about 1862, p. 402 (*cirrhosus*, not of Girard).

This genus differs from *Scorpæna* in the absence of palatine teeth. The species are of still larger size and more peculiar appearance.

(σκορπαίνα, Scorpæna; ὄψις, appearance.)

a. Pectorals never reaching much beyond tips of ventrals, never to anal; cranial spines entire; coloration greatly varied ..... *cirrhosa*, 32.
aa. Pectorals very long, reaching second anal spine; cranial spines much broken up with serrations; coloration less elaborately varied ..... *kagoshimana*, 33.

32. SCORPÆNOPSIS CIRRHOSA (Thunberg).

ONIKASAGO; ROKUBU (PILGRIM).

Perca cirrhosa Thunberg, Nya Handl., Stockholm, XIV, 1793, p. 199, pl. VII, fig. 2; near Nagasaki.
Scorpæna cirrhosa Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 318; Japan, Coll. Langsdorff; Malabar.—Schlegel, Fauna Japonica, Poiss., 1843, p. 42, pl. XVII, figs. 2, 3; Nagasaki.—Bleeker, Nieuwe Nalez., Japan, about 1863, p. 79.—Günther, Cat. Fish, II, 1860, p. 120; China, Japan, Raoul Island, Amboina.—Ishikawa, Prel. Cat., 1897, p. 50; Boshu.
Scorpænopsis cirrhosus Bleeker, Bydr. Ichth. Boero, Nat. Ned. Ind., XI, p. 402; Buru; Scorpænoides, 1876, p. 32; Singapore, Ternate, Buru, Amboina.
? *Scorpæna leonina* Richardson, Ichth. China, 1846, p. 216; Canton.

Head $2\frac{2}{5}$ in length without caudal; depth 3. Dorsal XII, 10; anal III, 6. Pores of lateral line 23. Eye 6 in head, $1\frac{2}{3}$ in snout; maxillary $2\frac{1}{5}$ in head; interorbital width $1\frac{1}{3}$ in orbit.

Lower jaw projecting; no knob at symphysis. Mouth large; the maxillary reaching to below posterior margin of orbit. Teeth rather coarse; set in very wide bands. Interorbital rather deeply concave; the interorbital ridges high and sharp; not ending in spines behind; a deep channel between them, divided anteriorly by a median ridge running back from premaxillary process. Premaxillary processes very high, forming a deep notch in profile between them and raised superorbital crests. Cranial spines large; nasal, preocular, superocu-

lar, postocular, tympanic, parietal, and nuchal spines present. A small double spine just behind upper posterior margin of eye; a ridge ending in a spine just behind it and above opercle ridge; a similar one behind it; and a third in the same series at beginning of lateral line, followed by much smaller plates on anterior end of lateral line. Opercle with two spines at the ends of diverging ridges, the lower ridge much the larger. Suborbital ridge of spines starts with a small spine at upper part of preorbital and ends with a double spine at preopercle, below which are two small preopercle spines. Preorbital with an anterior rounded lobe, a blunt spine just behind it directed forward, and a similar one at posterior end pointing backward. Gill-rakers very short, 11 of them on anterior limb of arch, counting three or four rudimentary ones.

Pectorals ending above tips of ventrals or reaching slightly past them, never reaching nearly to above front of anal. Spinous dorsal much lower than soft dorsal; the fourth ray 3 in head, the eleventh $6\frac{1}{3}$, the twelfth 4. Second anal spine slightly longer, or sometimes of equal length, with the more slender third spine; its length $3\frac{1}{2}$ in head. Caudal rounded.

Color in spirits, no uniform color pattern, backward sides everywhere marbled with dark brown or blackish; belly and lower parts white; the dark irregular markings on fins darker at the edges, making sharp contrast with the lighter markings; a light area on middle of upper part of pectoral; pectoral lighter around posterior edge; a lighter band across middle of caudal rays; radiating lines sometimes present around eye; axil variously marked, colorless or dusky.

This species is generally common in rocky places in southern Japan. We have specimens from 8 to 11 inches long from Wakanoura and Nagasaki. It is recorded from Honolulu and from various localities in the East Indies and Polynesia, but some references may belong to other species.

(*cirrhosus*, fringed with locks of hair.)

33. SCORPÆNOPSIS KAGOSHIMANA (Steindachner and Döderlein).

Scorpæna kagoshimana Steindachner and Döderlein, Fische Japans, III, 1884, p. 28; and in Fische Japans, IV, 1887, pl. III; Kagoshima.

Head 3 times in total length; depth $3\frac{1}{3}$; Dorsal XII, 10; anal III, 5. Lateral line 22; scales 44 or 45.

Head $1\frac{1}{2}$ times longer than broad. Diameter of eye $1\frac{1}{2}$ in snout, $5\frac{1}{2}$ in head, and $1\frac{1}{4}$ in interorbital width. Maxillary reaching to under middle of eye. The cranial ridges and spines are broken up into many small spines. Interorbital with a rather deep channel. Pit at occiput broader than long. Under the anterior part of the eye is a deep pit. No teeth on palatines. Second anal spine somewhat longer, though not stronger than the third.

Color deep gray with broad, dark, diffused cross bands; under side of head dark; all of the fins clouded with dark; posterior half of caudal with a broad, dark cross band, which is crossed with light, wavy lines; inner side of pectoral light blue, anteriorly with dark spots; posterior edge of pectoral with a broad dark border. (Steindachner and Döderlein.)

This species may be known from *Scorpænopsis cirrhosa* by the long pectoral, which is shown in the plate to reach to above the second or third anal spine, and by the serrated cranial ridges. It is not represented in our collections.

(Kagoshima, basket-island, a port in Satsuma, in southern Japan, noted for the richness of its fish fauna.)

10. SETARCHES Johnson.

Setarches Johnson, Proc. Zool. Soc. Lond., 1862, p. 177 (*guntheri*).

Bathysebastes Steindachner and Döderlein, Denschr. Akad. Wiss. Wein, 1884, p. 207 (*albescens*).

Head and body compressed; head scaleless above, its bones cavernous; only 1 pair of spines at occiput; no transverse groove at occiput, only small spines or none above orbit; opercle and preopercle strongly armed with straight, long spines. Eye moderate, near, but not touching, profile. Mouth terminal, broad, somewhat oblique; maxillary extending to posterior edge of eye, much expanded behind. Lower jaw somewhat projecting, the small symphyseal knob received in rostral notch. Villiform teeth on jaws, vomer, and palatines. Preorbital with 2 or 3 spines. Opercle scaly. Scales cycloid, moderate. Lateral line a broad, scaleless groove with dermal (about 27 to 30) tubes. No dermal flaps. Dorsal deeply notched, with 12 spines, its origin in front of pectoral; soft dorsal shorter, the rays fewer than the spines. Anal inserted under end of dorsal, its spines strong, graduated. Pectoral broad and bony, with 20 or more rays, of which a considerable number of median ones are branched. Branchiostegals 6 or 7. Pyloric appendages few. Deep water.

(Etymology not obvious.)

34. SETARCHES ALBESCENS (Steindachner and Döderlein).

SHIRO KASAGO (WHITE ROCK-FISH).

Bathysebastes albescens Steindachner and Döderlein, Fische Japans, III, 1884, p. 207; off Tokyo.

Setarches albescens Steindachner, Fische Japans, IV, 1887, p. 39, same specimens.—Jordan and Snyder, Check List, 1901, p. 99.

Head $2\frac{2}{5}$ in length without caudal; depth $3\frac{1}{5}$. Dorsal XII, 10; anal III, 5. Pores of lateral line 27, series of scales below lateral line running downward and backward, 58. Eye $4\frac{1}{2}$ in head; interorbital width $4\frac{2}{3}$; maxillary $1\frac{9}{10}$; third anal spine $3\frac{1}{6}$; second anal spine $4\frac{1}{5}$.

Lower jaw projecting; symphyseal knob moderate. Mouth large; maxillary projecting to below posterior rim of orbit. Eye much shorter than snout. Teeth in very narrow bands. Interorbital space rather wide and convex, the bones of top of head very cavernous. Nasal spines very tiny; preocular spines small, but sharp, scarcely rising above surface of superocular rim, but slightly projecting laterally; parietal spines preceded by very low, scarcely evident ridges; a low ridge running backward from upper third of eye and ending in a small spine above preopercle ridge.

Opercle with two ridges originating at a common point near preopercle ridge, diverging, and ending in 2 sharp spines near edge of opercle. Preopercle with 5 long spines, the next to the upper one the largest, its length from preopercle ridge five-sixths of diameter of eye; the next below and the upper one subequal, the upper one on a level with suborbital ridge, the lowest one pointing downward. Preorbital with 3 large sharp spines; the posterior one the largest and pointing somewhat backward, the anterior one pointing almost directly forward, and the middle one slightly forward. A slit behind last gill arch, half the diameter of the eye in length. Gill-rakers rather short and slender, widely spaced, the longest one-third eye; 10 of them on anterior limb of arch.

Scales thin and cycloid. Head naked everywhere, except on opercle and cheeks, where the scales are inconspicuous. Fins naked.

Pectoral reaching to above base of first soft ray of anal, outline of pectoral rounded, its lower rays swollen, but only the lower three or four simple; it has 21 rays. Ventrals reaching three-fifths of the distance from their base to front of anal. Fourth dorsal spine four-fifths length of longest dorsal rays, $3\frac{1}{2}$ in head; the eleventh 9 in head. Caudal truncate, or very slightly rounded, $1\frac{5}{6}$ in head. Peritoneum white.

Alcoholic specimen showing scarcely any color; a little brown pigment on back, a few dots in front of pectoral and cheeks, a dark shade on opercle, caused by dusky lining of opercles showing through; fins colorless. They were doubtless red in life.

Here described from a specimen 22 cm. in length. The picture of this species given by Steindachner and Döderlein, Kentniss der Fische Japans (IV), Plate I, agrees very well with our specimen.

This species is known to us from several specimens in the Imperial University Museum, one of which was presented to the Leland Stanford Junior University Museum, taken in deep water off Misaki. It was dredged by the U. S. Fish Commission steamer *Albatross* at Station 3729, off Omai Point, Totomi, in 34 fathoms.

(*albescens*, whitish.)

11. LYTHRICHTHYS Jordan and Starks.

Lythrichthys JORDAN and STARKS, new genus (*eulabes*).

This genus differs from *Setarches* chiefly in having the interorbital concave, the head more strongly armed with spines, the next to the upper preopercle spine (which in *Setarches* is the largest one) scarcely developed, with one less dorsal spine, and the last spine not longer than the one preceding it. The notch between dorsals is very deep, almost separating them.

Small species of the sea bottom in rather deep water.

(λύθρον, gore, from the red color; ἰχθύς, fish.)

35. LYTHRICHTHYS EULABES Jordan and Starks, new species.

Head $4\frac{1}{4}$ in length, without caudal; depth 3. Dorsal XI, 10; anal III, 5. Pores of lateral line 26. Eye 4 in head; interorbital $3\frac{3}{4}$; maxillary 2.

Body shaped as in the shorter species of *Sebastodes;* the back arched,

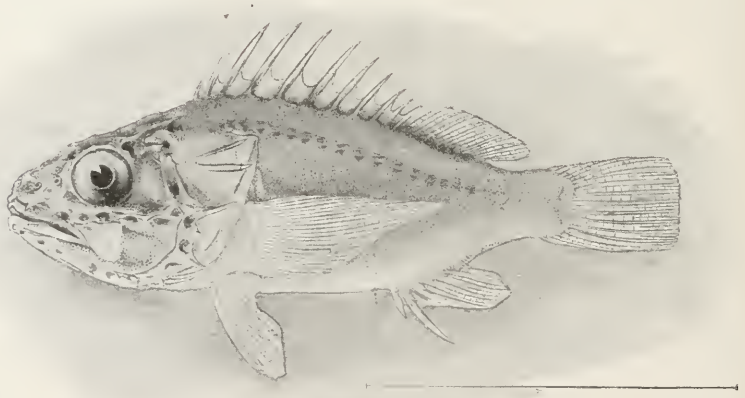


FIG. 11.—LYTHRICHTHYS EULABES.

highest at first dorsal spines, and the ventral outline from isthmus to anal straight.

Head large, wider than body. Mouth little oblique, the tip of premaxillary on a level with lower margin of orbit; maxillary extending to below posterior orbital margin. Lower jaw slightly projecting and with a small knob at symphysis, its tip fitting into a rostral notch. Teeth in narrow bands on jaws, vomer, and palatines. Interorbital space concave; at its middle a pair of interorbital ridges with rather a wide channel between. Nasal and preocular spines small, but rather sharp; superocular and postocular spines smaller and blunt, represented by notches in the superorbital ridge; parietal ridges moderately high and sharp, ending in rather blunt, small spines. Preopercle with 5 spines, the uppermost the longest, long and sharp, projecting beyond

preopercle edge, a distance equal to half the diameter of eye, the middle one but little shorter, the one between very short, triangular, as wide at its base as it is long, the lowest short, rather sharp and hooked forward. Preorbital armed with 3 long, sharp spines, the anterior one directed forward, the posterior one downward and backward, and the middle one downward. Opercle with 2 ridges radiating from a point near opercle and ending in spines. Gill rakers slender and moderately long, 10 on anterior limb of arch.

Scales very thin and cycloid. Head naked except cheeks and opercle. Lateral line with large dermal tubes. Fins naked.

Pectoral reaching to above middle of anal base. Ventrals nearly reaching vent. Dorsals nearly separated; last 3 spines not graduated in size, last 2 very tiny and subequal in length, the preceding one twice as long; the fourth spine longest, 2½ in head. Peritoneum white.

Body (red in life) with dots of dark brown scattered sparsely over it. Spinous dorsal dusky; other fins colorless, doubtless red in life. One small specimen 48 mm. in length, dredged by the U. S. Fish Commission steamer *Albatross* (at 3708) in Suruga Bay, off Ose Point, in 60 to 70 fathoms. It bears the number 50910 in the U. S. National Museum.

(*εὐλαβής*, wary.)

12. PTEROIS Cuvier.

Pseudomonopterus Klein, Missus. Pisces, V, 1756, p. 76 (nonbinomial) (*volitans*).
Pseudopterus Klein, same type.
Les Pterois Cuvier, Règne Animal, 1st ed., 1817, p. 286 (*volitans*).
Pterois Oken, Isis, 1817, p. 1182, same type.
Pterois Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 351 (*volitans*).
Macrochirus Swainson, Nat. Hist. Classn. Anim., II, 1839, p. 264 (*miles*).
Pteroleptus Swainson, Nat. Hist. Classn. Anim., II, 1839, p. 264 (*longicauda*).
Pteropterus Swainson, Nat. Hist. Classn. Anim., II, 1839, p. 264 (*radiata*).

Body elongate, compressed, covered with moderate or small-sized scales, which are usually not ciliated. Bones of head well armed; the upper surface of head with cirri; opercle with a spine; mouth large, with teeth on jaws and vomer, none on palatines; dorsal fin elevated, with 12 or 13 spines, which are slender, sharp, and joined by membrane only at base; soft dorsal with branched rays; anal with three spines and 6 to 8 branched rays; caudal rounded or truncate; ventral moderate, or long, the rays I, 5. Pectorals greatly elongate, the rays simple and largely free from the base, the tips reaching to or beyond the caudal fin.

Species of rather large size, abounding about the coral reefs in the tropical Pacific, dreaded by fishermen on account of their venomous spines. The coloration is very showy, most of the species being yellowish with dark bands.

(*πτερόν*, wing.)

a. Dorsal spines 13; scales not ciliated.

b. Scales very small, in 95 transverse series, 14 scales between median dorsal spines and lateral line; soft parts of vertical fins with brown spots; ventrals with yellow spots; pectoral rays about 15 ..... *volitans*, 36.

bb. Scales larger, "in 70 transverse series" (39 as usually counted); 8 scales between median dorsal spines and lateral line; soft parts of vertical fins faintly spotted; ventrals with dusky spots; pectoral rays about 13..... *lunulata*, 37.

36. PTEROIS VOLITANS (Linnæus).

MINOKASAGO (RAIN-COAT ROCKFISH) LION-FISH.

Gasterosteus volitans Linnæus, Syst. Nat., 10th ed., 1, 1758, p. 296, after *Perca dorso-monopterygio, capite cavernoso* of Gronow, Mus. No. 191.

Pterois volitans Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 352, fig. 88; Molucca, Amboyna, Ile de France, Bourbon, Ceylon, Red Sea, Seychelles, Pondicherry.—Günther Cat. Fishes, II, 1860, p. 122; Cape of Good Hope, Madras, China, Amboina, Sydney, Cape Upstart, Fische der Südsee, 1875, p. 81; Palau Is., Tahiti.—Ishikawa, Prel. Cat., 1897, p. 50; Miyakoshima, Riukiu Islands.

Pseudomonopterus volitans Bleeker, Acad. Roy. Sci. Amst., 1876, p. 44.

Scorpæna miles Bennett, Fishes Ceylon, 1828, p. 2, Ceylon.

Pterois muricata Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 363, Red Sea.

Pterois geniserra Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 366, Ava.

This species is thus described by Günther:

D. XII, I, 11; A. III, 6 or 7; scales 90, pyloric cæca 3; vertebræ 10 + 14.

Nape naked, space between eyes very concave, the width equal to the diameter of the eye which is $1\frac{2}{4}$ in snout. Pectoral fins reaching to or beyond the caudal fin. Color red; snout, head, and whole body with a great many blackish cross-streaks: all the rays of vertical fins spotted, the spots on the pectorals and ventrals larger and between the rays.

This species is very widely diffused throughout the East Indies. Two specimens from the Riu Kiu Islands, one being from Miyakoshima, are in the Imperial Museum of Tokyo. Another specimen is from Ogosahara in the Bonin Islands. There is no other certain record from Japan.

(*volitans*, flying.)

37. PTEROIS LUNULATA Schlegel.

MINOKASAGO,[a] YAMANOKAMI (MOUNTAIN WITCH).

Pterois lunulata Schlegel, Fauna Japonica, Poiss., 1843, p. 46, pl. xv; Nagasaki.—Richardson, Ichth. China, 1846, p. 213; Canton.—Bleeker, Verh. Kon. Ak. Wet., I, about 1862, p. 3; Japan.—Günther, Cat. Fish., II, 1860, p. 124; Japan.—Steindachner and Döderlein, Fische Japans, II, 1884, p. 31;

[a] Mino means Japanese rain coat. Kasago is an ancient name applied to *Sebastiscus marmoratus*.

Tokyo.—Ishikawa, Prel. Cat., 1897, p. 50; Tokyo, Enoshima.—Jordan and Snyder, Check-List, Fishes Japan, 1901, p. 99; Tokyo.

Pseudomonopterus lunulatus Bleeker, Ac. Roy. Sci. Amst., 1876, p. 47; Japan; Singapore.

Head $2\frac{3}{4}$ in length without caudal; depth 3; dorsal XIII, 12; anal III, 8. Scales 39; pores of lateral line 23. Eye 5 in head; interorbital $4\frac{1}{2}$; snout $2\frac{1}{2}$; maxillary $2\frac{1}{6}$.

Lower jaw not projecting; symphyseal knob well developed; tip of lower jaw fitting into a deep, toothless, rostral notch, but without teeth developed in a knob at tip. Palatines toothless; vomer with a triangular patch of teeth; moderate bands of villiform teeth in jaws. Maxillary reaching to below anterior edge of pupil; backward extending processes from premaxillaries forming a conspicuous bunch on snout, and making a notch in upper profile between them and raised supraorbital rim. Nasal spines small and sharp; preocular spines when present very small, sometimes absent; a small knob of bone present just behind preocular spine on supraorbital rim, to which supraorbital filament is attached; a rather sharp, triangular, postocular spine present; parietals with very high sharp ridges ending in a spine; a nuchal spine close behind; 2 spines behind eye in a line with lateral line; suborbitals with a slight ridge broken up into 2 small spines; preopercle with 3 spines and a rudimentary one below; the upper one the largest. Preorbital with an anterior low rounded lobe and 2 angulated filament-bearing lobes behind; no spines. Interorbital space very deeply concave and with two slight ridges, between which is a shallow wide channel. Supraorbital filament small in the adult, long in young examples (in a specimen 17 cm. in length they are as long as the interorbital width); a long filament on posterior angle of preorbital, longer than diameter of eye, and a smaller one, scarcely a third as long, on angle at middle of lower edge of preorbital; 2 filaments on lower edge of preorbital; a filament on posterior edge of anterior nostril. Gill-rakers very short, 10 of them on anterior limb of arch. Snout, occiput, mandible, maxillary, and interopercle naked; opercle, cheeks, and interorbital with scales; the scales on interorbital very fine.

Length of pectoral varying with size and sex: in male examples 21 cm. in length it reaches to middle of caudal rays, in those from 14 to 16 cm. it reaches to the tip of the caudal; in a female 21 cm. in length it barely reaches to base of caudal. The tips of the pectoral rays are filamentous in males; in females a broad thin membrane, free on the lower edge, extends to the tips of the upper pectoral rays. Membrane of upper pectoral ray incised about to the basal fourth of the second ray; that of second ray about to basal two-fifths of third ray; that of third to basal two-thirds or three-fourths of fourth; the membrane of the upper 3 rays is incised to the next ray below each,

each ray bearing the free membrane only on its lower edge; the membrane between the other rays is notched, each ray bearing an equal share of the free membrane. Dorsal spines of males longer than those of females, and the membrane growing gradually less to tip of spine; in females the membrane is wider and is of same width nearly to tip of spine; fifth, sixth, seventh, and eighth spines subequal; the second, third, and fourth growing slightly and gradually shorter anteriorly; the first abruptly shorter, three-fifths the length of fifth; the ninth, tenth, and eleventh growing gradually shorter; the twelfth and thirteenth abruptly shorter, the former 2½ times in fifth. Ventrals reaching to front of anal. Caudal rounded, as long as head. Peritoneum white.

Color in spirits: Body crossed with many dark brown or blackish narrow bars across light ground. Interorbital space with a dark longitudinal stripe running from behind eye to premaxillary processes, where it meets a V-shaped mark; a band from supraorbital rim to anterior preorbital barbel; two or three short ones before it; a band crossing iris and running downward from eye; three narrower ones in front of it radiating from eye; a band across occipital region just behind eye, continuous with its fellow of the opposite side, running obliquely backward across preopercular spines to edge of opercle; a narrower one in front of it; a band across parietal ridges running obliquely backward to edge of opercle to above base of upper pectoral ray; one or two shorter ones in front of it and three behind; a wide band from second dorsal spine crossing a conspicuous dark spot behind opercular flap and extending on axil; parallel to the last is a narrower band from third spine crossing body; a shorter, still narrower streak just in front of it; a wide band from fourth dorsal spine running downward and back parallel to the last and meeting a similar band from sixth spine running straight downward at a point some distance below lateral line, inclosing a short streak from fifth spine which stops at lateral line; behind this bands are parallel and run straight downward; a moderately wide one from eighth spine; a wider one from tenth; three narrow ones from eleventh, twelfth, and thirteenth spines, the middle one the widest; a wide one from second ray; a narrower one from fourth; a wide one from seventh, and a very narrow one under last ray. All of these bars involve membrane of spinous dorsal or base of soft dorsal. Two stripes across caudal peduncle and one at base of caudal rays. Each dorsal spine with three or four large dark spots having an interval between each equal in width to the spots. Each ray of pectoral crossed with several large spots equal in width to interval between; their edges soft and blended; on the membrane at each side they run obliquely backward. Rays of ventrals crossed by four or five distinct but irregular dark bars, which usually cross the membrane, but sometimes are broken between each ray. Small examples with distinct small black spots on dorsal, anal, and caudal, which

disappear more or less on the larger ones, though usually traces of a few of them remain.

Except where otherwise stated, measurements in this description were taken from male specimens 21 cm. in length. Specimens were collected by Jordan and Snyder at Tokyo, Misaki, Yokohama, and Wakanoura. It is a rather common market fish, but in market specimens the first dorsal is removed by the fishermen, who dread its sting.

(*lunulatus*, crescent-shaped.)

13. EBOSIA Jordan and Starks.

Ebosia JORDAN and STARKS, new genus (*bleekeri*).

This genus is allied to *Pterois*, differing in the shorter pectoral, which barely reaches the base of the caudal, and in which the rays are united by membrane nearly to their tips. From *Dendrochirus* Swainson, with which genus it agrees in these respects, it differs in the presence of a large saber shaped angulated ridge of bone rising on each side of the nape. The dorsal spines are high and joined by membrane nearly to their tips. The scales are large and rough. The single known species is thus far known only from Japan.

(Eboshi, an ancient Japanese helmet or head-dress shaped like the nuchal appendages in this genus, hence the vernacular name of Eboshi-Kasago.)

38. EBOSIA BLEEKERI (Steindachner and Döderlein).

EBOSHIKASAGO (HELMET ROCK-FISH).

Pterois bleekeri STEINDACHNER and DÖDERLEIN, Fische Japans, III, 1884, p. 32, pl. VI, fig. 1, 1a; Tokyo.—ISHIKAWA, Prel. Cat., 1897, p. 50; Tokyo.—JORDAN and SNYDER, Check List, 1901, p. 99; Tokyo.

Head $2\frac{3}{5}$ in body; depth $2\frac{6}{7}$. D, XIII, 9. A, III, 7. P, 16. Eye 4 in head, snout $3\frac{1}{5}$.

Maxillary extending to middle of eye; occipital crest, thin, lunate, varying in height; perhaps smaller in females; upper orbital margin irregularly toothed; tentacles all short over eye on anterior nostril on preorbital and preopercle. Interorbital space scaleless. Cheeks, opercle, and sides of posterior part of head with rough persistent scales. Preorbital (in male) rough. Longest dorsal spine, not quite 3 in head. Pectorals not reaching caudal; ventrals usually reaching anal.

Color much as in *Pterois lunulata*, the fins yellowish, only the pectorals showing broad dark cross-bars. Posterior part of head with a dark band, which descends vertically to the posterior edge of opercle. Three dark bands radiating from eye. (Steindachner and Döderlein).

This species is known to us from a single example found in the market at Tokyo by Mr. Otaki. It is very well figured by Steindachner and Döderlein.

(Named for Pieter van Bleeker).

14. APISTUS Cuvier.

Apistus Cuvier, Règne Animal, 10th ed., 1828 (*alatus*).
Pterichthys Swainson, Nat. Hist., II, 1839, p. 265 (*carinatus*).
Polemius Kaup, Wiegman's Archiv. 1858, p. 333 (*alatus*).

Body oblong, compressed, covered with moderate or small scales. Head without spinous crests above, the sides rough. Orbit serrate. Preorbital with three spines, the posterior elongate and directed backward; preopercle with 4 to 6 spines; opercle with 2. Mouth large; teeth on vomer and palatines. Dorsal fin long, beginning behind the eye, deeply notched, the spines 15, the soft rays 7 to 9; anal rays III, 7 or 8. Pectorals elongate, acute, of 11 rays, connected by membrane, the lower ray free. Ventral rays I, 5. Caudal fin rounded. Small fishes of the coasts of southern Asia, notable for their long pectoral fins and for the envenomed dorsal spines.

(ἄπιστός, perfidious.)

a. Scales about 72 in lengthwise series; maxillary 2½ in head; caudal fin with 6 or 7 narrow cross bands ..... *evolans*, 39.

aa. Scales about 60; maxillary 2¼ in head; caudal with three broad irregular dark bars ..... *venenans*, 40.

39. APISTUS EVOLANS Jordan and Starks, new species.

HIREKASAGO (LONG-FINNED ROCK-FISH).

Apistus alatus Bleeker, Ac. Roy. Sci. Amst., 1876, p. 59, pl. III, fig. 2; Kiusiu (not *Apistus alatus* Cuvier and Valenciennes, *Apistus carinatus* Bloch and Schneider).—Ishikawa, Prel. Cat., 1897, p. 50; Sagami Bay.—Jordan and Snyder, Check List, 1901, p. 99.

Head 2⅞ in length without caudal; depth 3⅘; dorsal XV, 9; anal III, 8; scales 72, counting series above lateral line running down and forward. Eye 4⅓ in head; maxillary 2½; interorbital 10.

Lower jaw with a well-developed knob at symthysis strongly projecting and sharp at tip, fitting into a deep rostral notch. Mouth oblique, the front of premaxillaries on level with lower margin of pupil. Posterior margin of eye nearer tip of snout than end of opercular flap by a diameter of the pupil. Maxillary scarcely extending to anterior margin of pupil. Teeth on premaxillaries in a narrow band widest at sides, becoming narrow and pointed in front; a wide toothless interval in front; band of teeth on lower jaw scarcely wider in front; the palatine and vomerine bands very narrow; those on the vomer in a sharply curved band which is widest at the ends. Interorbital narrow and deeply concave, having parallel interorbital ridges with a narrow channel between, the ridges curve outward behind the eye and are continuous with the sharp parietal ridges. Suborbital plates very wide, as wide as diameter of eye and covering cheek, their surface roughened with radiating ridges, as is that of opercle; along their center is a very slight ridge continuous with large preopercular

spine. Preopercle with a long sharp spine and 4 blunt triangular ones below, these not on preopercular ridge but on wide flat produced edge of preopercle; the next to the upper of the lower blunt spines the largest, the lowest but little developed. Opercle with 2 flat slight spines. Preorbital with a long curved spine at its posterior end reaching backward to end of maxillary, and a pair of small spines at its anterior end directed forward. Parietal ridges not ending in spines. From the upper posterior border of the eye a low broken ridge runs to the anterior end of the lateral line. Superior anterior border of eye denticulate. A long tentacle on each side of lower jaw three-fourths of diameter of eye from its tip, and a smaller one at its tip. Pseudobranchiæ large; a short slit behind last gill; gill-rakers long and slender, the longest a little over half the diameter of eye; 16 of them on anterior limb of arch. Lower jaw and lower part of pre-

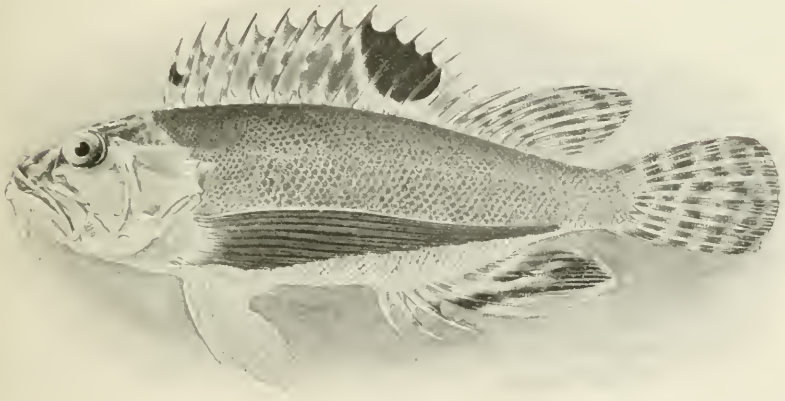


FIG. 12.—APISTUS EVOLANS.

opercle thickly covered with very small pores. Head naked, except a little patch on cheek below suborbital stay and behind maxillary.

Body, breast, and isthmus everywhere evenly scaled; scales thin and not rough to the touch, but appearing under the lens coarsely toothed. Lateral line straight, not following contour of back. Fins naked.

Pectoral reaches to within half the diameter of the eye to the base of the caudal rays. Pectoral rays all branched except a couple of the short lower ones; number of rays 10; the upper one the longest. Detached pectoral ray equal to distance from tip of snout to tip of large preopercular spine. Ventrals reaching past vent but scarcely to front of anal. Fourth dorsal spine 2 in head; from the fourth to the tenth or eleventh spine the spines are subequal; the first is 2½ in head, equal to the last; the next to the last the shortest, 4 in head. The second dorsal ray the longest, 1⅓ in head; when fin is depressed none

of the rays reach past the tips of the second and third; tips of last rays reach base of caudal; tips of the longest reach half the diameter of the eye past base of caudal. Anal spines graduated in length, the first equal to the diameter of the eye, the third twice as long. Longest anal ray 1⅓ in head, and reaching to base of caudal. Caudal rounded.

Color: Under part of head, base of pectoral, and small area behind pectoral white; sides of head silvery; lower part of body light, probably silvery; back a uniform light brown becoming lighter below and shading to the light lower parts; top of head and snout marbled with vermiculated light streaks; a broad light band across nape, bordered with white at ends of parietal ridges and in front of first dorsal spine; membrane of spinous dorsal white, mottled with darker; a small black spot on membrane behind first spine; an oblong jet-black spot on middle of spines from ninth to twelfth spine entirely surrounded with pure opaque white; soft dorsal crossed by irregular brown and white streaks; pectoral jet black, its upper and lower ray light; detached pectoral ray white; pectoral soiled white on inner surface; ventrals white, slightly dusky toward ends of rays; anal white with a black band in sharp contrast becoming wider behind and including within its borders some large spots of the white ground color; caudal crossed by 6 or 7 narrow irregular wavy brown bands, with white intervals of equal width. Peritoneum white.

This species differs from *Apistus venenans* in having the scales smaller, maxillary shorter, eye smaller, interorbital narrower, dorsal spines higher, head rougher, preorbital spine longer, and the color different, especially the pattern on caudal.

A single specimen, the type, collected at Tokyo by Professor Otaki, is 15 cm. in length, and is numbered 7393, ichthyological collections, Leland Stanford Junior University Museum.

(*erolans*, flying away.)

40. APISTUS VENENANS Jordan and Starks, new species.

Apistus alatus SCHLEGEL, Fauna Japon. Poiss., 1843, p. 49, pl. XXII, fig. 2; Nagasaki (not of Cuvier and Valenciennes, whose types came from Pondicherry=*Apistus carinatus* Bloch and Schneider).—STEINDACHNER and DÖDERLEIN, Fische Japans, IV, 1884, p. 200; Kagoshima, Kochi.

Head 3⅗ in length without caudal; depth 3½. Dorsal XV, 9; anal III, 8. Scales 60, counting series above lateral line running downward and forward. Eye 4 in head; maxillary 2¼; interorbital 9.

Lower jaw projecting and fitting into a rostral notch. Posterior margin of eye midway between tip of snout and end of opercular flap. Maxillary reaching just past front of pupil. Teeth in very narrow bands; narrower on palatines and vomer than on jaws; the bands on premaxillaries narrower and pointed in front, and separated from each other by a wide toothless area. Interorbital narrow and concave and

having a narrow channel between the slight interorbital ridges. Suborbital plates very wide, covering cheek, a slight ridge along them continuous with ridge from large preopercular spine; the plates otherwise smooth. Opercle with 2 small spines at the ends of slight ridges. Preopercle with a long sharp spine and 4 short blunt ones below, the largest forming an angle. Preorbital with a pair of small spines anteriorly pointing forward, and a long, sharp, curved spine posteriorly which fails to reach the end of the maxillary by a distance nearly equal to diameter of pupil. Parietal ridges not bearing spines. From upper posterior border of eye a slight broken ridge runs to beginning of lateral line. Superior anterior border of eye denticulate. A long tentacle at tip of mandible and one on each side of similar size half the diameter of the eye behind it. Pseudobranchiæ large; a small slit behind last gill arch; gill-rakers slender, equal to half eye; 14 of them

Fig. 13.—Apistus venenans.

below angle of arch. Head entirely naked, except a small patch of scales on cheek below suborbitals and just behind maxillary.

Body, breast, and isthmus evenly scaled with soft pectinate scales. Lateral line straight. Fins naked.

Pectoral reaches to just past base of dorsal or to within a diameter of eye of caudal base; number of rays 10, all branched except a couple of the lowest short ones, the upper ray the longest. Detached pectoral ray $1\frac{2}{3}$ in head. Ventrals reaching to base of second anal spine. Fourth dorsal spine $2\frac{2}{5}$ in head; last spine $3\frac{1}{5}$; next to the last $3\frac{1}{2}$. Tips of dorsal rays reach past base of caudal. First anal spine equal in length to the diameter of the eye, the third twice as long, and the second in length midway between. Caudal rounded.

Color: Lower parts of head and body white, sides of head silvery; back and sides of body uniform light brownish, shading gradually to the white of lower parts; a broad dark band across top of head, extend-

ing down on the sides to upper margin of pupil, its anterior edge above middle of eyes, its posterior edge at posterior end of parietal ridges, giving place to a light crescent in front of dorsal spine; it is irregularly vermiculated with white lines, and between the parietal ridges is a white spot: snout dusky: a dark band running anteriorly from eye; membrane of spinous dorsal white, mottled with dark, a dark spot between first and second spine, and a large black spot between eighth and thirteenth spines surrounded by white; soft dorsal with 3 or 4 dark bands across rays with intervals of white between equal to them in width; pectoral jet black on outer surface, white on inner; detached ray white; ventrals white, dusky toward tips, extreme tips white; first 2 anal spines white, the rest of fin dusky and with a darker band across middle of rays; caudal crossed by 3 rather broad irregular bars, the one at tips of rays darker, between them 3 white bands, equal to them in width, the first across base of rays. Peritoneum white.

The following color note made from a fresh specimen: Color brown; pale markings, dirty white; dark ones brown or black; no red or yellowish.

This species differs from Day's description of specimens from the Indian Ocean, particularly in not having the parietal ridges ending in spines, and from his plate in having the soft dorsal much higher, the first dorsal spine lower, in having the black dorsal spot surrounded by white, not shading into a dusky band along entire top of spinous dorsal, and in having no red or yellowish in life.

The type and single specimen taken at Nagasaki. It is 105 mm. in length and is numbered 7371 Ichthyological Collections, Leland Stanford Junior University Museum.

It is apparently the species described as *Apistus alatus* by Schlegel, while Bleeker's figure seems to belong rather to *A. evolans*. Both seem to be distinct from *Apistus carinatus*=*A. alatus* of the East Indies.

(*venenans*, poisoning).

15. MINOUS Cuvier and Valenciennes.

Minous Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 420 (*wroora*).
Corythobatus Cantor, Cat. Malayan Fishes, 1850, p. 45 (*wroora*) (*Minous*, supposed to be preoccupied by the prior name *Minois*).

This genus differs from *Apistus* chiefly in the absence of scales, the skin being smooth. The head has rough crests above and the preorbital has 2 diverging spines. Preopercle with 4 or 5 spines; 2 opercular spines; mouth moderate; lower jaw with slender cirri. Teeth on the vomer, none on the palatines.

Fin rays all simple. Dorsal with 10 or 11 stiff spines and 9 to 11 rays, the fin beginning behind the eye. Anal spines flexible; the rays

II, 9. Ventral rays I, 5. Pectoral fins moderate, the lower ray free. Small fishes of the East Indies.

(*woora-minoo*, a Hindu name given by Russell.)

a. Lower preopercular spine truncate; ventrals reaching front of anal; caudal with 2 broad, dark bars ..... *adamsi*, 41.

aa. Lower preopercular spine hooked backward; ventrals scarcely reaching vent; caudal with irregular bars ..... *echigonius*, 42.

41. MINOUS ADAMSI[a] Richardson.

OKOZE.

Minous adamsi Richardson, Voy. Samarang, 1850, p. 7, pl. II, figs. 4, 5; Sea of China.

Head (exclusive of projecting lower jaw) $2\frac{4}{5}$ in length without caudal; depth 3. Dorsal X, 11; anal 11 or 12. Eye 4 in head; maxillary $2\frac{1}{3}$.

Lower jaw strongly projecting and entering into the upper profile. Teeth in narrow bands on jaws in two widely separated patches on vomer. Maxillary extending to below front margin of pupil. Interorbital wide and concave, having a pair of ridges with a channel between, along which runs a slight median ridge which divides and diverges posteriorly; interorbital width $1\frac{1}{4}$ in length of orbit.

Preorbital with a long sharp posterior spine which reaches nearly or quite to end of maxillary, and a small spine in front pointing downward. Preopercle with 6 spines, the upper one short and triangular, directed slightly upward; the next below by far the longest and very sharp, reaching to edge of opercle; the two next below short and rather blunt, and the lower two directed downward and truncate at their tips. Bones of head, where they appear, everywhere rough and deeply sculptured; the suborbitals are wide, rough, bony bucklers bearing a prominent but blunt ridge, a transverse depression on top of head behind eye separating the postorbital from the interorbital region. Parietals produced in wide, blunt, rough ridges, which end behind in blunt spines. A similar ridge on side of head behind eye extending out on post-temporal and ending in a spine. Post-temporals apparently firmly joined to cranium. Nasals ending above in

[a] The following is the synonymy of the closely related Indian species, *Minous monodactylus* (Bloch and Schneider):

Scorpæna monodactyla Bloch and Schneider, Syst. Ichth., 1801, p. 194.

Minous monodactylus Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 424, pl. LIX, fig. 2.—Günther, Cat. Fish., II, 1860, p. 148; Madras, Borneo, China.—Bleeker, Ac. Sci. Roy. Amst., 1876, p. 64; Java, Borneo, Celebes, Banka, Singapore, Sumatra, Pinang.

Apistus minous Cuvier, Régne Anim., 2d ed., 1828, after Russell.

Minous woora Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 421; India (Woora-minoo of Russell).

Corythobatus woora Cantor, Cat., 1850, p. 45; Malay Peninsula.

produced angles, but not in spines, their upper edge denticulate, as is the entire supraorbital rim. A short slit behind last gill arch. Gill rakers very small and blunt, 9 or 10 of them on anterior limb of arch. A tentacle on middle of mandible below, and a smaller one midway between it and tip of mandible. Lower parts of head and isthmus, especially maxillary and lips, thickly covered with blunt, fleshy papillæ; upper parts more sparsely covered, and traces of them may often be made out with the aid of a lens, scattered over the body. Lateral line represented by 17 or 18 small inconspicuous pores.

First dorsal spine situated three-fifths or three-fourths the diameter of eye distant from the transverse ridge across top of head behind eye; the first spine the longest of the anterior spines, its length equal to distance from tip of snout to front of pupil; the last spine the longest, longer than the first spine by the longest diameter of the pupil. No notch between dorsal spines and rays, the longest of the latter much longer than the spines; the tips of the last rays reach past the base of the caudal. Pectoral reaching to above base of third or fourth anal ray; the pectoral rays all simple, 11 in number. Detached pectoral ray in large specimens (12 cm. in length) equal in length to distance from tip of snout to middle of eye; comparatively longer in smaller specimens usually not reaching front of anal. Ventrals usually reaching about to front of anal, adnate to body, except a small portion at ends of rays; free portion equal to diameter of eye. Caudal rounded. Distance from base of pectoral filament to anal nearly equal to head.

Color brownish above, usually with vermiculated diagonal or longitudinal light streaks above and below lateral line, but never crossing it; lateral line runs along a brown streak and often has a light streak above and below defining it; above the light and dark streaks extend on dorsal; lower part of sides, belly, and under part of head white; a black spot on membrane behind tip of each dorsal spine; a larger black spot across tips of first 3 or 4 dorsal rays; anal, ventrals, and pectoral black, shaded at base into the white of lower parts of body; the pectoral crossed by inconspicuous lighter vermiculated streaks, its inner surface white; caudal crossed by 2 wide solid dusky bands, separated by an interval narrower than themselves; these bands very constant; scarcely any variation in a hundred specimens examined. Peritoneum white.

Here described from specimens about 12 cm. in length. Upward of a hundred specimens were obtained by us from Onomichi, Nagasaki, Kobe, and Wakanoura. This species is closely allied to *Minous monodactylus* of the East Indies, differing in the stouter body shorter first dorsal species and in other details of color and structure. In Richardson's figure of *Minous adamsi*, the belly is shown as very short, the pectoral reaching middle of anal, the pectoral filament and

ventrals also past its front, the distance from base of filament to front of anal only about half head. His specimen was probably a shriveled male of this species. There is no previous record of this species from Japan, and this form belongs to a different faunal area. This is the common Okoze, or poison fish of the Inland Sea of Japan.

(Named for Arthur Adams, its discoverer.)

42. MINOUS ECHIGONIUS Jordan and Starks, new species.

Minous monodactylus Ishikawa, Prel. Cat., 1897, p. 49, No. 863; Niigata.

Head $2\frac{3}{4}$ in length without caudal; depth $2\frac{3}{4}$. Dorsal X, 11; anal 12. Eye $4\frac{1}{2}$ in head; maxillary $2\frac{1}{2}$. Lateral line with 17 pores.

Lower jaw strongly projecting, its tip sharply hooked up. Teeth in a very narrow band in lower jaw, scarcely wider in front, in a much wider band on premaxillaries, wider in front; teeth on vomer in 2

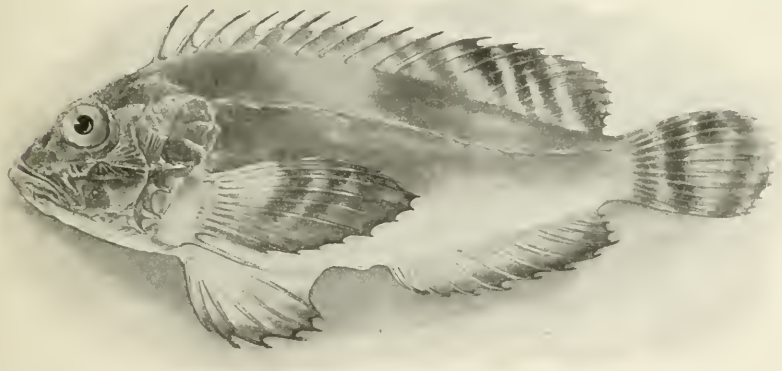


Fig. 14.—Minous echigonius.

widely separated patches. Maxillary reaching to just past front of orbit. Interorbital wide and concave, the ridges as in *M. adamsi*, its width equal to diameter of orbit. Preorbital with a long, sharp posterior spine, which reaches nearly to end of maxillary, and a small spine in front which points downward. Preopercle with a long, slender, sharp spine, reaching nearly to margin of opercle; above it, a wide triangular spine; below it, 4 short spines, the upper of which is closer to the large spine than to the next below; it is short and not very sharp; the next below is slightly longer and sharper; the next, closer to it than to the next below, its point rather sharp and hooked backward; the lowest is smaller and is directed downward. Exposed bones and ridges of head rough and arranged as in *M. adamsi*. Last gill arch with a short slit behind it. Gill rakers short and blunt, 8 in number on anterior limb. A tentacle at middle of lower jaw below, a smaller one midway between it and tip of jaw, and several small ones

at tip of jaw. Head and especially lips and maxillary covered with small, fleshy papillæ.

Pectoral reaching to above base of second anal ray; detached pectoral ray equal to distance from tip of snout to posterior border of pupil. Ventrals adnate to body for nearly their whole length, their tips scarcely reaching to vent. Last dorsal spine the longest, $2\frac{2}{5}$ in head; the longest dorsal rays equal in length the length of snout and eye.

Color of type much faded; light brownish above; lower parts of body and head white; a light streak running along lateral line above and below leaves it in a dark streak; each dorsal spine with a brown spot on membrane behind its tip; soft dorsal with a large brown spot on distal ends of first 6 rays, the rays crossed by light streaks; pectoral dark brown on its outer surface, white on its inner; ventrals and anal dark brown at tips of rays, shading to the white of body; tip of caudal white, on distal third rays are crossed by a dark bar, which divides below; in front of it is a wide light interval with a brown spot in the middle; then a narrow, dark, irregular bar across middle of rays, and then a wide white area with traces of bars above and below. Peritoneum white.

This species is close to *Minous adamsi*, differing in having a smaller eye; the tip of the mandible more hooked upward; the lower preopercular spines hooked backward, rather than truncate; the maxillary slightly shorter; the ventrals shorter and more adnate; the posterior outline of soft dorsal more broadly rounded; and in having the caudal marked with irregular bars. In *M. adamsi* there is scarcely any variation in the 2 broad bars crossing the caudal.

The type is a specimen 115 mm. in length from Niigata, in Echigo, presented to us by Dr. Ishikawa, of the Imperial Museum of Tokyo. It is numbered 7380, Ichthyological Collections, Leland Stanford Junior University Museum. It was formerly No. 863, Imperial Museum.

16. DECTERIAS Jordan and Starks.

Decterias Jordan and Starks, new genus (*pusillus*).

This genus differs from *Minous* principally in having the dorsal spines slender and flexible, rather than stiff and sharp; a narrow, deeply concave interorbital region, and no enlarged posterior preorbital spine. Japan.

(δεκτερός, stinging.)

43. DECTERIAS PUSILLUS (Schlegel).

Minous pusillus Schlegel, Fauna Japonica, Poiss., 1843, p. 50; Nagasaki.—Günther, Cat. Fish, II, 1860, p. 149, copied.—Steindachner and Döderlein, Fische Japans, III, 1884, p. 297; Kagoshima.

Head $2\frac{3}{5}$ in length without caudal; depth $3\frac{2}{5}$. Dorsal IX or X, 10 or 11; anal 10. Eye $3\frac{1}{2}$ in head; maxillary $2\frac{4}{5}$.

The upper profile of head very much broken up, the superior post-orbital region depressed anteriorly, leaving the supraorbital region much produced; a deep notch in front of orbital rim caused by the produced nasal region. Exposed bones of head very rough, the orbital rim denticulate; and 2 or 3 irregular denticulate ridges along suborbitals. Preorbital with 2 short spines, the anterior directed downward, the posterior downward and backward. Preopercle with a long, sharp spine above and 4 smaller ones below. Parietals very rough and produced behind in spines, a rough ridge running backward from posterior margin of eye. Mouth large; maxillary reaching to below front of eye. Narrow bands of teeth on jaws scarcely widened anteriorly; teeth on vomer in 2 small, widely separated patches. Interorbital space narrow and deeply concave; through it runs a pair of slight interorbital ridges, not very close together, its

FIG. 15.—DECTERIAS PUSILLUS.

width three-fifths of orbit, or 6 in head. Middle of under part of mandible with a rather long barbel, and a smaller one between it and tip of mandible. Last gill arch with a short slit behind it; 8 or 9 short, blunt gill rakers on anterior limb of arch.

Pectorals reaching to or a little past front of anal, and having 10 simple rays; lower detached ray reaching to tips of ventrals. Ventrals reaching to vent; about half of last ray adnate to body. Dorsal spines long and hair-like; the third, or longest, equal to snout and half eye. No notch between dorsals. Caudal rounded.

Color in spirits: Finely mottled with slaty above, abruptly white on lower half of side and body; membrane of spinous dorsal black; soft dorsal crossed by irregular dark lines; pectoral black on outer face; inside sometimes black, sometimes with a tinge of white, but never strikingly white as in species of *Minous;* ventrals and anal black toward tips of rays, shading at base into the white of the under

parts of body; each ray of caudal with 5 or 6 small dark spots arranged to form irregular dark cross lines across fin. Peritoneum white.

About a dozen specimens were taken by Jordan and Snyder at Wakanoura, the longest 6 cm. in length.

(*pusillus*, feeble.)

17. EROSA (Swainson) Jordan and Starks, new genus.

Erosa Swainson, Nat. Hist. Classn. Anim., II, 1839, p. 61; diagnosis, no reference to type, *erosa* understood from context.

Synanchia "Swainson" Bleeker, Nat. Verh. Holl. Maats. Wetens., 1874, p. 11 (reprint) (*erosa*): (not *Synanchia* Swainson, which was a mere misprint or vagary of spelling for *Synanceia*).

Body short and thick, covered with naked skin, on which are skinny flaps. Head very large, cuboid, irregularly formed, with deep grooves and depressions. Eyes small; mouth large, almost vertical; teeth on the vomer, none on the palatine; preorbital with two strong spines; preopercle with 5 bluntish spines; bones of the skull very thick; top of head rough; a large quadrangular pit at the vertex. Dorsal fin continuous with 13 stout spines and 9 soft rays; none of the spines separated; dorsal fin beginning behind the nape; none of the fin rays filamentous. Anal short, with 3 distinct and 5 soft rays. Pectoral short without free ray. Ventrals moderate, the rays 1, 4. Caudal rounded, skin smooth.

A single species, distinguished from *Synanceia* (*horrida*) = *Synancidium* = *Bufichthys*, by the form of the head, by the absence of warts and fringes on the smooth skin of the body, and by the absence of a deep cavity below the eye. As originally presented, neither *Erosa* nor *Synanchia* seem to have any standing in nomenclature. The genus is however valid, and we may adopt *Erosa* as its name, unless *Erosia* (1857) be regarded as excluding it.

(*erosus*, ragged, gnawed out.)

44. EROSA EROSA (Langsdorf).

DARUMA,[a] DARUMAOKOZE, TOKENOKO (BAMBOO-SPROUTS).

Synanceia erosa Langsdorff, in Cuvier and Valenciennes Hist. Poiss., IV, 1829, p. 459; Japan.—Schlegel, Fauna Japonica, Poiss., 1843, p. 45, pl. xvii, fig. 1; Nagasaki.

Synanchia erosa Swainson, Nat. Hist. Classn. Fishes, II, 1839, p. 268. (Name only; misprint for *Synanceia*.)

Synancidium erosum Günther, Cat. Fish, II, 1860, p. 146; Japan.—Steindachner and Döderlein, Fische Japans, III, 1884, p. 31; Tokyo, Kagoshima.—Nystrom, Kong. Vet. Akad., 1887, p. 19; Nagasaki.—Ishikawa, Prel. Cat., 1897, p. 49; Kagoshima.

Head $2\frac{1}{6}$ in length without caudal; depth 2. Dorsal XIV, 7; anal III, 6. Lateral line with 11 pores. Eye $4\frac{2}{5}$ in head; maxillary $2\frac{1}{3}$;

[a] Daruma is the red-faced squatting figure of a Buddhist saint.

interorbital space $2\frac{1}{6}$. Head very large, as wide as deep and much wider than body, covered with coarsely sculptured bones, rough, blunt spines and ridges. Mouth very oblique, more nearly vertical than horizontal, the bluntly rounded lower jaw shutting into it and scarcely projecting, a knob developed at symphysis. Teeth in narrow bands on jaws and vomer; slightly wider in front, wider in front on premaxillaries than on mandible. Top of head between eyes nearly flat, anteriorly at each side are rough, square projections between which is a square opening for the reception of the processes from the premaxillaries; across interorbital space just behind middle of eyes is a rough transverse ridge separating a square, deep pit behind it from the premaxillary process pit; a similar transverse ridge is at occiput at the posterior end of quadrate pit; at the sides the ridges are depressed slightly below the level of the occipital and interorbital ridges. The

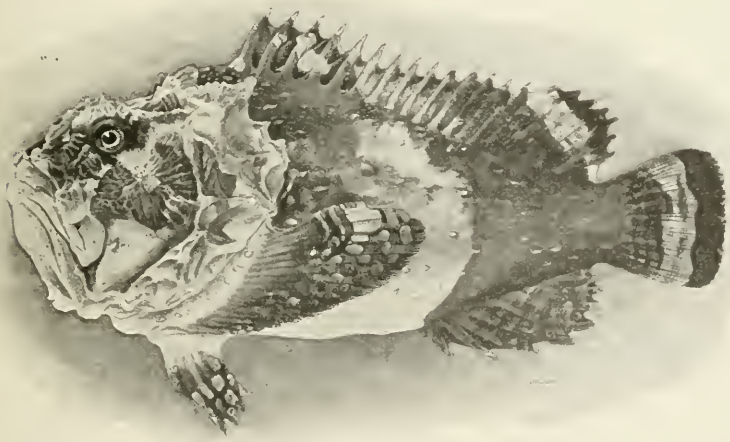


FIG. 16.—EROSA EROSA.

parietals end in a triangular rough process, while more lateral and posterior is a larger but similar process (probably on post-temporal). Behind eye is a very rough broken ridge on a level with lateral line. Superorbital rim very rough. Preorbital with 3 blunt spines along anterior edge. Suborbitals widen posteriorly into a rough, bony buckler nearly covering cheek, at the center of which is a prominent blunt spine. Preorbital ridge with 3 spines; preorbital edge with 5 rather long blunt spines, the upper ones the largest, growing smaller below; in a line with them is a similar spine on outer angle of articular. Opercle with 2 spines at the ends of ridges.

Distance of dorsal from tip of snout contained $2\frac{3}{5}$ times in entire length without caudal. The last dorsal spine the highest, $3\frac{1}{4}$ in head; the anterior spines only a little lower; no notch between dorsals; the rays higher than the spines, $2\frac{3}{4}$ in head. Pectoral with 16 rays, all branched, its tip reaching to front of anal, its fourth ray from the top

the longest, 1½ in head. Ventrals short, having 1 spine and 4 rays, their length 2½ in head. Anal spines graduated in length, the soft anal rays much longer, 3 in head. Caudal short and rounded, equal to length of ventrals.

Body scaleless; 3 or 4 rows of wart-like papillæ scattered over the back, and a few smaller ones above anal.

Color in spirits: Back and sides light brownish; top of head at interorbital space and a spot at pterotic region frosted with white; from base of second to seventh dorsal spine a pinkish red band extends downward to lateral line, a similar one on last 3 spines and entire soft dorsal extends down nearly to anal; a pinkish band mixed with fine brown lines across basal half of caudal, and one across tips of rays leaving a white band between; middle of soft dorsal with a white band across all rays but last 2; pectoral brown, crossed by fine, dark brown lines, a white spot on upper rays; ventrals and anal similar to dark part of pectoral; traces of pink on interorbital and suborbitals.

A smaller specimen has the pink very bright, and in addition has pink on opercles, on occipital region, and on basal two-thirds of pectoral. Another specimen has much milk white about the head, and the lower parts of body are lighter.

A fourth specimen differs in being nearly uniformly dusky or blackish on back, and in having the lateral line running in a white streak; fins marked similarly, but with blackish instead of red or dark brown.

Several specimens from Misaki, the largest 120 mm. in length.

18. INIMICUS Jordan and Starks.

Inimicus Jordan and Starks, new genus (*japonicus*).

Body elongate, little compressed, anteriorly low, covered with smooth skin; head depressed, fantastically formed; body, head, and fins with skinny flaps; mouth small, subvertical; teeth on vomer, none on palatines; dorsal spines slender, about 17 in number, the 3 anterior separate from the rest, the others connected by membrane at base. Pectoral fin large, the upper rays not filamentous, the 2 lower rays detached, connected by membrane at base. Ventral rays *i*, 5, the fin large. Fantastic, misshapen fishes often highly colored; dreaded by fishermen for their stinging spines. This genus differs from *Pelor* (*filamentosum*) chiefly in the absence of long filamentous tips to the upper rays of the pectorals. The head is more depressed and somewhat differently formed.

(*inimicus*, enemy.)

a. Color brownish or blackish with cross-bands of black or blood-red; orbital rim much elevated; a sharp ridge in front of orbital rim ..... *japonicus*, 45.

aa. Color orange with black spots, or else diffuse blackish shaded with orange; no distinct cross-bands; orbital rim and its ridges less elevated ..... *aurantiacus*, 46.

45. INIMICUS JAPONICUS (Cuvier and Valenciennes).

OKOZE, ONIOKOZE (DEVIL POISON-FISH).

Pelor japonicum Cuvier and Valenciennes, Hist. Poiss., IV., 1829, p. 437; Japan. Coll. Langsdorf.—Schlegel, Fauna Japonica, Poiss., 1843, p. 44, pl. xviii, fig. 2; Nagasaki.—Richardson, Ichth. China, 1846, p. 212; Canton.—Günther, Cat. Fish, II, 1860, p. 151; Canton, Japan.—Steindachner and Döderlein, Fische Japans, III, 1884, p. 197; Tokyo.—Steindachner, Reise Aurora, 1897, p. 203; Kobe.—Nystrom, Kong. Vet. Ak., 1887, p. 19; Nagasaki.—Ishikawa, Prel. Cat., 1897, p. 49, etc.; locality unknown.—Jordan and Snyder, Check List, 1901, p. 100; Yokohama.

Pelor tigrinum Richardson, Ichth. China, 1846, p. 212; Canton.

Head 3 in length without caudal; depth, $3\frac{1}{2}$. Dorsal XVII, 7; anal II, 9. Lateral line tentacles 15. Eye 7 in head; maxillary $2\frac{2}{5}$.

Orbital rim and premaxillary processes more produced than in *I. aurantiacus*, the snout narrower, the distance across maxillaries just behind angle of mouth is half of length of head. The teeth similar. The arrangement of cranial spines and ridges the same, but they are much higher and sharper, the transverse ridge across posterior part of interorbital space is developed as a very high, sharp crest; a conspicuous sharp ridge runs from a tubercle in front of orbital rim inward in a curve along interorbital space nearly to transverse crest. (In *I. aurantiacus* this ridge is scarcely developed.) The interorbital space, the transverse depression, and the preorbital pits are deeper. The dermal fringes are arranged the same and are the same number and size.

Pectoral reaching to or a little past front of anal and having 10 rays. Ventrals adnate for their whole length, the membrane extending past the tip of the last ray nearly to the front of the anal. Anal spines short, their tips not projecting through the skin. Front of dorsal distant from tip of snout a space contained $4\frac{1}{2}$ times in entire length without caudal. Caudal rounded.

Color in life dark brown, with cross bands of black or deep red. The specimen above described, in spirits, has alternate light brown and opaque pinkish red areas on back and sides, outlined with darker color; head almost entirely red down to branchiostegals, with irregular light brown spots outlined with dark brown; these mottling interorbital space and preorbital pits; a pair of them at occipital region, one on end of maxillary, a couple on opercle, and one on suborbital; cheek and snout nearly solid red; tip of mandible with a large red spot; anterior dermal fringes red; under part of head otherwise white or brownish, freckled with dark brown; the red of head extends back to third dorsal spine, involving the front of dorsal; behind which is an irregular brownish crossbar, involving dorsal to sixth spine and reaching to opposite anterior third of pectoral; next behind is a large red area containing some small light brown spots, extending on dorsal to

eleventh spine, extending down to just past middle of side, and sending an arm along middle of side back to a similar red spot from fourteenth spine to second or third soft ray, inclosing between a light brown spot which extends on dorsal; middle of soft dorsal crossed by a light brown band which extends down and is continuous with the light color of the lower parts; end of soft dorsal and base of caudal with a red bar; then a narrow white bar across caudal, followed by a wider red one, a white one across middle of rays, a still wider red and dark brown one, and the tips of the rays with a narrow white border; pectoral with a white bar across base of rays continuous with a similar bar obliquely across rays beyond their middle, inclosing a red spot above; posterior third of pectoral red; lower parts white, covered with large and small irregular brown spots; ventrals and anal similar, but darker with brown.

Another specimen has dark brown taking the place of the red of the head, with similar light brown spots; the lower parts nearly solid brown; the dark bands of pectoral and caudal dark brown, a tinge of red on the former, the red areas of back approximately in the same place, but more restricted by the brown color.

A third specimen has the head slaty black with the spots and mottling gray; the areas on back and fins, which were red in the first specimen, are here dusky or slate color, and those which were light brown are here gray; the lower part of side and belly is dusky, slightly brownish, and crossed in all directions by nearly straight white lines appearing like the cracks in old crockery.

Numerous specimens are in the collection from Tokyo, Tsuruga, Onomichi, Yohohama, and Kobe. The species is common throughout southern Japan, and is daily in the markets, usually with the spinous dorsal removed.

Measurements of Inimicus japonicus.

Length in mm. without caudal	150	165	195	145	163
Head in hundredths of length	36	35	35	34	35
Depth	33	28	28	29	32
Eye	5	5½	5	5½	5
Maxillary	16	16	16	15	16
Interorbital width	10	10½	10	9	10
Width snout across maxillaries, just behind angle of mouth	18	18	19	17	19
Length of third dorsal spine	20	.....	18	19	18
Length of caudal	31	.....	28	31	29
Number of dorsal spines	XVII	XVII	XVI	XVII	XVII
Number of dorsal rays	7	7	8	7	7
Number of anal spines	11	11	11	11	11
Number of anal rays	9	9	8	10	9

46. INIMICUS AURANTIACUS (Schlegel).

AKAOKOZE (RED POISON-FISH).

Pelor aurantiacum SCHLEGEL, Fauna Japonica, Poiss., 1843, p. 44, pl. XVIII, fig. 1; Nagasaki.—GÜNTHER, Cat. Fish, II, 1860, p. 151, copied.

Head $2\frac{5}{6}$ in length without caudal; depth $3\frac{1}{3}$; dorsal XVII, 7; anal II, 9. Lateral line with 15 pores (or tentacles). Eye 7 in head; maxillary $2\frac{1}{6}$.

Upper profile of head deeply concave from first dorsal spine to posterior end of produced premaxillary processes, the eye much produced above level of rest of profile. Mandible with a knob at symphysis. Snout very broad, the distance across maxillaries just behind angle of mouth $1\frac{1}{2}$ to $1\frac{3}{5}$ in length of head. Teeth on mandible in a broad band in front, very narrow at the sides; on premaxillaries much wider at sides and about equal in front to band on front of mandible; on vomer in a band as wide as on front of jaws; palatines toothless.

Top of head with many blunt spines and ridges, much lower than in *Inimicus japonicus*. A rather sharp ridge across posterior part of interorbital separating interorbital space from a transverse depression across occipital region, which is somewhat more shallow than interorbital space. A couple of spines on occipital region (probably on parietals), a third farther back and slightly out of line with them, and a pair behind posterior margin of eye on a level with lateral line. A spine on middle of preorbital and 2 on its lower edge, the posterior of which is the larger. One on suborbital just below deep depression in front of eye, and a pair below eye slightly before its middle, one placed above the other. Opercle with 2 small spines and a row of 3 or 4 around preopercle. A row of multifid dermal fringes around preopercle extending around lower side of mandible; the largest of these at side of mandible and at end of maxillary. A couple of small dermal flaps on preorbital and several on lower edge of opercle. A row of dermal flaps along lateral line and above it a row of shorter wart-like ones placed about half as frequently. The dorsal spines decorated with numerous tentacles.

Pectoral reaching to front of anal or a little past, 10 rays without the 2 detached ones, all branched, the lower 4 appearing simple. Ventrals adnate for their whole length, the membrane extending past the tip of the last nearly to the front of anal. Anal spines entirely covered with skin, their points not free; the tips of the posterior rays reach to the base of caudal. Front of dorsal placed from tip of snout a distance contained 4 times in entire length without caudal. Caudal rounded.

Color in spirits of one specimen is entirely white (bright orange in life) with the exception of 5 or 6 black spots the size of pupil scattered irregularly over each side and not placed the same on opposite sides; 3 or 4 similar spots on inner surface of pectoral. This specimen in life was bright yellowish orange.

Another specimen is slightly dusky on back and has several regularly placed irregular dark brown blotches; interorbital space and preocular pits uniform dark brown; a similar colored area on opercle and preopercle, leaving a light area behind eye and on cheek; another dark brown one on back above lateral line below third to fifth dorsal spines; one just below the last and behind base of pectoral, one at tip of pectoral and one under soft dorsal rays extending on soft

dorsal; all dermal flaps dark brown; lips and maxillary dusky; pectoral dark at middle, lighter below and behind, a few black spots on under surface; ventrals, caudal, and anal dusky; belly and lower parts sparsely freckled with slightly diffused spots, not so large, black, or clear-cut as on the other specimen. This specimen in life, where not dark brown, was golden yellow.

We have two specimens from Hiroshima and Kobe, 24 and 28 cm. in length.

The species is much less common than *Inimicus japonicus*.

(*aurantiacus*, orange color.)

Measurements of Inimicus aurantiacus.

Locality.	Kobe.	Hiroshima.
Length in millimeters without caudal	205	180
Head in hundredths of length	36	37
Depth	30	31
Eye	5	5½
Maxillary	17½	17½
Interorbital width	9	8
Width of snout across maxillaries	23	22
Length of pectoral	38	36
Length of third dorsal spine	17	17
Length of caudal	28	29
Number of dorsal spines	XVII	XVII
Number of dorsal rays	7	7
Number of anal spines	II	II
Number of anal rays	9	9

19. OCOSIA Jordan and Starks.

Ocosia Jordan and Starks, new genus (*vespa*).

Body compressed, elevated, covered with smooth skin. Head pointed, rather small; mouth small, little oblique; teeth on vomer and palatines; preorbital, with a long curved spine reaching nearly to the tip of the maxillary; small spines on top and sides of head; preopercle with 4 spines; spinous dorsal high, continuous, beginning above middle of eye, of 16 spines and 9 soft rays; anal rays III, 6. Ventral rays I, 5; pectoral without free rays. Small fishes of rather deep water in Japan, differing from *Agriopus* in lacking the preopercular spine and in having 3 spines in the anal.

(*okoze* or *okose*, the Japanese name for venomous Scorpænoid fishes.)

47. OCOSIA VESPA Jordan and Starks, new species.

Head 2¾ in length without caudal; depth 2½. Dorsal XVI, 9; anal III, 6. Ventral rays I, 5. Lateral line with 12 or 13 pores. Eye 4 in head; maxillary 2¾.

Anterior profile from first dorsal spine to tip of snout nearly straight and rather steep, a notch between eye and premaxillary processes. Mouth scarcely oblique and below axis of body; the maxillary reaching to below middle of eye. Lower jaw very slightly projecting, and

without a symphyseal knob; teeth in moderate bands on jaws; in narrow bands on vomer and palatines. Interorbital narrow in front, equal to half the diameter of eye, increasing to twice that width over middle of eye. Superorbital rim raised in a slight crest, with a pair of ridges between, which diverge posteriorly. Posterior end of preorbital armed with a long, sharp, curved spine, which reaches nearly to tip of maxillary; anterior lower edge with a very small spine inclined back and downward. A pair of spines on upper part of head in line with superorbital rim, and a couple behind eye in line with anterior end of lateral line. Suborbitals with a broken ridge, but without spines, ending in upper preopercle spine. Preopercle with 4 spines and traces of a fifth below; long and sharp above, growing evenly and gradually shorter below. Last gill arch without a slit

FIG. 17.—OCOSIA VESPA.

behind. Gill rakers rudimentary, represented by 4 or 5 small tubercles.

No notch between soft rays and spines of dorsal. Spinous dorsal very high; its origin above middle of eye; its first spine equal in length to orbit and contained $2\frac{3}{5}$ times in second; the anterior (except the first) spines the longest, decreasing gradually, but very slightly, in length to the last, which is shorter than second spine from one-half to four-fifths eye. Soft dorsal rays scarcely, or very slightly, longer than posterior spines, decreasing quickly in length behind middle rays; the last ray adnate to body and reaching a little past base of caudal. Pectoral reaches beyond tips of ventrals, but scarcely to front of anal; it has 12 rays, the fifth or sixth from the top the longest. Ventrals with spine and 5 rays, their tips scarcely reaching to vent. First anal spine equal in length to diameter of eye, and contained $1\frac{4}{5}$ in third spine; second spine intermediate in length. Second anal ray the long-

est, 2 in head; last ray not adnate to body. Body and head everywhere without scales.

Color in spirits, brownish or dusky irregular cross bars over a white ground; one downward under seventh dorsal spine, broader below lateral line and inclosing a white spot just below it, fading on lower part of sides; the next under last spine and first 4 or 5 rays, extending nearly to anal; a narrow band across base of caudal, and one across rays toward their tips; extreme tips white; dorsal without color, except a little dusky at end of soft dorsal; anal and tips of ventrals dusky; pectoral with a broad white band across middle of rays, a black band toward tips, and extreme tips white; a dusky spot on nape; a dark stripe from eye to upper preopercle spine, one obliquely across cheek, and one forward across maxillary and mandible; snout and tip of mandible white; a dusky band covered with small black points across interorbital space. Other specimens have small dark points on front of dorsal, base of pectoral, and on head following the radiating lines from eye. Sometimes entire dorsal is more or less spotted. One specimen shows traces of pink above lateral line and on head. In life the species was pink or pinkish gray with darker markings.

Specimens were dredged by the U. S. Fish Commission steamer *Albatross* in 40 to 50 fathoms in Sagami Bay. Stations 3757, off Sano Point, Sagami Bay, 41 to 50 fathoms; 3762, same locality, 42 to 49 fathoms, and 3764, same locality, 44 to 50 fathoms. They do not exceed 50 mm. in length.

The types are in the U. S. National Museum and are numbered 50911. Cotypes are numbered 7375 and 7376 Leland Stanford Junior Ichthyological collection.

(*vespa*, wasp.)

20. SNYDERINA Jordan and Starks.

Snyderina Jordan and Starks, Proc. Cal. Acad. Sci., 1901, p. 381 (*yamanokami*).

Body robust, compressed, sparsely covered with nonimbricate, thickened or granular scales. Head naked, ridged, without cranial spines. Profile angulated in front of eye; preorbital with a long sharp spine. Preopercle with a long sharp spine above and 4 smaller ones. Teeth villiform, in bands on jaws and vomer; palatines toothless. Gill-membranes narrowly united and narrowly connected with the isthmus. No slit behind fourth gill. Branchiostegals 7. Lateral line present. Dorsal continuous, with about 13 spines and 10 rays. Anal with 3 spines. First dorsal spine short, inserted above middle of eye; last dorsal ray adnate to caudal peduncle. Ventral rays I, 5. Pectoral without free ray. Caudal rounded. Fins all scaleless.

This genus is close to *Tetraroge* (*barbatus*), differing at least in the absence of barbels at the chin.

(Named for John Otterbein Snyder.)

48. SNYDERINA YAMANOKAMI Jordan and Starks.

YAMA-NO-KAMI (MOUNTAIN WITCH).

?Tetraroge güntheri Boulenger, Proc. Zool. Soc. London, 1889, p. 239, with plate; Muscat, Arabia (palatines said to have teeth).

Snyderina yamanokami Jordan and Starks, Proc. Cal. Ac. Sci., 1901, p. 381, pl. xx; Kagoshima, Japan.

Head 2.6 in body; depth 2.7; eye 4 in head; maxillary 2.5. Dorsal XIII, 10; anal III, 5. Pores of lateral line 21.

Body compressed, the back elevated anteriorly, deepest over posterior part of head, tapering to a rather small caudal peduncle.

Head with many spines and ridges, the ridges smooth and covered with thin skin. Profile very steep from first dorsal spine to snout,

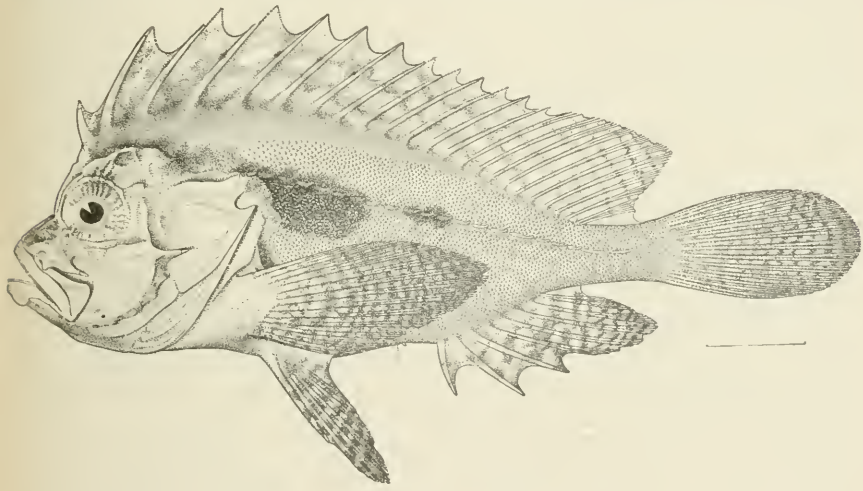


Fig. 18.—Snyderina yamanokami.

which latter projects at a sharp angle and is less nearly vertical. Mouth very oblique, the lower jaw slightly projecting. Maxillary broad at the posterior end, transversely concave. Teeth finely villiform, in bands on jaws and vomer; palatines toothless. Width of interorbital space about two-thirds diameter of eye. Two nearly parallel high sharp ridges run from first dorsal spine to snout. A ridge around anterior margin of eye runs backward to beneath base of third dorsal spine; it has a depression above middle of eye and another above posterior part of eye. Superior margin of eye with a ridge which is scarcely continuous with that of anterior margin. From behind eye, about on a level with superior margin of pupil, a broken horizontal ridge extends backward above gill-opening nearly to tip of opercular flap. Suborbital stay with a sharp, smooth ridge extending back and joining at right angles a ridge that follows around margin of preopercle. From the latter and below its junction with suborbital ridge

the preopercle sends a ridge backward which ends in a sharp spine. Preorbital with a short spine anteriorly projecting transversely to maxillary; a long sharp spine follows upper contour of maxillary and is as long as half the diameter of eye. Gill-rakers short, blunt, uneven; about 4+8 in number.

Entire head, a space on back below dorsal, breast, and a space behind base of pectoral, naked. Sides of body covered with small granulations which are somewhat thickened toward their posterior margins, but are not spiniferous.

Dorsal without a notch between the spinous and rayed portions. The first spine not longer than eye (its tip broken), its base above middle of eye. The second spine over twice as long as the first; the fifth equal to distance from eye to tip of opercular flap. The middle rays of soft dorsal longest; their length equal to the distance from tip of snout to preopercular ridge; the posterior margin of the fin straight, forming an angle slightly less than a right angle with the superior margin. The last ray is adnate to the caudal peduncle for its whole length, the membrane not quite reaching to base of caudal.

The anal spines are graduated; the first scarcely as long as diameter of eye, the third twice the length of the first. When the fin is depressed the tips of the middle rays reach the base of the caudal. The last ray is adnate to the caudal peduncle for about half its length. When ventral fins are depressed the longest ray reaches to the base of the first anal spine, while the tip of the ventral spine falls short of it a distance equal to the diameter of the eye. Pectoral angulated, the sixth and seventh rays longest, reaching to above the first anal ray. Caudal fin narrow and elongate, with the posterior margin rounded; its length 1¼ in head.

Color (from a specimen long in spirits) slaty white with brownish markings. Membrane of spinous dorsal clouded with brownish; some of the spines with a small, dark spot in front of them. All of the other fins with vermiculated markings transversely across the rays. A large dark-brown spot behind upper part of gill-opening and a smaller one on lateral line below base of last dorsal spines. Eye with traces of lines radiating from the center.

The type is a single specimen (No. 6433 on the Stanford Museum Register) in good condition, 217 mm. long, presented to Stanford University by Professor Mitsukuri of the Imperial University of Tokyo. It is said to be from Kagoshima in Kiusiu, and to bear the local name of Yama-no-kami, or Mountain Goddess, in local mythology a woman with wings, capable of starting a storm. Dr. Boulenger calls our attention to the probable identity of this species, with his *Tetrarogè güntheri*. The two agree in form and color, but *S. guntheri* is said to have palatines toothed and there is some difference in size of mouth.

21. PARACENTROPOGON Bleeker.

Paracentropogon Bleeker, Act. Sci. Roy. Amst., 1876, p. 66, (*longispinis*).

Body oblong, compressed, covered with minute scales or almost naked. Head obtuse, without spinous crests. Preorbital with two spines, preopercle with 4 or 5; opercle with 2; mouth moderate, oblique, the jaws subequal; teeth on vomer and palatines; no barbels at the chin; gills 3½, no slit behind the last; pectorals moderate, without free rays; dorsal continuous, not joined to the caudal, the spines 12 to 14, the first inserted over the eye, the anterior spines strong and divergent; soft rays 8 or 9; ventral rays I, 4; anal rays III, 4 to 6; caudal rounded. Small brightly colored fishes, with stinging spines. They are distinguished from the genus *Tetraroge* chiefly by the absence of barbels. From *Gymnapistus* (*Pentaroge*) the absence of a slit behind the last gill is the chief distinction. Both *Tetraroge* and *Gymnapistus* are said to have the ventral rays I, 5, but Valenciennes incorrectly assigns the same number to *Paracentropogon longispinis*.

(παρά, near; *Centropogon*, a related genus; κέντρον, spine; πογών, beard.)

49. PARACENTROPOGON RUBRIPINNIS (Schlegel).

OKOZE.

Apistus rubripinnis Schlegel, Faun. Jap. Poiss., 1843, p. 49, pl. xxii, fig. 2; Nagasaki.

Tetraroge rubripinnis Günther, Cat. Fish. Brit. Mus., II, 1860, p. 133; after Schlegel.—Ishikawa, Prel. Cat., 1897, p. 50; Boshu, Misaki.—Jordan and Snyder, Check List Fishes Japan, 1901, p. 100; Yokohama.

Tetraroge longispinis Steindachner, Fische Japans, III, 1884, p. 29; Tokyo, Tagawa, Tango, not of Cuvier and Valenciennes, a species from Amboina, found also in China.

Paracentropogon longispinis Steindachner, Reise Aurora, 1897, p. 203; Kobe, Hiogo

Tetraroge longispinis var. *nuda* Günther, Shore fishes Challenger, 1880, p. 66; Kobe, Japan.

Head 3 in length without caudal; depth 2¾. Dorsal XIV, 7; anal III, 4 or 5, usually 4. Ventral ray I, 4. Eye 3½ in head; maxillary 2¾; interorbital 5¼. Lateral line with 20 pores.

Anterior profile of head very steep and very slightly convex from first dorsal spine, which is above middle of eye, to tip of snout. Mouth moderately oblique, the front of premaxillaries on a level with lower margin of eye. Maxillary reaching to below middle of eye. Jaws equal, the lower with a slight knob at symphysis. Broad bands of villiform teeth on jaws, vomer and palatines; the bands on premaxillaries broader than on mandible, those on palatines short in comparison with their breadth. Interorbital space rather narrow, its edges converging anteriorly, and having a pair of large ridges which

diverge anteriorly; the superorbital ridge is somewhat raised, and were the interorbital ridges absent, the interorbital space would be concave. Preopercle with a large, sharp spine at its edge on a level with suborbital stay, and 3 or 4 slight, sharp tubercles covered with skin on its edge below. A long sharp spine on posterior edge of preorbital reaches backward past end of maxillary nearly to below posterior orbital margin, and a small spine at its base, which is directed downward. Anterior limb of first gill arch with 8 or 9 very short blunt gill-rakers. Pseudobranchiæ present. Gills $3\frac{1}{2}$, no slit behind the last.

Pectoral reaching past tips of ventrals to opposite vent; pectoral rays 11, all branched. Dorsals without a notch between them; the first spine less than half the length of second; second and third subequal $1\frac{1}{4}$ to $1\frac{1}{3}$ times in head, the third to sixth decreasing in length backward and the remaining ones subequal, the last spines two times

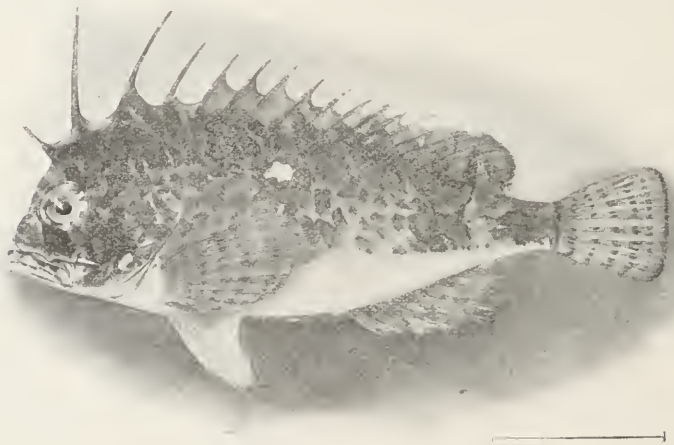


FIG. 19.—PARACENTROPOGON RUBRIPINNIS.

in head, and equal to the longest rays; last dorsal ray connected to body for nearly its full length by a membrane. (These measurements taken from a specimen 10 cm. in length.) In specimens 6 cm. in length the first spine is longer in comparison with second, which latter is equal to half head, and the posterior spines behind the fourth are subequal in length and contained $2\frac{1}{2}$ times in head. Third anal spine longer, but equal to second in diameter; its length $2\frac{1}{6}$ in head.

Head and body appearing to the naked eye and to the touch naked; under a lens, however, the posterior part of the body is seen to be sparsely covered with small, round, embedded, nonimbricated scales, in greater or fewer numbers (sometimes entirely absent) and not always of the same size; these not developed anterior to the tip of the pectoral.

Color in spirits: Sides and backs mottled and spotted with small irregular dark-brown or black spots, sometimes arranged to form very

much broken and irregular crossbars; when these are evident, there is one under front of soft dorsal, one under posterior part of soft dorsal and on caudal peduncle, one across body under pectoral, one at nape, and one across interorbital space. Radiating bars commonly present from eye; these extending on iris nearly to pupil, leaving a narrow silvery ring of the iris around pupil; one downward across maxillary, one downward across cheek, one downward and backward to preopercle spine, one upward and backward toward base of second dorsal spine. A spot usually of the light ground color present just above or resting on lateral line, situated at a point midway between tip of snout and middle of caudal rays; sometimes it is made conspicuous with opaque white pigment especially in females. Rays of soft fins crossed with narrow wavy lines, except ventrals, which are white with dusky tips. Spinous dorsal irregularly marbled; a large deep black blotch from sixth to ninth ray, extending slightly on back. Peritoneum white.

A fresh specimen showed the following color: Olive spotted with darker olive; a jet-black spot on back; lower fins and belly rosy; dorsal blotched with brownish red, a pale spot above lateral line. The coloration is subject to great variation in degree of mottling. The females are rather duller in color and with lower spines.

This description is based on many specimens from Tokyo, Tomo in Bingo, Misaki, Kobe, and Wakanoura.

According to Dr. Günther, this species (which he calls var. *nuda*) is distinguished from *Paracentropogon longispinis* of the East Indies by the virtual absence of scales.

(*ruber*, red; *pinna*, fin.)

22. ERISPHEX Jordan and Starks.

Erisphex Jordan and Starks, new genus (*pottii*).

Body oblong, compressed, scaleless, but covered with velvety prickles. Head without spines or rough crests above; preorbital with 2 spines below; preopercle with 3 or 4 blunt spines, opercle with 2 spines; mouth moderate; teeth on the vomer, none on the palatines. Dorsal fin continuous, notched after the third or fourth spine, beginning over the eye, of 11 to 13 spines and 9 to 11 soft rays; pectorals rounded, without free rays; anal with 2 spines and 8 to 10 soft rays; ventral rays I, 2, or I, 3.

Small fishes of the East Indies, ranging northward to Japan. From *Cocotropus* Kaup (*echinatus*), the most nearly related genus, the Japanese genus differ in the presence of but 1 or 2 soft rays in the ventrals instead of 5.

(ἔρι, very; σφέξ, wasp.)

a. Dorsal rays XI, 13; the 3 anterior spines set off by a notch; maxillary reaching to opposite middle of eye ..... *pottii*, 50.

aa. Dorsal rays XIII, 10; the 4 anterior spines set off by a notch; maxillary barely reaching front of eye ..... *kagoshimensis*, 51.

50. ERISPHEX POTTII (Steindachner).

Cocotropus pottii STEINDACHNER, Reise der Aurora, 1897, p. 203, pl. IV, fig. 1; Kobe.—JORDAN and SNYDER, Check List, 1901, p. 101; Yokohama.

Head $3\frac{1}{2}$ in length without caudal; depth $2\frac{5}{6}$. Dorsal XI. 13; anal II, 10. Ventral I, 2. Lateral line with 14 pores. Eye 4 in head; maxillary 2.

Upper profile of head nearly uniformly convex from first dorsal spine to tip of snout, a slight notch between slightly produced processes from premaxillaries and superorbital rim. Mouth very oblique, more nearly vertical than horizontal. Lower jaw bluntly rounded and strongly projecting. Anterior end of premaxillaries on a level with lower margin of pupil; maxillary reaching to below middle of eye. Teeth in moderate bands on jaws, growing wider in front; the patch on vomer narrower than on jaws, widest at the middle; palatines toothless. Interorbital slightly concave; $4\frac{1}{2}$ in head; a high median ridge divides anteriorly and surrounds a pit behind premaxillary processes, posteriorly it stops at a slight transverse depression just in front of dorsal. Preorbital with 2 spines, the posterior much the larger, nearly reaching to end of maxillary, the anterior small and pointing downward and outward. Preopercle with 4 spines, the upper one the largest, the others growing gradually smaller below. A blunt spine or tubercle at upper posterior edge of eye, another behind it opposite base of third dorsal spine; 2 similar ones behind eye on a level with beginning of lateral line. A slight ridge on suborbitals extending obliquely across cheek to upper preopercle spine.

No slit behind last gill arch; gill-rakers with slight tubercles, 5 or 6 of them below angle of first arch. Head and body, base of pectoral, and base of dorsal and anal covered with soft hair-like papillæ.

Fin rays all simple. Pectoral with 12 rays, the third from the top the longest, reaching to front of anal or a little past. Ventrals with 1 spine and 2 rays, their length equal to combined length of snout and eye. Anterior 3 spines of dorsal separated from rest of fin by a notch; the first spine a little behind middle of eye, its length $2\frac{1}{6}$ in head, or equal to the second; no notch between dorsal spines and rays; the latter a little higher than the former; last dorsal ray adnate to caudal peduncle; tips of last ray reaching base of caudal. Anal a little lower than caudal and ending opposite to it; its origin midway between tip of mandible and middle of caudal rays. Caudal rounded.

Color in spirits: Uniform brownish on back and sides, or the color broken up into diffused spots as large as eye; belly lighter; fins usually darker than body, and darker toward ends of rays, though sometimes they are as light as body and have similar diffused spots; pectoral darker toward tips of rays, the extreme tips white; inner surface of pectoral similar to outer; tips of caudal rays white.

Of this species we have numerous specimens, the longest 85 mm. in length. These were taken at Tokyo, Wakanoura, and Matsushima Bay, Station 3771, off Doumiki Point in 61 fathoms.

(Named for Constantine von Pott, captain of the *Aurora*.)

51. ERISPHEX KAGOSHIMENSIS (Ishikawa).

Tetraroge dermacanthus Ishikawa, Prel. Cat., 1897, p. 50; Kagoshima, not of Bleeker.

Tetraroge kagoshimensis Ishikawa, Notes on species of fishes new to Japanese waters. (MSS., 1902; Kagoshima.)

"D. IV, IX, 10; A. I. 9; V. I, 3.

"Skin studded with small prickles. Snout slightly longer than eye, which is equal to interorbital space. Lower jaw projecting; maxillary not quite reaching orbit; no barbels. Dorsal fin beginning over posterior edge of eye, the four anterior spines partly separated from the others; second and third spines longest. About 9 groups of larger prickles along the lateral line. Color, in spirits, sepia brown, with faint irregular markings of darker color. Type, a single specimen from Kagoshima 84 mm. in length; head 28 mm. in length; snout 10; eye 7.5; first dorsal spine 10, second 11; pectoral 21; ventral 15; greatest depth of body 33." (Ishikawa MS.)

This specimen, No. 869, in the Imperial Museum of Tokyo, was examined by us. It is close to *Erisphex dermacanthus*, but apparently distinct from *E. pottii*. It is distinguished by the partial separation of the first four dorsal spines.

23. APLOACTIS Schlegel.

Aploactis Schlegel, Fauna Japonica, Poiss., 1843, p. 51 (*aspera*).

?*Aploactisoma* Castelnau, Proc. Zool. Soc. Victoria, II, 1872, p. 64 (*schomburgki* a species with 5 detached spines).

Head and body compressed, studded with small prickles; bones of the head with obtuse prominences; preorbital without spine; mouth moderate, with teeth on vomer; none on palatines. Dorsal fin beginning anteriorly with 14 spines and 11 to 14 soft rays; the 3 anterior spines detached from the others; anal long, without distinct spines; ventral rays I, 2. Pectorals moderate, without free-ray; caudal rounded.

Japan and East Indies.

(ἁπλοός, simple; ἄκτις, ray.)

52. APLOACTIS ASPERA Richardson.

Aploactis Schlegel, Fauna Japonica, Poiss., 1843, p. 51, pl. XXII, fig. 3; Nagasaki.

Aploactis aspera Richardson, Voy. Sulphur, Fishes, 1846, p. 72; China.—Günther, Cat. Fish, II, 1860, p. 142; Japan.—Steindachner and Döderlein, Fische Japans, IV, 1884, p. 197; Kagoshima.

Head 3¼ in length without caudal; depth 3⅘. Dorsal III, XI, 12; anal 13. Ventral I, 2. Lateral line with 12 pores. Eye 4½ in head; maxillary 2½.

The supraorbital rim is but little produced, leaving the upper profile of head nearly uniformly convex from first dorsal spine to tip of snout; there is a slight notch in front and behind eye. Mouth very oblique; the anterior end of premaxillary is slightly above the level of middle of eye; the maxillary scarcely reaches to below anterior margin of pupil. Lower jaw bluntly rounded and projecting. Teeth in broad bands on jaws, narrower on vomer, palatines toothless; bands on premaxillaries not widened in front, those on mandible very slightly widened. Interorbital with a pair of ridges slightly raised above superorbital rim and having a wide shallow depression between, which is closed behind by a transverse ridge bounding a slight transverse depression across head in front of first dorsal spine. Superorbital rim uneven and continuous posteriorly with a broken, very crooked ridge; just below which are a couple of blunt tubercles forming a broken ridge from upper posterior border of eye. Suborbitals with a

FIG. 20.—APLOACTIS ASPERA.

blunt, crooked ridge ending in the upper preopercle spine. Preorbital ending posteriorly in a pair of very blunt, short spines and having a similar spine on its anterior edge, which points down and forwards. Preopercle with 5 spines, all blunt, the upper one the largest, the others growing gradually smaller below. Opercle with 2 blunt spines at the ends of slight ridges. Last gill arch without a slit behind it. Gill rakers scarcely developed; 5 or 6 slight tubercles below angle of first arch.

Head and body completely covered with coarse, rather soft papillæ, which vary in size and abundance on different specimens; sometimes they are rather fine and scattered on head, and the blunt cranial spines and ridges stand out prominently, sometimes they are so coarse and abundant as to obscure the spines more or less.

Pectoral reaching to opposite vent, its border rounded, having 13 simple rays. Ventrals short and with 1 spine and 2 rays, their length

2 in head. The first 3 spines of dorsal separated from succeeding spines; no notch between spines and rays, and as rays are all simple it is difficult to distinguish spines from rays. Dorsal base ending just in front of caudal base. Anal not reaching so far back as dorsal; its insertion midway between tip of mandible and posterior third of caudal.

Color slate or brownish, usually lighter below, but not always; sides sometimes with fine black spots; fins all black or dark slate color, sometimes showing black cross lines, particularly on pectoral; tips of pectoral rays and dorsal rays and spines light. This description is based on 6 specimens from Nagasaki, the longest 95 mm. in length. The species is apparently rather rare.

(*asper*, rough.)

SUMMARY.

Family SCORPÆNIDÆ.

1. *Sebastolobus* Gill.

1. *macrochir* (Günther); Miyako, Misaki, Nemuro, Sagami Bay.

2. *Sebastodes* Gill.

2. *glaucus* (Hilgendorf); Bering Island.
3. *taczanowskii* (Steindachner); Otaru, Mororan, Iwanai, Aomori, Samé.
4. *itinus* Jordan and Starks; Hakodate.
5. *steindachneri* (Hilgendorf); Hakodate.
6. *güntheri* Jordan and Starks; Misaki, Wakanoura, Hakodate.
7. *inermis* (Cuvier and Valenciennes); Hakodate, Matsushima, Tokyo, Misaki, Enoshima, Kobe, Onomichi, Hiroshima, Wakanoura, Nagasaki, Tsushima.
8. *tokionis* Jordan and Starks; Misaki, Tokyo, Wakanoura, Tsuruga.
9. *joyneri* (Günther); Aomori, Miyako, Tokyo.
10. *matsubarae* (Hilgendorf); Misaki.
11. *iracundus* Jordan and Starks; Kushiro.
12. *flammeus* Jordan and Starks; Misaki.
13. *scythropus* Jordan and Snyder; Misaki, Tokyo.
14. *fuscescens* (Houttuyn); Tokyo, Nagasaki, Otaru, Iwanai, Aomori, Samé, Mororan, Hakodate.

3. *Sebastichthys* Gill.

15. *vulpes* (Steindachner and Döderlein); Hakodate, Samé, Miyako near Morioka.
16. *nivosus* (Hilgendorf); Samé, Misaki.
17. *trivittatus* (Hilgendorf); Aomori, Kushiro.
18. *oblongus* (Günther); (not seen).
19. *mitsukurii* (Cramer); Hakodate, Aomori, Matsushima, Tokyo, Yokohama, Onomichi, Kobe, Nagasaki.
20. *pachycephalus* (Schlegel); Wakanoura, Kobe, Hiroshima, Shimonoseki.
21. *elegans* (Steindachner and Döderlein); Misaki, Onomichi, Miyajima.

4. *Neosebastes* Guichenot.

22. *entaxis* Jordan and Starks; Misaki, Chosu.

5. *Thysanichthys* Jordan and Starks.

23. *crossotus* Jordan and Starks; Suruga Bay.

6. *Sebastiscus* Jordan and Starks.

24. *marmoratus* (Cuvier and Valenciennes); Hakodate, Samé, Tokyo, Misaki, Sagami Bay, Enoshima, Suruga Bay, Kobe, Hiroshima, Wakanoura, Nagasaki.
25. *albofasciatus* (Lacépède); Tokyo, Misaki, Awa, Wakanoura, Nagasaki, Suruga Bay, Totomi Bay.

7. *Helicolenus* Goode and Bean.

26. *dactylopterus* (De la Roche); Misaki, Awa, Sagami Bay, Suruga Bay.
27. *emblemarius* Jordan and Starks; Okinose, Misaki.

8. *Scorpæna* (Artedi) Linnæus.

28. *fimbriata* Döderlein; Wakanoura, Kobe, Misaki, Tokyo.
29. *miostoma* Günther; (not seen.)
30. *onaria* Jordan and Snyder; Tokyo.
31. *izensis* Jordan and Snyder; Suruga Bay, Sagami Bay, Totomi Bay.

9. *Scorpænopsis* Heckel.

32. *cirrhosa* (Thunberg); Wakanoura, Nagasaki.
33. *kagoshimana* (Steindachner and Döderlein); not seen.

10. *Setarches* Johnson.

34. *albescens* (Steindachner and Döderlein); Misaki, Totomi Bay.

11. *Lythrichthys* Jordan and Starks.

35. *eulabes* Jordan and Starks; Suruga Bay.

12. *Pterois* Cuvier.

36. *volitans* (Linnæus).
37. *lunulata* Schlegel; Tokyo, Yokohama, Wakanoura, Misaki.

13. *Ebosia* Jordan and Starks.

38. *bleekeri* (Steindachner and Döderlein); Tokyo.

14. *Apistus* Cuvier.

39. *evolans* Jordan and Starks; Tokyo.
40. *venenans* Jordan and Starks; Nagasaki.

15. *Minous* Cuvier and Valenciennes.

41. *adamsi* Richardson; Kobe, Onomichi, Wakanoura, Nagasaki.
42. *echigonius* Jordan and Starks; Niigata.

16. *Decterias* Jordan and Starks.

43. *pusillus* (Schlegel); Wakanoura.

17. *Erosa* (Swainson) Jordan and Starks.

44. *erosa* (Langsdorf); Misaki.

18. *Iniinicus* Jordan and Starks.

45. *japonicus* (Cuvier and Valenciennes); Tokyo, Ononichi, Yokohama, Kobe.
46. *aurantiacus* (Schlegel); Hiroshima, Kobe.

19. *Ocosia* Jordan and Starks.

47. *vespa* Jordan and Starks; Sagami Bay.

20. *Sugerina* Jordan and Starks.

48. *yamanokami* Jordan and Starks; Kagoshima.

21. *Paracentropogon* Bleeker.

49. *rubripinnis* (Schlegel); Tokyo, Tomo, Misaki, Kobe, Wakanoura.

22. *Erisphex* Jordan and Starks.

50. *pottii* (Steindachner); Tokyo, Wakanoura, Matsushima Bay.
51. *kagoshimeuis* (Ishikawa); Kagoshima.

23. *Apioactis* Schlegel.

52. *aspera* Richardson; Nagasaki.

NOTE.

The *Sebastodes flammeus* described on page 108 is known only from a single specimen in very poor condition, and no satisfactory illustration could be made. An outline drawing is here given which errs in representing the lowermost pectoral rays branched; there are eight simplex ones as described.

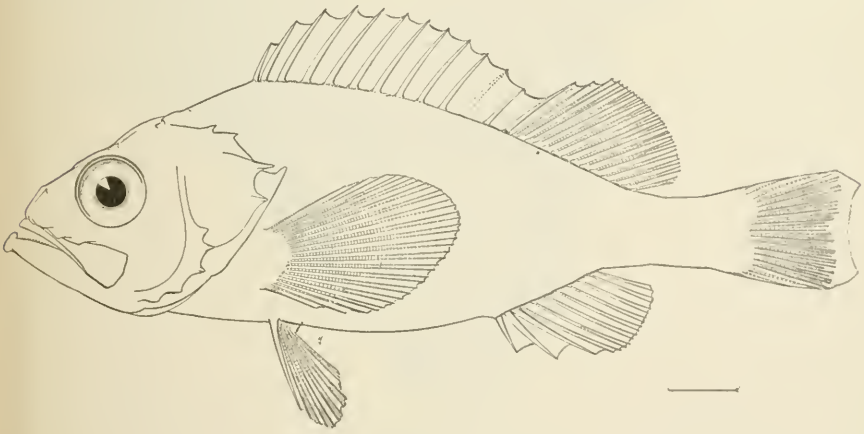
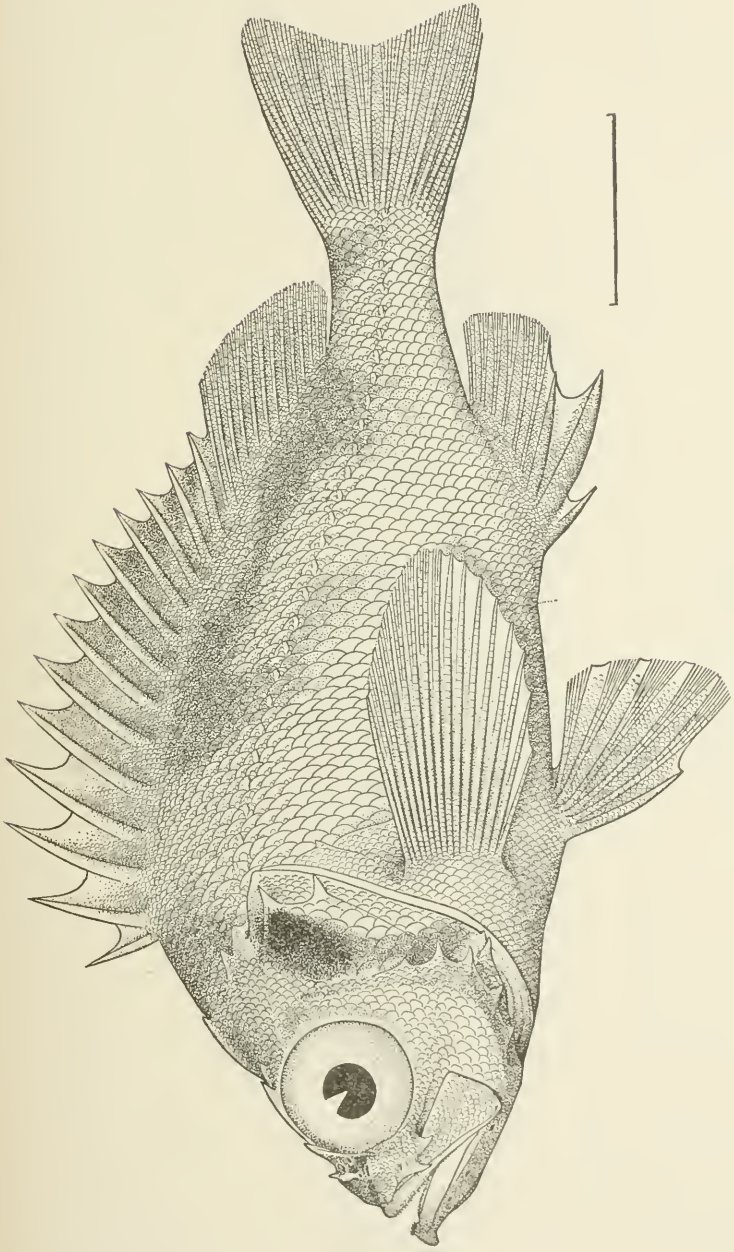
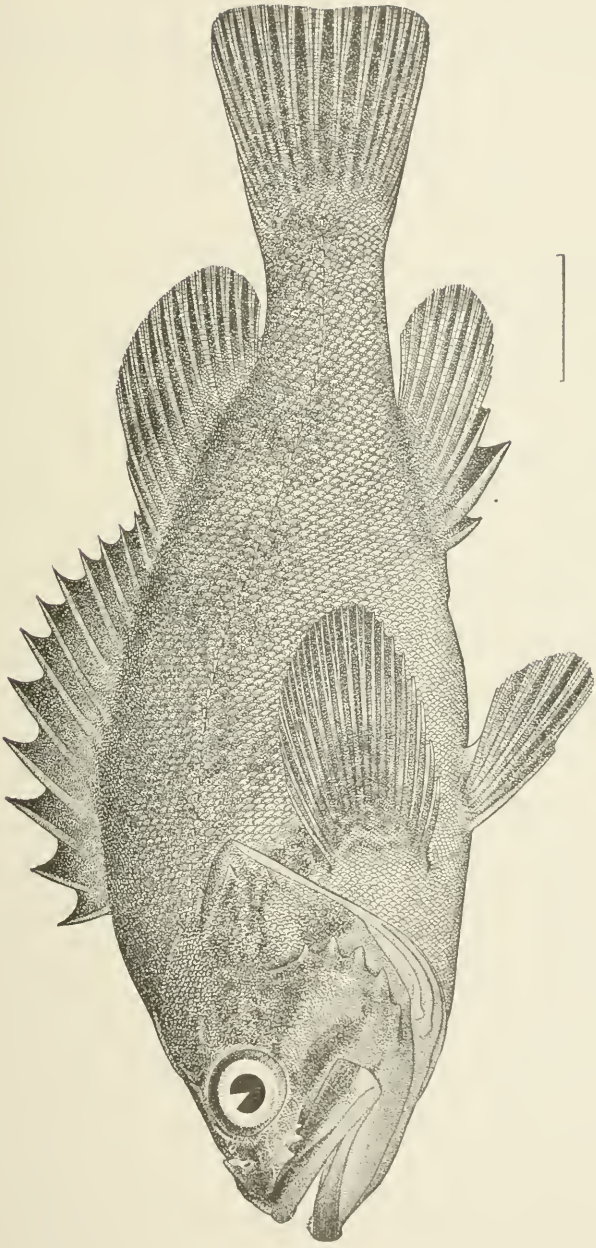


FIG. 21.—SEBASTODES FLAMMEUS.



SEBASTODES SCYTHROPUS.

FOR EXPLANATION OF PLATE SEE PAGE 109.



SEBASTODES FUSCESCENS.

FOR EXPLANATION OF PLATE SEE PAGE 110.

A REVISION OF THE AMERICAN GREAT HORNED OWLS.

By Harry C. Oberholser,
Assistant Ornithologist, Department of Agriculture.

The difficulty of accumulating a satisfactory amount of material has always been a serious obstacle in the study of the great horned owls. The author has been fortunate enough to bring together more than 200 specimens, representing all but one of the American forms, and the opportunity thus afforded for a better understanding of their relationships has, of course, been exceptional.

That the number of subspecies must be considerably increased is hardly surprising, in view of the comparatively small number hitherto recognized and the great geographical area involved. It is evident, however, that there is but one species in all America—North, Central, and South, the various races being intimately connected by individual or geographical intergrades. In contrast to the condition existing in many other similarly plastic types, very few of the New World representatives of *Asio*[a] are confined within closely circumscribed geographical limits. With the exception of *occidentalis* and *wapacuthu*, all seem to be strictly nonmigratory, and thus any record safely may be considered as based upon the resident bird.

Although size seems to be the sole sexual difference, the range of individual variation is very great, further complicating the already difficult problem of relationship. A key to the solution of this problem is furnished by what is probably the most interesting result of the present study—the discovery of the fact that there exists in at least several of the American forms, and probably in not a few of the Old World species as well, a dichromatism, comparable to that of the genus *Otus*,[b] though perhaps not so impressive, which is manifested in a light and a dark, sometimes also a rufous or ochraceous, phase, independent of sex, age, season, or locality; in extreme conditions entirely distinct, yet completely connected by various intermediates.

[a] The proper name of *Bubo*. For explanation of the change see Stone, Auk, XX, 1903, pp. 272–276.

[b] An earlier name for *Pisorhina* (=*Megascops*). See Stone, Auk, XX, 1903, pp. 272–276.

This dichromatism, or rather, polychromatism, together with better knowledge of actual distribution, serve to explain away the supposed interrupted distribution of one or two West American races.

In the present investigation the author has been much aided by the collection of the Biological Survey, by access to the collection of the U. S. National Museum that Mr. Ridgway has accorded, and by the loan of specimens from Mr. William Brewster, Mr. Outram Bangs, Dr. Louis B. Bishop, Mr. Jewell D. Sornborger, and the Academy of Natural Sciences of Philadelphia through Mr. Witmer Stone.

ANALYTICAL KEY TO THE AMERICAN FORMS OF ASIO, BASED ON ADULT FEMALES.

I. Wing averaging less than 350 mm.
  A. Wing averaging less than 320 mm.
    a. Exposed culmen less than 40 mm ..... *clachistus*.
    a^1. Exposed culmen not less than 40 mm ..... *mayensis*.
  B. Wing averaging more than 320 mm.
    a. More rufescent throughout ..... *mesembrinus*.
    a^1. Less rufescent throughout.
      b. Upper parts darker ..... *nigrescens*.
      b^1. Upper parts lighter.
        c. More finely barred below; bill smaller ..... *magellanicus*.
        c^1. More coarsely barred below; bill larger ..... *melancercus*.
II. Wing averaging more than 350 mm.
  A. Wing averaging over 370 mm.
    a. Light colored.
      b. Very pale; feet immaculate ..... *wapacuthu*.
      b^1. Darker; feet more or less spotted.
        c. Darker above; lower parts more heavily barred ..... *algistus*.
        c^1. Lighter above; lower parts less heavily barred ..... *occidentalis*.
    a^1. Dark colored.
      b. Face and notæum more blackish, less rufescent.
        c. Lower parts paler; feet less mottled ..... *heterocnemis*.
        c^1. Lower parts darker; feet more heavily mottled ..... *saturatus*.
      b^1. Face and notæum lighter, more rufescent ..... *lagophonus*.
  B. Wing averaging under 370 mm.
    a. Upper parts lighter.
      b. Face and lower parts lighter; feet less spotted ..... *pallescens*.
      b^1. Face and lower parts darker; feet more spotted ..... *pacificus*.
    a^1. Upper parts darker.
      b. Wing averaging over 360 mm.; very rufescent ..... *virginianus*.
      b^1. Wing averaging under 360 mm.; less rufescent.
        c. More blackish above; feet scarcely mottled ..... *nigrescens*.
        c^1. Less blackish above; feet much mottled ..... *icelus*.

ASIO MAGELLANICUS MAGELLANICUS (Gmelin).

Strix bubo δ. magellanicus Gmelin, Syst. Nat., I, 1788, p. 286.
Strix nacurutu Vieillot, Nouv. Dict. d'Hist. Nat., VII, 1817, p. 44.

Type locality.—Southern South America.

Geographical distribution.—Southern South America, north to Peru and Southern Brazil.

Measurements (*4 males*).—Wing, 312–327 (average, 320.3) mm.; tail, 183–200 (average, 191) mm.; exposed culmen, 35–37 (average, 36) mm.; culmen without cere, 25–26 (average, 25.8) mm.—(*1 female*).—Wing, 342 mm.; tail, 204 mm.; exposed culmen, 37 mm.; culmen without cere, 25 mm.

This race is very closely allied to those from Mexico and the southwestern United States, averaging different from *pacificus* only in reduced size and narrower character of the dark barring on the lower surface; from *melanocerus* in smaller bill, paler upper parts, and less heavily barred ventral surface.

Gmelin described both *magellanicus* and *virginianus* on the same page,[a] but as all the American forms of the genus seem to be conspecific, the name *magellanicus*, as it stands first, must be used for the species.

Specimens have been examined from the following localities:

Chile.—Gregory Bay, Straits of Magellan; Santiago.

Argentine Republic.—Upper Rio Chico, Patagonia.

ASIO MAGELLANICUS NIGRESCENS (Berlepsch).

Bubo nigrescens Berlepsch, Proc. Zool. Soc. Lond., 1884, p. 309.

Chars. subsp.—Similar to *Asio magellanicus magellanicus*, but with more blackish and less rufous both above and below.

Type locality.—Cechce (10,000 feet), western Ecuador.

Geographical distribution.—Ecuador.

Measurements (*of type, a female*).—Wing, 350 mm.; tail, 185 mm.; culmen, 30.5 mm.; tarsus, 80 mm.

Although not examined in the present connection, this form is apparently quite distinct, differing from *virginianus* and the other similar races in its deep blackish appearance and its notable reduction or lack of fulvous tints.

ASIO MAGELLANICUS MESEMBRINUS, new subspecies.

Chars. subsp.—Resembling *Asio magellanicus magellanicus*, but very much more rufescent throughout, and with a larger bill.

Type locality.—San José, Costa Rica.

Geographical distribution.—Costa Rica.

Measurements (*of type*).—Wing, 340 mm.; tail, 198 mm.; exposed culmen, 41 mm.; culmen without cere, 29 mm.; tarsus, 63 mm.; middle toe, 39 mm.

Description.—Type, [female] adult, No. 33218, U.S.N.M.; San José, Costa Rica; J. Carmiol. Above brownish black, much mottled and vermiculated with whitish and buffy, these markings least conspicuous on the head; the cervix, upper back, and rump with much

[a] Syst. Nat., I, 1788, p. 286.

tawny; all the feathers of the upper parts with the subbasal portions tawny, the exterior webs of scapulars also of this color; wing-coverts like the back, but with more whitish; wing-quills fuscous, with broad, broken, buffy bars on the outer webs, and bars of ochraceous buff on the inner vanes, these markings becoming distally more obsolete and brownish; tail fuscous, the middle feathers very irregularly barred and mottled with buffy and whitish, the rest vermiculated and more regularly barred with buffy and ochraceous; forehead and supraloral region mixed white, buffy, ochraceous, and dark brown; facial disk tawny, mixed with whitish and blackish, bounded behind by a black bar which is almost continuous with the black and tawny "horns;" chin and throat white, between them a band of dark brown and tawny feathers; chest deep tawny with vermiculations and large spots of blackish, mixed with some white; rest of lower parts deep tawny, with some admixture of white medially, and thickly barred with dark brown; lining of wing white and tawny, barred and spotted with blackish; tibiæ tawny, slightly spotted posteriorly with dusky; feet and tarsi dull buff, almost unmarked.

This form is much more different from all of its nearest geographic relatives than it is from *Asio m. virginianus*, with which it closely agrees in color, though much inferior in size.

ASIO MAGELLANICUS MELANCERUS, new subspecies.

Chars. subsp.—Similar to *Asio magellanicus mesembrinus*, but rufescent colors paler and less extensive both above and below, particularly on abdomen, thighs, and feet, the last more spotted; face somewhat lighter.

Type locality.—Tehuantepec City, Oaxaca, Mexico.

Geographical distribution.—Guatemala, and Mexico north to Jalisco, Guanajuato, and southern Tamaulipas.

Measurements (*1 male*).—Wing, 320 mm.; tail, 180 mm.; exposed culmen, 36 mm.; culmen without cere, 26. (*3 females.*)—Wing, 345–355 (average, 349) mm.; tail, 205–210 (average, 207.3) mm.; exposed culmen, 39–41 (average, 40) mm.; culmen without cere, 27–29 (average, 28) mm.

Description.—Type, adult female, No. 59497, U.S.N.M.; Tehuantepec City, Oaxaca, Mexico, October 16, 1869; F. Sumichrast. Upper surface brownish black, mottled and vermiculated with white, buffy, and deep ochraceous, this marking least extensive on the head; wing-coverts like the back; wing-quills fuscous, with wide broken bars, exteriorly of whitish or light brownish, interiorly of ochraceous or ochraceous buff; tail fuscous, broadly barred with whitish and ochraceous, most irregularly on the middle feathers; forehead and supraloral region brownish black, mottled with white and buffy; facial disk grayish, mixed with ochraceous and blackish, bounded behind by a

black bar; horns brownish black, the inner and basal parts ochraceous; sides of neck mingled white, dark brown, and ochraceous; chin and throat white, separated by a band of dark brown and ochraceous; breast ochraceous, mottled with whitish and dark brown, and heavily spotted with brownish black; rest of lower parts, with lining of wing, white, more or less mixed with ochraceous, and barred with dark brown; the ochraceous legs and dull buffy feet barred and spotted with dusky.

This race more closely resembles *pacificus* than it does either *pallescens* or *mayensis*, both of which in geographical position are nearer. It may be distinguished from *pacificus* by its smaller size, larger bill, darker upper parts, and the usually greater amount of rufescent admixture in the plumage of the face.

The type of this race is a specimen in rufous (or better, ochraceous) plumage, but not less common is a gray phase, differing in the restriction and pallor of the rufescent parts of the plumage, though the general effect of the whole bird is just as dark.

Specimens examined come from the following localities:

Oaxaca.—Tehuantepec.

Guanajuato.—Guanajuato.

Jalisco.—Guadalajara; Etzatlan; La Barca.

Puebla.—Orizaba; Chalchicomula.

Michoacan.—Querendaro; Zamora.

Mexico.—Mount Popocatepetl; Tlalpam.

Tamaulipas.—Soto La Marina.

Guatemala.—[No further locality given.]

ASIO MAGELLANICUS MAYENSIS (Nelson).

Bubo virginianus mayensis Nelson, Proc. Biol. Soc. Washington, XIV, 1901, p. 170.

Chars. subsp.—Resembling *Asio magellanicus melanocrus*, but paler; the lower parts not so heavily barred, and with less rufous; face and feet less rufescent, the latter less conspicuously mottled with dusky.

Type locality.—Chichen Itza, Yucatan, Mexico.

Geographical distribution.—Yucatan, Mexico.

Measurements (of type, a female).—Wing, 315 mm.; tail, 198 mm.; exposed culmen, 41 mm.; culmen without cere, 29 mm.; tarsus, 54 mm.; middle toe, 45 mm.

This form was described by Mr. Nelson from a single specimen, and none but the type has been available for present comparison. The validity of the race, however, seems to be sufficiently attested by the characters above detailed. It approaches apparently most closely to *pallescens* and *pacificus;* differing from the latter in smaller size, larger bill, usually more grayish face, and slightly paler lower surface.

ASIO MAGELLANICUS PALLESCENS (Stone).

Bubo virginianus pallescens STONE, Amer. Nat., XXXI, 1897, p. 237 (in text).

Chars. subsp.—Like *Asio magellanicus mayensis*, but larger, with relatively smaller bill; upper surface paler.

Type locality.—Watson Ranch, Medina River, 18 miles southwest of San Antonio, Texas.

Geographical distribution.—Western Texas to southeastern California; south to northern Mexico.

Measurements (*9 males*).—Wing, 330–360 (average, 341) mm.; tail, 195–225 (average, 215.9) mm.; exposed culmen, 33–39 (average, 37.3) mm.; culmen without cere, 24–29.5 (average, 27.3) mm. (*9 females.*)—Wing, 355–375 (average, 362.8) mm.; tail, 200–235 (average, 222) mm.; exposed culmen, 35–43 (average, 39) mm.; culmen without cere, 26–31 (average, 29) mm.

The present subspecies, by reason of its much smaller size and much paler colors throughout, is so very different from *virginianus* that for typical specimens no comparison is necessary. It seems to reach its greatest degree of pallor in Arizona and the immediately contiguous region. A specimen from Rodriguez, Nuevo Leon, Mexico, somewhat approaches *virginianus*, though not strongly enough to warrant its reference to that form.

In *Asio m. pallescens* there is, in almost any locality, a remarkably wide range of variation, irrespective of altitude or other influences sometimes supposed to be potent in producing such differences in this group of birds; for, in fine, this race exhibits to a marked degree the dichromatism existing in many of the others. The ordinary or light phase in its extreme manifestation is almost as white below as *Asio m. wapacuthu*, with legs and feet as immaculate, and is sometimes even paler above, though of course on account of small size not to be confused with that form. The dark phase is of very different appearance, the color above being very blackish, the lower parts dark, with markings blackish instead of brownish, the feet ochraceous and much mottled, thus to some degree resembling the similar condition of both *occidentalis* and *wapacuthu*, yet rather more ochraceous. There is also a third phase which comes close to the light phase of *virginianus*, and in which ochraceous predominates throughout the plumage of both upper and lower parts, including the face and feet. The type of *pallescens* is intermediate between the ochraceous and the light gray phases.

Specimens examined are from the following localities:

Arizona.—Tucson; Colorado River at Monument 204, Mexican Boundary Line; San Bernardino Ranch; Fort Lowell; Camp 98, Kennerly and Möllhausen; Fullers; Oracle; Fort Whipple; Huachuca Mountains; Phoenix.

New Mexico.—San Luis Mountains; Chico Springs; Longitude 107° 15′, Mexican Boundary Line.

Texas.—Fort Clark; Marathon; Medina; Presidio County; Watson Ranch, 18 miles southwest of San Antonio; Monahans.

Lower California.—Salton River (United States Boundary Line); Gardiners Lagoon (United States Boundary Line).

Nuevo Leon.—Rodriguez.

Coahuila.—Sabinas.

ASIO MAGELLANICUS PACIFICUS (Cassin).

Bubo virginianus variety *pacificus* Cassin, Illustr. Birds Calif., Texas, etc., 1854, p. 178.

Chars. subsp.—Similar to *Asio magellanicus pallescens*, but darker throughout; feet much more heavily mottled with dusky; face with usually more admixture of rufous.

Type locality.—Western North America (southern California[a]).

Geographical distribution.—California, except the southeastern part and the northern and central coast districts; extending northward to Fort Klamath, Oregon, eastward to the San Francisco Mountains, Arizona.

Measurements (*6 males*).—Wing, 313–353 (average 336.5) mm.; tail, 190–218 (average, 204.5) mm.; exposed culmen, 34–38 (average, 36) mm.; culmen without cere, 25–27 (average, 26) mm. (*4 females.*)—Wing, 350–370 (average, 360.7) mm.; tail, 213–228 (average, 219.3) mm.; exposed culmen, 34–38 (average 36.8) mm.; culmen without cere, 27–28 (average, 27.5) mm.

A specimen from Fort Klamath, Oregon, doubtless referable here, is very ochraceous, and suggests the existence of another phase in this race. A single bird from San Bernardino, California, is quite as small as *dachistus*, but probably is abnormally so, as specimens from farther south are much larger. None of *pacificus* from Lower California have been examined, though the present subspecies undoubtedly occupies at least the extreme northern portion. The reference of the birds from the region of the Grand Canyon of the Colorado, Arizona, to *pacificus* is not wholly satisfactory, though the only specimens we have seen—one from the San Francisco Mountains and another from the Coconino Plateau, Arizona—appear to be nearest this form. The first-mentioned example is decidedly larger than any of our specimens of *pacificus*, besides being rather dark, and, after all, this and the one from the Coconino Plateau may be nothing more than dark-phase intermediates between *pallescens* and *occidentalis*.

Specimens from the following localities have been seen:

California.—Dulzura; San Diego; Fort Tejon; Fullerton; San Bernardino; Fort Crook; Kern Lakes; Red Bluff.

Arizona.—San Francisco Mountain; Coconino Plateau, Grand Canyon of the Colorado.

Oregon.—Fort Klamath.

[a] Stone, Auk, XIII, 1896, p. 155.

ASIO MAGELLANICUS ELACHISTUS (Brewster).

Bubo virginianus elachistus BREWSTER, Bull. Mus. Comp. Zool., XLI, 1902, p. 96.

Chars. subsp.—Similar to *Asio magellanicus pacificus*, but very much smaller.

Type locality.—Sierra de la Laguna, Lower California.

Geographical distribution.—Southern Lower California.

Measurements (*5 males*).—Wing, 305–325 (average, 315.6) mm.; tail, 175–206 (average, 190.3) mm.; exposed culmen, 33–38 (average, 36.5) mm.; culmen without cere, 21–26 (average, 24.8) mm. (*1 female*).—Wing, 330 mm.; tail, 211 mm.; exposed culmen, 38 mm.; culmen without cere, 27.5 mm.

Description (*light phase*).—Adult male, No. 17238, U.S.N.M.; Caduana, Lower California, November 25, 1859; John Xantus. Upper surface dull brown, so much mixed and mottled with white, grayish, buff, and pale ochraceous that the general appearance is quite light; wing-coverts and exposed surface of innermost secondaries like the back, with, however, somewhat more white; rest of wing-quills fuscous, with broad bars of buffy and ochraceous distally growing obsolete; tail-feathers fuscous, the middle pair and outer webs of all but outermost brokenly barred with whitish or buff. The remainder broadly barred with ochraceous buff; extreme forehead and supraloral line white; facial disk ochraceous, slightly mixed with dusky, and bordered posteriorly by a black band; ear tufts deep brown, the inner webs and basal portion of the feathers chiefly ochraceous buff; sides of neck mixed white, buff, and dark brown; chin and throat white, divided by a band of ochraceous mixed with dark brown; breast pale ochraceous mingled with white, spotted and vermiculated with blackish; rest of lower surface white, somewhat mixed with pale ochraceous posteriorly, and barred with dark brown except on median portion of abdomen; lining of wing white, spotted with ochraceous and dark brown; tibiæ ochraceous buff, indistinctly marked with dusky; feet and tarsi dull white, the latter posteriorly a little spotted with dusky.

This race may be distinguished from *Asio m. melanocrus* by its reduced size, paler and less rufescent coloration. Compared with *mayensis*, it has a smaller bill, and more ochraceous or rufous in the plumage, particularly that of the face.

In *elachistus* there are two very distinct phases, one light, the other dark. Mr. Brewster's type is an example of the latter, which seems to be the more common, and from which the former so much differs as to be deemed worthy of the above description.

Examples from the following localities have been examined:

Lower California.—La Paz: Caduana; San José del Rancho; Sierra de la Laguna; Santa Anita.

ASIO MAGELLANICUS ICELUS, new subspecies.

Chars. subsp.—Resembling *Asio magellanicus pacificus*, but very much darker, particularly on the upper parts.

Type locality.—San Luis Obispo, California.

Geographical distribution.—Coast of California, north of about 35 north latitude.

Measurements (*1 male*).—Wing, 335 mm.; tail, 215 mm. (*2 females*).—Wing, 345–360 (average, 352.5) mm.; tail, 203–230 (average, 216.5) mm.; exposed culmen, 38–40 (average, 39) mm.; culmen without cere, 27.5–28.5 (average, 28) mm.

Description.—Type, adult female, No. 141225, U.S.N.M.; Biological Survey Collection; San Luis Obispo, California, November 29, 1891; E. W. Nelson. Upper surface brownish black, mottled and irregularly barred with buffy ochraceous and grayish white, least so on the forehead and horns; tail fuscous, with broad broken bars of ochraceous, which, on the middle feathers, become almost white; wings fuscous, both the quills and their coverts barred on exterior webs with dull, mottled grayish, brownish or whitish, on the inner webs with pale ochraceous; face mixed grayish, ochraceous, and blackish; chin and sides of neck generally similar to the upper surface; throat white; breast buffy, with spots and irregular bars of black; rest of lower surface buffy whitish, heavily barred with black, except in middle of abdomen, where these markings are brown and less conspicuous; feet and tarsi pale buff, or whitish, much mottled with dark brown; under wing-coverts white or buffy, with heavy irregular bars and other markings of dark brown and blackish.

The affinities of this new form are with the *saturatus* group, as to reasonable extent might be expected from its range, rather than with *pacificus*. An example from Redwood City, California, is somewhat darker and more rufescent than those from the localities more southern, indicating an intergradation to the northward with either *lagophonus* or *saturatus*.

Our specimens are from the subjoined localities:

California.—San Luis Obispo; Redwood City; Nicasio.

ASIO MAGELLANICUS LAGOPHONUS, new subspecies.

Chars. subsp.—Resembling *Asio magellanicus icelus*, but larger; the feet darker; all the ochraceous and rufous tints, particularly on face and feet, much more pronounced.

Type locality.—Fort Walla Walla, Washington.

Geographical distribution.—Washington and northern Oregon (excepting the coast region), with Idaho; north through eastern and central British Columbia to Cook Inlet and the interior of Alaska.

Measurements (*9 males*).—Wing, 345–370 (average, 355.8) mm.; tail, 210–235 (average, 223.5) mm.; exposed culmen, 35–41 (average, 37.9) mm.; culmen without cere, 25–30 (average, 27.4) mm. (*6 females*).—Wing, 350–400 (average, 375.8) mm.; tail, 213–252 (average, 238.5) mm.; exposed culmen, 36–42.5 (average, 40.1) mm.; culmen without cere, 26–31 (average, 29.2) mm.

Description.—Type, adult male, No. 88377, U.S.N.M.; Fort Walla Walla, Washington, November 13, 1881; Capt. Charles Bendire. Upper surface brownish black, much mottled and vermiculated with whitish, buffy, and ochraceous, the last most conspicuous anteriorly, but the subbasal portions of all the feathers more or less ochraceous; wing-coverts like the back; wing-quills fuscous, barred broadly though somewhat irregularly on outer webs with dull buffy or brownish white, on interior webs with ochraceous; tail sepia, barred brokenly and vermiculated with whitish, buff, and ochraceous, the last predominating; forehead and supraloral line grayish white, mixed with ochraceous and brownish; facial disk ochraceous, somewhat mixed with blackish, and bounded behind by a black band; horns blackish, with considerable ochraceous on inner webs and basal portions; sides of neck mixed dark brown, whitish, and ochraceous; chin and throat white, divided by a collarette of dark brown, ochraceous-margined feathers; remainder of lower surface white and ochraceous, heavily, and in places confluently, barred with brownish black, the breast also blotched with the same; lining of wing white and ochraceous, barred and spotted with blackish; legs and feet ochraceous, barred and spotted with dark brown.

This subspecies differs from *pacificus* in its larger size; darker upper and lower parts, the latter more heavily barred; more strongly mottled legs and feet; darker and more rufescent facial disk. It is apparently most closely allied to *saturatus* and *icelus*, but is quite easily distinguishable from either.

The specimen from Pengra, Oregon, here referred, is decidedly intermediate between *lagophonus* and *occidentalis*. Birds from Cook Inlet and the interior of Alaska are in color apparently identical with those from Idaho and Washington, though one from Fort Yukon is almost dark enough for *saturatus*. These birds from Alaska are, however, somewhat larger than typical *lagophonus*, and their inclusion in the measurements above given to some extent accounts for the wide range of variation.

Although there is much individual color difference among examples of this race, yet, in so far as is shown by our material, there is little or no indication of a pale phase.

. Specimens from the following localities have been examined:

Washington.—Walla Walla; Cascade Mountains; 25 miles southeast of Toledo.

Oregon.—Douglas County; Des Chutes River; Pengra.

Idaho.—Sawtooth Lake.

British Columbia.—Vernon.

Alaska.—Nulato; Fort Yukon; Hope, Cook Inlet; Knik, Cook Inlet; Kowak River.

ASIO MAGELLANICUS SATURATUS (Ridgway).

Bubo virginianus saturatus Ridgway, Explor. and Surv. 40th Par., IV, 1877, p. 572, footnote.

Chars. subsp.—Similar to *Asio magellanicus lagophonus*, but darker, particularly above; face and rest of plumage with less ochraceous and rufous, producing on the upper surface a more uniform appearance; feet much darker and more heavily mottled.

Type locality.—Simiahmoo, Washington.

Geographical distribution.—Pacific coast region, from Washington (and probably at least northern Oregon) north to southern Alaska.

Measurements (*4 males*).—Wing, 345–358 (average, 348.3) mm.; tail, 205–222 (average, 212.3) mm.; exposed culmen, 39–41 (average, 39.8) mm.; culmen without cere, 28.5–29 (average, 28.9) mm. (*6 females*).—Wing, 360–383 (average, 374.7) mm.; tail, 215–242 (average, 227.2) mm.; exposed culmen, 38–42 (average, 40) mm.; culmen without cere, 28–31 (average, 30) mm.

With the possible exception of *nigrescens*, this race is more deeply colored than any of its American congeners, the legs and feet being particularly dark and heavily mottled. So far as we have been able to determine, there is no light phase. A single example from Ashcroft, British Columbia, is intermediate between *saturatus* and *lagophonus;* and another from Sitka, Alaska, verges also somewhat toward the latter form.

Specimens examined come from the following localities:

Washington.—Fort Steilacoom; Skagit County; Similkameen; Port Townsend; American Lake; Simiahmoo.

British Columbia.—Kamloops; Lund; Ashcroft.

Alaska.—Sitka.

ASIO MAGELLANICUS HETEROCNEMIS, new subspecies.

Chars. subsp.—Like *Asio magellanicus saturatus*, but bill larger; posterior lower parts paler; feet lighter colored and less heavily spotted; upper parts with usually less ochraceous.

Type locality.—Lance au Loup, Labrador.

Geographical distribution.—Labrador, including at least the north coast of the Territory of Ungava.

Measurements (*2 males*).—Wing, 350–365 (average, 357.5) mm.; tail, 220–230 (average, 225) mm.; exposed culmen, 41 mm.; culmen without cere, 30 mm. (*7 females*).—Wing, 370–390 (average, 380) mm.; tail,

225–250 (average, 239) mm.; exposed culmen, 38–44 (average, 41.3) mm.; culmen without cere, 28–32 (average, 30.1) mm.

Description.—Type, adult male, No. 4445, collection of E. A. and O. Bangs; Lance au Loup, Labrador, April 9, 1899; Ernest Doane. Above brownish black, vermiculated and mottled with whitish, least so on the head; wing-coverts like the back, though with rather more white; wing-quills fuscous, the outer webs with broken bars of whitish or buffy, the inner with partial bars of ochraceous buff on the basal portion; tail sepia brown, the middle feathers with mottlings and broken bars of whitish and buffy, the rest with irregular bars of paler brown and ochraceous; forehead and supraloral streak white, much mixed with brown; facial disk dull gray, with mixture of blackish and some ochraceous, bordered behind by a black band which joins the black horns; sides of the neck mottled with dark brown, whitish, and ochraceous; chin and throat white, separated by a dark brown band whose feathers have grayish or ochraceous edgings; breast ochraceous, with blotches, bars, and mottlings of brown and white; remainder of lower surface barred with black and white, with laterally much ochraceous and buffy; lining of wing mottled with white, brown, and ochraceous; tarsi and tibiæ deep ochraceous, spotted and irregularly barred with dusky; feet dull buffy grayish, spotted and obsoletely barred with dark brown.

Although by authors heretofore referred to *saturatus*, the Labrador bird differs from that form as detailed above, and its characters, though not as strongly marked as are those of some of the other races, are yet sufficient for recognition by name, particularly in view of a widely separated range. Although, of course, nearest *saturatus*, the differences may be readily appreciated in a good series. For the privilege of describing this form the writer is indebted to the courtesy of Mr. Outram Bangs, who had already noted its distinctness.

Specimens from the following localities have been seen:

Labrador.—Okkak; Makkovik; Hopedale; Turnavik Island; Lance au Loup; Fort Nascopee.

Ungava.—Fort Chimo; Near Forks.

ASIO MAGELLANICUS VIRGINIANUS (Gmelin).

Strix virginiana Gmelin, Syst. Nat., I, 1788, p. 287.
Strix bubo variété *E. ludovicianus* Daudin, Traité d'Orn., II, 1800, p. 210.
Bubo pinicola Vieillot, Hist. Nat. Ois. Am. Sept., I, 1807, p. 51, pl. xix.
Strix crassirostris Vieillot, Nouv. Dict. d'Hist. Nat., VII, 1817, p. 44.
Strix macrorhyncha Temminck, Pl. Color., II, 1821, pl. 62.
Bubo virginianus variety *atlanticus* Cassin, Illustr. Birds California, Texas, etc., 1854, p. 178.

Chars. subsp.—Similar to *Asio magellanicus heterocnemis*, but much smaller; very much more rufous throughout; legs and feet less conspicuously mottled.

Type locality.—Virginia.

Geographical distribution.—Southern Canada and eastern United States, west to Ontario, Wisconsin, Iowa, and eastern Texas; accidental in Ireland.[a]

Measurements (*7 males*).—Wing, 320–355 (average, 343.3) mm.; tail, 190–210 (average, 199.4) mm.; exposed culmen, 38–40 (average, 39.4) mm.; culmen without cere, 26–30 (average, 28.6) mm. (*6 females*).—Wing, 352–380 (average, 366.3) mm.; tail, 200–225 (average, 218) mm.; exposed culmen, 38–43 (average, 40.7) mm.; culmen without cere, 29–32.5 (average, 30.6) mm.

In normal phase this race is characterized by a deep rufescence throughout, very different from the other subspecies living north of Mexico. There are, however, two other phases of *virginianus*—one in which the coloration is light, and the place of rufous tints is taken by ochraceous; the other in which grayish and blackish colors predominate; all three phases being connected by intermediates. The last seems to be most prevalent in the New England States, and possibly indicates vergence toward *heterocnemis*.

A careful comparison proves that birds from Florida do not differ at all, either in size or color, from those of the Middle Atlantic States. Some specimens from the region of the Lower Rio Grande are rather light-colored, but neither in this respect nor in any other can they be distinguished from examples of the light phase commonly occurring in the Eastern States; while a specimen taken at Rockport, Texas, is typical of *virginianus* in dark rufous plumage. The breeding bird of Iowa is undoubtedly *virginianus*, though *occidentalis* occurs in winter. We have seen no summer birds from Minnesota, but at least the southern part of this State is probably inhabited by the present race.

Specimens from the subjoined localities have been examined:

Arkansas.—Fayetteville.

District of Columbia.—

Florida.—Sebastian; Fort Bassinger; Orange Hammock; Lake Kissimmee.

Illinois.—Sugar Creek Prairie; Mount Carmel.

Indiana.—Upperville; Tolesto.

Indian Territory.—[No further locality given.]

Iowa.—Mitchell County.

Maryland.—Rockville; Laurel; Sandy Spring; Cornfield Harbor.

Michigan.—Saginaw County.

Missouri.—Marble Cave.

New Jersey.—[No further locality given.]

Ohio.—Madisonville; Wooster.

Pennsylvania.—Carlisle.

Texas.—Rockport; Brownsville.

Virginia.—Ammondale; Glymont; Amelia.

[a] Belle Lake, county Waterford, January 27, 1851; see Zoologist, 1881, p. 308.

ASIO MAGELLANICUS ALGISTUS, new subspecies.

Chars. subsp.—Similar to *Asio magellanicus lagophonus*, but much paler throughout; the lower parts less heavily barred; the legs and feet not so conspicuously mottled.

Type locality.—Saint Michael, Alaska.

Geographical distribution.—Northwest coast region of Alaska.

Measurements (*2 males*).—Wing, 355–360 (average, 357.5) mm.; tail, 225–245 (average, 235) mm.; exposed culmen, 41 mm.; culmen without cere, 29 mm. (*4 females*).—Wing, 355–390 (average, 371.5) mm.; tail, 225–240 (average, 232) mm.; exposed culmen, 39–43 (average, 41) mm.; culmen without cere, 28–31 (average, 29.3) mm.

Description.—Type, [male] adult, No. 70276, U.S.N.M.; St. Michael, Alaska; L. M. Turner.—Upper parts brownish black, with numerous mottlings and irregular bars and spots of white, most of the feathers extensively ochraceous basally; tail dark brown, the middle feathers and outer webs of all but the outermost vermiculated, and irregularly and broadly barred with white or buffy white, this replaced by ochraceous on the rest of the tail; wing-coverts like the back; wing-quills dark brown, broadly barred irregularly with buff and ochraceous; horns brownish black, mottled with ochraceous and whitish; forehead and supraloral stripe white; facial disk grayish, mixed to some extent with ochraceous, and bordered behind by a black band; sides of neck mottled brown, white, and ochraceous; chin and throat white, separated by a band of blackish feathers with ochraceous and buffy edgings; breast white with some ochraceous buff, blotched, irregularly barred, and mottled with blackish brown; abdomen and crissum white, with more or less regular bars of dark brown; sides much mixed with ochraceous; lining of wing white, with markings of dark brown and ochraceous; tarsi and tibiæ ochraceous buff, with broken bars of brownish; feet buffy white, obscurely spotted with dusky.

This subspecies of *Asio magellanicus* really much more resembles *occidentalis* or *pacificus* than it does its nearest geographic relative, *lagophonus;* but is not identical with either. From *occidentalis* it may be separated by its darker upper surface, particularly the wings, and by its somewhat less heavily barred lower surface; while from *pacificus* its larger size, less ochraceous face, and the paler ochraceous of the upper surface will serve for differentiation.

It is possible that I err in referring to *lagophonus* the Alaskan specimens of *Asio* from the timbered region, for it may be that these large birds are but the dark phase of *algistus*, yet in so far as the material now available shows, save in one single instance, the difference in plumage is correllated with change of area, the lighter birds being confined in a general way to the Barren Grounds.

Examples from the following localities are referred to this form:

Alaska.—St. Michael; Kowak River; Lower Yukon River; Port Huron; Aleknagik River.

ASIO MAGELLANICUS OCCIDENTALIS (Stone).

Bubo virginianus occidentalis Stone, Auk, XIII, 1896, p. 155.

Chars. subsp.—Like *Asio magellanicus pallescens*, but considerably larger; colors averaging darker.

Type locality.—Mitchell County, Iowa (winter).

Geographical distribution.—Western United States, from Minnesota and Kansas to Nevada, southeastern Oregon, Utah, and Montana; south in winter to Iowa.

Measurements (*10 males*).—Wing, 333–365 (average, 349.6) mm.; tail, 200–225 (average, 212.8) mm.; exposed culmen, 35–40 (average, 37.6) mm.; culmen without cere, 26–28 (average, 27.1) mm. (*9 females.*)—Wing, 360–390 (average, 376.1) mm.; tail, 220–240 (average, 230.5) mm.; exposed culmen, 37–43 (average, 40.7) mm.; culmen without cere, 28–33 (average, 30.2) mm.

Although hitherto not recognized, this form is a fairly well-marked one, and covering, as it does, an extensive area, is well worthy a name. Colorado and Nevada specimens are somewhat darker than those from Montana and the Dakotas. In Colorado, and doubtless in other localities also, *occidentalis* has a dark phase, characterized by great increase of blackish both above and below.

Specimens of this race examined come from the following places:

Colorado.—Elk Mountains; Routt County; Pueblo County; Twin Lakes; Cache la Poudre River.

Iowa.—Mitchell County; Grinnell.

Kansas.—Pendennis.

Montana.—St. Marys Lake; Fort Custer; Fort Shaw.

Minnesota.—Aitkin; Elk River; Excelsior.

Nevada.—Austin (35 miles southwest).

North Dakota.—Missouri River, 87 miles below Fort Union; Devils Lake.

Oregon.—Prineville.

Wyoming.—Fort Bridger; Deer Creek; West Fork of Medicine Bow Creek.

ASIO MAGELLANICUS WAPACUTHU (Gmelin).

Strix wapacuthu Gmelin, Syst. Nat., I, 1788, p. 291.

Bubo arcticus Swainson, Faun. Bor.-Amer., II, 1832, p. 86, pl. xxx.

Bubo subarcticus Hoy, Proc. Acad. Nat. Sci. Phila., VI, 1852, p. 211.

Chars. subsp.—Similar to *Asio magellanicus occidentalis*, but paler, the upper parts with lighter ochraceous, less black, and more white, the lower surface more whitish, less heavily barred, the feet with less mottling and less ochraceous—usually immaculate.

Type locality.—Hudson Bay, Canada.

Geographical distribution.—Northern Canada, from Hudson Bay to the Valley of the Mackenzie River; south in winter to the northern United States, from Idaho to Wisconsin.

Measurements (*5 males*).—Wing, 337–368 (average, 352) mm.; tail, 215–230 (average, 221.6) mm.; exposed culmen, 37–42 (average, 39.5) mm.; culmen without cere, 27–30 (average 28.5) mm. (*2 females.*)—Wing, 385–390 (average, 387.5) mm.; tail, 235–237 (average, 236) mm.; exposed culmen, 43 mm.; culmen without cere, 31–31.5 (average, 31.3) mm.

This is the palest of all the American members of the genus *Asio*, the general whiteness being usually very conspicuous. From *Asio m. algistus* it differs as from *occidentalis*, though in greater measure. In dark phase it is most like the normal or light condition of *occidentalis*, but the dark markings are deeper and more contrasted, the feet usually white with little or no ochraceous or dark mottling.

The southward limit of the breeding range it is impossible at present to delineate with even approximate exactness, as proper material from the interior of British America is not available. Specimens that have been examined, however, point to the probability that *wapacuthu* summers at least as far south as Saskatchewan.

Dr. Richmond has shown[a] that the name *arcticus* of Swainson, so long in use for this race, is preoccupied and consequently untenable. As a substitute he proposes to revive *subarcticus* of Hoy, which has been commonly applied to the pale forms of the western United States. There seems to be, however, a prior name in *Strix wapacuthu* Gmelin,[b] which by nearly all authors has been synonymized with *arcticus*. This name is based on the "Wapacuthu Owl" of Pennant,[c] and its accompanying description is an excellent one of the arctic horned owl, with the exception of the statement that the bird is without ears, a mistake that might easily occur, particularly with an imperfect specimen. Furthermore, that it is not *Nyctea nyctea*, the only other owl to which the name could by any possibility apply, is clearly evidenced by the diagnosis, added to which is the statement that the young are white.

Specimens of this form from the following localities have been examined, probable breeding records being indicated by an asterisk:

Mackenzie.—Fort Resolution*; Slave River, 75 miles below Fort Smith.*

Saskatchewan.—Moose Lake*; Pas*.

Ontario.—Moose Factory; Michipicoten Island, Lake Superior.

Minnesota.—Aitkin.

North Dakota.—Devils Lake.

Wisconsin.—Racine.

[a] Proc. Biol. Soc. Wash., XV, 1902, p. 86.

[b] Syst. Nat., I, 1788, p. 291.

[c] Arct. Zool., II, 1785, p. 231.

A NEW BATRACHIAN AND A NEW REPTILE FROM THE TRIAS OF ARIZONA.

By Frederic A. Lucas,
Acting Curator, Section of Vertebrate Fossils.

The two species of fossil vertebrates to be described add two genera to the Triassic fauna of North America, one representing the large labyrinthodonts hitherto known only from Europe, the other being a new and large Cotylosaurian. The history of the discovery of these vertebrates is as follows:

In November, 1899, while visiting the fossil forest of Arizona, Dr. Lester F. Ward obtained near Tanners Crossing of the Little Colorado River a few specimens of Triassic vertebrates. The majority of them proved to belong to the large belodont described as *Heterodontosuchus ganei*,[a] two scutes were from the belodont *Episcoposaurus* Cope, while a small portion of a cranial plate was identified by Dr. E. Fraas as being from some large labyrinthodont. The subsequent year, 1900, Mr. Barnum Brown visited the locality to collect for the U. S. National Museum, largely in the hope of obtaining some ancestral forms of Stegosaurus. While this hope was not realized Mr. Brown secured a valuable collection of Triassic fossils, mainly belonging to the two belodonts mentioned above, though comprising a few examples of other animals. This material was mostly in a very fragmentary condition, one of the few noteworthy exceptions to this rule being an episternum of a large labyrinthodont, which, though badly shattered, proved to be practically all present. This was pronounced by Dr. E. Fraas, to whom a photograph was submitted, to be unmistakably from some species of the genus *Metoposaurus*, and in consideration of this fact I have named the species in his honor. This seems particularly appropriate in view of his various memoirs on the Triassic vertebrates of Europe.

[a] Am. Journ. Sci., 1898, VI, p. 399.

METOPOSAURUS FRAASI, new species.

Type.—An episternum, No. 2152, catalogue of fossil vertebrates, U. S. National Museum, from 5 miles east of Tanners Crossing, Little Colorado River, Arizona. This locality is about 25 miles above the junction of the Little Colorado with the Colorado. The specimen is shown on Plate III.

The species is characterized by the coarseness of the sculpturing of the episternum and the fact that the markings of the center of the plate consist of irregular pits which, toward the margin, are transformed into radiating grooves. These grooves are most marked on the anterior portion of the bone. The portions of clavicles present also have the ornamentation in the shape of pits rather than as grooves, and in this respect and in the greater coarseness of the sculpture the present species differs from the European *Metoposaurus diagnosticus* of von Meyer. It is furthermore characterized by the extent of the articulation of the clavicle with the episternum, the posterior end of the clavicle being well behind a line drawn through the center of the plate. The postero-internal angle of the clavicle is very much rounded instead of being decidedly angular, as it is in *Metoposaurus diagnosticus*.

The episternum is 43 cm. (16¾ inches) long and 30 cm. (11¾ inches) wide.

The only other specimen that can be referred to this species is the anterior portion of a left mandible, somewhat weathered, found at the same locality as the episternum. This mandible is coarsely sculptured on the external face, and bears indications of two large teeth at the very front of the ramus, and behind these 15 small teeth. These seem to have been largely attached to the external wall of the alveolus in a manner somewhat suggestive of the pleurodont dentition of an iguana.

From the same Triassic beds, though at some little distance from the locality where the episternal plate of Metoposaurus was obtained, Mr. Brown secured a number of fragments which, when put together, proved to be the humerus of a large Anomodont, or, more strictly speaking, Cotylosaurian. This represents a new species and new genus for which the name of *Placerias hesternus* is proposed, the generic name being given on account of the breadth of body indicated by the short, broad humerus.

PLACERIAS, new genus.

PLACERIAS HESTERNUS, new species.

Type.—A right humerus, No. 2198 catalogue of fossil vertebrates, U.S.N.M., from 3 miles north of Tanners Crossing of the Little Colorado River, Arizona. The specimen is figured on Plate IV. The characteristic features of the genus and species are the great and sudden expansion of the deltoid ridge, the contraction of the humerus at the

center of the shaft, and the sharp definition and differentiation of the radial and ulnar articulations. While the deltoid ridge is prominent in many Anomodonts, it is peculiar in the present species from the fact that it seems to have started practically from the proximal end and not from a little distance down the shaft, as it does in such a form as Gomphognathus.[a]

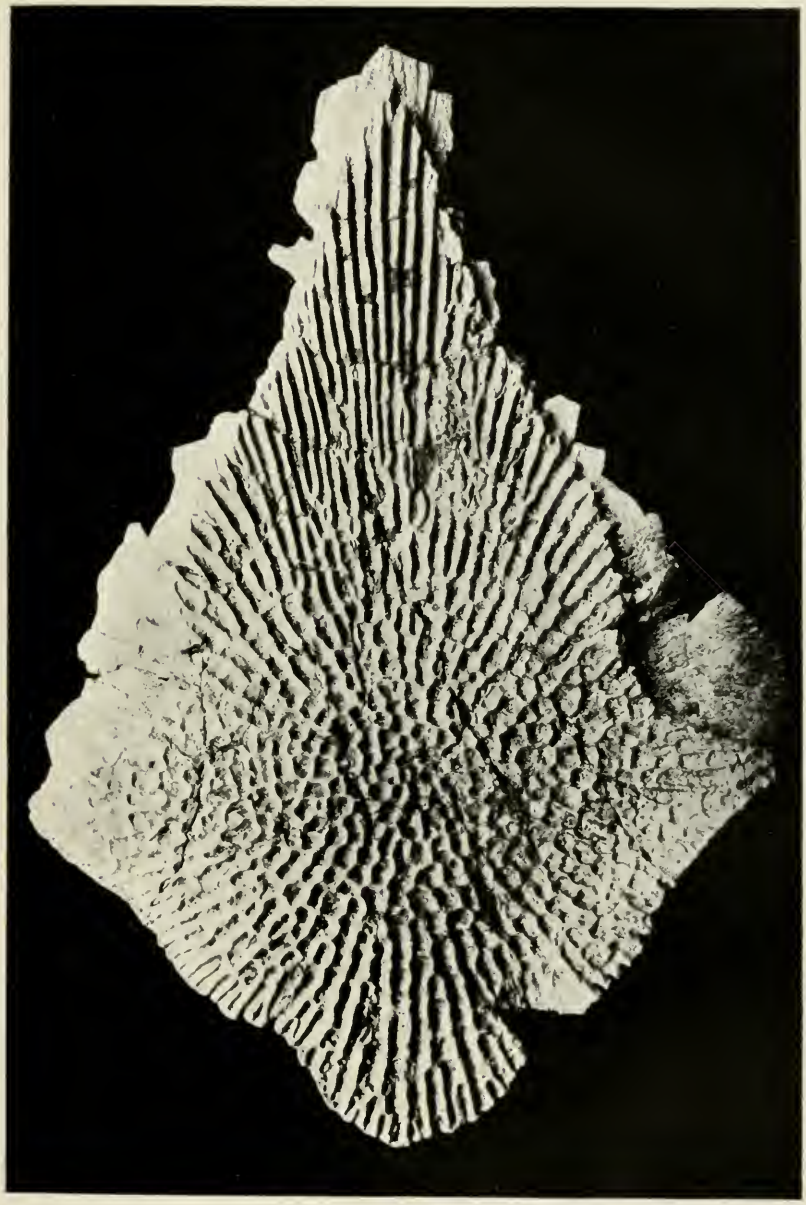
The humerus of *Placerias* otherwise bears a slight resemblance to that of Gomphognathus, but is vastly larger, and indicates an animal of much greater size and power. Among African Anomodonts the humerus suggests most that of Cynodrakon, but here again it is much more expanded proximally. A large, elongate entepicondylar foramen was present, but the portion bounding the outer side of this is missing and its position is not clearly indicated on the accompanying plate. The articular face for the radius is large, round, and well defined, and the olecrenal fossa is of good size; the proximal end of the humerus was capped with cartilage, but the amount in the elbow joint must have been small. The indications are that *Placerias* was a creature largely, if not entirely, terrestrial in habit.

The measurements of the humerus are as follows: Greatest length, 398 mm. (15¾ inches); estimated breadth across deltoid ridge, 200 mm. (7⅞ inches); breadth of portion actually present, 170 mm. (6¾ inches); breadth at lower end of deltoid ridge, 144 mm. (5½ inches); least diameter of shaft, 60 mm. (2⅜ inches); greatest distal breadth, 155 mm. (6⅛ inches).

The large Cotylosaurians hitherto described from North America are from the Permian, while the present specimen is from the Trias. The animal represented is also larger than any of the Permian species, and, in this respect, is on a par with *Pariasaurus*. The humerus, however, is quite different from that ascribed to *Pariasaurus*, and while the discovery of animals of this genus in Russia indicates that the group to which it belongs was widely distributed, it is evident that the present specimen is not *Pariasaurus*. It is nevertheless quite probable that *Placerias* belongs to some allied family, or possibly to the same family.

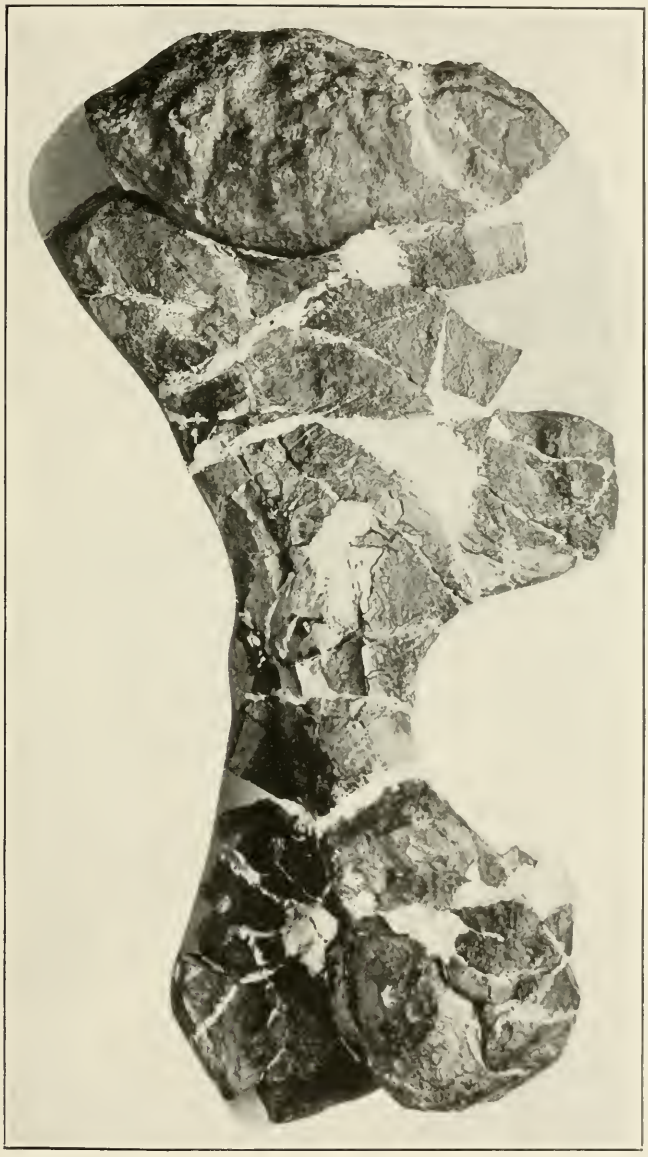
The beds from which the two species just described were obtained also contained remains of the large Belodon, *Heterodontosuchus ganei* and of the dinosaur Palæoctonus. The same assemblage of species has recently been found by Mr. Newton H. Brown near Lander, Fremont County, Wyoming, which considerably extends the northerly limit of these Triasic beds. Aside from the interest attached to the finding of this new species is the more important fact, pointed out by Dr. Fraas, that the genus *Metoposaurus* is characteristic of the Keuper of Europe, and that we have in these Triassic beds of Arizona, Utah, and Wyoming the same combination of belodont and labyrinthodont as in the Keuper.

[a] Seeley, Trans. Roy. Soc., 1895, B, p. 29.



EPISTERNUM OF METOPOSAURUS FRAASI.

(Type. No. 2152, U.S.N.M.)



EXTERNAL ASPECT OF RIGHT HUMERUS OF PLACERIAS HESTERNUS.

(Type. No. 2198, U.S.N.M.)

A REVIEW OF THE WRENS OF THE GENUS TROGLODYTES.

By Harry C. Oberholser,
Assistant Ornithologist, Department of Agriculture.

The genus *Troglodytes*, as here restricted, comprises a group of wrens that is wholly American. Notwithstanding very considerable interspecific differences, no thoroughly satisfactory generic division seems possible, further than the segregation of that peculiar form *Troglodytes browni*.[a] While it is true that *solstitialis* and *ochraceus* have short tails, large feet, rather slender bills, and somewhat peculiar coloration, and therefore seem quite different from typical *Troglodytes* (*aedon*), yet this distinction loses any significance it appears to possess when other forms are compared with these, particularly *Troglodytes s. macrourus*, which is an evident subspecies of *solstitialis!* These species—*solstitialis* and its allies—have sometimes been referred to *Heminra* (= *Uropsila*), but they certainly are out of place in such position, for the structure of the nostril is quite different in that group, being round and open instead of linear and strongly operculate. Furthermore, the West Indian forms commonly attributed to *Thryothorus* should be included in *Troglodytes*. Thus, although it is a far cry from the slender bill and feet of *aedon* to the heavy beak and large feet of *tanneri* or *musicus;* from the long wings of *musicus* to the short ones of *brunneicollis;* from the long tail of *beani* to the short one of *grenadensis* or *solstitialis;* and from the gray and white coloration of *azteeus* to the dark, almost uniform, reddish chestnut of *rufescens*, there is no place where the trenchant line of generic division can be drawn.

By far the most difficult part of the genus is the so-called *musculus* group, which, from lack of adequate material, has always been a source of considerable annoyance to ornithologists. While our means have not been all that could be desired, yet the interrelations of the various forms have been worked out with the considerable care that

[a] Bangs, Proc. New Eng. Zool. Club, III, 1902, p. 53.

the question warrants, and it is to be hoped that some little additional light has thus been thrown upon a dark subject, although it may be premised that the lines of distribution on the accompanying map are in great measure tentative, while delineating at least in part what may reasonably be supposed to be the geographical homes of the various forms. At least one conclusion of importance has been rendered obvious by the present investigation, and this is the conspecific relationship of this group, throughout both South and Central America, with the single exception of *Troglodytes peninsularis*, which seems to be a distinct species.

The collection of the U. S. National Museum, including that of the Biological Survey, has of course furnished the major part of the material for this review, but for very substantial reenforcements the writer is indebted to the authorities of the American Museum of Natural History, through Dr. J. A. Allen; to the Academy of Natural Sciences of Philadelphia, through Mr. Witmer Stone; and to Mr. Outram Bangs, of Boston, to whom further is due my privilege of describing the following new genus:

THRYORCHILUS,[a] new genus.

Chars. gen.—Similar to *Troglodytes*, but tail of *ten* feathers, and much abbreviated; feet proportionately much larger, reaching far beyond the end of tail; coloration suggesting that of *Henicorhina*.

Type.—*Troglodytes browni* Bangs.

Range.—Same as that of the type species.

THRYORCHILUS BROWNI (Bangs).

Troglodytes browni Bangs, Proc. New Eng. Zool. Club, III, 1902, p. 53.

Type locality.—Volcan de Chiriqui, Panama, Colombia.

Geographical distribution.—Volcan de Chiriqui, Panama, Colombia.

This remarkable wren, which Mr. Bangs has so recently made known to science, is, by its combination of characters, apparently well worthy of generic separation from *Troglodytes*. In superficial appearance it resembles rather the species of *Henicorhina*, though in reality not very closely allied. Its habits, according to Mr. Brown, are those of a marsh wren.[b]

TROGLODYTES Vieillot.

Troglodytes Vieillot, Hist. Nat. Ois. Am. Sept., II, 1807, p. 52.

Type.—*Troglodytes aedon* Vieillot.

Range.—South and Central America, the West Indies, and North America north to southern Canada.

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[a] θρύον, juncus; ὀρχίλος, regulus.

[b] Proc. New Eng. Zool. Club, III, 1902, p. 54.

TROGLODYTES SOLSTITIALIS SOLSTITIALIS Sclater.

Troglodytes solstitialis SCLATER, Proc. Zool. Soc. Lond., 1858, p. 550.

Type locality.—Vicinity of Riobamba, Ecuador.

Geographical distribution.—Ecuador and Colombia.

Decidedly paler throughout and with a somewhat longer bill than *Troglodytes rufociliatus*. Although reported from Peru, its place is probably taken there by the next form, though the distribution of the two has not yet been fully determined. Costa Rican records of *solstitialis* belong to *T. ochraceus*.

TROGLODYTES SOLSTITIALIS MACROURUS Berlepsch and Stolzmann.

Troglodytes solstitialis macrourus BERLEPSCH and STOLZMANN, Proc. Zool. Soc. Lond., 1902, Pt. 2, p. 55.

Type locality.—Maraynioc, central Peru.

Geographical distribution.—Peru.

This recently described form appears to be rather close to *Troglodytes s. frater*, being in fact intermediate between the latter and true *solstitialis*. From *solstitialis* it differs by reason of a longer tail; lighter, less rufescent coloration on the upper surface; distinctly whitish superciliary stripe; paler cheeks, throat, breast, lining of wing, and sides of neck; together with more grayish flanks. In length of tail, as well as other measurements, it agrees with *frater*.

TROGLODYTES SOLSTITIALIS FRATER Sharpe.

Troglodytes solstitialis, subsp. *α. frater* SHARPE, Cat. Birds Brit. Mus., VI, 1881, p. 261.

Type locality.—Bolivia.

Geographical distribution.—Bolivia.

This readily recognizable race differs from *solstitialis* in color much as does *T. s. macrourus*, but even more decidedly. The ochraceous of throat, breast, and sides of the neck is paler than in *macrourus;* the supercilium is pure white instead of being tinged with ochraceous; the abdomen is less purely white; and the upper parts less rufescent.

TROGLODYTES AURICULARIS Cabanis.

Troglodytes (*Uropsila*) *auricularis* CABANIS, Journ. f. Orn., 1883, p. 105.

Type locality.—Mountains of Tucuman, Argentina.

Geographical distribution.—Province of Tucuman, Argentina.

We have not seen this species, but it is apparently closely allied to *Troglodytes solstitialis frater*, perhaps only subspecifically separable.

TROGLODYTES OCHRACEUS Ridgway.

Troglodytes (?) ochraceus RIDGWAY, Proc. U. S. Nat. Mus., IV, 1882, p. 334.

Type locality.—Volcan de Irazú, Costa Rica.

Geographical distribution.—Costa Rica and Panama.

Although by some writers this bird has been considered indistinguishable from *Troglodytes solstitialis*, it is nevertheless very different. The upper parts are much paler; the entire lower surface more deeply and more continuously fulvescent; the flanks without any indication of bars; and the lower tail-coverts ochraceous, slightly barred with darker, instead of white with conspicuous blackish cross markings.

Mr. Goodfellow records[a] *Troglodytes ochraceus* from western Ecuador, but we have been unable to verify the identification.

TROGLODYTES RUFOCILIATUS Sharpe.

Troglodytes brunneicollis, subsp. *α. rufociliatus* SHARPE, Cat. Bds. Brit. Mus., VI, 1881, p. 262.

Type locality.—Volcan de Fuego, Guatemala.

Geographical distribution.—Guatemala; and eastern Chiapas, Mexico.

Although originally considered but a subspecies of *Troglodytes brunneicollis*, this is apparently quite a distinct species, more nearly related, indeed, to *Troglodytes ochraceus* and *T. solstitialis*.

TROGLODYTES BRUNNEICOLLIS BRUNNEICOLLIS Sclater.

Troglodytes brunneicollis SCLATER, Proc. Zool. Soc. Lond., 1858, p. 297.

Type locality.—La Parada, Oaxaca, Mexico.

Geographical distribution.—Southern Mexico.

Much larger than *Troglodytes rufociliatus;* paler and conspicuously less rufescent throughout.

TROGLODYTES BRUNNEICOLLIS CAHOONI (Brewster).

Troglodytes cahooni BREWSTER, Auk, V, 1888, p. 94.

Type locality.—Near Oposura, Sonora, Mexico.

Geographical distribution.—Northwestern Mexico.

Similar to *Troglodytes b. brunneicollis*, but decidedly paler, particularly below, with the bars on flanks and abdomen less conspicuous.

TROGLODYTES MONTICOLA Bangs.

Troglodytes monticola BANGS, Proc. Biol. Soc. Wash., XIII, 1899, p. 106.

Type locality.—Paramo de Chiruqua, Sierra de Santa Marta, Colombia.

Geographical distribution.—Santa Marta region, Colombia.

This recent discovery is quite similar to *Troglodytes brunneicollis*

[a] Ibis, 1901, p. 313.

brunneicollis, but differs in being larger, in having the anterior upper surface, sides of neck and head darker, more rufescent; furthermore, the flanks and sides are more heavily barred, and, together with the tail, rump, upper tail-coverts, and greater portion of the wings, are much more grayish or blackish.

TROGLODYTES AEDON AEDON Vieillot.

Troglodytes aedon VIEILLOT, Hist. Nat. Ois. Amér. Sept., II, 1807, p. 52, pl. CVII.
Motacilla domestica WILSON, Amer. Orn., I, 1808, p. 129, pl. VIII, fig. 3.
Troglodytes fulvus NUTTALL, Man. Orn., I, 1832, p. 422.
Troglodytes americana AUDUBON, Ornith. Biog., II, 1834, p. 452, pl. CLXXIX.
Troglodytes sylvestris GAMBEL, Proc. Acad. Nat. Sci. Phila., 1846, p. 113 (new name for *Troglodytes americana* Audubon).

Type locality.—Northeastern North America.

Geographical distribution.—Eastern United States west to Indiana; southern part of eastern Canada; in winter also to Texas.

This species is apparently distinct from *intermedius* of Central America, though in most respects quite similar.

TROGLODYTES AEDON PARKMANII (Audubon).

Troglodytes parkmanii AUDUBON, Ornith. Biog., V, 1839, p. 310.
Troglodytes ædon var. *parkmanni* COUES, Key to N. Am. Birds, 1872, p. 87.

Type locality.—Columbia River.

Geographical distribution.—Pacific Coast region of North America, from southern British Columbia to Southern California; south in winter to southwestern Mexico.

This subspecies is very close to typical *aedon*, but is less reddish above, and usually somewhat paler.

TROGLODYTES AEDON AZTECUS Baird.

Troglodytes ædon var. *aztecus* BAIRD, Rev. Amer. Birds, I, 1864, p. 139.
Troglodytes aëdon marianae SCOTT, Auk, II, 1885, p. 351.

Type locality.—Jalapa, Vera Cruz, Mexico.

Geographical distribution.—Western United States, except the Pacific Coast, east to Illinois; north to Manitoba, south in winter to southern Mexico.

This form resembles *Troglodytes aedon parkmanii*, but is decidedly paler and more grayish, both above and below.

TROGLODYTES PENINSULARIS Nelson.

Tróglodytes peninsularis, NELSON, Proc. Biol. Soc. Wash., XIV, 1901, p. 174.

Type locality.—Progreso, Yucatan, Mexico.

Geographical distribution.—Northwestern Yucatan, Mexico.

This recent discovery of Mr. Nelson's is remarkably different from its nearest geographical relatives, being, in fact, intermediate between *T. aedon aztecus* and *Troglodytes musculus striatulus*. From the

former, which, by the way, it closely resembles, it differs in the pronounced isabelline suffusion of breast, sides, flanks, crissum, and sides of head and neck. It is rather lighter above than *striatulus*, and usually also below, but the chief and constant difference lies in the shade of the breast, sides, flanks, and crissum, which in *striatulus* is ochraceous.

TROGLODYTES MUSCULUS MUSCULUS Naumann.

Troglodytes musculus NAUMANN, Vögel Deutschl., III, 1823, p. 724 (table) (Lichtenstein manuscript.)

Thryothorus æquinoctialis SWAINSON, Birds Brazil and Mexico, 1834–1841, pl. XIII.

Type locality.—Bahia, Brazil.

Geographical distribution.—Eastern Brazil, southwest to Paraguay.

This is a very dark form, the lower parts being deeply, sometimes almost uniformly suffused with rufous; the back is crossbarred with blackish, and the lower tail-coverts are spotted or irregularly barred with the same.

The bird described as *Thryothorus æquinoctialis* by Swainson[a] seems undoubtedly to be the same as that previously called *musculus* by Naumann.[b]

TROGLODYTES MUSCULUS WIEDI (Berlepsch).

Thryothorus platensis WIED, Beitr. Naturg. Bras., III, 1830, p. 742 (not *Sylvia platensis* LATHAM, quæ *Cistothorus platensis*).

Thryothorus wiedi BERLEPSCH, Journ. f. Orn., 1873, p. 231.

Type locality.—Blumenau, Santa Catharina, Brazil.

Geographical distribution.—Province of Santa Catharina, southeastern Brazil.

Although heretofore, by almost all writers, synonymized with *musculus*, this form is well worthy of recognition, since it is readily distinguishable by its rather lighter under surface and its decidedly paler, more grayish coloration above.

The name *platensis*, under which Wied described this wren, can not be used for it, as he simply identified his bird with the *Sylvia platensis* of Latham, which is a *Cistothorus*.

TROGLODYTES MUSCULUS REX (Berlepsch and Leverkühn).

Troglodytes furvus rex BERLEPSCH and LEVERKÜHN, Ornis., 1890, p. 6.

Type locality.—Samaipata, Bolivia.

Geographical distribution.—Southwestern Brazil (Matto Grosso) to central Bolivia.

This easily recognizable race is separable from *musculus* by its rather larger size; much paler coloration, particularly below; more buffy

[a] Birds Brazil and Mexico, 1834–1841, pl. XIII.

[b] Vög. Deutschl., III, 1823, p. 724 (table).

under surface; and sparsely spotted lower tail-coverts. There is also more contrast between the rump and the back. A fairly uniform series from Matto Grosso, Brazil, seems to indicate that the bird from this region should be referred to *rex*, though some of these specimens have obsolete dark barring on the back, and though we have seen no specimens from the type locality.

TROGLODYTES MUSCULUS TECELLATUS (Lafresnaye and d'Orbigny).

Troglodytes tecellata LAFRESNAYE and D'ORBIGNY, Mag. de Zool., 1837, cl. ii, p. 25.
Troglodytes murinus LESSON, Rev. Zool., 1844, p. 434.
Troglodytes audax TSCHUDI, Fauna Peruana, 1845–46, p. 185.
Troglodytes musculus puna BERLEPSCH and STOLZMANN, Proc. Zool. Soc. Lond., 1896, p. 329.

Type locality.—Tacna, Peru.

Geographical distribution.—Central and southern Peru to northwestern Bolivia.

This race is similar to *Troglodytes musculus musculus*, differing in paler, somewhat more rufescent upper surface; lighter, more ochraceous under parts; and very slightly or not at all spotted crissum. It is thus close to *rex*, oddly enough somewhat intermediate between the latter and *musculus*, but is darker throughout, particularly on the flanks and under tail-coverts.

There is apparently little doubt that *Troglodytes murinus* Lesson, from "Peru;" *Troglodytes audax* Tschudi, from "Peru," and *Troglodytes musculus puna*, from Ingipirca, Peru, all refer to the same bird—the one called earlier *Troglodytes tecellata* by Lafresnaye and d'Orbigny—for all these descriptions indicate a moderately dark bird with blackish or dusky bars on the back, thus agreeing perfectly with specimens from central and southern Peru. An example from Mapiri, Bolivia, is in all essential respects identical.

TROGLODYTES MUSCULUS HORNENSIS (Lesson).

Troglodytes hornensis LESSON, L'Institut, 1834, p. 316.
Troglodytes magellanicus GOULD, Proc. Zool. Soc. Lond., 1836, p. 88.
Troglodytes pallida LAFRESNAYE and D'ORBIGNY, Mag. de Zool., 1837, cl. ii, p. 25.
Thriothorus rosaceus LESSON, Rev. Zool., 1840, p. 262.
Troglodytes hortensis GRAY, Gen. Birds, I, 1847, p. 158.

Type locality.—At sea, 20 leagues southeast of Cape Horn.[a]

Geographical distribution.—Argentine Republic and extreme southern Chile.

This southern race resembles *musculus*, but is paler, more grayish above; lighter and isabelline below instead of ochraceous; the crissum much less marked with blackish, sometimes immaculate. Birds from

[a] Cet oiseau a été pris en mer, le 7 janvier 1831, à 20 lieues dans le sud-est du cap Horn.—Lesson, L'Institut, 1834, p. 316. This reference was kindly verified by Mr. Outram Bangs.

the Straits of Magellan are identical with those from Buenos Aires, but Chilean specimens, though heretofore always considered identical, prove to be different from either.

All the names above quoted are undoubted synonyms of *hornensis*, as their descriptions and localities show, thus leaving the bird from central Chile without a subspecific designation. The *Troglodytes magellanicus* of Gould is from the Straits of Magellan; *Troglodytes pallida* Lafresnaye and d'Orbigny is from Patagonia; *Thriothorus rosaceus* Lesson from La Plata (and Chile); while *Troglodytes hortensis* Gray is a variant or emendation of Lesson's *hornensis*.

TROGLODYTES MUSCULUS ACOSMUS, new subspecies.

Chars. subsp.—Similar to *Troglodytes musculus hornensis*, but paler above, the rump more rufous; lower surface with rather more of ochraceous tinge.

Geographical distribution.—Central Chile.

Description.—Type, No. 148694, U.S.N.M.; Chile; E. C. Reed. Upper parts broccoli brown, becoming slightly rufescent posteriorly, and shading into dull rufous on the upper tail-coverts, which, with the back, are very faintly barred with dusky; tail dull rufous, with many narrow bars of blackish; exposed surface of closed wings like the back, but, with the exception of the lesser coverts, rather more ochraceous, and narrowly barred with fuscous; lores and sides of head dull brownish white, mixed with brownish and buffy; lower surface pale buffy isabella color, whitish on throat and center of abdomen, darkest on sides, flanks, and crissum, which last has a few rather indistinct blackish spots. Length of wing, 56 mm.; tail, 49 mm.; exposed culmen, 12 mm.; tarsus, 16 mm.; middle toe, 11 mm.

All the characters which separate this form from *Troglodytes m. hornensis* are much more pronounced in young than in adult birds. From *musculus* and *tecellatus* it differs in its paler upper parts, its much lighter and more isabelline lower surface, as well as from the former in much less spotted crissum. It may be readily distinguished from *Troglodytes m. rex* by its strikingly isabelline lower surface.

TROGLODYTES MUSCULUS HYPAEDON (Sclater).

Troglodytes hypaëdon Sclater, Proc. Zool. Soc. Lond., 1861, p. 128.

Type locality.—Oaxaca, Mexico.

Geographical distribution.—Southern Mexico (Oaxaca and Yucatan) to Guatemala.

Although commonly considered identical with *intermedius* of Costa Rica, the birds from southern Mexico exhibit easily recognizable differences which entitle them to a subspecific name, being darker and much more strongly rufescent, particularly on the lower surface.

Specimens from Yucatan are intermediate between *hypaedon* and *intermedius*, but seem to be nearer the former. No wrens of this species from Salvador or from northern Honduras have been examined, so that I am unable to say whether it is *hypaedon* or *intermedius* that occurs in those localities.

TROGLODYTES MUSCULUS INTERMEDIUS (Cabanis).

Troglodytes intermedius CABANIS, Journ. of Orn., 1860, p. 407.

Type locality.—San José, Costa Rica.

Geographical distribution.—Costa Rica to southern Honduras.

This is a dark form, approaching true *musculus*, from which it differs in having a shorter tail, more heavily barred crissum, and barred flanks.

TROGLODYTES MUSCULUS INQUIETUS (Baird).

Troglodytes inquietus BAIRD, Rev. Amer. Birds, I, 1864, p. 143 (Lawrence manuscript).

Type locality.—Panama Railroad, Isthmus of Panama, Colombia.

Geographical distribution.—State of Panama, Colombia.

Though seldom recognized as a distinct form, this race has been placed sometimes under *intermedius*, sometimes under *striatulus*, a circumstance which of itself lays strong emphasis upon its intermediate character; yet almost without exception *Troglodytes m. intermedius* and *T. m. striatulus* have been treated as distinct species. While undoubtedly close to the latter, differing chiefly in the more rufescent and usually somewhat darker upper surface, *inquietus*, under the circumstances, is probably best kept separate. From *intermedius* it may be distinguished by its more grayish upper parts, more whitish median and more grayish lateral lower surface, more plainly barred flanks and lower back. Though superficially resembling the more grayish specimens of *clarus*, it has a much more heavily barred crissum, barred and more rufescent flanks, with the dark bars of the tail usually more broken.

TROGLODYTES MUSCULUS STRIATULUS (Lafresnaye).

Thriothorus striatulus LAFRESNAYE, Rev. Zool., 1845, p. 338.

Troglodytes columbæ STONE, Proc. Acad. Nat. Sci. Phila., 1899, p. 308.

Type locality.—Bogota, Colombia.

Geographical distribution.—Colombia, excepting the Santa Marta region and the State of Panama.

This form is easily distinguishable from *Troglodytes m. intermedius* by its much less rufescent upper parts and usually more whitish under surface. Examination of a good series of *striatulus* makes evident the existence of a wide range of variation that seems to be quite certainly but individual. The color varies from warm yellowish brown or

rufescent brown to brownish gray above, and on the lower surface from almost uniform deep, dull buff to pale buff which is even almost white medially. The bird described by Mr. Stone as *Troglodytes columbæ*[a] seems to be without much doubt nothing more than a somewhat extreme or peculiar example of this excessive individual variation, for all of its characters can be very closely matched in the series of *striatulus* available in the present connection. Notwithstanding the contrary intimations of Mr. Stone,[b] *striatulus* quite frequently has the lower parts almost uniform ochraceous, a character he claims as distinctive of his *columbæ*.

TROGLODYTES MUSCULUS TOBAGENSIS (Lawrence).

Troglodytes tobagensis LAWRENCE, Auk, V, 1888, p. 404.

Type locality.—Tobago, West Indies.

Geographical distribution.—Island of Tobago, West Indies.

This island race is similar to *clarus*, with which it has often been synonymized, but from which it differs in its conspicuously larger size, particularly the wing and bill, and in usually somewhat paler flanks, crissum, and upper parts. Measurements of two specimens are as follows:

Sex.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe.
Unknown[a]	57	40	16	18	14
Female	55	40	15	19	13

[a] Type.

TROGLODYTES MUSCULUS CLARUS Berlepsch and Hartert.

? Motacilla furva GMELIN, Syst. Nat., I, 1788, p. 994.

Troglodytes rufulus AUCT., not CABANIS.

Troglodytes musculus clarus BERLEPSCH and HARTERT, Novit. Zool., IX, 1902, p. 8.

Type locality.—Altagracia, Orinoco River, Venezuela.

Geographical distribution.—Venezuela, Guiana, and the valley of the Lower Amazon.

This subspecies differs from *Troglodytes musculus musculus* in being rather paler above and very much so below, the median portion of the lower surface frequently white or whitish. From *striatulus* it may be separated by its decidedly more rufescent upper parts, flanks, and crissum.

Not improbably there are two races here united under the name *clarus*, as birds from the Amazon seem to be less rufescent than those from Venezuela, though this difference may be due to the paucity of our material, a conclusion rendered more probable by the demonstrated existence of a great amount of individual variation in specimens

[a] Proc. Acad. Nat. Sci. Phila., 1899, p. 308. [b] Idem., pp. 308, 309.

from other localities, some individuals being grayish above, others quite rufescent, and from normally almost pure white medially below to quite uniform ochraceous. Birds from the island of Trinidad are intermediate between *clarus* and *tobagensis*, but so much nearer the former that there is no doubt of their proper reference to that form.

TROGLODYTES MUSCULUS ATOPUS, new subspecies.

Chars. subsp.—Similar to *Troglodytes musculus clarus*, but smaller, the entire ventral surface more deeply ochraceous, particularly on the sides and flanks.

Geographical distribution.—Santa Marta region, Colombia.

Description.—Type, adult male, No. 70473, American Museum of Natural History; Cacagualito, Santa Marta, Colombia, May 16, 1898; Mrs. H. H. Smith. Upper surface dull brown, becoming chestnut on the rump and upper tail-coverts, these both and the back with obsolete narrow blackish bars; tail dull chestnut with numerous blackish bars; exposed surface of closed wings similar to the back, and with fuscous crossbars; an ill-defined buff superciliary stripe; sides of head buff mixed with brown; throat white, with a buffy tinge; breast dull ochraceous buff; sides, flanks, and crissum dull rufous, the last with irregular bars of blackish; center of abdomen dull buff; under wing-coverts dull buffy white. Length of wing, 51 mm.; tail, 39 mm.; exposed culmen, 14 mm.; tarsus, 19 mm.; middle toe, 13 mm.

Although as with many of the other forms there is in this one much individual variation, the majority of specimens are quite different from *clarus*, to which apparently *atopus* is closely allied. From *tecellatus*, which it even more closely approaches, it may be distinguished by its usually heavily marked crissum and somewhat lighter upper surface.

TROGLODYTES MUSCULUS ALBICANS (Berlepsch and Taczanowski).

Troglodytes furvus albicans Berlepsch and Taczanowski, Proc. Zool. Soc. Lond., 1883, p. 540.

Type locality.—Guayaquil, Ecuador.

Geographical distribution.—Ecuador, and possibly northern Peru.

A pale form, which comes very close to *Troglodytes musculus clarus*, but which differs in having plain lower tail-coverts. A specimen in the collection of the Philadelphia Academy of Natural Sciences, marked "Peru," seems to be intermediate between *T. m. albicans* and *T. m. rex*, though nearer the former.

TROGLODYTES MUSCULUS ENOCHRUS, new subspecies.

Chars. subsp.—Similar to *Troglodytes musculus tecellatus*, but paler above, the back, rump, and upper tail-coverts not barred with dusky or blackish; very decidedly lighter below, the center of throat and of abdomen whitish.

Geographical distribution.—Coast region of Peru, in the neighborhood of Lima.

Description.—Type, adult female, No. 39816, U.S.N.M.; Lima, Peru; Walter S. Church. Upper parts light wood brown, rather tinged with ochraceous, the rump and upper tail-coverts deep, dull tawny; tail like the rump, but darker, crossed by numerous narrow bars of dark brown; wing-quills fuscous, broadly barred on exterior webs with ochraceous, which on the tertials extends to both webs; wing-coverts like the back, the greater and median series with bars of dusky; sides of head, including the lores and a narrow, inconspicuous superciliary stripe, pale buff, the ear-coverts with brownish admixture; sides of neck wood brown like the back; entire lower surface buff, though whitish on throat and center of abdomen, and deepening to ochraceous on sides, flanks, and crissum, the last unmarked with darker; lining of wing buffy white. Length of wing, 50.5 mm.; tail, 38 mm.; exposed culmen, 13 mm.; tarsus, 19.5 mm.; middle toe, 11 mm.

This is a very pale form, thus resembling *albicans*, but distinguishable by reason of the brighter ochraceous of sides, flanks, and crissum, and the deeper buffy suffusion of the entire lower surface. It differs from *T. m. rex* in being lighter below and above, particularly on the rump, and in having no spots at all on the crissum. A specimen from Callao, Peru, is identical with the type.

TROGLODYTES TANNERI Townsend.

Troglodytes tanneri Townsend, Proc. U. S. Nat. Mus., XIII, 1890, p. 133.

Type locality.—Clarion Island, Revillagigedo Islands, Mexico.

Geographical distribution.—Clarion Island, Revillagigedo Islands, Mexico.

Similar to *Troglodytes beani*, but the lower back and rump are very little or not at all rufescent, and sometimes obscurely barred with dusky; the wings and tail are more grayish brown; the entire lower surface is dull cream color, slightly brownish on the flanks.

This species is a perfectly typical *Troglodytes*, while strangely enough the wren that inhabits the neighboring island of Socorro is apparently a *Thryomanes*.[a]

TROGLODYTES BEANI Ridgway.

Troglodytes beani Ridgway, Proc. Biol. Soc. Wash., III, 1885, p. 21.

Type locality.—Cozumel Island, Yucatan, Mexico.

Geographical distribution.—Cozumel Island, Yucatan, Mexico.

A very distinct species, apparently confined to the island of Cozumel.

[a] *Troglodytes insularis* Lawrence, Ann. N. Y. Lyc. Nat. Hist., X, 1871, p. 3; see also Oberholser, Proc. U. S. Nat. Mus., XXI, 1898, pp. 446–447.

It resembles *Troglodytes musculus tobagensis*, but has a somewhat shorter wing and longer tail; is without indication of dusky barring on the back; is rather darker above, and more purely white below, with the flanks and crissum less rufescent; the barring on the tail is less distinct.

TROGLODYTES MESOLEUCUS (Sclater).

Thryothorus mesoleucus SCLATER, Proc. Zool. Soc. Lond., 1876, p. 14.
Troglodytes mesoleucus OBERHOLSER, Proc. U. S. Nat. Mus., XXI, 1898, p. 421.

Type locality.—Santa Lucia, West Indies.
Geographical distribution.—Santa Lucia, West Indies.

Similar to *Troglodytes m. tobagensis*, but wing and tarsus shorter; the entire upper surface, including wings and tail, and particularly the back and rump, much more rufescent, the back without dusky bars; under parts rather more purely white.

TROGLODYTES MUSICUS (Lawrence).

Thryothorus musicus LAWRENCE, Ann. N. Y. Acad. Sci., I, 1878, p. 148.
Troglodytes musicus OBERHOLSER, Proc. U. S. Nat. Mus., XXI, 1898, p. 421.

Type locality.—Saint Vincent, West Indies.
Geographical distribution.—Saint Vincent, West Indies.

A very distinct species, allied to *mesoleucus*, but larger; much more ferruginous on the entire upper surface, sides, flanks, and crissum, the back with obsolete narrow dusky bars.

TROGLODYTES MARTINICENSIS (Sclater).

Thryothorus martinicensis SCLATER, Proc. Zool. Soc. Lond., 1866, p. 321.
Troglodytes martinicensis OBERHOLSER, Proc. U. S. Nat. Mus., XXI, 1898, p. 421.

Type locality.—Martinique, West Indies.
Geographical distribution.—Martinique, West Indies.

Although, like most of the other West Indian wrens, possessing some superficial resemblance to *Thryothorus*, this bird is undoubtedly a *Troglodytes*. It differs from *tanneri* in its conspicuously shorter tail, darker upper parts, and darker, very decidedly rufescent lower surface, with a heavily barred crissum.

TROGLODYTES GUADELOUPENSIS (Cory).

Thryothorus guadeloupensis CORY, Auk., III, 1886, p. 381.
Troglodytes guadeloupensis OBERHOLSER, Proc. U. S. Nat. Mus., XXI, 1898, p. 421.

Type locality.—Grand Terre, Guadeloupe, West Indies.
Geographical distribution.—Guadeloupe, West Indies.

This species resembles *T. martinicensis*, from Martinique, but is appreciably smaller and more rufescent both above and below.

TROGLODYTES GRENADENSIS (Lawrence).

Thryothorus grenadensis Lawrence, Ann. N. Y. Acad. Sci., I, 1878, p. 161.
Troglodytes grenadensis Oberholser, Proc. U. S. Nat. Mus., XXI, 1898, p. 421.

Type locality.—Grand Etang, Grenada, West Indies.

Geographical distribution.—Grenada, West Indies.

Although similar to *Troglodytes guadeloupensis*, this species is rather larger, decidedly lighter, more rufescent on all the upper parts, the back without evident blackish bars; somewhat paler below, and more fulvescent on the flanks and crissum, both of which are unbarred with blackish.

TROGLODYTES RUFESCENS (Lawrence).

Thryothorus rufescens Lawrence, Ann. N. Y. Acad. Sci., I, 1877, p. 47.
Troglodytes rufescens Oberholser, Proc. U. S. Nat. Mus., XXI, 1898, p. 421.

Type locality.—Dominica, West Indies.

Geographical distribution.—Dominica, West Indies.

Similar to *T. grenadensis*, but very much darker throughout, the under surface almost uniform rufous chestnut, not whitish even on the chin and upper throat, the crissum barred with black.

TROGLODYTES RUFULUS Cabanis.

Troglodytes rufulus, Cabanis, in Schomburgk's Reis. Guian., III, 1848, p. 672.

Type locality.—Roraima Mountains, British Guiana.

Geographical distribution.—Roraima Mountains, British Guiana.

This very remarkable species has nothing whatever to do with *Troglodytes musculus*, but is apparently most closely allied to *T. rufescens*. From this it differs in the uniform dark chestnut color of the upper surface; the very obsolete barring of wings and tail; unbarred crissum; darker sides of head and neck; and less fulvescent lower parts, the sides and flanks being darker and duller, the center of throat and breast paler, more grayish, the latter even whitish.

In view of this bird's rarity the following description is added as of interest:

Adult male, No. 148695, U.S.N.M.; Roraima, British Guiana, 6,000 feet, September 6, 1883; H. Whitely.—Upper surface, including tail and exposed surface of closed wings, uniform chestnut, the wings and tail faintly barred with darker; superciliary stripe ochraceous, much mixed with chestnut anteriorly; sides of neck and auriculars like the back, the latter somewhat mingled with ochraceous; cheeks pale chestnut mixed with darker; center of throat dull grayish with a heavy wash of dull rufous; sides, flanks, abdomen, and crissum dull chestnut, somewhat lighter than that of the back; middle of breast dull pale grayish, tinged with dull rufous. Length of wing, 53 mm.; tail, 40 mm.; exposed culmen, 13.5 mm.; tarsus, 23 mm.; middle toe, 15 mm.

DISTRIBUTION OF THE SUBSPECIES OF TROGLODYTES MUSCULUS.

1. hornensis.
2. acosmus.
3. wiedi.
4. musculus.
5. rex.
6. tecellatus.
7. enochrus.
8. albicans.
9. clarus.
10. striatulus.
11. inquietus.
12. intermedius.
13. atopus.
14. tobagensis.

Troglodytes m. hypaedon is not shown.

REPORT ON THE FRESH-WATER BRYOZOA OF THE UNITED STATES.[a]

By Charles B. Davenport,
Associate Professor of Zoology, University of Chicago.

The fresh-water Bryozoa do not constitute a natural group of animals, but have descended from ancestors belonging to widely distinct families. There can be no question that these ancestors were marine animals. Excepting the suborder Phylactolæmata, all fresh-water Bryozoa belong to groups most of whose representatives are marine. The fresh-water forms seem to have made their way up estuaries and rivers to lakes and ponds. Here they acquired the capacity of forming statoblasts or hibernacula, by virtue of which the species was enabled, on the one hand, to survive the winter and, on the other, to be carried by waterfowl and winds over divides from one drainage basin to another. Thus the fresh-water species have become nearly cosmopolitan. *Plumatella princeps* has been found in North and South America, throughout Europe, in Molucca, Japan, and Australia—i. e., in all but one of the great geographical divisions of the land areas of the globe. The localities given in the following list do not at all represent the true area of distribution of fresh-water Bryozoa in North America, but only the regions where the inhabitants of the waters have been carefully studied. These regions are for the most part eastern Maine (Hyatt); eastern Massachusetts (Hyatt and the writer); southeastern New York, especially Cold Spring Harbor, Long Island (the writer); vicinity of Philadelphia and Baltimore (Leidy, Potts, and Hyatt); lakes Erie and Michigan (Reighard, Ward, Forbes, Landacre, and the writer); Illinois lakes and rivers (Forbes and H. Garman); Yellowstone National Park (Forbes). It is

[a]This paper is based chiefly on materials collected during 1898 and 1899 by the laboratory of the U. S. Fish Commission, located at Put in Bay, Ohio, and under the direction of Prof. Jacob Reighard; by the Illinois State Laboratory of Natural History, Prof. S. A. Forbes, director; and by the writer in the Eastern and Middle States. It was made at the request of Professor Reighard and all recorded data on the distribution of American fresh-water Bryozoa have been consulted in its preparation.

much to be hoped that records will be published concerning the occurrence of the various species in the Central, Southern, and Pacific States. The writer will be glad to receive references to or separate copies of such published records. To facilitate the publication of such records the following synoptic key to the fresh-water Bryozoa is given. This includes a single species (*Victorella pavida*) unrecorded for America, which may be found here in the future. The key and list are based on the classification of Kraepelin (1887).

SYNOPTIC KEY TO SPECIES.

a. Anus opening inside the tentacular corona; tentacles incapable of complete retraction (Endoprocta) ..... *Urnatella gracilis.*

aa. Anus opening outside the tentacular corona, which is capable of being retracted (Ectoprocta).

b. Zooecia sharply separated from each other; no epistome (Gymnolæmata).

c. Stock consists of cylindrical zooecia and long stolons, which latter enlarge at intervals to give rise to new cylindrical zooecia. The zooecia by lateral budding produce stolons or new zooecia directly. Aperture terminal. *Victorella pavida.*

cc. Stock consists of cylindrical zooecia, stolons, and irregular swellings, which constitute winter buds. The zooecia do not produce lateral buds. Aperture terminal ..... *Pottsiella erecta.*

ccc. Zooecia club-shaped; no stolons; aperture lateral.... *Paludicella ehrenbergii.*

bb. Zooecia continent; epistome present (Phylactolæmata).

c'. Statoblasts without hooks, rounded at ends.

d. Tentacles 20–22, arranged nearly in a circle; statoblasts without peripheral float ..... *Fredericella sultana.*

dd. Tentacles 40–60, arranged in the form of a horseshoe. Free elliptical statoblasts with a peripheral float (Plumatella).

e. Colony with vertical as well as horizontal branches.

f. Cuticula thick and brown, with a keel that broadens at aperture. Free statoblasts elongated; proportions 1:1.53 to 1:2.8 . *Plumatella princeps.*

ff. Cuticula rarely browned or keeled. Free statoblasts nearly circular, 1:1 to 1:1.5 ..... *Plumatella polymorpha.*

ee. Horizontal branches only. Cuticula delicate, colorless, hyaline. Elevated aperture-cone wrinkled and bespreckled with white. Free statoblasts nearly circular ..... *Plumatella punctata.*

c'c'. Statoblasts without hooks; acutely pointed at both ends. *Lophopus cristallinus.*

c'c'c'. Statoblasts with hooks.

d'. Stock compound, composed of many rosettes of individuals. A thick gelatinous base secreted ..... *Pectinatella magnifica.*

d'd'. Stock caterpillar-like, with a broad sole but no gelatinous base. *Cristatella mucedo.*

ECOLOGY OF THE FRESH-WATER BRYOZOA.

The fresh-water Bryozoa live in all kinds of fresh waters and are indeed among the most ubiquitous of aquatic animals. They are found in stagnant pools and in rushing rivers, although particular species favor special habitats. The different species of *Plumatella* occur in varied habitats. *Paludicella* and *Pectinatella* favor running water and *Lophopus*, *Cristatella*, and *Plumatella polymorpha fungosa* favor quiet

ponds. The fresh-water Bryozoa feed on microscopic organisms which are caught in the vortex created by their ciliated tentacles. Diatoms are especially conspicuous objects in their alimentary tracts. Since diatoms require light for their constructive metabolism, they are found chiefly in the upper strata of the water, and consequently Bryozoa are usually not found at great depths. However, in a mass of material dredged by Prof. H. B. Ward[a] from the Middle Ground Traverse Bay, Lake Michigan, at a depth of 23 to 36 meters, I found *Paludicella ehrenbergii* and *Fredericella sultana* abundant. Although *Cristatella* is usually found on the under side of floating lily pads or in other situations near the surface, I have obtained it from the still waters of Trinity Lake, Westchester County, New York, at a depth of 2 to 3 meters. Asper[b] records dredging *Fredericella sultana* in certain Swiss lakes at a depth of 50 to 80 meters. Little light penetrates to such a depth, and we may conclude that light is not at all directly necessary for the development of fresh-water Bryozoa. Indeed, I have received from Prof. D. S. Hartline, of Bloomsburg, Pennsylvania, masses of *Paludicella* that were obtained from water pipes where they flourished to an alarming extent. The Bryozoa have become adapted to life in ponds by forming statoblasts at certain seasons of the year. The entire significance of the statoblast is not sufficiently known. Typically, they winter over and one may find the shores strewn with them in the early spring. They hatch out in New England late in May or early in June. So the statoblasts have come to be regarded as winter buds, or adaptations to preserve the race from being killed off by freezing of the water. They often begin to develop early in the summer and I have observed what has been seen by European observers, that some statoblasts hatch in nature even in September.[c] Also Fr. Müller has informed Kraepelin[d] that the fresh-water Bryozoa of Blumenbau, Brazil, which experience no winters, nevertheless form statoblasts. It seems fair to conclude that there are other functions performed by the statoblasts than resistance to winter. For instance, they serve to maintain the species during drought, or they aid in distribution by clinging to the waterfowl or resisting the action of digestive fluids. The wide distribution of the the species of fresh-water Bryozoa indicates the value of the statoblast in the act of dispersion.

METHODS OF PRESERVING.

The chief difficulties in the way of preserving fresh-water Bryozoa arise, first, from the rapid contraction of the polypides into the corm and, secondly, in the case of the gelatinous forms, from the large

[a] Bulletin Michigan Fish Commission, No. 6, 1896, p. 13.

[b] Zoologischer Anzeiger, III, 1880, p. 200.

[c] Bull. Mus. Comp. Zool., XX, 1890, p. 102.

[d] Kraepelin, Die Deutschen Süsswasser Bryozoen, 1887, p. 86.

amount of water in the body; for, if the specific gravity of the killing or preserving medium is very different from that of water, distortion will occur.

To kill expanded it is necessary first to narcotize. Chloral hydrate is used, added slowly in crystals until the polypides do not react to touch. To preserve in the natural form, the animals may be plunged directly into 4 per cent formaldehyde (formalin, 10 per cent).

The classification of fresh-water Bryozoa has been in a state of great confusion owing to the great variability in the form of the colony. The form of the colony depends very largely upon external factors, such as food supply, form of substratum, and crowding. The statoblast has a form that is quite independent of external factors, and upon it, consequently, great stress is laid in systematic work. The form of the statoblast is, however, not wholly uncorrelated with that of the stock, so the form of the stock is to be considered. In the following classification that proposed by Kraepelin[a] has been adopted entire, although it does not conform to the writer's judgment in all particulars.

A LIST OF ALL FRESH-WATER BRYOZOA HITHERTO FOUND IN THE UNITED STATES AND THE LOCALITIES WHERE THEY HAVE BEEN OBSERVED.

Subclass 1.—ENDOPROCTA.

This subclass comprises chiefly marine species, the only exception being *Urnatella gracilis*, which was first described from the neighborhood of Philadelphia, but which also inhabits the Mississippi Valley.

Family PEDICELLINIDÆ.

URNATELLA Leidy.

URNATELLA GRACILIS Leidy (1851).

Stock consisting of a basal plate, from which there usually arise two segmented stems terminating in the polypide. More rarely one or more than two stems arise from the disc.

Habitat.—Running water.

Distribution.[b]—Schuylkill River under low-tide mark below Fairmount dam, Philadelphia, 1851–1870, Leidy; *canal at Fairmount, near Philadelphia, 1884, Potts (Leidy, 1884), 1890, Potts and C. B. D.; Scioto River, Ohio, Lea (Leidy, 1883, p. 6); * Illinois River at Havana, Illinois, Station E (middle of river), August, 1895 (Kofoid, 1898).

The specimens from the Illinois River contrast with those from Fairmount in the profuseness with which they form lateral buds. (Plate V, fig. 1.)

[a] Die Deutschen Süsswasser Bryozoen, 1887.

[b] An asterisk before a locality name indicates that specimens from the locality have been examined by the author.

Subclass 2.—ECTOPROCTA.

Order GYMNOLÆMATA.

Suborder CTENOSTOMATA.

Includes chiefly marine species, but also a number of fresh-water genera.

Family PALUDICELLIDÆ.

POTTSIELLA Kraepelin (1887).

Colony consists of stolons, from which at intervals an erect, cylindrical, hyaline single individual arises, having a terminal aperture. Lophophore circular, 20 (19 to 21) tentacles.

POTTSIELLA ERECTA Potts (1884).

Paludicella erecta Potts.
Pottsiella erecta Kraepelin, 1887.

This species possesses the characters of the genus. (Plate V, fig. 2.)

Habitat. Photophil; on upper surface of stones in rapids; sometimes penetrating incrusting sponges, particularly *Meyenia leidyi*.

Distribution.—*Tacony Creek, near Chiltenham, Montgomery County, Pennsylvania, 50 feet above tide water. (Potts and C. B. D., 1892.)

PALUDICELLA Gervais.

Stock composed of individuals that are sharply separated from one another by partitions; sparsely, usually oppositely, branched; with a chitinous cuticula. The individuals are club-shaped, with a lateral, quadrangular aperture near the larger, distal end. Tentacles arranged in a circle, few in number. No statoblasts, but winter buds instead.

PALUDICELLA EHRENBERGHII van Beneden (1848).

Aperture-cone short; individuals about 2 mm. long; lateral buds partly repent, partly erect; about 16 tentacles. (Plate V, fig. 3.)

Habitat.—Especially flowing streams; occasionally in water pipes.

Geographical distribution.—Europe; India; *Arlington Creek, Arlington, Massachusetts, under railway bridge near Massachusetts avenue (C. B. D., 1890); *Bloomsburg, Pennsylvania, 1900 (Hartline); *Illinois River at Havana, Station G (Thompsons Lake), May 9, 1894; *Middle Ground, Traverse Bay, Lake Michigan (Ward, 1896).

The specimen figured differs from a German specimen figured by Kraepelin by the individuals being relatively smaller at the distal end.

Order PHYLACTOLÆMATA.

Family FREDERICELLIDÆ.

Lophophore nearly circular; statoblasts without peripheral float.

FREDERICELLA Gervais.

Stock branched in form of antlers; more rarely massed with recumbent and elevated tubes; mostly brown or incrusted with algæ and grains of sand; rarely hyaline. Tubes cylindrical, the older ones mostly keeled. Without complete dissepiments. Apertures terminal at the broadened or bifid ends of tubes. Polypide very long and slender; tentacles arranged in a nearly circular corona. Few tentacles, not exceeding 24. Statoblasts dark brown, bean-shaped or elliptical, without float, and with smooth upper surface.

FRÆDERICELLA SULTANA Blumenbach (1777).

Fredericella walcottii Hyatt (1868).
Fredericella pulcherrima Hyatt (1868).
Fredericella reginæ Leidy.

This species has the characters of the genus. (Plate V, fig. 4).

Habitat.—On wood, stones, and water plants in standing and slowly flowing waters.

Distribution.—Europe; Australia; Pennisewassee Pond, Norway, Maine; Youngs Brook, Gorham, Maine (Hyatt, 1868); Lake Sebago, Maine (Hyatt); Fresh Pond, Cambridge, Massachusetts (Hyatt); Georgetown, Massachusetts (Hyatt);* Lily Pond, Newport (Leidy); Schuylkill River and Delaware River near Philadelphia (Leidy); Gwinns Falls, Baltimore, Maryland (Hyatt); *Middle Ground, Traverse Bay, Lake Michigan, 23 to 36 meters (Ward, 1896); *Hatchery Harbor, Put-in Bay, 1899; *East Harbor, Sandusky, Ohio, 1899; *Erie, Pennsylvania, Boat Landing; *Illinois River at Havana, Illinois, Station G (Thompsons Lake) 1894; *Lake Geneva, Wisconsin, off Long Point, July, 1891 (Forbes); *Lake Geneva, dredging from Forest Glen to Belvidere, May, 1892 (Forbes); *Flathead Lake, Yellowstone National Park, August, 1891 (Forbes).

PLUMATELLA Lamarck (Kraepelin).

Colonies consist of cylindrical tubes, which are either branched or form massive clumps or run over the substratum as hyaline, lobed tubes. Partitions rudimentary or absent, cuticula brown to hyaline, often incrusted. Tentacular corona markedly horseshoe shaped, with 40 to 60 tentacles. Intertentacular membrane present. Statoblasts

without hooks; either free, elliptical, with broad float, or (in the horizontal tubes) without float, of large size and irregular shape.

The commonest genus of our fresh-water Bryozoa. Has been reported from all continents except Africa. Lives in the most diverse habitats, in ponds or streams, usually not in the light.

PLUMATELLA PRINCEPS Kraepelin.

Plumatella emarginata ALLMAN, 1844.
Plumatella repens VAN BENEDEN, 1848.
Plumatella diffusa LEIDY, 1851.

Branches both vertical and horizontal. Cuticula thick and brown with a keel that broadens at the aperture.

Var. α, *emarginata*.—Tubes openly branched, repent, with short lateral branches, antler-like. (Plate V, fig. 5.)

*Squaw Bay, Put-in Bay, July 17 and 18, 1899, on lily stems and leaves; *Rondeau Harbor, Ontario, August 30, 1899; *Flathead River, Montana Bayou, on bark and rotten logs, August 19, 1891 (Forbes); *Big Creek, Hamilton County, Illinois, October 3, 1900.

Var. β, *fruticosa*.—Colony robust, branched, often rising from substratum. Keel little developed. Statoblasts elongated.

*Erie, Pennsylvania, Boat Landing, August 16, 1899.

Var. γ, *mucosa*.—Vertical branches predominate, forming an intertwined mass.

Var. δ, *spongiosa* (=*Aleyonella Benedeni* Allman).—Vertical tubes fused into a mass from which only the apertures rise free.

Havana, Illinois, Station G (Thompson's Lake), April 10, 1895; Matanzas Lake, Illinois River, July 9, 1896.

PLUMATELLA POLYMORPHA Kraepelin.

With vertical as well as horizontal tips of branches. Cuticula *rarely* browned or keeled. Includes numerous synonyms, especially *Plumatella coralloides* Allman; *P. elegans* Allman; *P. dumortieri* Allman; *P. nitida* Leidy (1851); *P. arethusa* Hyatt (1868). Found on all continents except Africa.

Var, α, *repens* (=*P. arethusa* Hyatt).—Tubes creeping with short vertical side branches. Cuticula mostly semitransparent; keel not evident. (Plate V, fig. 6.)

*Squaw Bay, Put-in Bay, July 12, 1899; *Long Point, Canada, August 23, 24, 1899; *Rondeau Harbor, Ontario, "East Swamp" and Business Creek, August 28, 29, 1899; *Swan Lake, Montana, under stones, August 24, 1891; *Havana, Illinois, Station L (Dogfish Lake), August 7 and 23, 1895.

This form varies greatly in the thickness and transparency of the cuticula. The specimens from Long Point have an unusually thick and clear cuticula.

Var. *β*, *oppressa*.—Tubes repent, branching or thickly intertwined, covering the substratum. Few or no vertical branches. Cuticula lightly colored to transparent.

Var. *γ*, *cæspitosa*.—Tubes repent, with many elongated and branched vertical rami. Cuticula semiopaque, no evident keel.

*Station E (main river) Illinois River, Havana, Illinois, September 10, 1894; *Calumet River, South Chicago, August 10, 1881 (Forbes).

Var. *δ*, *fungosa*.—Tubes repent. Vertical branches close together, even fused, forming great solid masses. Cuticula brown; aperture hyaline, slightly elongated.

Pennisewassee Pond in Norway, Gorham, Great Falls, outlet of Great Pond on Cape Elizabeth, Presumpscot River, all in Maine; Fresh Pond, Cambridge, Mystic Pond, Arlington, Green River, all in Massachusetts (Hyatt); *Payson Park, Belmont, Massachusetts, June, 1890 (C. B. D.), growing profusely on north side of stone wall; Lily Lake, Mississippi River bottoms near Quincy, Illinois (Garman, 1888).

PLUMATELLA PUNCTATA Hancock.

Plumatella vesicularis Leidy, 1854.
Plumatella vitrea Hyatt (1868).

Horizontal branches only. Cuticula delicate, colorless, hyaline. Elevated mouth cone, wrinkled and bespeckled with white. Found in Europe and North America.

Var. *α*, *prostrata*.—Stock repent and open, forming long hyaline tubes that give rise to only a few, likewise repent lateral tubes. (Plate V, fig. 7.)

Sebago Lake, Maine (Hyatt); Mystic and Fresh ponds near Cambridge (Hyatt, 1868); Schuylkill River, underside of flat stones (Leidy, 1854); Libby Lake, Mississippi River bottoms near Quincy, Illinois (H. Garman, 1888); *East end Gibraltar, Put-in Bay, August 15, 1898; *Long Point, Canada, August 21, 24, 1898.

Var. *β*, *densa*.—Stock repent, very thickly branched, completely covering the substratum, which seems enveloped in a thick layer of gelatinous vesicles.

LOPHOPUS Dumortier.

Colony shaped like a sack; erect, sometimes more or less lobed by indentations of margin, looking then something like a glove. Outer cuticula layer delicate and hyaline, more incrusted at base. Polypides scattered, a group of them rising from each lobe. Lophophors with about 60 tentacles. Statoblasts large, elliptical, but at each end drawn out into a sharp apex; float broad, hooks absent. The colony may divide along the constrictions between the lobes.

LOPHOPUS CRISTALLINUS Pallas (1766).

This species possesses the characters of the genus.

Habitat.—Chiefly standing water such as pools or, rarely, slow-flowing streams. Chiefly attached to plant stems.

Distribution.—Europe; Schuylkill River near Philadelphia (Leidy, 1858); Illinois River at Havana (Kofoid, 1898).

PECTINATELLA Leidy.

Colonies are hyaline and have the form of a rosette, lobed, with horizontal tubes only. They secrete a great gelatinous base which is common to many colonies. Aperture slightly elevated above common cœnecium. Statoblasts large and circular to subrectangular, with broad bent float and one marginal row of anchor-shaped hooks.

PECTINATELLA MAGNIFICA Leidy (1851).

Polypides scattered or in double row along each lobe, the gelatinous base often 10 to 20 centimeters thick. Tentacles 60 to 84 in number. Statoblasts about 1 mm. in diameter, provided with 11 to 22 hooks from 0.15 to 0.25 mm. long. (Plate V, fig. 8.)

Habitat.—Submerged branches or twigs of trees, wooden stakes, gates of dams, walls of reservoirs, stones in brooks. Shady situations, such as south walls of reservoirs or wood-covered streams.

Distribution.—Confined to North America, except as introduced at Hamburg, Germany. *Jones's Pond, near West Gouldsboro, Maine ("P. astræoidea, Hyatt," collected by Una A. Clark, 1897, in National Museum, Acc. No. 32589; also in Boston Soc. Nat. Hist.); Pennisseewassee Pond, Maine (20–22 hooks on statoblast); Fresh Pond, Cambridge, Massachusetts (12–17), both by Hyatt; *walls of College Hill reservoir, Somerville, Massachusetts; *Cold Spring Harbor, Long Island, New York, gates of dam between middle and lowest lake; Philadelphia (Leidy, 1851); Black Channel, Sandusky (Landacre, 1901); Jackson Park Lagoon, Lake Michigan, at Chicago (C. B. D., 1900); "back water" of Mississippi bottoms near Quincy, Illinois (H. Garman, 1888); Columbus, Mississippi (Leidy, 1858); *Squaw Bay, Put in Bay, Lake Erie (August 16, 1898, Reighard); *Illinois River, near Havana, from rocks and shells, "island" near old bridge, October 14, 1894 (Forbes); *Roadside Pond, in Hamilton County, Illinois (October 3, 1900, Forbes); *Little Muddy River, Franklin County, Illinois, October 18, 1900 (Forbes).

CRISTATELLA Cuvier.

Colony unbranched, gelatinous, with a flat "sole." External cuticula lacking, or developed merely as a thin gelatinous layer under the

sole. All polypides contract into a common cavity. Statoblast large, circular, with float and a circlet of hooks on both sides.

Habitat.—In standing or slow-flowing water, on submerged branches of dead trees, underside of lily pads, and on other aquatic plants.

CRISTATELLA MUCEDO.

Young corm of circular form, later elongated, worm-like, attaining a length of 2 to 5 cm. in summer, to 28 cm. in autumn. Colonies often gregarious in a common gelatinous substance. Eighty to 90 tentacles. Statoblasts with 10 to 34 dorsal hooks, 20 to 50 ventral hooks. (Plate V, fig. 9.)

Var. α, *genuina* (= *C. ophidea* Hyatt, 1868).—Statoblasts less than 1 mm. in diameter; hooks on dorsal side 10 to 22; on ventral side 20 to 37.

Distribution.—Europe; Pennissewassee Pond, Maine (Hyatt, 1868); *Fresh Pond, Falmouth, Massachusetts (C. B. D., 1889); *Trinity Lake, Pound Ridge, New York (C. B. D., August, 1889); *Union Lake, Illinois River, Havana, Illinois, May 12, 1894; *Long Point, Canada (Reighard, August 21 and 24, 1899); Station E, Illinois River, Havana, Illinois, September 2, 1890.

Var. β, *idæ* (= *C. idæ* Leidy, 1858; *C. lacustris* Potts, 1884).—Statoblasts over 1 mm.; hooks on dorsal side 20–34; on ventral side 38–50.

Distribution.—Lily Pond, Newport, Rhode Island (Leidy, 1858; C. B. D., 1890); Harvey's Lake, Luzerne County, Pennsylvania (Potts, 1884).

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EXPLANATION OF PLATE VI.

Fig. 1. *Urnatella gracilis* from Illinois River at Urbana. x 20.

2. *Pottsiella erecta* from Kraepelin's figure of a Pennsylvania specimen. x 35.

3. *Paludicella ehrenbergii* from Illinois River. x 8.

4. *Fredericella regina* from East Harbor, Sandusky. x 10.

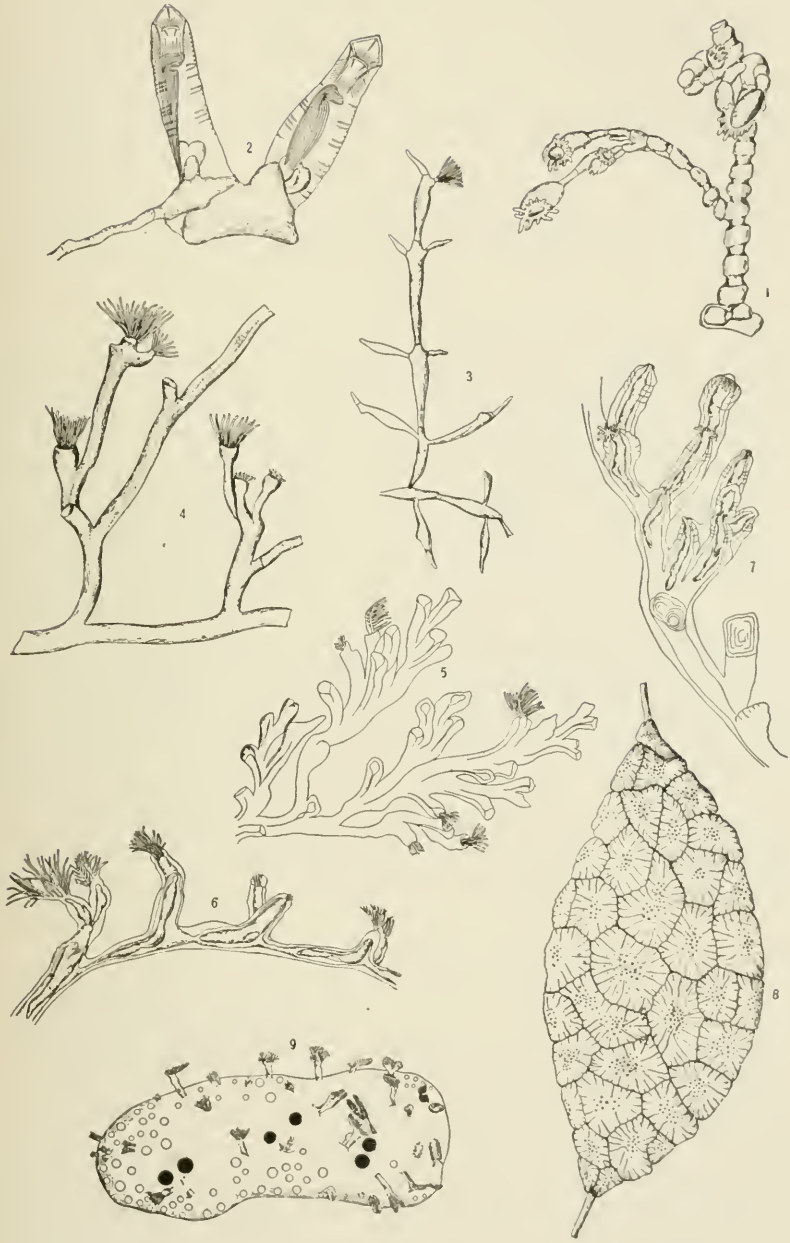
5. *Plumatella princeps*, var. *emarginata*, Squaw Bay, Put in Bay, Ohio; lily pads. x 6.

6. *Plumatella polymorpha*, var. *repens*, Lake Erie. x 8.

7. *Plumatella punctata*, var. *prostrata*, Lake Erie. x 8.

8. *Pectinatella magnifica*, on plant stem. Squaw Bay, Put in Bay, Ohio. x $\frac{3}{4}$.

9. *Cristatella mucedo*. Illinois River. x 10.



FRESH-WATER BRYOZOA.

FOR EXPLANATION OF PLATE SEE PAGE 221.

ON THE SPECIES OF WHITE CHIMÆRA FROM JAPAN.

By David Starr Jordan and John Otterbein Snyder,
Of the Leland Stanford Junior University.

In a review of the Elasmobranchiate fishes of Japan by Messrs. Jordan and Fowler in these Proceedings,[a] the specimens of white *Chimæras* or Ginzame collected by Jordan and Snyder in Japan are all referred to *Chimæra phantasma*. A reexamination of the same material shows that two species are included by Jordan and Fowler under this head. One of these is the original *Chimæra phantasma* of Jordan and Snyder[b] from the market of Tokyo. The other is the *Chimæra phantasma* of Jordan and Fowler,[a] from a specimen from Sagami Bay.

The latter is a new species, and Dr. Bashford Dean tells us that he has proposed for it, in a paper still unpublished, the name of *Chimæra mitsukurii*. This name we accept in place of one devised by ourselves. The two smaller specimens mentioned by Jordan and Fowler[c] are the young of *Chimæra phantasma*. All the specimens of both species now extant came from Sagami Bay, off Misaki.

The synonymy and distinctive characters of the two species are given below. The accompanying figures are by Mr. W. S. Atkinson, that of *Chimæra phantasma* being from the original type, No. 49398, U.S.N.M.

1. CHIMÆRA PHANTASMA Jordan and Snyder.

Chimæra monstrosa Schlegel, Fauna Japonica, Poiss., 1850, p. 300, pl. cxxxii; Nagasaki (not of Linnæus).

Chimæra phantasma Jordan and Snyder, Proc. U. S. Nat. Mus., 1900, p. 338; Market of Tokyo; Coll. K. Otaki—Jordan and Fowler, Proc. U. S. Nat. Mus., 1903, p. 670; "two other specimens from Sagami Bay" (not description).

In this species the anal fin is sharply notched opposite the notch in the second dorsal fin, so that the anal is separated from the caudal. The dorsal spine is strongly serrated behind and perfectly smooth in

[a] Proc. U. S. Nat. Mus., XXVI, 1903, p. 669.
[b] Idem, XXIII, 1901, p. 338.
[c] Idem, XXVI, 1903, p. 670.

front. The claspers are trifid, their length beyond the point of division being equal to 4 times the diameter of the pupil. The lateral line has conspicuous undulations extending along the sides of the body. Below the eye it gives off 2 branches, the upper of which passes backward toward the gill opening, the lower extending forward below the eye. There are 9 enamel rods in each anterior lamina of the upper jaw.

Three specimens have been examined, the type, No. 49398, U.S.N.M., and two others in the Ichthyological Collections of Stanford University. The latter are females and do not differ from the type except in the sexual characters.

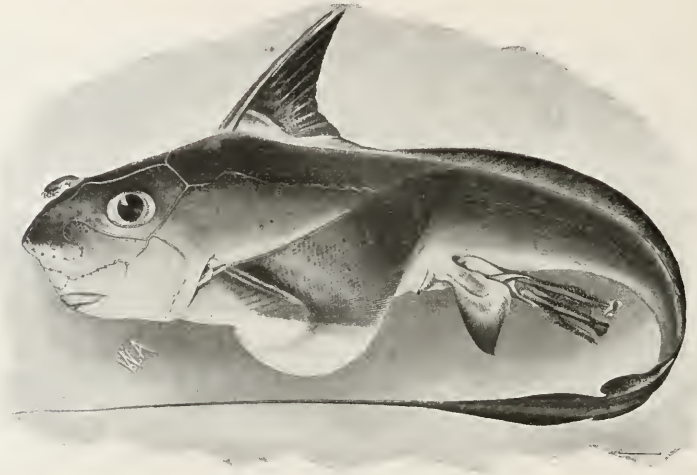


FIG. 1.—CHIMÆRA PHANTASMA.

2. CHIMÆRA MITSUKURII Dean Manuscript.

Chimæra phantasma JORDAN and FOWLER, Proc. U. S. Nat. Mus., XXVI 1903, p. 669. Description from a male specimen from Sagami Bay.

This species differs notably from *Chimæra phantasma* in the following points. There is no notch between the anal and caudal fins. The dorsal spine is finely serrated in front, and is smooth behind except near the tip, where it is finely serrated, the posterior edges appearing smooth, however, when compared with the serrated area of the spine of *C. phantasma*. The claspers are bifid, their length beyond the point of division being equal to about $1\frac{1}{4}$ times the diameter of pupil. The lateral line is straight along the side of the body. Below the eye it gives off 2 branches, the upper of which passes forward below the orbit. There are 6 enamel rods in each anterior lamina of the upper jaw.

The following is a more detailed description of our specimen of *Chimæra mitsukurii*, No. 7739, Ichthyological Collections, Stanford University.

Head measured from tip of snout to gill opening equal to the depth, contained $1\frac{1}{10}$ times in the dorsal spine; longitudinal diameter of eye equal to width of base of pectoral, $3\frac{1}{5}$ in length of dorsal spine. The eye is oblong, the longitudinal diameter of the iris contained 4 times in length of dorsal spine. Hook inserted on snout just anterior to the eye, its length slightly greater than the diameter of pupil. Anterior laminæ of upper jaw with sharp, sinuated edges; 6 enamel rods visible from before, the posterior of which is very short; posterior laminæ with rough edges, the enamel rods lying almost horizontally. Laminæ of lower jaw with about 11 enamel rods on each side, the cutting edges concave.

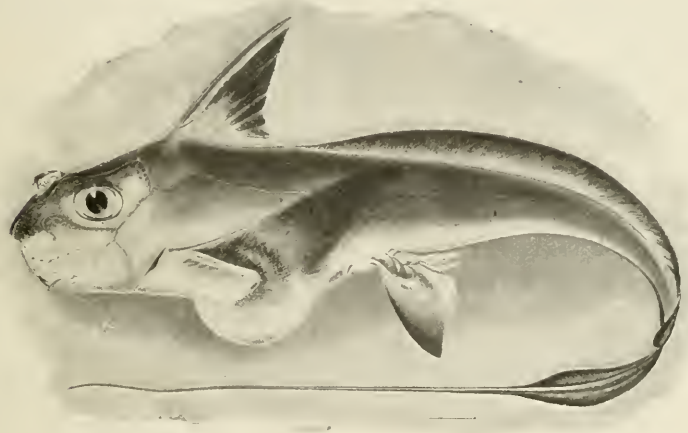


FIG. 2.—CHIMÆRA MITSUKURII.

Lateral line straight along the sides except for an abrupt upward curve below the dorsal spine and a gentle bend downward just posterior to the notch separating the dorsal and caudal; posterior to the eye it sends a branch upward, which divides, sending one part over the occiput to meet a similar line from the opposite side, and the other part forward above the eye, along base of hook, and downward to tip of snout, where it joins a deep groove with frilled edges; the second branch from the main lateral line passes downward and forward behind the eye, where it divides, the upper division extending forward below the eye, curving upward, then downward and backward to join the groove mentioned above; the lower division passes downward almost immediately dividing, one section running backward and downward, passing as a row of pores across the throat, the other section continuing downward and forward a short distance, finally splitting, one-half uniting with a groove which crosses the snout dividing above the mouth, the other half crossing the chin as a line of pores.

The dorsal spine is curved, acutely pointed, triangular in cross sec-

tion, grooved behind; anteriorly there is a serrated, narrow keel extending the length of the spine; posteriorly the edges of the spine are smooth, except near the tip, where they are minutely serrated. The rays are attached to the basal third of spine only, longest rays not reaching tip of spine. The dorsal fins are connected by a rayless fold of skin. Second dorsal separated from caudal by a notch. Anal and caudal continuous. Caudal filament very long and slender, the distance from the end (notch) of the dorsal to tip of filament equal to distance from end of dorsal to insertion of pectoral. Pectoral somewhat falcate, when depressed the tip reaching to middle of base of ventral. Length of ventral contained $1\frac{1}{2}$ times in dorsal spine. Claspers bifid, the length beyond point of division equal to $1\frac{1}{4}$ times the diameter of pupil. Four spines on ventral edge of intromittent organ.

Total length of specimen $29\frac{3}{8}$ inches with caudal filament.

This species is named for Dr. Kakichi Mitsukuri

NOTES ON A KILLER WHALE (GENUS ORCINUS) FROM THE COAST OF MAINE.

By Frederick W. True,
Head Curator, Department of Biology.

The number of species of killer whales which inhabit the North Atlantic is uncertain. Lilljeborg, Eschricht, Van Beneden, Gray, Lütken, and other cetologists have endeavored to solve the question, but have been unable to do so, owing chiefly, it would appear, to lack of sufficient material. Eschricht thought it possible to distinguish three species in European waters, and Reinhardt appears to have concurred in that view. Gray considered that two European species could be distinguished by the skulls. Van Beneden remarked in 1889:

> We not only believe that it is necessary to refer all these killers of the European seas to one and the same species, but we believe it possible to add also the killers of the Pacific and those of our antipodes.[a]

Lütken in 1887 summed up his study of the genus as follows:

> As regards the northern waters, I can only recognize two [species], and one of these, which bears the name of *eschrichtii*, still has need to be studied with new material.[b]

It has been known from a very early date that killers frequent the Atlantic coast of North America, but very little attention has been paid to them by American zoölogists, owing no doubt in part to the scarcity of opportunities to examine specimens. At all events, nothing of importance regarding these cetaceans is to be found in American zoölogical literature. I omitted them from my Revision of the Delphinidæ, as, on account of insufficient material, I feared to increase rather than to lessen the uncertainty regarding the real number of existing species.

In view of the present condition of the subject, it has seemed to me

[a] P. J. Van Beneden, Hist. nat. des Cétacés des mers d'Europe, 1889, p. 43.

[b] C. F. Lütken, Krit. Studier over nogle Tandhvaler af Slægterne *Tursiops, Orca* og *Lagenorhynchus*. Videns. Selsk. Skr., 6. Række, nat. og math. Afd., 4, art. 6, 1887, p. 394.

desirable to publish reproductions of two admirable photographs of a killer stranded at Eastport, Maine, in March, 1902. These photographs were obtained by the National Museum from Mr. William S. Hume, through Dr. Richard Rathbun.

My attention was first attracted to the animal by the following item which appeared in the New York *Sun* newspaper of March 3, 1902:

EASTPORT, MAINE, *March 2.*—Two large finback whales found their way into a small cove in the western part of the city on Thursday and will probably soon be killed. The whales have been seen in different parts of Passamaquoddy Bay for four weeks, and had made their way a few days ago up the Concook River, where the water is shallow.

A small stream flows out from the river to the east, passing under the toll bridge which connects this island city with the mainland, 4 miles away. It was under this bridge that the two whales made their way into the small cove, which is inclosed on the other entrance by the three wooden bridges of the Washington County Railroad.

At low tide the cove is shallow and there is hardly room for the whales to move about. The cove is within a half-mile of the Passamaquoddy Indian settlement, where there are 400 Indians.

Upon writing to Mr. Hume, I was surprised to learn that the whales were not finbacks, but killers. Later Mr. Hume forwarded the two photographs of one of the specimens, which are published herewith, and the following measurements and memoranda:

	Ft.	in.
Total length of whale, straight	25	4
Vertical height of dorsal fin	5	7
Length of base of dorsal fin	3	0
Length of pectoral	3	0
Breadth of pectoral	3	0
Spread of flukes	9	2

General color above, black; below, white. Color of pectorals above, black; below, white. Color of flukes above, black; below, white. Sex, male.

Much to my regret the carcasses of these fine specimens were towed out to sea before it was known that the skeletons and casts of the exterior would be of interest to science.

European killers have been figured many times, the best drawings being those published by Schlegel,[a] Lütken,[b] and Van Beneden.[c]

Lütken's figure agrees with the photograph of the Eastport specimen with the greatest exactness, except that the grayish mark on the back, posterior to the dorsal fin, is not observable in the latter. As this mark is probably rather indistinct, it may have been present in the Eastport specimen, but is not visible in the photographs on account

[a] H. Schlegel, Abhandl. aus dem Gebiete der Zoologie und Vergleich. Anatomie, 1841, pl. vii. Female, about 14 feet long. Wyk op Zee, Holland, 1841.

[b] C. F. Lütken, Vidensk. Selsk. Skv., 6 Række, nat. og math. Afh., 4, art. 6, 1887, pl. 1. Female, about 16 feet long. Limfiord, Norway. 1872.

[c] P. J. Van Beneden, Mem. Acad. R. Belgique, XLIII, 1879, pl. 1. Young, about 6 feet 8 inches long. Ostende, Belgium. 1843 or 1844.

of the manner in which the light strikes the back.[a] Schlegel's figure also agrees admirably, but the lower jaw is represented as longer, and there are slight differences in the shape of the postocular spot, and the boundary between the white of the lower surfaces and the black of the upper surfaces. The dorsal mark is present in Schlegel's figure, but is colored purple.

Van Beneden's figure of a young individual is remarkable in that the lower surfaces are bright yellow, instead of white. This appears from other indications to be a character of immaturity. The postocular mark is very large and has a serrated anterior margin.[b]

There appears to be no reasonable doubt that Lütken's figure and the Eastport photograph represent one and the same species, namely, *Orcinus orca* (Linnæus), the type-species of the genus. It must be confessed, however, that a comparison of measurements of various North Atlantic specimens only leads to confusion. The different specimens show no decided tendency to group themselves into separate species, or to agree with one another in proportions. Doubtless many of the discrepancies are due to faulty measurements or differences in the methods of measuring, but my experience with whalebone whales leads me to believe that this may not be taken for granted. It is quite likely that there is a considerable amount of individual variation in proportions among these animals, the extent of which can not, however, be ascertained without the examination of a much larger number of specimens than has been available hitherto. The measurements above referred to, reduced in each case to percentages of the total length, are shown in the table on the following page.

While any opinion regarding the species of *Orcinus* can have little weight at present, such data as are available appear to indicate that a single species occupies the North and South Atlantic, a very distinct form the South Pacific (coast of Chile, etc.), and possibly a third species the North Pacific. The Faroe species, generally known as *O. eschrichtii*, appears to me to have but slight claims to recognition at present.

[a] These two photographs illustrate in an admirable manner how errors are likely to arise from the examination of a single picture of this kind. From Plate VIII it would be imagined that the posterior end of the upper lip and a spot in front of the eye were white and also that the white of the postocular spot joined that of the throat, but on comparing Plate VII it is seen that these apparent extensions of the white are due to reflections.

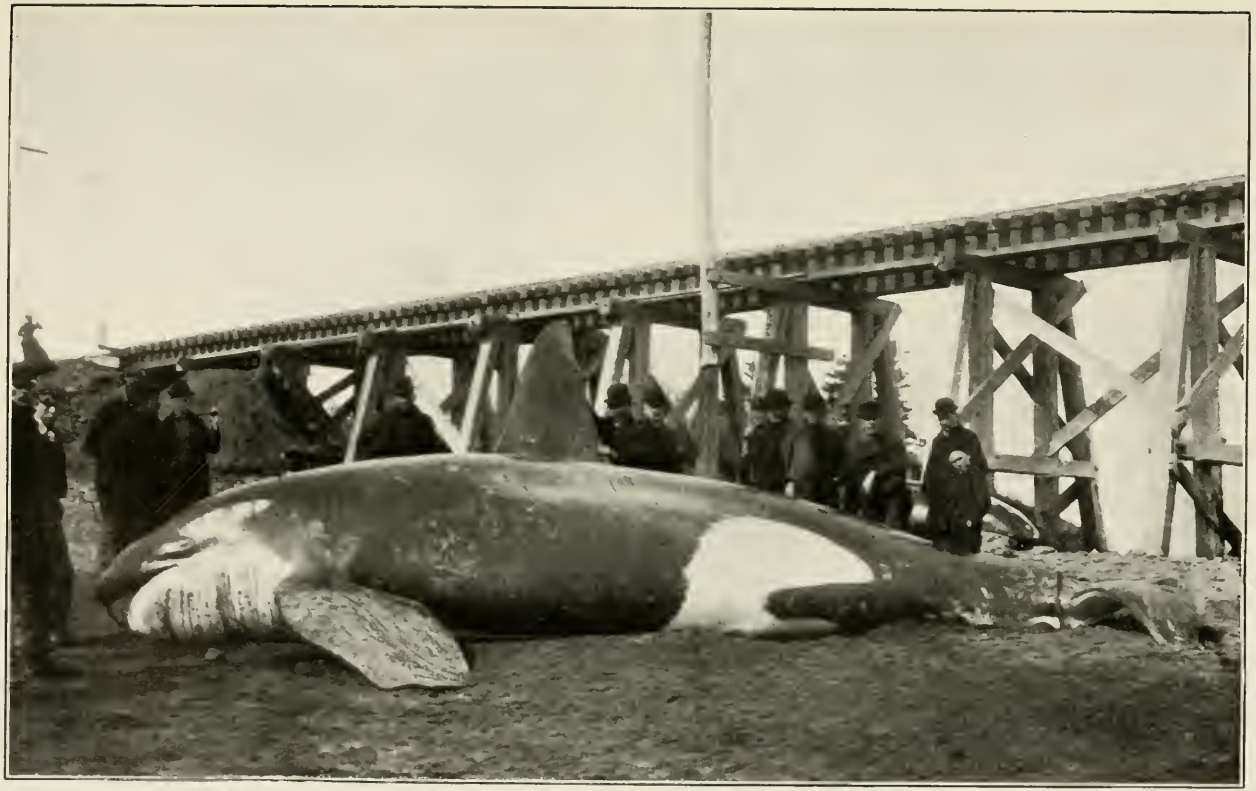
[b] See also the figure published by Guldberg and Nansen in Bergens Mus. Skrift., V, 1894, pl. v, fig. 2.

	Eastport, Maine, 1903, male.	Benzon, Norway, 1861, male.	Vannes, France, 1876, male, young.	Lynn, England, 1836, male.	Lormont, France, 1876, male, young.	Greenland, 1844, female.	Wyk op Zee, Holland, 1841. female.	Aarhuis, Denmark, 1855 female, young.	Bohusan, Sweden, 1871, female, young.
Total length	a25′ 4″	b21′ 4″	a20′ 3″	a19′ 0″	a10′ 8″	b17′ 6″	c16′ 3″	b13′ 0″	a11′ 7″
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Vertical height of dorsal	22.0	18.7	14.8	21.0	11.4	9.8	11.8	11.5	8.4
Length of pectoral	11.8	18.3	15.8	21.0	13.7	10.9	12.3	14.4	11.4
Greatest breadth of pectoral	11.8	15.0	8.0	14.1	8.2	6.0	8.7	[7.0]	5.7
Breadth of flukes	36.2	29.3	21.8	37.5	24.8	18.6	28.2	27.0	22.5
		(Eschricht.)	(Duhamel.)	(G. M.)	(Souverbie.)	(Eschricht.)	(Schlegel.)	(Eschricht.)	(Friesen.)

a English measure. b Danish measure. c Rheinland measure.

KILLER WHALE, ORCINUS ORCA (LINNÆUS).

Eastport, Maine. Male, 25 feet 4 inches long.



KILLER WHALE, ORCINUS ORCA (LINNÆUS).

Eastport, Maine. Male, 25 feet 4 inches long.

A REVIEW OF THE COTTIDÆ OR SCULPINS FOUND IN THE WATERS OF JAPAN.

By David Starr Jordan and Edwin Chapin Starks,
Of the Leland Stanford Junior University.

In the present paper is given a review of the genera and species of fishes of the family of Cottidæ, known in English as Sculpins, in Japanese as Kajika or Bero, found in the waters of Japan. The paper is based on the collections made in 1900 by Professors Jordan and Snyder and those made in the same year by the U. S. Fish Commission steamer *Albatross*. Series of the species mentioned are deposited in the United States National Museum and in the collections of Leland Stanford Junior University. The accompanying illustrations are the work of Mrs. Chloe Lesley Starks, Capt. Charles Bradley Hudson, Mr. Kako Morita, Mr. Sekko Shimada, and Mr. Robert Logan Hudson.

Family COTTIDÆ.

THE SCULPINS.

Body moderately elongate, fusiform or compressed, tapering backward from the head, which is usually broad and depressed. Eyes placed high, the interocular space usually narrow; a bony stay connecting the suborbital with the preopercle, usually covered by the skin; upper angle of preopercle usually with 1 or more spinous processes, the head sometimes wholly unarmed. Teeth equal, in villiform or cardiform bands on jaws, and often on vomer and palatines; premaxillaries protractile; maxillary without supplemental bone. Gills 3½ or 4, slit behind the last small, often obsolete; gill rakers short, tubercle-like or obsolete; gill membranes broadly connected, often jointed to the isthmus. Body naked, or variously armed with scales, prickles, or bony plates, but never uniformly scaled; lateral line present, simple, sometimes chain-like. Dorsal fins separate or somewhat connected, the spines, 6 to 18 in number, usually slender, sometimes concealed in the skin, the soft part elongate; caudal fin separate, usually rounded, rarely forked; anal fin similar to the soft dorsal, without spines; pectoral fins large, with broad procurrent bases, the rays mostly simple, the upper sometimes branched; ventrals thoracic, rarely entirely wanting, the rays usually I, 3 to I, 5, their

insertion well forward. Pseudobranchiæ present. Vertebræ numerous, 30 to 50. Scapular arch normal; myodome developed; actinosts large, partly intervening between coracoids; ribs sessile on the vertebræ. Pyloric cæca usually in small number (4 to 8); air bladder commonly wanting. Genera numerous, mostly of the rock pools and shores of northern regions; many species found in fresh waters; some of the salt-water species descending to great depths. Most of the species are of small size and singular aspect, and none is valued as food. The family is an extremely varied one, which can not readily be thrown into subordinate groups. Almost every species has an individuality of its own, and among the marine forms it is necessary to recognize almost as many genera as species. It is impossible to throw these small genera together into large groups. Of the various forms, probably the American genus *Jordania* is nearest the primitive scaly stock, from which such forms as *Zaniolepis* and *Oxylebius* among the *Hexagrammidæ* are also descended. Fresh-water degeneration is exemplified in *Cottus* and *Uranidea* and deep-water degeneration in *Zesticelus*, *Cottunculus*, and *Psychrolutes*.

A. Ventral fins well developed, the rays I, 2 to I, 5.

B. Spinous dorsal evident, not concealed in the flesh nor indistinguishable from soft part; head with spines or tubercles (except in rare cases), its bones not all hidden in lax skin.

C. Pectoral fins without free rays below, and not coalescent.

D. Ventral rays not I, 5; usually I, 3, sometimes I, 2 or I, 4.

E. Spinous dorsal shorter than soft part, of less than 13 spines.

F. HEMILEPIDOTINÆ. Body definitely more or less scaly above, the scales sometimes arranged in bands or sometimes modified as bony plates, these usually placed along lateral line or at base of dorsal (skin naked in *Artediellus*).

G. Last gill arch without slit behind it; gill membranes united, free from the isthmus.

H. Vomer and palatines with teeth; ventral rays I, 2.

I. Preopercular spine with 1 to 5 enlarged hooks or antler-like processes above, besides the two on its bifid or emarginate tip.

J. Body with three series of bony plates, those of the upper and lower series strongly keeled ..... *Stlengis*, 1.

JJ. Body with a single row of rough plates along the side; head with conspicuous pores ..... *Schmidtia*, 2.

II. Preopercular spine bifid or simple, without hooks or antler-like processes above.

K. Vent very close behind ventrals; supraoccipital cirrus very high; skin with small, rough plates ..... *Archistes*, 3.

KK. Vent well behind ventrals; supraorbital cirrus low or wanting.

L. Upper preopercular spine forked; a simple flap above eye; body covered with rough scales above ..... *Daruma*, 4.

LL. Upper preopercular spine simple, more or less hooked at tip.

M. Body covered above with small, rough plates, those on lateral line larger; preopercle with four spines; preopercular spine slightly hooked ..... *Ricuzenius*, 5.

MM. Body entirely scaleless; preopercular spine strongly hooked ..... *Artediellus*, 6.

LLL. Upper preopercular spine simple or emarginate; back with a series of larger plates along base of dorsal; sides with scattered scales; body slender and elongate.. *Icelus*, 7.

HH. Vomer with teeth; palatines with none; sides with a series of bony, keeled plates.

N. Plates on head very small; body rather robust; preopercle with four spines, the uppermost hooked upward..... *Stelgistrum*, 8.

GG. Last gill arch with a distinct slit behind it.

O. Sides of body with oblique, serrated folds; preopercular spines small, simple or bifid; gill membranes free from the isthmus; no palatine teeth.

P. Caudal fin truncate or nearly so.

Q. Back with a series of bony tubercles along base of dorsal; breast naked, with cross folds of skin..... *Triglops*, 9.

PP. Caudal fin emarginate; body very slender; lower rays of pectoral produced; no bony plates along base of dorsal..... *Prionistius*, 10.

OO. Sides of body without oblique, serrated folds; no bony tubercles along dorsal fin; body very robust.

R. Back with one or two bands of large, rough scales; lateral line without bony shields; palatines with teeth; preopercular spine short.

S. Back and sides with two separate bands of coarse, rough scales; ventrals moderate; spinous dorsal notched; gill openings forming a broad fold across isthmus. *Hemilepidotus*, 11.

SS. Body without scales, but with a band of coarse, bony plates along lateral line; gill membranes broadly united to the isthmus.

T. Preopercular spine simple, very strong. *Enophrys*, 12.

TT. Preopercular spine very long, armed above with recurved hooks. *Ceratocottus*, 13.

FF. Body not definitely scaly nor armed with bony plates, the skin smooth or prickly or with scattered warts; no bony armature along lateral line.

U. Cottinæ. Skin smooth or warty or velvety, not evenly hispid with stiff prickles; head and body more or less depressed.

V. Gill membranes broadly united to the isthmus, not forming a fold across it; fresh-water species with the head feebly armed; palatine teeth present, occasionally few or wanting altogether; no slit behind last gill arch.

W. Pectoral fin with the lower rays simple.

X. Ventral rays I, 4; palatine teeth usually present.

Y. Suborbital stay with a prominent ridge; head with distinct ridges above; skin prickly; preopercular spine strongly hooked.

Trachidermus, 14.

YY. Suborbital stay flat, without ridge; head rounded above.

Cottus, 15.

XX. Ventral rays I, 3; palatines mostly toothless.

Uranidea, 16.

WW. Pectoral fin with the rays all branched; ventral rays I, 4.

Rheopresbe, 17.

VV. Gill membranes free from the isthmus or else forming a broad fold across it.

Z. Palatines without teeth.

a. Vomer with teeth.

b. Dorsal spines simple, not fringed with tentacles; no tentacles on temporal region.

c. Preopercle with three spines only, the uppermost straight, the third turned downward; skeleton well ossified; lateral line developed, with or without concealed plates. Lower jaw included; post temporal with one spine.

Myoxocephalus, 18.

cc. Preopercle with three spines; lower jaw projecting; post temporal with a double spine ..... *Megalocottus*, 19.

ccc. Preopercle with four spines; the lowermost turned downward.

d. Nasal spines strong; bones of head firm; lower jaw included.

e. Upper preopercular spine very long and straight; no slit behind fourth gill ..... *Hemilepidotus*, 20.

ee. Upper preopercular spines curved.

f. Ventral fins moderate, not reaching vent ..... *Porocottus*, 21.

ff. Ventral fins very long; reaching past front of anal ..... *Artedius*, 22.

dd. Nasal spines obsolete; bones of head soft and spongy; lower jaw projecting; lateral line reduced to scattered pores; vomer with teeth; deep water sculpins, with feeble fins and reduced armature.

g. Uppermost preopercular spine long and sharp; dorsals separated.

Zesticelus, 23.

gg. Uppermost preopercular spine short and concealed in the skin; dorsals continuous ..... *Cottunculus*, 24.

aa. Vomer and palatines toothless; upper preopercular spine stout, armed with antler-like processes; slit behind last gill small or wanting .. *Gymnocanthus*, 25.

bb. Dorsal spines each with a fringe of tentacles; ventral rays I, 3; a pair of multifid flaps behind orbit ..... *Crossias*, 26.

ZZ. Palatines as well as vomer with teeth; gill membranes free from the isthmus; last gill slit small or wanting.

h. Ventral rays I, 3 (allies of *Oligocottus*).

i. Upper preopercular spine long, with antler-like processes; no anal papilla, no flap above eye ..... *Cottiusculus*, 27.

hh. Ventral rays I, 2 (allies of *Pseudoblennius*).

j. Preopercle with antler-like hooks or processes above.

k. Preopercular spine rather long and slender, with one or more hooked teeth above; skin naked; no cirrus above eye. *Elaphichthys*, 28.

kk. Preopercular spine short and flat, divided into many points at tip; a simple cirrus above eye ..... *Aleichthys*, 29.

ii. Preopercular spine, simple or forked, without antler-like processes or hooks above.

l. Preopercular spine forked at tip, a pair of simple cirri at the nape ..... *Furcina*, 30.

ll. Preopercular spine simple.

m. Head normally formed.

n. Pectoral fins very large; a small tentacle on each pore of lateral line ..... *Oxymetes*, 31.

nn. Pectoral fins moderate; anal papilla large.

o. Anal papilla cylindrical, trilobate; a tentacle over eye ..... *Pseudoblennius*, 32.

oo. Anal papilla simple; three pairs of multifid flaps above head ..... *Bero*, 33.

mm. Head very slender, depressed, and pointed, pike-like; body compressed, with very slender caudal peduncle; no cirri on head; preopercular spine straight and sharp; skin smooth ..... *Vellitor*, 34.

hhh. Ventral rays I, 4; preopercular spine strongly hooked upward. *Artediellus*, 6.

FF. BLEPSIINÆ. Skin almost everywhere evenly rough with small bluntish prickles; head and body more or less compressed; fins more or less elevated.

p. Gill membranes free from the isthmus.

q. Spinous dorsal not notched; sides without smooth areas ..... *Histiocottus*, 35.

qq. Spinous dorsal deeply notched; sides with definite smooth areas ..... *Blepsias*, 36.

pp. Gill membranes united to isthmus; first dorsal not elevated ..... *Nautiscus*, 37.

EE. HEMITRIPTERINÆ. Spinous dorsal longer than soft part, of 14 to 18 spines; skin rough with prickles and tubercles; teeth on vomer and palatines; gill membranes free from isthmus; no slit behind last gill; head depressed.

q. Spinous dorsal of 16 to 18 spines, deeply notched, the first spines highest. *Hemitripterus*, 38.

BB. PSYCHROLUTINÆ. Spinous dorsal not evident, its slender spines hidden in the skin; head unarmed, covered by lax skin; no slit behind last gill; no teeth on vomer or palatines; ventral rays I, 3; bones of head moderately cavernous ..... *Psychrolutes*, 39.

AA. EREUNIINÆ. Ventral fins wholly wanting; pectoral fins with the four lowermost rays simple and free from the membrane; teeth on vomer and palatines; gill membranes free from the isthmus; skin covered with velvety prickles. *Ereunias*, 40.

1. STLENGIS Jordan and Starks.

Stlengis JORDAN and STARKS, new genus (*osensis*).

Body not compressed. Jaws, vomer, and palatines with villiform teeth. Eyes large, narrowly separated. No slit behind last gill. Gill membranes broadly united, free from the isthmus. Branchiostegals 6. Preopercle with a long slender spine armed above with several antler-like processes, 3 small sharp spines below. Body encased in 3 longitudinal series of bony plates, which are sharply toothed behind; in addition each plate of the upper and lower series is armed with a sharp keel ending in a sharp hooked spine much as in *Agonidæ*. Belly naked. Ventrals with two soft rays.

(*στλέγγις*, a comb.)

1. STLENGIS OSENSIS Jordan and Starks, new species.

Head $2\frac{3}{4}$ in length without caudal; depth 5; dorsal VII–14; anal 13; eye 3 in head; interorbital width 10; snout 4; maxillary $2\frac{1}{3}$; preopercle

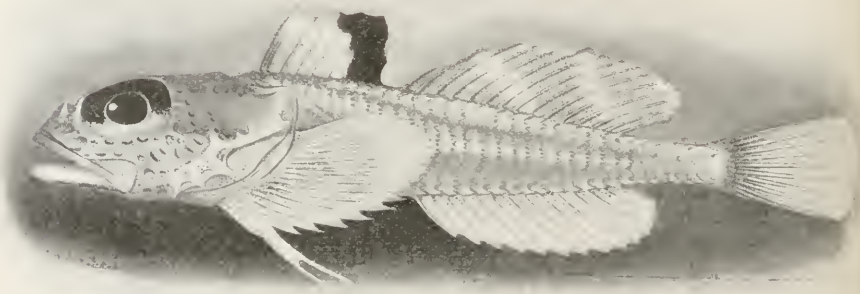


FIG. 1.—STLENGIS OSENSIS.

spine 4; pectoral $1\frac{3}{4}$; ventral $1\frac{5}{6}$; caudal $2\frac{1}{3}$; height of caudal peduncle $5\frac{1}{2}$.

Upper profile of head broadly rounded; the snout not steep. Body elongate, not compressed; tapering to a slender caudal peduncle; mouth rather large; the maxillary reaching to slightly past middle of eye. Lower jaw slightly included. Small villiform teeth on jaws, vomer, and palatines. Eyes large and very narrowly separated; at upper profile of head. Nasal spines sharp. Angle of preopercle with a long slender spine which reaches to edge of opercle, its upper edge armed with 5 antler-like processes. Lower edge of preopercle with 3 small sharp spines; the lowest one pointing forward. No tentacles on top of head.

Body encased in 3 longitudinal series of bony plates, which are sharply toothed behind; each plate of the upper and lower series has an enlarged spine directed backward. The lowest series contains 24 plates and extends from just in front of the anal to the base of the

caudal fin; the middle series contains 28 plates, and begins just behind the parietal region on top of head, bends obliquely down to side of body at tip of pectoral, thence runs straight and ends a distance equal to diameter of eye in front of caudal; the top row contains 26 plates, and runs from under middle of spinous dorsal to caudal fin. Belly naked.

Dorsal separate; tips of last dorsal rays end vertically above those of anal, but not reaching to caudal. Pectoral reaches a little past front of anal. Ventrals with 2 rays each; their tips almost reach to first anal ray. Caudal rounded.

Color faintly brownish above; a slightly dusky band at base of caudal; a black spot on posterior part of spinous dorsal; soft dorsal dusky; other fins colorless.

The type and only specimen was dredged by the U. S. Fish Commission steamer *Albatross* in Suruga Bay at Station 3788, off Ose Point. It is 38 mm. in length, and is numbered 50912, U.S.N.M.

2. SCHMIDTIA Jordan and Starks.

Schmidtia Jordan and Starks, new genus (*misakia*).

Body elongate, not compressed; tapering into a slender caudal peduncle. Eyes large, close together. Preopercle armed with 4 spines; the upper one long and slender, and armed above with 5 sharp antler-like processes. Villiform teeth in bands on jaws, vomer, and palatines. Gill membranes broadly united; free from isthmus. No slit behind last gill. Head with many large pores. Dorsals separate, but close together. Ventrals with a concealed spine and 2 soft rays each. Caudal slightly rounded. Sides with a lateral row of wide plates, which are ctenoid on their posterior edges; body otherwise naked.

(Named for Peter Schmidt, of St. Petersburg, in recognition of his studies of Japanese fishes.)

2. SCHMIDTIA MISAKIA Jordan and Starks, new species.

Head $2\frac{5}{6}$ in length without caudal; depth $5\frac{1}{2}$; dorsal IX–16; anal 12; lateral plates 35; eye $3\frac{1}{4}$ in head; interorbital 15; snout $4\frac{5}{6}$; maxillary $2\frac{3}{5}$; fourth dorsal spine 3; longest dorsal rays $2\frac{1}{2}$; longest anal rays $3\frac{1}{2}$; length of pectoral $1\frac{3}{5}$; ventral 2; caudal $1\frac{3}{5}$; height of caudal peduncle 6.

Upper profile of head broadly rounded; the snout moderately steep. Top and sides of head and mandible with many pores. Mouth at extreme lower aspect of head; little oblique; the maxillary reaching to below posterior margin of pupil; anterior end of maxillary on a level or slightly below a level with lower margin of eye. Small villiform teeth in rather narrow bands on jaws, vomer, and palatines. Lower jaw slightly included. Eyes large, at upper profile of head; narrowly separated by a slight, convex, interorbital bone; orbit less

curved at lower edge than at any other point. Nasal spines well developed and sharp. Upper preopercular spine long and slender, its tip reaching to or a little past edge of opercle; armed above with 4 sharp antler-like processes. Lower edge of preopercle with 3 moderately large sharp spines; the upper one the largest; the lowest one hooked forward. Lateral plates rather long and narrow; sharply toothed on posterior edge; the longest ones near middle of body, where they are about equal to height of caudal peduncle; the line of plates beginning on nape at each side of second dorsal spine, running obliquely to sides a little behind tip of pectoral, and thence straight to caudal.

Origin of spinous dorsal anterior to tip of opercle flap a distance equal to half the diameter of eye. Dorsals completely but slightly separated. Tips of last soft dorsal rays each well past those of anal,

FIG. 2.—SCHMIDTIA MISAKIA.

but fail to reach base of caudal by a distance equal to three-fifths diameter of eye. Origin of anal under third ray of soft dorsal. Pectoral with 17 simple rays; its tip reaches to opposite front of anal. Ventral with a concealed spine and 2 soft rays; the inner ray the longer; reaching two-thirds of distance from its base to origin of anal. Caudal slightly rounded.

Color, light uniform brown above, white below; a few roundish diffused spots, irregular in size and position, along sides below lateral plates; a similar spot at base of upper pectoral rays; a dark bar with blended edges runs from middle of eye downward and slightly backward; another runs from anterior end of eye to side of snout; pectoral slightly dusky toward tips of rays; spinous dorsal dusky, sometimes with a dark spot posteriorly; soft dorsal obliquely crossed with light and dark bars; other fins colorless.

Two specimens dredged by the U. S. Fish Commission steamer *Albatross* (Station 3698), in 153 fathoms, in Sagami Bay, off Manazuru Point. They are 68 and 77 mm. in length. The larger one is the type and is numbered 50913 in the United States National Museum; the other is No. 7506, Ichthyological Collection, Stanford University.

3. ARCHISTES Jordan and Gilbert.

Archistes Jordan and Gilbert, Fish. Bering Sea, in Rept. Fur Seal Invest. for 1896–97, III, 1899, p. 454 (*plumarius*).

Head and body compressed; lateral line armed with a series of spinous plates; a series of smaller similar plates along base of dorsal widening anteriorly so as to fill the space between dorsal and lateral line, but not extending around front of dorsal to connect with band on the other side. Head naked; gill membranes broadly united, free from the isthmus; no slit or pore behind last gill; no spines above eye or on vertex; a single gently curved preopercular spine, not forked and without cusps or processes; a large fringed supraorbital flap; small flaps and cirri on occiput, sides of head, and along lateral line; teeth on jaws, vomer, and palatines; dorsals continuous, notched between spinous and soft portions; ventrals I, 3, without setæ; vent far forward, immediately behind base of ventral fins, the male with a long anal papilla.

(ἄρχος, vent; alluding to its unusual position.)

3. ARCHISTES PLUMARIUS Jordan and Gilbert.

Archistes plumarius Jordan and Gilbert, Fish. Bering Sea, in Rept. Fur Seal Invest. for 1896–97, III, 1899, p. 454, pl. liii; Ushishir Island.—Jordan and Evermann, Fish. N. and M. Amer., II, 1898, p. 1901; Ushishir Island.

Head $3\frac{3}{5}$ in length; depth 4; eye $3\frac{1}{2}$ in head. D. X-23; A. 18; P. 15 or 16. Anterior portion of head compressed and narrow, with vertical sides, the width at angle of mouth little greater than diameter of orbit. From the ocular region the head widens rapidly backward and downward to preopercular spine, leaving the occiput narrow; greatest width of head and body near preopercular spine, slightly less than depth of head at occiput; body compressed, everywhere much deeper than wide. Mouth slightly oblique, maxillary reaching slightly beyond vertical from front of pupil, $3\frac{1}{5}$ in head. Jaws and vomer with rather wide bands of uniform fine teeth; a small patch on front of palatines; nasal spines strong, fixed; preopercular spine strong, simple, directed upward and backward, gently curved; preocular margin without further spines or prominences. Opercle thin, without rib or spine; supraocular rim elevated, projecting above profile of head; interorbital space narrow, deeply channeled, the sides sloping convexly; occiput depressed behind the eyes and transversely rounded, rendering the profile somewhat concave; posteriorly the occiput rises and is literally angulated, somewhat quadrate therefore in cross section; vertex without ridges or spines; supraocular flap as long as eye, lanceolate in form, coarsely fringed along the margins; a pair of broad, deeply cleft flaps near middle of occiput, and a second pair at posterior edge of occiput; a long nasal cirrus, a series of short filaments along margin

of preopercle, 1 on suborbital stay, 1 near tip of maxillary, a cleft filament near opercular angle, and a series of 4 filaments along middle of lateral line; anterior nostrils in a short tube; gill membranes widely joined across the throat, entirely free from isthmus. Lateral line rising in a high convex curve anteriorly, the curved and straight portions equal; along its course is a series of 44 plates, with the upper edge free and spinous, large along the curved portion of the line, but diminishing rapidly in size posteriorly, the free edge becoming smooth or nearly so; a series of much smaller but similar plates lies along base of dorsal, extending halfway along back of caudal peduncle, widening under anterior half of spinous dorsal to form a band which nearly fills the space between dorsal and lateral line; skin otherwise entirely naked. Dorsal beginning a pupil's diameter behind occiput. Spines very slender, the anterior ones highest, each crowned with a membranaceous flap which is digitately cleft; the third spine longest, one-half length of head; the last spine about two-fifths the third and one-half

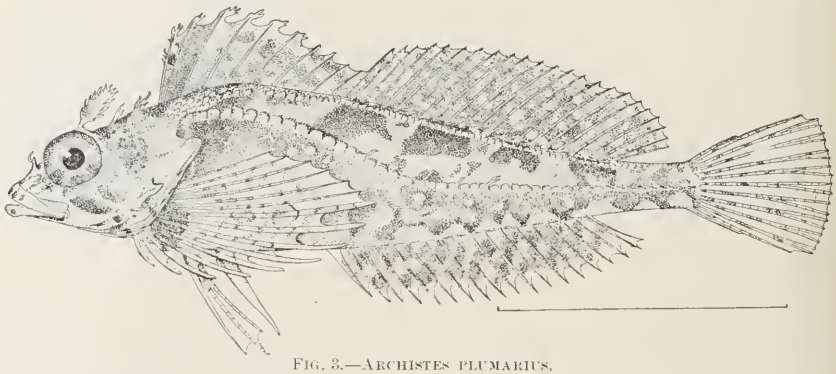


FIG. 3.—ARCHISTES PLUMARIUS.

the succeeding short ray; pectoral rays all simple, the lower thickened with incised membranes, the longest rays reaching vertical from third anal ray; ventrals narrow, reaching front of anal when declined; vent immediately behind ventral fins, the long anal papilla reaching front of anal fin when declined. Color in spirits, light grayish olive, a series of 5 irregular quadrate blotches along the back, usually connected at their lower margins; middle of sides with dusky marblings, from the lower edge of which a series of 7 V-shaped black blotches descend toward lower outline; the dusky marking of sides inclosing small round spots of ground color; an oblique dark bar on snout and a black blotch on lower portions of cheek; interopercle and upper branchiostegals with cross series of black spots; pectoral with a large dark blotch and indistinct cross bars on the rays; anal crossed by oblique dark bars; caudal indistinctly cross-barred; dorsals dusky, without definite pattern; ventrals plain. Length 3 inches. Ushishir Island, of the Kuril Group; only the type known. (Jordan and Gilbert.)

(*plumarius*, feathery.)

4. DARUMA Jordan and Starks.

Daruma Jordan and Starks, new genus (*sagamia*).

Body rather robust, covered above with rough scales, not arranged in definite bands; extending below lateral line posteriorly; no bony plates along base of dorsal; no naked area below dorsal nor in front of dorsal; preopercular spine long, bifurcate; teeth on vomer and palatines; gill membranes broadly united, free from the isthmus; no slit behind last gill.

This genus differs from *Ruscarius*, its nearest relative, in having the ventrals 2-rayed, the scales extending below the lateral line posteriorly, the upper preopercle spine more widely forked, and in having a single flat flap over the posterior part of eye, which is fringed but not divided.

(*Daruma*, a name applied to squat figures of Buddha, and thence to certain thick-headed fishes of Japan.)

4. DARUMA SAGAMIA Jordan and Starks, new species.

Head $2\frac{3}{4}$ in length without caudal; depth $3\frac{3}{4}$; dorsal VIII–12; anal 9; lateral line 30; eye $3\frac{1}{2}$ in head; interorbital 8; snout $3\frac{3}{4}$; maxillary

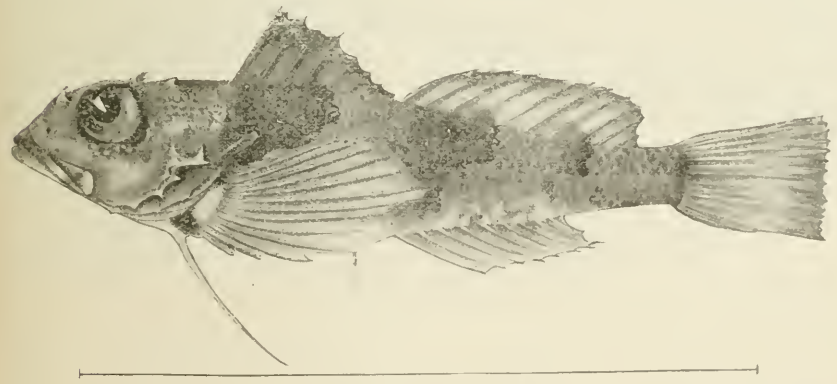


Fig. 4.—Daruma sagamia.

$2\frac{3}{5}$; length of ventral $1\frac{5}{6}$; pectoral $1\frac{1}{4}$; caudal $1\frac{1}{2}$; height of caudal peduncle $3\frac{1}{2}$.

Body robust, deepest under spinous dorsal. Snout steep. Mouth low. Maxillary reaching to below anterior margin of pupil; its anterior end just below the level of eye. Fine villiform teeth in narrow bands on jaws, vomer, and palatines. Lower jaw included. Eyes large, projecting a little above upper profile of head. Interorbital space very narrow. Nasal spines small but sharp. Upper preopercular spine not reaching to edge of opercle; its tip divided into two spines, the largest hooked upward. On lower edge of preopercle are 3 small rather sharp spines, the lowest pointing forward. Top of

head with a slight ridge running back from each eye, leaving vertex slightly concave. A flat fringed tentacle on superorbital rim above posterior sixth of orbit.

Lateral line armed with plates which are rough on their posterior edge and are but slightly larger than the scales on back. The anterior half of the lateral line bends upward and reaches to just above upper angle of gill opening. Back above lateral line and posterior part of body below lateral line evenly covered with ctenoid scales; these in 32 oblique series; 6 scales between bend of lateral line and back, counting the series running upward and forward.

Pectoral with 15 simple rays, the seventh from the top the longest; reaching to above the base of the fourth or fifth anal ray. The posterior outline of the fin is pointed. Dorsals close together; scarcely attached; first dorsal spine longest, or at least as long as the second and third; slightly shorter than the longest soft rays; $2\frac{3}{5}$ in head. Tips of last dorsal and anal rays ending on the same vertical, but not reaching to base of caudal rays. Caudal somewhat rounded.

Color, light brown on back, white below; a dark band between eyes with sometimes traces of its continuation below eye across cheek; a cross band under front of spinous dorsal; one under anterior third of soft dorsal, one under last dorsal rays, and one across caudal peduncle; spinous dorsal black; other fins colorless, except a dark spot at base of middle pectoral rays and a smaller similar one at base of upper rays; belly and under parts white.

Four specimens collected by the U. S. Fish Commission steamer *Albatross* in 42 to 52 fathoms, in Sagami Bay, stations 3754, 3762, 3763, off Suno Point, Totomi Bay (station 3729, off Omai Point), and from Owari Bay.

The type is from Sagami Bay; it is 32 mm. in length, and is numbered 50914, U.S.N.M. A cotype is No. 7702, Ichthyological Collection, Leland Stanford Junior University.

5. RICUZENIUS Jordan and Starks.

Ricuzenius Jordan and Starks, new genus (*pinetorum*).

Head and body slightly compressed; covered with rough scales of moderate size; enlarged plates along lateral line. Eyes large; interorbital space convex. Preopercle with 4 moderate spines; the upper one not enlarged nor with antler-like processes; short and simply hooked upward. Villiform teeth on jaws, vomer, and palatines. Gill membrane broadly united; free from the isthmus. No slit behind last gill. Dorsals close together, but separate. Ventrals with a concealed spine and 2 soft rays each.

(Named for the province of Rikuzen, front-land, on the shores of which region it was taken.)

5. RICUZENIUS PINETORUM Jordan and Starks, new species.

Head $2\frac{3}{4}$ in length without caudal; depth $4\frac{1}{5}$; dorsal IX–15; anal 12; lateral line 35; eye 4 in head; interorbital $7\frac{1}{2}$; snout 4; maxillary $2\frac{1}{4}$; fourth dorsal spine $4\frac{1}{6}$; longest dorsal ray $2\frac{1}{3}$; longest anal rays 3; pectoral $1\frac{1}{3}$; ventral I, 2.

Body compressed, the back slightly elevated. Superorbital rim projecting. Mouth large, low; anterior end of maxillary on a level with lower margin of eye; maxillary reaching posteriorly to below posterior margin of pupil. Jaws equal. Small villiform teeth in narrow bands on jaws, vomer, and palatines. Eyes large, separated by a moderately narrow deeply concave interorbital space. Posterior processes of premaxillary strongly projecting. Nasal spines small, but sharp. Edge of preopercle with 4 small sharp spines; the upper one the largest, and slightly hooked upward; the next below directed backward and slightly downward; the two lower ones directed down-

FIG. 5.—RICUZENIUS PINETORUM.

ward. Head and body everywhere covered with rather large rough scales; maxillary scaly. A series of enlarged plates along lateral line.

First dorsal spine opposite upper angle of gill slit; the spinous dorsal rather low; not connected with soft dorsal; the first spine slightly the highest, a little lower than the longest soft rays. Tips of last soft dorsal rays ending on the same vertical with those of anal, but not reaching to caudal. Pectoral reaching a little past front of anal. Ventral 2-rayed; the inner ray the longer; not reaching to vent.[a]

Color, brownish and mottled above, with irregular cross bars; one under middle of spinous dorsal; one under each end of soft dorsal; one across caudal peduncle at base of rays; the anterior ones are the widest and run downward and forward, growing narrower below; a

[a] The caudal of our specimen is broken and can not, therefore, be described.

dark streak from eye across side of snout to tip of chin; a less conspicuous one from eye across cheek; a dark-brown spot on base of pectoral rays; dorsals and pectoral with fine cross lines; ventrals and anal colorless.

The type and only specimen is 55 mm. in length; it was dredged by the U. S. Fish Commission steamer *Albatross* (station 3773) off Kinkwazan Island, in Matsushima Bay; it is numbered 50915, U.S.N.M.

(*pinetorum*, of the pines; Matsushima means pine island.)

6. ARTEDIELLUS Jordan.

Artediellus Jordan, Cat. Fish. N. A., 1885, p. 110 (*uncinatus*).

Head broad; teeth on vomer and palatines; preopercular spines 2, the upper large, strongly hooked upward, with no antler-like processes above; no slit behind last gill; gill membranes free from isthmus; skin naked, smooth; spinous dorsal short, not notched. Northern seas. This genus seems to be nearest to *Artedius*, from which it differs chiefly in the naked skin of head and body.

(Name: A diminutive of *Artedius*.)

6. ARTEDIELLUS PACIFICUS Gilbert.

Artediellus pacificus Gilbert, Rept. U. S. Fish Comm., 1893 (1896), p. 416; south of Sannak Island, at Albatross Station 3216. (Type in U. S. Nat. Mus.; Coll. Gilbert.)—Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, 1898, p. 454; St. Paul Island, Povorotnaya, Kamchatka, Karluk, Robben Island, Bristol Bay, Sannak, Unalaska.

D. VII or VIII–12 or 13; A. 11 or 12; P. 23, 2 (22 to 24); V. I, 3; caudal with 9 divided rays; lateral line 24 (22 to 26); length of head (measured to end of opercular flap) $2\frac{3}{4}$ to $2\frac{9}{10}$; depth $4\frac{1}{6}$; least depth of caudal peduncle $1\frac{3}{4}$ times in orbit; its length, from base of last anal ray, $2\frac{5}{6}$ in head. Very closely related to *Artediellus uncinatus*, differing in the entire obsolescence of the occipital protuberances or ridges in the increased number of cirri on the head, the more numerous pores of the lateral line, the greater number of rays in the pectoral fins, and the reduction in the rays of the caudal. Head evenly rounded in all directions, the orbital region not elevated, the snout not angulated; mouth slightly larger in males than in females, reaching vertical from middle or posterior margin of pupil, $2\frac{1}{2}$ to $2\frac{1}{5}$ in head; lower jaw shorter than the upper, a portion of the premaxillary band of teeth projecting beyond the mandible in closed mouth; teeth cardiform, in rather broad bands on jaws, and in patches of varying size on vomer and palatines; in some specimens a few teeth occur in a single convex series on front of vomer, and but 3 or 4 form a line on palatines; in others, we find an irregular double series or a narrow band on each of these bones; the teeth are always strong and are probably in adult specimens never entirely wanting on either vomer or palatines; longi-

tudinal diameter of orbit 3½ in head; interorbital space very narrow, shallowly concave, entirely occupied by the supraocular canals, which unite in a single pore opposite posterior margin of orbit; least interocular width two-thirds pupil; premaxillary processes projecting but little beyond the profile; nasal spines very small; both pairs of nostrils in short tubes, the posterior situated on anterior orbital rim; occiput with 2 very inconspicuous low-rounded ridges, appreciated with difficulty, and sometimes entirely wanting. No trace of the occipital spine seen in Massachusetts specimens of *Artediellus atlanticus*, nor of the conical protuberances described and figured by Collett in *A. uncinatus* of Europe. Barbels numerous; maxillary barbel large and conspicuous, sometimes simple, more often compound, furnished with from 1 to 4 short lateral branches; a well-developed supraocular cirrus, and a pair of cirri on posterior margin of occiput, the latter occupying the position of occipital spines; a short cirrus near base of opercular flap, and 2 or 3 on preopercle, 2 of which are usually at base of the preopercular spines; 2 cirri on anterior part of trunk, 1 immediately above base of pectorals, the other halfway between lateral line and front of spinuous dorsal; sometimes additional cirri above front of lateral line, and on lower margin of subocular ring; a series of 4 or 5 very short cirri crossing the eye horizontally immediately above the pupil; gill membranes broadly united, joined to the isthmus anteriorily with a wide free margin; gills 3½, no slit or pore behind last arch; preopercular spines as in *Artediellus uncinatus*, the upper one without smaller basal spine. Dorsal fins well separated, low in females, extraordinarily developed in males, the spinous dorsal in the latter well overlapping front of second dorsal and having all of the spines exserted, the median ones for one-half their length; these exserted spines with their free portions narrowly margined with membrane which widens at their tips to form a cutaneous flap; soft dorsal also somewhat elevated in males; ventral fins reaching halfway to vent in females, about three-fourths this distance in males. A series of 5 wide mucous slits running along lower edge of suborbital ring and across cheek; pores of lateral line minute, at the ends of short downwardly directed branches, the main line opening in a large slit-like pore at base of caudal. Color much as in *Artediellus uncinatus*, the lower parts whitish, unmarked, the dorsal region of the trunk crossed by 3 wide dark bars, which often, in adults, break up into spots separated by vermiculations of the lighter ground color, 1 of these bars below the spinous dorsal, running downward and forward to base of pectorals, the second under soft dorsal, the third on caudal peduncle; top and sides of head generally dark, with fine light dots or vermiculations; a light streak sometimes present, extending from preopercular spine forward and inward, meeting its fellow immediately behind eyes; this V-shaped mark usually absent

or inconspicuous, but sometimes, in young specimens, formed of bright silvery-white pigment; other silvery spots or blotches may occur on the lighter intervals of the back or sides; pectorals, dorsal, and caudal cross-banded; a black blotch at base of upper and 1 at base of lower pectoral rays; tips of elongate dorsal spines of the male black; ventrals and anal unmarked. Coast of Alaska, in Bristol Bay, south of Sannak Island and north of Unalaska, at depths of from 8 to 61 fathoms. Also at Karluk, off Kamchatka and Robben Island.

This description from Dr. Gilbert's account.

Dr. Schmidt reports this species as occurring in the Japan Sea.

7. ICELUS Krøyer.

Icelus KRØYER, Natur. Tidsskr., I, 1845, p. 253 (*hamatus*).

Head large. Preopercular spines 4, the upper hooked, simple or bifurcate at tip, without antler-like processes. Occiput with or without spines. Body slender, fusiform, with a dorsal series of bony plates from neck to base of caudal; lateral line with osseous tubercles, scattered scales on sides and belly. Gill membranes broadly united, free from the isthmus, no slit behind fourth gill. Dorsals separate; ventrals I, 3, thoracic; no pectoral filaments. Villiform teeth on jaws; vomer, and palatines. Branchiostegals 6. Artic regions.

("Ικελος, *Icelus*, son of *Hypnus*, the god of sleep; Krøyer says: "Navnet valgt med Hensyn till ulkearternes Dorskhed, saavelsom til den Nordlige Bopael, nogle af Oldtidens Forfattere anviste Søvnguden.")

7. ICELUS SPINIGER Gilbert.

Icelus spiniger GILBERT, Rept. U. S. Fish Comm., 1893 (1896), p. 412, pl. XXIV; Bristol Bay and Unalaska, at Albatross Stations 3216, 3223, and elsewhere, in 17 to 121 fathoms.—JORDAN and EVERMANN, Fish. N. and M. Amer., II, 1898, p. 1914; same specimens.—SCHMIDT, Faune de la mer du Japon, etc., 1903, p. 15; Japan Sea.

Head $2\frac{4}{5}$ to 3 in length; depth 5; eye 3 to $3\frac{1}{2}$ in head. D. IX–20; A. 17; P. 18; V. I, 3. Closely resembling *Icelus bicornis* of the Atlantic, but differing conspicuously in the armature of the dorsal series of plates in the comparatively plane occiput, and in other characters. Caudal peduncle very slender, its depth $2\frac{1}{2}$ in orbit; mouth large, the maxillary reaching slightly beyond middle of orbit, its length one-half head; teeth very finely villiform, present in rather wide bands in jaws and on vomer and palatine bones; nasal spines strong, separated by the high ascending processes of the premaxillaries; interorbital space very narrow, grooved, its width less than one-half diameter of pupil; orbital rim becoming elevated anteriorly and posteriorly, and, at the latter point, strongly denticulated; behind the orbital region the occiput is shallowly concave, being bounded laterally by 2 low, evenly rounded ridges, which become narrower posteriorly, and end

each in a strong spine projecting backward in line with the series of dorsal prickles; preopercular spines similar to those of *Icelus bicornis*, the uppermost, as in the latter, occasionally simple instead of bifurcate; the second spine usually directed straight backward, and the 2 following downward and forward; gill membranes broadly united, free from the isthmus, and neither pore nor slit behind the innermost gill; branchiostegals 6; eye large, longer than snout; a slender tentacle present over the posterior part of each orbit; a series of plates from nape along each side of dorsals to back of caudal peduncle, and a second series along lateral line; the dorsal series with 28 to 35 plates, each of which bears at its center a single strong spine directed outward and backward. In *Icelus bicornis* each plate is traversed by an oblique ridge, the margin of which is denticulated, the central tooth being the strongest and corresponding to the single spine present in *Icelus spiniger*. The latter agrees with *Icelus canaliculatus* in having an inner series of dorsal plates alternating with the principal series,

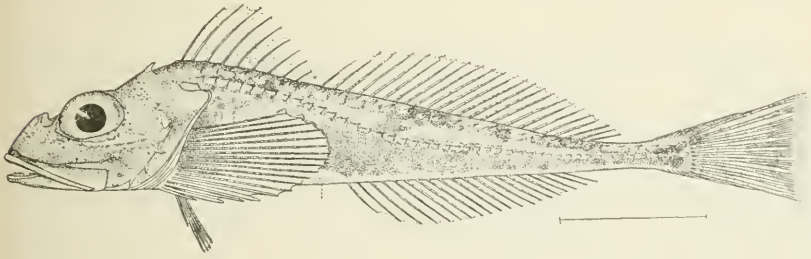


FIG. 6.—ICELUS SPINIGER.

each of the smaller plates bearing a minute prickle, discernible with difficulty; the plates along the lateral line, 41 to 44 in number, similar to those in *Icelus bicornis*, having their upper and posterior free margins serrulate. A few scattered spinous plates present in axillary region. Dorsal fins not connected, the spines very slender and rather high; pectorals long, reaching front of anal; ventrals not reaching vent. Color light olivaceous above, white below; upper parts mottled with dark brown; back with 4 faint black crossbars, the first under spinous dorsal, the second and third under soft dorsal, the fourth at base of caudal; a brown blotch on cheek, 1 on base of pectoral, and an irregular series along full length of body just under the lateral line; 2 prominent black blotches on first dorsal; the second dorsal, caudal, and pectoral barred; other fins unmarked; mouth and gill cavity white. Coast of Alaska; numerous specimens from the U. S. Fish Commission steamer *Albatross* stations off Bristol Bay and Unalaska. Recorded by Schmidt from near Vladivostok.

(*spiniger*, bearing spines.)

8. STELGISTRUM Jordan and Gilbert.

Stelgistrum JORDAN and GILBERT, Fish. Bering Sea, in Fur Seal Invest. for 1896–97, III, 1899, p. 456 (*stejnegeri*).

Body formed as in *Hemilepidotus*. Gill membranes widely joined across the throat, wholly free from the isthmus. Teeth on jaws and vomer, none on palatines. No slit or pore behind last gill. Upper preopercular spine simple, gently upcurved, 3 short spines below it. No opercular rib or spine. Nasal spines short and strong. Vertex without spines or ridges and without long tentacles. Spinous dorsal without anterior notch, the vertical fins all few-rayed. A series of plates along lateral line and a band along the back which merges anteriorly into the mass of minute plates covering top and sides of head. Ventrals I, 3, without setæ. Vent immediately before origin of anal.

(*στέλγιστρον*, scraper.)

8. STELGISTRUM STEJNEGERI Jordan and Gilbert.

Stelgistrum stejnegeri JORDAN and GILBERT, Fish. Bering Sea, in Rept. Fur Seal Invest. for 1896–97, III, 1899, p. 456, pl. LIV; Robben Island (coll. *Albatross*).—JORDAN and EVERMANN, Fish. N. and M. Amer., II, 1898, p. 1921; Robben Island.

Head $2\frac{3}{5}$ in length; depth $3\frac{1}{5}$. D. IX–17; A. 13; P. 16; caudal with 9 divided rays; lateral line with 40 plates; lower series of dorsal band containing 35 to 38 plates. Head narrowly wedge-shaped, tapering upward; width below eyes equaling length of snout and one-half eye; width at preopercles equaling depth at occiput. Mouth large, slightly oblique, the wide maxillary reaching vertical behind pupil, equaling length of snout and eye, $\frac{1}{2}$ length of head. Teeth small, uniform, in narrow bands on jaws and vomer; palatines toothless. A deep naked transverse groove between nasal spines and front of orbits; orbital rims moderately elevated, the interorbital space very narrow, channeled; occiput flat or slightly concave, angulated along lines running backward from orbits, but without spines or ridges; a slender filament above each eye; 2 minute pairs along sides of occiput, 1 on suborbital stay, 1 on maxillary, and a few on plates of lateral line; no nasal cirri, none along edge of preopercle; upper preopercular spine gently curved upward, without cusps or processes; below it 3 short spines, the first directed backward, the second vertically downward, the third, somewhat longer, directed downward and forward. Eyes small, the diameter equaling length of snout, one-fourth length of head measured to end of opercular flap; interorbital width equaling diameter of pupil. Straight portion of lateral line longer than the obliquely placed anterior portion, which is not strongly curved; plates of lateral line strongly spinous on their upper free edges, and of similar and nearly equal size throughout; dorsal band continued on to

back of caudal peduncle, where it is continuous with the band of the opposite side, the lower plates of the band in a definite lengthwise series and as large as those of lateral line or slightly larger, the other plates of the band decreasing rapidly in size toward base of fin, where they are minute. They are partially arranged in series running obliquely upward and backward from the lower larger plates to the bases of the dorsal rays, on which they extend for at least one-half the height of ray. Dorsal spines with minute spinous plates extending almost or quite to their tips. The snout, top of head, nape, suborbital ring, opercles, and cheek above the suborbital stay covered with minute plates similar to the upper part of dorsal band, with which the invested area on top of head is continuous; sides below lateral line naked, except for a few plates behind axil. Dorsals divided to the base, the last spine extremely short, its membrane joining extreme base of the first soft ray; spinous dorsal low, of slender weak spines, the longest ray one-third length of head; longest soft ray $2\frac{1}{4}$ in

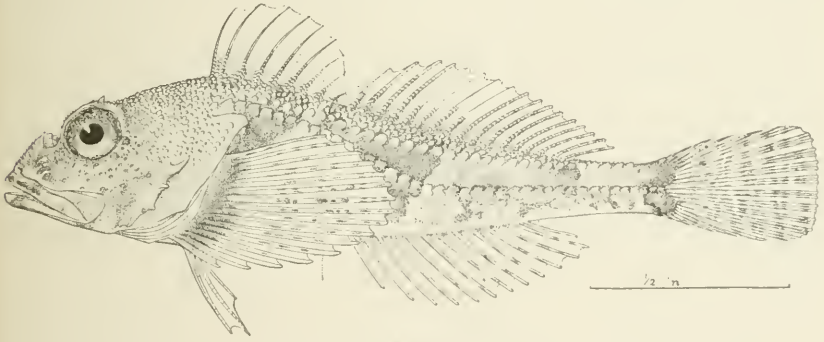


FIG. 7.—STELGISTRUM STEINEGERI.

head; anal beginning under third ray of soft dorsal, ending under its fourteenth ray; caudal peduncle slender, its least width one-third its length; pectorals broad and short, all simple, the lower thickened with moderately incised membranes, the eighth to the tenth rays the longest, extending beyond vertical from origin of anal; ventrals not reaching vent, $2\frac{1}{6}$ in head. Ground color light grayish olive; lower part of sides regularly reticulated with narrow dusky lines; a dusky cross bar from base of posterior dorsal spines and forward to axil; a second much broader bar from front of soft dorsal, ending irregularly below, where it merges into the reticulating lines; a third broad bar, less clearly defined, under posterior portion of soft dorsal; a conspicuous broad V-shaped blotch at base of caudal, the apex directed forward; a faint dark streak from eye forward to tip of mandible, and a cross bar behind eyes, continued faintly on to cheek; spinous dorsal with a small dark spot on anterior and 1 on posterior spines; rays of soft dorsal and caudal with dusky markings so arranged as to form fine

cross bars; terminal half of pectorals finely cross-barred, the proximal half plain, with a large dusky blotch on extreme base; anal very faintly barred; ventrals unmarked. Sea, off Robben Island; one specimen 52 mm. long, dredged in 10 fathoms.—(Jordan and Gilbert.)

A second specimen sent us from Aniva Bay, Sakhalin, was collected by Dr. Peter Schmidt of the Museum of St. Petersburg.

(Named for Dr. Leonhard Stejneger, curator of reptiles and batrachoans in the U. S. National Museum.)

9. TRIGLOPS Reinhardt.

Triglops Reinhardt, Vid. Selsk. Natur. Math. Afh., V, 1832, p. 52 (*pingeli*).

Body rather elongate, the tail very slender. Head small and compressed. Mouth moderate; villiform teeth on jaws and vomer, none on the palatines; preopercular spines 4, small, simple; head prickly, but without scales; a row of enlarged plate-like scales along the lateral line; a similar row above it at the base of the dorsal fin; the space between these densely prickly; lower half of body crossed at short intervals by transverse undulating folds of skin, the edge of the fold with minute rough scales, causing it to appear sharply and finely serrate, these cross folds being really formed by branches of the lateral line. Gill membranes united, free from the isthmus; a distinct slit behind last gill. Dorsal spines rather high and slender; ventrals I, 3. Arctic seas.

(*trigla*; ὄψ, appearance: the transverse folds resembling the lateral plates of *Trigla*.)

9. TRIGLOPS BEANI Gilbert.

Triglops pingeli Bean, Proc. U. S. Nat. Mus., 1883, p. 355, not of Reinhardt; Plover Bay, Siberia.

Triglops beani Gilbert, Rept. U. S. Fish Comm., 1893 (1896), p. 428, pl. xxviii, fig. 2; Aleutian Islands, Bristol Bay, at *Albatross* stations 3214, 3217, and many others, in 7½ to 42 fathoms.—Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, 1898, p. 455; St. Paul I., Robben I., Karluk.

Head 3⅔ to 3⅖; depth 6; snout longer than eye, 3⅕ to 3⅓ in head; eye 3¼ to 3⅖; D. X or XI–23 to 26; A. 24 to 26; C. 12; P. 18; V. I, 3; lateral line 48 to 50; branchiostegals 6. Body heavy at shoulders, tapering rapidly to slender caudal peduncle; depth of caudal peduncle one-fourth its length from base of last dorsal ray; greatest width of head slightly less than its depth, its lower profile straight, the upper descending in a gentle, even curve; mouth nearly horizontal, the maxillary almost reaching vertical from middle of eye, 2⅙ to 2¼ in head; villiform teeth on jaws and vomer, none on palatines; supraorbital rim slightly elevated, a groove-like depression behind it; interorbital space rather wide, forming a shallow groove, its width 3½ to 5 in diameter of orbit; occipital ridges obsolete, a faint trace of them sometimes present, never ending in a spine; opercle with 4 spinous points, the

lowermost directed downward and forward, the others radiating downward and backward. Branchiostegal membranes broadly united, free from the isthmus. Longest dorsal spine $3\frac{1}{3}$ to 4 in head; base of spinous dorsal $1\frac{9}{10}$ to $1\frac{1}{2}$ in head; of soft dorsal $2\frac{2}{3}$ to 3 in length of head and body; length of base of anal $2\frac{9}{10}$ in head and body; caudal slightly emarginate, $2\frac{1}{10}$ in head. Head and upper part of body densely covered with very fine prickles, much finer than in *Triglops scepticus;* lower side of head, the maxillaries, and a narrow strip along the lower side of cheek naked; the usual series of enlarged prickles along the base of dorsals; lateral folds few in number, scarcely exceeding the scutes of the lateral line; they leave a wide, naked strip along the base of anal and do not encircle the caudal peduncle below; breast with 5 or 6 cross folds similar to those on the sides, the scales along margins of folds very small, those of successive folds widely separated, not overlapping as in *Triglops scepticus.* Color light olive brown above, whitish on lower parts of sides and below; the breast and belly, including area in front of pectorals, silvery; back crossed with 4 saddle-shaped black blotches, most distinct in the males; the

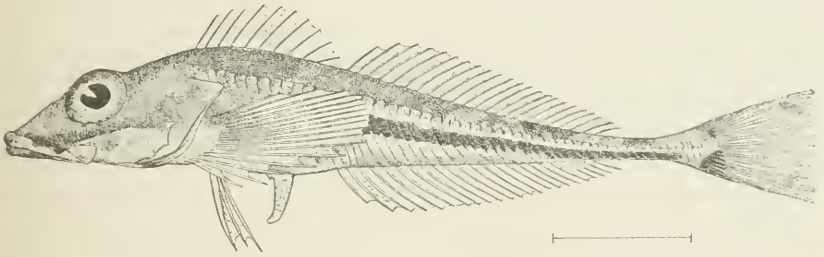


FIG. 8.—TRIGLOPS BEANI.

first of these under the middle of the spinous dorsal and extending obliquely forward to the upper axil of pectorals, the second and third under the soft dorsal, narrowing rapidly downward to lateral line, the fourth on the back of caudal peduncle. In males, the lower ends of these cross bars are connected by a narrow lengthwise jet-black streak, extending from shoulder below lateral line nearly to base of caudal, the narrow interval between this streak and lateral line occupied by a bright silvery streak, interrupted by the crossbars; a black blotch at base of upper and one at base of lower caudal rays; a small black spot near tips of the outer caudal rays, the fin otherwise unmarked; an indistinct, dusky blotch below the eye, and a dusky streak along under side of suborbital stay, extending forward along the margin of the preorbital to tip of snout; a blotch on middle of maxillary and upper lip; front of lower lip dusky; a dark blotch on opercle, and a dusky bar on branchiostegal membranes. In the females the general pattern of coloration is the same, but the darker markings are less distinct, and the black lateral streak of the males is represented

by a disconnected series of irregular, dark blotches and vermiculations. In both sexes the dorsals and pectorals are crossed by narrow, dusky bars, formed by series of dark streaks on the rays; mouth whitish, gill cavity silvery white, with the exception of the lining of the opercle and the outer half of branchiostegal membranes, which are dusky. This is the Pacific representative of the Atlantic *Triglops pingeli*, from which it differs in the greater slenderness of the body, particularly of the caudal peduncle, in the somewhat smaller eye, the more pointed snout, the less fine subdivision of the lateral folds, the less complete investment of the fins with prickly scales, and, above all, in the peculiar coloration of the male. (Gilbert.) Alaska to Puget Sound and the Kurils, taken very abundantly by the U. S. Fish Commission steamer *Albatross* at stations located both north and south of the Aleutian Islands and in Bristol Bay; also from about St. Paul Island in 24 to 37 fathoms, off Karluk in 31 fathoms, and off Robben Island in 18 fathoms, and by the present writers in Puget Sound and the Gulf of Georgia, the depths ranging from 10½ to 42 fathoms; specimens 82 to 140 mm. in length also taken in Plover Bay, Siberia.

(Named for Dr. Tarleton Hoffman Bean.)

10. PRIONISTIUS (Bean).

Prionistius Bean, Proc. U. S. Nat. Mus., 1883, p. 355 (*macellus*).

This genus is nearly related to *Triglops*, from which it differs in the absence of a series of enlarged scutes along each side of base of dorsal fins, in the elongation of the body, in the dorsal and anal fins, and in the emarginate caudal fin. Preopercular spines 4, the lower 3 developed as thin, flat lobes. It agrees with *Triglops* and *Elanura* in all other important structural details, including the exserted, more or less produced lower pectoral rays. Alaska.

(πρίων, saw; ἱστίον, dorsal fin.)

10. PRIONISTIUS JORDANI Schmidt.

Elanura jordani Schmidt, MS.; Peter the Great Bay, Vladivostok, Aniva Bay, Sagkalin.

Head 3½ in length to base of caudal; depth 6. Dorsal IX–27; anal 27; lateral plates 49. Eye 3½ in head; snout 3½; interorbital space 7¼; maxillary 2½. Body deepest at base of ventrals, tapering evenly backward to a slender caudal peduncle; very slightly deeper than wide behind base of pectorals and for a short distance behind their tips, as wide as deep posteriorly. Maxillary reaching a very little past anterior border of pupil. Jaws even. Teeth very fine, in narrow bands on jaws, in a narrower band on vomer; none on palatines. Interorbital space slightly concave. Nasal spines very small, but sharp. Edge of preopercle with 3 spines, none of them enlarged; the upper one

inclined a little upward, the next downward and a trifle backward, the next downward and a little forward, the lowest hooked nearly straight forward. Top and sides of head and back above lateral plates with a fine, shagreen-like covering. Maxillaries, mandible, interopercle, branchiostegal region, and a space in front of pectorals, naked. Breast with about 5 rough cross folds. Lateral plates finely toothed posteriorly. Sides below lateral plates with oblique folds, which are roughened on their posterior edges.

Pectoral with 19 rays; the fifth ray from the top the longest; its tip reaches to above the base of the fifth anal ray. Anal beginning and ending a little behind the soft dorsal. The third dorsal spine the longest, equal to the length of snout and half eye. Longest soft dorsal rays a trifle longer than orbit. Dorsals separated by a space equal to a third of eye. Dorsal spine scarcely serrulate. Ventral with a spine

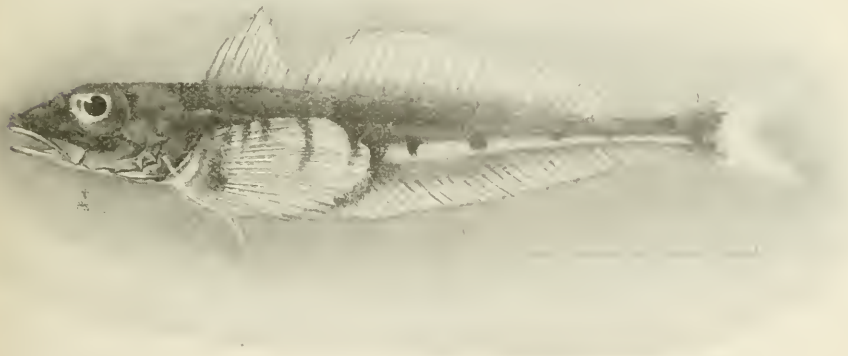


FIG. 9.—PRIONISTIUS JORDANI.

and 3 soft rays; the inner ray the longest, reaching to midway between vent and front of anal. The caudal of our specimen is broken.

Color gray on back, white on lower parts; the indistinct beginnings of 4 or 5 cross bands on back; sides below lateral line, with several irregular, large, dark spots; some indistinct dark bands across upper part of pectoral; ventrals and anal white.

Here described from a cotype, a specimen 70 mm. in length (No. 7704, Leland Stanford Junior University), collected by Peter Schmidt at Vladivostok, and sent by him to the writers, with permission to include the species in the present paper. It was also taken in Aniva Bay, Sagkalin.

This species is between *Elanura forficata* and *Prionistius macellus*, differing from the former in the absence of enlarged tubercles on back at base of dorsal fin, from the latter in having cross folds on breast in front of base of ventrals; the head and body not so rough; no multifid

prickles on head. In a recent letter, Dr. Schmidt refers the species to *Priomistius* and doubts its distinction from *P. macellus*. The latter species is more slender, more rough, and lacks the cross-folds on the breast.

(Named for David Starr Jordan, president of Leland Stanford Junior University.)

11. HEMILEPIDOTUS Cuvier.

Hemilepidotus Cuvier, Règne Anim., 2d ed., II, 1829, p. 165 (*hemilepidotus*).
Temnistius Richardson, Fauna Bor.-Amer., III, 1836, p. 59 (*ventricosus*).

Body with 2 broad bands of rough, scale-like plates on each side, 1 along the side of the back, 1 along the lateral line, the upper bands meeting anteriorly in front of dorsal; scales roundish, their upper and posterior margins free; skin otherwise naked, the naked skin thick and firm; head naked. Villiform teeth on jaws, vomer, and palatines. Top of head rugose, the ridges low, without spines, no spines on supraorbital rim. Branchiostegals 6. A small slit behind fourth gill; gill membranes joined to the isthmus anteriorly but forming a rather broad fold across it; preopercular spines simple, strong. Dorsal fins connected, the first long, with strong spines, emarginate, the first 3 spines shorter than those which follow; ventrals I, 4. North Pacific, in shallow water.

(ἥμι, half; λεπιδωτός, scaled.)

11. HEMILEPIDOTUS GILBERTI Jordan and Starks, new species.

Cottus trachurus Pallas, Zoogr. Rosso-Asiat., III, 1811, p 138 (larger specimen brought from the Kuriles by Joseph Billings, not type, which is spotted underneath, and came from "shores of America").

Head $2\frac{5}{6}$ in length without caudal; depth $3\frac{4}{5}$. Dorsal III, VIII–22 or 23; anal 19. Band of scales on back in 4 transverse series, in 77 longitudinal series. Eye $3\frac{1}{2}$ in head; maxillary $2\frac{1}{3}$; snout 4; interorbital $5\frac{1}{2}$.

Body rapidly tapering and very slender posteriorly. Anterior profile from first dorsal spine to eyes straight; superorbital rim produced; a notch between eyes and produced premaxillary processes; profile in front of nasal spines straight and steep to tip of snout. Mouth rather large, very little oblique, the maxillary reaching to posterior rim of pupil; lower jaw included. Teeth in very wide bands on jaws, palatines, and vomer; wider at front of jaws than at sides; wider on premaxillaries than mandible; about as wide on palatines as on front of mandible. Interorbital rather deeply concave, a pair of parallel ridges at the middle with a channel between them; width of interorbital space, two-thirds of eye. Nasal spines rather long and sharp. Edge of preorbital with 4 spines; the two upper ones the largest, about equal in length; the upper one directed upward and backward; the

next below backward and slightly upward; the next very much smaller, directed backward, a wider space between it and the next than between the others; the next is hooked forward. Opercle with a flat spine at the end of a ridge. Two spines on edge of subopercle, the upper one behind and just above the next to the top preopercular spine; the lower one at union of subopercle with interopercle. A sharp spine on clavicle projecting just below opercular flap; a shorter blunter one on posttemporal just above opercular flap. A long, thin flap on end of maxillary; a short one on upper posterior margin of eye; a very small one at nape.

Distance of first dorsal spine from tip of snout equal to eye and postorbital part of head; the first spine $2\frac{3}{4}$ in head; the third 4; the fourth $2\frac{4}{5}$; the last and next to the last $5\frac{1}{2}$. The soft dorsal higher than the spinous, the third ray $2\frac{1}{5}$ in head; the rays hold their length

FIG. 10.—HEMILEPIDOTUS GILBERTI.

with but little decrease to the sixth from the last where they abruptly and rapidly decrease, the sixth from the last projecting past the tips of the others in the reclined fin. Pectoral reaching to opposite base of second or third anal ray; it has 17 rays, the fifth from the top the longest, $1\frac{1}{3}$ in head. Ventrals nearly reaching vent; the rays I, 4. Anal rays slender, the membrane rather deeply incised; the fourth ray 3 in head. Caudal truncate or slightly rounded, its length $1\frac{3}{5}$ in head.

Color in spirits slightly dusky above, white below, crossed by blackish bars, irregular in shape but the same shape in both of our specimens; head dusky between darker spots; tip of snout dark; a light streak behind, a dark blotch below eye; a dark spot on first 2 dorsal spines, a dark cross-bar under second, third and fourth spines

of second portion of dorsal, running up on fin and spreading out, occupying greater portion of second part of dorsal, below it runs down to behind pectoral base; a spot under front of soft dorsal running down to lateral line where it is widely forked; the forks slender and running to lower part of sides; the next bar under middle of soft dorsal, running up on fin, the next under last part of soft dorsal, widely forked below, the posterior fork running across caudal peduncle and meeting its fellow of the opposite side below; the light interspaces continued on spines to their tips, on soft rays on basal third or fourth; a black bar across base of caudal followed by a wider white bar; a slightly narrower black bar just behind middle of caudal, then a very narrow white bar, then a very narrow dark bar, and the tips of the rays white; anal crossed obliquely by 2 or 3 dusky bars; pectoral dusky; tips of rays lighter and a lighter bar across middle of rays; ventrals white.

The following note was taken from this specimen when it was fresh:

Clear light olive green; mottled with white and dusky, becoming abruptly pinkish white below; bars dusky olive above, dusky red below; greenish below eye; lower side of head pearly; fins all faintly washed with pinkish red; the pectoral pink, whitish and blackish; ventral plain white, very faintly shaded.

The above description is from the type, a female. A cotype, a male, shows the following differences: First dorsal spine $2\frac{1}{5}$ in head; the third $3\frac{1}{10}$; ventrals very long, reaching past tip of pectoral to fifth or sixth anal ray. The interspaces between bars are white and the bars are darker; the head is white except at dark spots as described for the female; the ventrals regularly and conspicuously spotted with black on the rays, each ray with 9 or 10 black spots equal in size to the interspaces; a very few scattered dusky spots on belly; the dusky on pectoral broken up into 4 or 5 inconspicuous bars across rays.

The following note was taken from this specimen when fresh:

Light translucent olive tinged with violet; head tinged with purplish; lips with yellowish; black spot below eye with golden green spots around it; lower side of head pink; bars on side reddish brown; dorsal mottled, orange, black, and whitish; caudal flesh color barred with dark red; pectoral scarlet orange and whitish; ventrals yellow, spotted with black.

This species differs from *Hemilepidotus jordani* chiefly in having a larger eye (which is much longer than snout), a blunter snout, and in being smoother on sides of head and somewhat differently colored.

The type is a female from Hakodate, 235 mm. in length, and is numbered 7446, Ichthyological Collections, Leland Stanford Junior University Museum. A cotype is No. 50916, U.S.N.M. The specimen from the Kuriles, mentioned by Pallas, apparently belongs to this species, which is readily distinguished from the two species found in Bering Sea, *Hemilepidotus hemilepidotus* and *H. jordani*, by the immaculate belly, greater number of dorsal rays, and large eye.

(Named for Charles Henry Gilbert.)

12. ENOPHRYS Swainson.

Enophrys Swainson, Class'n Fishes, II, 1839, p. 271 (*claviger*).

Body short and thick, depressed anteriorly. Head very large, mailed above with rugose, bony plates; a series of large, rough, bony plates along lateral line, each with a serrated keel or spine; no scales. Teeth in villiform bands in jaws and on vomer, none on palatines; preopercle with a strong, straight spine which reaches beyond front of dorsal; suborbital stay broad, externally bony; gill membranes joined to the isthmus, not forming a fold across it; a slit behind fourth gill. Dorsal fins separate, the anterior short, not notched; anal short. Intestinal canal elongate. Herbivorous, feeding chiefly on algæ. North Pacific.

(ἐν, on; ὀφρύς, eyebrow.)

12. ENOPHRYS CLAVIGER (Cuvier and Valenciennes).

Cottus claviger Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 195; Kamchatka (Coll. M. Collée).—Günther, Cat., II, 167.

Cottus elegans Gray, in Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 195; same type.

Enophrys claviger Jordan and Gilbert, Synopsis, 1883, p. 711.—Gilbert, Rept. U. S. Fish Comm., 1893 (1896), p. 426.—Jordan and Gilbert, Rep. Fur Seal Comm., III, 1898, p. 458, pl. LV; Robben Island.—Jordan and Evermann, Fish N. and M. Am., II, 1898, p. 1938; Bristol Bay.

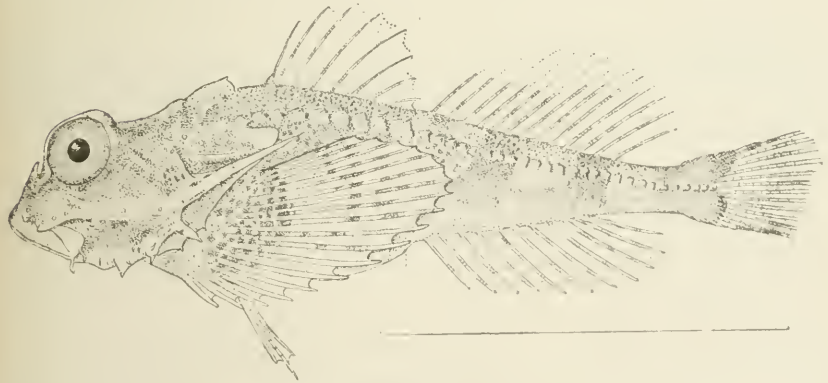


Fig. 11.—Enophrys claviger.

Head $2\frac{2}{3}$; depth $3\frac{3}{5}$; D. VIII–14; A. 12; P. 16; lateral line with 35 plates. Preorbital with 2 strong spinous projections, which overlap the premaxillary in closed mouth. Interorbital space deeply channeled, the orbital rim raised posteriorly into a blunt spinous tubercle. A small, spinous, occipital tubercle, behind which rises a high, sharp nuchal ridge, which is highest posteriorly and has its upper edge finely toothed. No cirri on top of head. Upper preopercular spine long, simple, reaching beyond head to fourth or fifth plate of lateral line;

below it 3 short, strong spines, the lowermost directed downward and forward; outer surface of the upper spine with 3 or 4 low, finely serrated ridges, its inner edge smooth, without accessory cusps or spinules; opercular ridge high, serrate; 2 sharp spines on anterior angle of subopercle; top and sides of head rough, with minute spinous points; preopercle and lower jaw with numerous short filaments, a longer one on end of maxillary. Body entirely covered with minute prickles, which invest also the abdominal region; those above lateral line longest and most thickly placed; lateral line with a series of plates similar to those in *E. bison*, each surmounted by a sharp spine; lateral line with 2 curves, approaching back most nearly at end of spinous and at end of soft dorsal; many conspicuous white filaments scattered over sides below lateral line. Dorsals entirely separate, the free interspace as wide as pupil. Eye larger than interorbital width $4\frac{3}{4}$ in head. Dusky above, with faint, darker crossbars; light below; 2 black blotches on cheek; some faint dusky V-shaped prolongations of the coloration of the back down toward base of anal fin; fins indistinctly cross-banded; a dark area at base of pectoral, a narrow oblique dusky crossbar on base of caudal fin. Here described from a specimen taken at Robben Island, 151 mm. long. Known also from Bristol Bay, Alaska, and from Kamchatka.

(*clavis*, key; *gero*, I bear.)

13. CERATOCOTTUS Gill.

Ceratocottus Gill, Proc. Ac. Nat. Sci. Phila., 1859, p. 165 (*diceraus*).

This genus is very close to *Enophrys*, from which it differs in having the long preopercular spine armed above with recurved hooks or antler-like processes. Bering Sea.

(κέρας, horn; *Cottus*.)

a. Interorbital width 7 in head, much narrower than distance between parietal ridges; eye $1\frac{3}{5}$ in superior postorbital part of head ..... *diceraus*, 13.

aa. Interorbital width 4 in head, as wide as distance between parietal ridges; eye $1\frac{1}{5}$ in superior postorbital part of head ..... *namiyei*, 14.

13. CERATOCOTTUS DICERAUS (Pallas).

Cottus diceraus Pallas, Nov. Act. Petropol., 1783, p. 354, pl. x, fig. 7; Petropaulski, Kamchatka (Coll. Steller).—Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 189.—Günther, Cat., II, p. 189.

Ceratocottus diceraus Gill, Proc. Ac. Nat. Sci. Phila., 1859, p. 165; 1861, p. 167.—Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, 1898, p. 458, pl. lvi; Robben I., Petropaulsky, Bering I.—Jordan and Evermann, Fish. N. and M. Amer., 1898, p. 1940; Herendeen Bay, Robben Island.

Enophrys diceraus Jordan and Gilbert, Synopsis, 1883, p. 711.—Gilbert, Rept. U. S. Fish Comm., 1893 (1896), p. 426.

Synanceia cervus Tilesius, Mém. Ac. Petersb., III, 1811, p. 278, pl. xiii; Petropaulski. (Coll. Steller.)

Cottus stelleri Bloch and Schneider, Syst. Ichth., 1801, p. 63; after Steller

D. VII-14; A. 10; C. 12; P. 17; V. I, 3. The head large, wider than deep or long; the ridges higher and very rough; orbital ridges elevated, continued backward toward the nape, the occipital ridges sharp behind; upper preopercular spine very long, rough, nearly two-thirds as long as head, reaching middle of spinous dorsal, with 6 or 7 strong recurved hooks or serrations on the upper edge; lower preopercular spines strong; opercle with a longitudinal rib and no distinct spine; lateral line with a row of rough, bony scutella, each with a minute central spine; skin on sides, more or less villous or prickly, with numerous fleshy slips, elsewhere smooth. Isthmus wide; a slit behind last gill; vomer with teeth; anal papilla very large. Bering

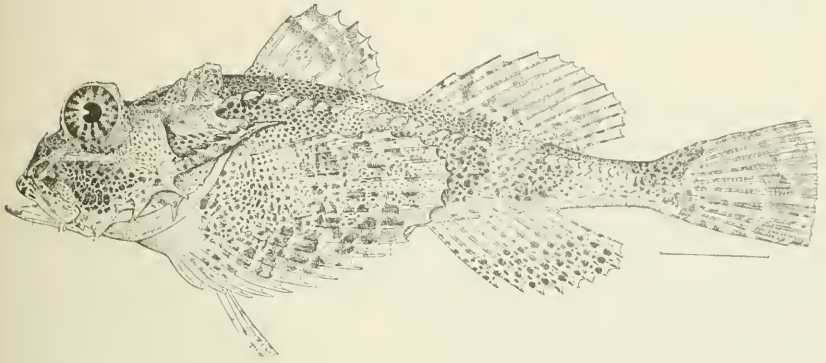


FIG. 12.—CERATOCOTTUS DICERAUS.

Sea, rather common from Alaska to Kamchatka and Saghalin. One specimen examined by us from Robben Island. It has been also taken by Dr. Schmidt off Pestschuzoff, coast of Korea.

(δις, two; κεραύς, horned.)

14. CERATOCOTTUS NAMIYEI Jordan and Starks.

Head $2\frac{1}{2}$ in length without caudal; depth $3\frac{3}{4}$; dorsal VII-13; anal 11, eye 5 in head; interorbital 4; maxillary $2\frac{4}{5}$; snout 4.

Profile of head very uneven; the parietal spines are produced, leaving a deep notch between them and first dorsal spine; the profile is thence straight and sloping to the greatly produced superorbital rims; in front of eye is a notch formed by nasal spines and produced premaxillary processes, in front of which snout is steep and straight. Lower jaw projecting; mouth large and little oblique, the maxillary reaching to posterior margin of pupil. Teeth rather coarse, villiform, in broad bands on jaw and vomer, palatines toothless. Interorbital broad and deeply concave; no ridges along its middle; its width a little greater than distance between parietal ridges, nearly equal to post-orbital part of cranium in a median line on top, greater than length of snout measured straight on a median line, and equal to snout measur-

ing the chord of its curve from union of premaxillaries to front of eye. Nasal, preorbital, and suborbitals, rough surface bones; the nasals ending in a prominent, wide, rather sharp spine. Preorbital with 2 blunt spines on its lower edge; suborbital stay expanded on cheek to a wide, long plate, but growing narrow and sharp behind. Preopercle spine long, reaching a little past opercle flap, measured along lower edge from notch with spine below its length is $2\frac{1}{2}$ in head; above it is armed with 6 or 7 prominent irregular spines; preopercle below armed with 3 spines; the lowest slightly the longest, the top one at base of long spine and pointing straight back; the next pointing downward and slightly backward, its position midway between the others, the lowest directed obliquely downward and forward. Opercle with a prominent rough ridge ending behind in a blunt spine; subopercle

FIG. 13.—CERATOCOTTUS NAMIYEI.

with 2 small, sharp, slender spines; the upper one on a level with top of pectoral, directed downward and backward; the lower one directed downward. Superior postorbital part of head anteriorly depressed below surface of interorbital region, leaving a transverse ridge behind eyes; nape similarly depressed, leaving a transverse ridge at occiput; the depressed postorbital area bounded laterally by straight, rough parietal ridges which end behind in rough, blunt, but very prominent spines. Two small tentacles at under part of side of mandible, and a similar one at symphysis; 3 at end of maxillary. A patch of scattered, small, acute spines on the skin under pectoral, and a lateral row of 32 bony plates along side of back.

Pectoral extending to opposite front of anal or a little past; its posterior border very broadly rounded; it has 19 rays, the lower 10 or 11 swollen; its length is contained $1\frac{2}{5}$ in head. The distal fifth of ventrals extends over the median point between their base and front

of anal. Dorsal spines long and slender, the tips of the second and third crooked and extending far beyond membrane and other spines, the third spine reaches base of third dorsal ray when it is reclined. Fourth dorsal ray 2 in head; the fin high and rounded in outline; when reclined it reaches to within fourth-fifths of diameter of eye of the base of upper caudal rays. Anal very high, the sixth to ninth equal in length and equal to postorbital part of head and half eye; the first ray the shortest 2¾ in head. Caudal truncate or very slightly rounded. Intromittent organ very large; thick at the base, and as long as the anterior anal rays. Lower part of side above anal with many small filaments scattered over it.

Color, gray on back and head, profusely spotted with dark-brown spots of various sizes, larger anteriorly, becoming smaller and lighter posteriorly; the spots on head below suborbital stay larger and closer than elsewhere; back with 4 regular but not conspicuous crossbars; faint traces of one under last dorsal spines, broad, diffuse, and dusky under pectoral; more conspicuous one near each end of soft dorsal and across base of caudal; the dark color of back changes abruptly to white at middle of sides; entire underparts of body and head white; caudal with 2 broad, black bars containing 3 or 4 irregular white spots across rays; caudal bordered behind with white; the white interspace between bars is narrow, and there is a broader white space near base of rays; soft dorsal crossed with 5 vertical bars obliquely across the rays, the interspaces narrower than the bars, and white; fin bordered behind with white; spinous dorsal black, with 3 or 4 diffused spots; pectoral bordered with white, the basal half of the rays light, spotted and mottled with dusky, the posterior half black with blended white spots and streaks, the short lower swollen rays are white, the membrane between dead black; ventrals dusky; the anal is everywhere profusely spotted with small, light, grayish brown spots, crowded, but separated by fine white lines; the spots are composed of fine dark points; each ray is followed by a row of 7 or 8 more conspicuous spots more broadly outlined with white.

The type is a male from Nemuro in Hokkaido, and is about 245 millimeters in length. The single cotype from Soya, west coast of Hokkaido, is a dried specimen presented by Mr. Motokichi Namiye, then curator in the museum of the Imperial University of Tokyo.

The type is numbered 8107, Ichthyological Collection Leland Stanford Junior University Museum. The cotype is numbered 50917, U.S.N.M.

(Named for Motokichi Namiye.)

14. TRACHIDERMUS Heckel.

Trachidermus Heckel, Ann. Wiener Mus., II, 1840, p. 159 (*fasciatus*); not *Trachyderma*, the correct orthography, used by Latreille in 1929 for a genus of Coleoptera.

Centridermichthys Richardson, Voyage Sulphur, Fishes, 1846, p. 73 (*ansatus*).

This genus differs from *Cottus* chiefly in having a much depressed head bearing ridges covered by a moderately thick skin; 2 ridges on each side of top of head from behind eye, diverging backward; a ridge on opercle, and a prominent one on suborbital stay; spine at angle of preopercle very much hooked and having the gill membrane more narrowly connected to isthmus. It has teeth on jaws, vomer, and palatines; branchiostegals 6; no slit behind last gill arch; origin of anal behind middle of entire length, and skin usually with prickles; lower pectoral rays simple. Ventral rays I, 4. Mountain streams of southern Japan, China, and the Philippines.

(τραχύς, rough; δέρμα, skin.)

15. TRACHIDERMUS ANSATUS (Richardson.)

YAMA-NO KAMI (MOUNTAIN WITCH); AYUKAKE.

??*Trachidermus fasciatus* Heckel, Ann. Wiener Mus., II, 1840, p. 160, pl. IX, figs. 1, 2; Philippines.

??*Centridermichthys fasciatus* Günther, Cat. Fish., II, 1860, p. 170, copied.—Isuikawa, Prel. Cat., 1897, p. 48; Kii, Shikoku, Tokushima.

Cottus uncinatus Schlegel, Fauna Japonica, Poiss., 1843, p. 38; "Mers du Japon" probably from Chikugo River, northeast of Nagasaki (not *Cottus uncinatus* of Reinhardt, 1833, a species of *Icelus*.)

Centridermichthys ansatus Richardson, Voyage of Sulphur, Fishes, 1844, p. 74, pl. LIV, figs. 6–10; Woo Sung, mouth of the Yangtze.

Head $2\frac{1}{2}$ to $2\frac{3}{5}$ in length without caudal; depth $5\frac{1}{2}$; dorsal VIII–18 or 19; anal 15 to 18;[a] eye $5\frac{1}{3}$ to $5\frac{1}{2}$ in head; interorbital width $6\frac{1}{2}$ to 7; maxillary $2\frac{1}{6}$.

Head and anterior part of body depressed; the head is nearly twice as wide as deep. Teeth in moderate bands on mandible, vomer, and sides of premaxillary, becoming wide on front of premaxillary; in a narrow line pointed at each end on palatines. Lower jaw included; maxillary reaching to posterior margin of eye. Interorbital rather wide, concave, and without ridges, continuous with a wide concave area on top of head between ridge from eyes, superorbital rim very much widened posteriorly. From each eye a pair of ridges run backward which are covered by moderately thick skin; the inner ridge diverges from the outer one toward its fellow of the opposite side and, in specimens 8 cm. and under in length, ends in a small blunt spine at

[a] Fin formulæ of 32 specimens: 22 specimens have 19 dorsal rays; 10 specimens have 18 dorsal rays; 20 specimens have 17 anal rays; 11 specimens have 18 anal rays; 1 specimen has 15 anal rays.

each side of occiput; in larger ones it becomes lower at the end and is not even angulated; the outer ridge runs along pterotic region and ends without a spine. Opercle with a rather strong ridge, and a strong wide ridge runs along the suborbital stay and ends at the upper preopercle spine. Nasal spines scarcely developed, not projecting through the skin. Preopercle with 4 spines; the upper larger than the others and very strongly hooked; the 2 next below rather blunt and directed downward and backward, the lowest one hooked forward. Body of the smaller specimens closely covered with small rough prickles, the head with a few smooth papillæ; in large specimens the prickles are more scattered and not nearly so rough.

Origin of anal under fifth dorsal ray, or midway between tip of caudal and middle of eye. Pectoral reaches to front of anal; it has 18

FIG. 14.—TRACHIDERMUS ANSATUS.

rays, the lower 10 simple, the upper ones divided once; the fifth ray and 3 below are the longest, 1½ in head. Ventrals with one concealed spine and 4 rays; their tips reach half way from their base to front of anal. Origin of spinous dorsal a little in front of tip of opercular flap, its base 1⅘ to 2 in head, its longest spines three-fourths of length of longest soft rays; the soft rays behind the third or fourth are subequal in length to within a like number from the posterior end. Caudal somewhat rounded; its length 2⅓ in head.

Color grayish brown on back, white below, back and sides crossed by 5 slightly oblique crossbars similar in position to those on *Cottus kazika* and *Cottus pollux;* a conspicuous black bar running forward from each eye to tip of snout, involving tip of mandible; another bar running from eye obliquely backward and downward across cheek; a similar bar connecting eyes across interorbital space. Ventrals and anal white; other fins with irregular cross lines, formed by light-brown spots on rays; a dark spot on base of pectoral and first 3 or 4 spines

of dorsal with a large black spot. All of these markings, but especially the crossbars, more conspicuous in the young.

The following color note was taken from a fresh specimen: A vertical bar of deep scarlet with yellow dashes on the skin under preopercle partly covered by that bone, this bar extending on upper branchiostegal rays. Fins and body light and dark olive.

Numerous specimens of this species taken in the Chikugo River at Kurume, the largest 125 mm. in entire length. It is said to be abundant in mountain streams of Kiusiu in company with *Bryttosus kawamebari*. The long description of *Centridermichtys ansatus* by Richardson, from the Yangtze seems to agree closely with our specimens. Its bright scarlet head markings are very conspicuous in life. *Trachidermus fasciatus* Hechel, from the Philippines, seems to be closely related, but is probably not the same fish.

The specimen here figured has a smaller number of anal rays than usual.

(*ansatus*, jug-handled, from the curved, preopercular spine.)

13. COTTUS (Artedi) Linnæus.

Cottus Artedi, Genera Piscium, 1738, p. 49.
Cottus Linnæus, Syst. Nat., X, 1758, p. 264 (*gobio*).
Pegedictis Rafinesque, Ichth. Ohiensis, 1820, p. 85 (*ictalops*).
Cottopsis Girard, Proc. Bost. Soc. Nat. Hist., III, 1850, p. 303 (*asper*).
Potamocottus Gill, Proc. Bost. Soc. Nat. Hist., VIII, 1861, p. 40 (*punctulatus*).
Tauridea Jordan and Rice, Man Vert. E. U. S., 2d Ed., 1875, p. 255 (*ricei*).

Fresh water sculpins. Body fusiform. Head feebly armed; skin smooth or more or less velvety, its prickles, if present, not bony or scale-like; villiform teeth on jaws and vomer, and sometimes on palatines. Gill openings separated by a wide isthmus, over which the membranes do not form a fold; no slit behind fourth gill. Branchiostegals 6; suborbital stay flat, without a ridge, no ridges on opercle. Dorsals nearly or quite separate, the first of 6 to 9 slender spines; ventrals moderate, each with a short concealed spine and 4 soft rays; pectoral rays usually all simple, lower ones always so. Lateral line present usually more or less chain-like, sometimes incomplete. Preopercle with a simple spine at its angle which is usually curved upward, its base more or less covered by skin, very rarely obsolete; usually 2 or 3 spines turned downward below this; subopercle usually with a concave spine turned downward. Vertebræ 10+23=33; pyloric cæca about 4. Fishes of small size, inhabiting clear waters in the northern parts of Europe, Asia, and America. The species are extremely numerous, and are very difficult to distinguish, all being very similar in form, coloration, and habits. The Miller's Thumb, or Blob, in Japan called Kajika, is found in most streams and lakes where trout occur, and it is one of the most destructive enemies of the trout, devouring its eggs in great numbers.

(*Cottus;* κόττος, an old name of the European Miller's Thumb. *Cottus gobio*, Linnæus, from κόττα head).

a PEGEDICTIS. Preopercular spines 4; palatine teeth present, D. VIII–14 or 15; A, 13 or 14 ..... *kazika*, 16.

aa COTTUS. Preopercle with but one distinct spine; palatine teeth obsolete, D. VIII–16 to 18; A, 11 to 13 ..... *pollux*, 17.

16. COTTUS KAZIKA Jordan and Starks, new species.

Head $2\frac{2}{3}$ in length without caudal; depth $4\frac{3}{4}$. Dorsal VIII–14 to 16; anal 13 to 15; ventral I, 4. Pores of lateral line 28; eye $4\frac{2}{3}$ in head; interorbital (bone only) 8; maxillary $2\frac{1}{5}$; snout 4; height of caudal peduncle $4\frac{1}{2}$ to 5.

Body deepest at shoulders; head somewhat depressed, the snout narrow; a notch in profile at front of eyes. Mouth rather large; the maxillary reaching to below posterior margin of pupil; lower jaw included

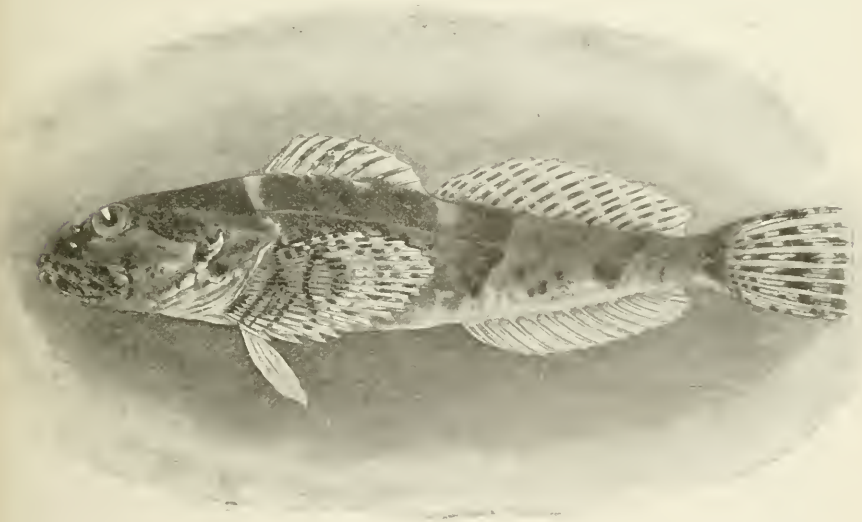


FIG. 15.—COTTUS KAZIKA.

or even with upper. Teeth in broad bands on jaws, vomer, and palatines; those on palatines in bands as wide as on vomer and equally conspicuous, somewhat coarser than those on jaws. Interorbital space concave and continuous behind with a broad shallow concave area on top of head, which is between low inconspicuous rounded parietal ridges. Nasal spine sharp; between them are the slightly produced processes from the premaxillaries. Edge of preopercle armed with 4 spines, all sharp, the upper one very strongly hooked upward, the next much smaller, pointing backward, the next hooked downward, and the lowest pointing forward. A small sharp spine on lower anterior end of subopercle directed forward.

Fin formulæ of 7 specimens: 5 specimens have 15 dorsal rays; 1 has 16; 1 has 14; 3 specimens have 14 anal rays; 2 have 13; 2 have 15. Longest dorsal spine 5 in head; longest soft ray 3; tips of last dorsal rays not nearly reaching base of caudal. Pectoral reaching a little past front of anal; it has 17 rays, the fifth to the eighth from the top the longest, $1\frac{2}{5}$ in head. The distal fourth or fifth of ventrals extends over the median point between their base and origin of anal. Origin of anal midway between tip of snout and distal sixth of caudal. Caudal truncated, its length $1\frac{3}{4}$ in head.

Body rough with small prickles; top of head appearing similar to body under a lens, but smooth to the touch.

Color brownish or slate color on back and head, under parts white; sides crossed with 4 conspicuous, black, oblique, cross bars extending downward and slightly forward; one not evident as the others under front of spinous dorsal; one under fifth to seventh dorsal rays, growing narrower below and nearly reaching front of anal; a narrower one under last dorsal rays, and one across base of caudal; the rays of pectoral, dorsals, and caudal with black spots forming irregular bars across fins; anal and ventrals white; lips with black spots; chin dusky. Small specimens show a white crescent on nape in front of dorsal, the bars more conspicuous, and the interspaces lighter, sometimes white immediately behind bars from dorsal to lower parts.

This species differs from *Uranidea reinii* (Hilgendorf) and *Uranidea dybowskii* (Hilgendorf) in having the ventral rays I, 4, in having 4 preopercular spines rather than 3, and in having teeth on the palate; from the former in having a large head, nasal spines developed, ventrals not nearly reaching to anal and much shorter soft dorsal; from the latter in having the height of head much less (5 to $5\frac{1}{2}$ rather than $3\frac{1}{2}$ in length, without caudal), in having fewer pores in lateral line and in color, the conspicuous cross bars not being described. Hilgendorf describes 7 anal rays for *U. dybowskii*, which number is doubtless a misprint. Four specimens taken in the streams at Niigata and at Tsuruga; the largest, the type, is 9 cm. in length, the smallest 6 cm.

The type is numbered 7705, Ichthyological Collections, Leland Stanford Junior University Museum, and is from Niigata, where it was obtained by Mr. Eitaro Iijima, a student in Stanford University. Cotypes are numbered 50918, U. S. N. M.

(*kajika*, the Japanese name of river sculpins.)

17. COTTUS POLLUX Günther.

KAJIKA.

Cottus pollux GÜNTHER, Ann. and Mag. Nat. Hist., 1873, p. 240; Otaru in Hokkaido (Ishikari River).—ISHIKAWA, Prel. Cat., 1897, p. 42; Tokazu River.
Cottus hilgendorfi STEINDACHNER and DÖDERLEIN, Beiträge zur Kennt. der Fische Japan's, III, 1884, p. 40; IV, pl. IV (near Tokyo, probably Tana R.).—ISHIKAWA, Prel. Cat., 1897, p. 48; Tsugaru, Uzen, Iwashiro, Shimotsuki, Chichibu, Yamashiro, Kai, Kamo R., Katsura R., Tokyo.

Head $3\frac{1}{4}$ to $3\frac{2}{5}$ in length without caudal; depth 5 to $5\frac{1}{2}$. D. VIII or IX–16 to 18; anal 11 to 13. Eye 5 in head; maxillary 2 to $2\frac{2}{5}$ in head; interorbital width $\frac{3}{5}$ of eye; bone only $\frac{1}{3}$ in eye.

Body slender and head rather small. Teeth in moderate bands on jaws, narrower on vomer; palatines toothless. Lower jaw included. Maxillary variable with size; in the smaller examples (10 cm. long) it does not reach past posterior margin of pupil; in the larger ones (14 cm. long) it reaches to posterior border of eye. Preopercle with but one small hooked spine, usually covered by the skin; subopercle with a very small spine at its anterior lower end. Interorbital concave; top of head evenly rounded.

Length of ventrals variable; in the largest examples they nearly always reach to or cover the vent; in the smaller ones they sometimes reach to vent or sometimes to end within a distance of vent equal to the diameter of the eye. Pectoral reaches to opposite front of anal, its length $1\frac{1}{6}$ or $1\frac{1}{4}$ in head. Dorsal spines slender, the longest two-thirds or three-fourths of the longest soft rays. Longest anal rays 2 in head. Caudal slightly rounded; its length $1\frac{1}{2}$ in head. Skin everywhere perfectly smooth.

Color grayish or brown above, lighter or white below; back with 5 crossbars, the first under front of spinous dorsal, the next near posterior end of spinous dorsal, the others more conspicuous and longer, the middle one more oblique than the others, running from under the fourth to seventh dorsal rays, becoming narrower below and reaching obliquely forward to toward a point just in front of anal, the next bar under last dorsal rays and continued downward to light under parts, the fifth across base of caudal. Some specimens are uniform brown or gray above, shading rather suddenly but evenly to the lighter below; others especially the smaller ones are mottled with white and the line on lower parts between the light and the dark is much broken up and irregular, sometimes the back and the top of head plentifully sprinkled with small dark spots; the rays of the dorsals, pectoral, and caudal are spotted with dark, making irregular lines across fins; anal and ventrals usually white; sometimes on the large specimens there are a few spots on the anal rays and the tips of the ventrals are dusky.

Cottus hilgendorfi is certainly the same as *Cottus pollux*. The only

alleged difference is that the former is said to have D. VIII–17 (VIII–18, in figure), instead of IX–19, and that the ventrals reach to within an eye diameter of the vent. All these variations are represented among our specimens. Our very many specimens are from the Tana River at Tachikawa near Tokyo, from the Semida River at Tokyo, from the Kitakami River near Morioka, from the Kinu River at Utsonomiya, from Niigata in Echigo, from the river at Aomori, and from Kamashiro.

(*pollux*, a twin.)

The following are the fin formulæ and localities of our specimens:

	Tana River.				Kitakami River.			
Dorsal	VIII, 17	VIII, 18	IX, 17	IX, 18	IX, 17	IX, 17	IX, 16	VIII, 17
Anal	12	12	12	11	13	12	12	13

	Kitakami River.						Semida River.	
Dorsal	VIII, 18	IX, 17	VIII, 16	IX, 16	IX, 17	VIII, 17	IX, 17	IX, 18
Anal	13	12	12	12	12	13	12	13

	Aomori.				Niigata.		Kinu River, Utsonomiya.		Kamashiro.
Dorsal	IX, 17	IX, 18	IX, 17	IX, 17	IX, 18	IX, 19	VIII, 16	IX, 17	IX, 17
Anal	13	13	12	12	12	13	13	13	12

16. URANIDEA DeKay.

Uranidea DeKay, New York Fauna, Fishes, 1842, p. 61 (*quiescens=gracilis*).

This genus is very close to *Cottus*, from which it differs in the reduction of its ventrals to a concealed spine and 3 soft rays. The skin is smooth or very nearly so, the preopercular spine small, and there are usually no teeth on the palatines. Brook fishes, smaller in size than most of the species of *Cottus*, and with fewer ventral rays; the genus very doubtfully distinct. We refer to this genus, with some doubt, two Japanese species not represented in our collections.

(*οὐρανός*, sky; *εἶδον*, I looked, i. e., stargazer.)

a Head 3¼ in length; D. IX–17 to 20 ..... *reini*, 18.
aa Head 2½ in length; D. IX–14 ..... *dybowskii*, 19.

18. URANIDEA REINII (Hilgendorf).

Cottus reinii Hilgendorf, Sitzungsbericht der Gesellschaft naturforschender Freunde zu Berlin, 1879, p. 105; "Yeso and South Nippon."

Head 3½ in length, without caudal; depth of head 5⅓. Dorsal IX, 17 to 20; anal 13 to 15; pectoral 13 to 16; ventral 1, 3.

Vomer toothed. Skin of head with raised points; over the pectoral are fine prickles; no spines on snout. Preopercle with 3 spines, the upper one simple and curved, the two lower ones directed forward; subopercle with a covered spine on the lower anterior edge. Lateral

line complete. Front of anal somewhat farther from the tip of the snout than from the base of the caudal. Ventral reaches to anal. Spinous dorsal three-fourths as high as the soft dorsal. Gill membrane not continuous across isthmus. Diameter of eye somewhat less than length of snout, and somewhat greater than interorbital width. The maxillary reaches to somewhat behind the middle of the eye.

Color chocolate brown with darker spots and several irregular crossbars; fins with spots. Yeso and South Nippon; fresh water (Hilgendorf).

(Named for Professor Rein.)

19. URANIDEA DYBOWSKII (Hilgendorf).

Cottus dybowskii Hilgendorf, Sitz. der Gesell. natur. Freunde zu Berlin, 1879, p. 106; no locality named.

Head $2\frac{1}{2}$ in length, without caudal; depth of head $3\frac{1}{2}$. Dorsal IX–14; anal 7 (17?); pectoral 17; ventrals, 1, 2 (?); lateral line 37.

Vomer toothed. Nasal spines developed. Skin of head with papillæ; sides without prickles. Preopercle with 3 spines, the upper 2 directed backward; a smooth spine at the opercle, that on interopercle directed forward; supersecapular with a spine. Front of anal nearer to the base of caudal than to tip of snout. Ventral not reaching to anal. Diameter of eye equal to length of snout; wider than the interorbital. The maxillary nearly reaches to the posterior edge of eye.

Color dark brown marbled with white; underside white; ventral and anal with dark; dorsal, pectoral, and caudal with white bands; back with round light spots in color similar to that on belly. (Hilgendorf.) The locality of this species is not specified.

(Named for Professor Dybowsky.)

17. RHEOPRESBE Jordan and Starks.

Rheopresbe Jordan and Starks, new genus (*fujiyama*).

This genus differs from *Cottus* and *Trachidermus* in having the pectoral rays all branched; from *Cottus* in the flat depressed head with long postorbital portion; body not elevated anteriorly, and particularly in the backward position of the anal and vent, which are well behind the middle of the entire length; ventrals not nearly reaching halfway from their base to front of anal. It differs from *Trachidermus* in having the suborbital stay flat as in *Cottus*, the gill membranes widely joined to the isthmus, in not having ridges on top of head and in having top of head convex.

Rivers of Japan, a large fish similar to *Cottus* in habit, but well distinguished by the branched rays of the pectoral.

(ῥέω to flow swiftly; πρέσβη, first born, in allusion to the Japanese name Takitaroō, first born of the Cataract.)

20. RHEOPRESBE FUJIYAMÆ Jordan and Starks, new species.

TAKITAROŌ.[a]

Head 3 in length without caudal; depth 6. Dorsal VII–15; anal 14; eye $5\frac{1}{2}$ in head; interorbital space $5\frac{1}{2}$; maxillary $2\frac{1}{6}$.

Head and anterior part of body depressed, the body scarcely deeper than the head; upper profile of head very gently curved, nearly straight from dorsal to premaxillary processes, thence bluntly rounded to snout, jaws even. Mouth rather large; maxillary reaching to posterior margin of orbit; anterior end of premaxillary on a level with middle of eye. Teeth small cardiform; the band on mandible moderate and widened but little anteriorly; that on premaxillary narrow at the side, rather wide anteriorly; teeth on vomer and palatines similar to those on jaws, in bands as wide as at front of premaxillary. Interorbital space wide, concave, and without ridges; top of head nearly flat, very slightly convex. Nasal spines acute, but not sharp; not projecting through the skin. Preopercle spine sharp and

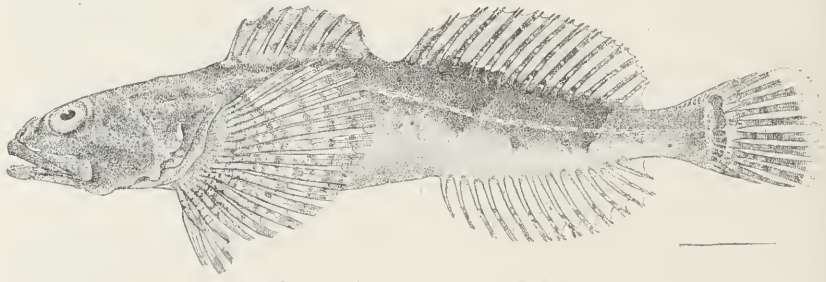


FIG. 16.—RHEOPRESBE FUJIYAMÆ.

strongly hooked; 3 blunt spines below it, not projecting through the skin, the lowest hooked forward. Snout very slightly longer than eye; postorbital part of head $1\frac{1}{2}$ times combined length of snout and eye. Skin everywhere smooth.

Pectoral rather broadly rounded behind, not reaching to opposite vent; it has 17 rays, all branched, the lower rays divided 3 or 4 times, the middle ones about 6 times; the fifth to seventh rays from the top the longest, $1\frac{2}{5}$ in head. Length of ventrals, $2\frac{1}{3}$ in length of head and $2\frac{1}{2}$ times in distance from their base to front of anal; they have one concealed spine and 4 rays. Origin of dorsal just behind a line drawn between tip of opercle flaps. Spinous dorsal low and rounded in outline, its second to fourth spines subequal in length, three-fifths of longest soft rays, which are equal to combined length of snout and eye. Dorsal and anal rays, except the first, 1 or 2 branched, their tips not divided over 2 or 3 times. Origin of anal midway between tips of caudal rays and middle of eye; anal ray from the fourth to within a couple of the last are subequal, their length $3\frac{1}{2}$ in head. Caudal slightly rounded, its length $2\frac{1}{4}$ in head.

[a] *Taki*, waterfall, *taroō*, firstborn.

Color, head and back dark brown, lighter on sides, belly white; a dark bar under the fourth to seventh dorsal ray running obliquely forward and downward toward front of anal; a similar one under last part of soft dorsal, and one across base of caudal; top of head mottled with small dark spots; lips dark brown, under parts of head dusky; dorsal spines dark brown, the membrane white, soiled with diffused dusky spots; the dorsal rays dark brown, with small light spots, causing light streaks obliquely across the rays, the membrane white. Caudal brown, with darker brown irregular cross streaks; anal white, each ray with 2 dark spots toward its tip; ventrals white.

Our single specimen was presented by Professor Mitsukuri. It bears a label in Japanese saying, "Locality unknown," and also a label in English stating that it came from Odawara, a town on Sagami Bay, near the foot of the famous sacred mountain of Fuji or Fujiyama. It also says that the vernacular name is "Takitaroō," first born of the cataract. It is a female full of spawn and is 21 cm. in length.

The type is numbered 7706, Ichthyological Collections, Leland Stanford Junior University Museum.

18. MYOXOCEPHALUS (Steller) Tilesius.

Myoxocephalus STELLER MS., 1741.
Myoxocephalus TILESIUS, Mém. Acad. Sci. Petersb., IV, 1811, p. 273 (*stelleri*).
Acanthocottus GIRARD, Proc. Bost. Soc. Nat. Hist., III, 1849, p. 185 (*groenlandicus*).
Cottus PUTNAM, Bull. Mus. Comp. Zool., I, 1863, p. 3 (*scorpius*), not of Linnæus.
Borcocottus GILL, Proc. Ac. Nat. Sci. Phila., 1859, p. 166 (*axillaris*).

Body slender or robust, subfusiform, covered with thick skin, in which are sometimes embedded prickly plates; deciduous, granular, or stellate tubercles also sometimes present, but no true scales. Head large. Mouth terminal, large, the lower jaw always included, the uppermost the longer; villiform teeth on the jaws and vomer, none on the palatines; suborbital stay strong; preopercle with 2 strong straight spines above directed backward, and 1 below directed downward and forward; opercle, nasal bones, orbital rim, and shoulder girdle more or less armed; gill membranes forming a fold across the rather narrow isthmus; slit behind last gill small or wanting, if present, reduced to a mere pore; vertebræ about 28. Branchiostegals mostly 6. Dorsal fins 2, separate, the first short, its spines rather slender; ventral rays I, 3; caudal fin moderate, fan-shaped; pectoral fin broad, its lower rays procurrent. Lateral line well developed, its tubes sometimes provided with bony or cartilaginous plates, never chain-like nor reduced to separated pores. Species numerous, in the seas of northern regions; coarse fishes, little valued as food.

Nearly all of the Japanese species differ from those from the north in the absence of rough bony plates, even in specimens 13 inches long.

(*μυοξός*, the dormouse; *κεφαλή*, head; the allusion not evident.)

a. Compressed tubercles or pointed spines over eye and at occiput; no filaments behind eye.

b. Anal rays 12; second preopercular spine moderate.....*polyacanthocephalus*, 21.

bb. Anal rays, 14; second preopercular spine very short, not one-fourth length of upper; anal fin usually plain; head very long and flat; body with round, rough plates above.....*jaok*, 22.

bbb. Anal rays, 13; second preopercular spine long, one-third or more length of upper; anal fin with 4 black crossbands; spines and ridges on top of head high and sharp; top of head sparsely covered with warts.....*edomius*, 23.

aaa. No spines or tubercles over eye or occiput; a pair of postorbital filaments; preopercular spines 3.

c. Ridges on head high and continuous; interorbital space and top of head deeply concave; lower parts with small white spots.....*nivosus*, 24.

cc. Ridges on head scarcely developed; interorbital space shallowly concave; top of head evenly rounded from side to side; chin and throat with black and white markings.....*ranimus*, 25.

21. MYOXOCEPHALUS POLYACANTHOCEPHALUS (Pallas).

Cottus polyacanthocephalus Pallas, Zoogr. Rosso-Asiat., III, 1811, p. 133; Aleutian Islands; no definite locality.—Günther, Cat., II, p. 166.—Jordan and Gilbert, Synopsis, 1883, p. 704.

Myoxocephalus polyacanthocephalus Jordan and Gilbert, U. S. Fur Seal Comm., III, p. 463, pl. lxiii; Unalaska, Robben I., St. Paul, Unga, etc.—Jordan and Evermann, Fish. N. and M. Amer., II, p. 1976.

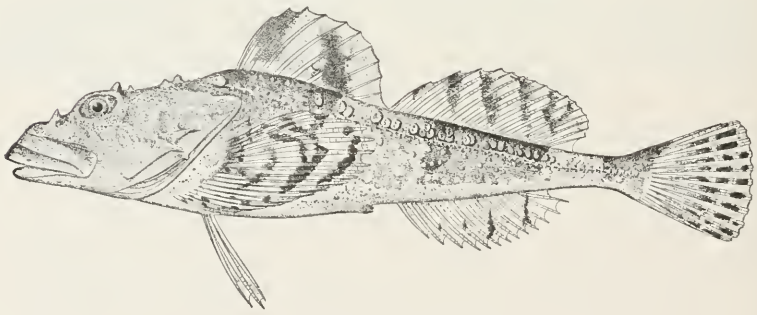


Fig. 17.—Myoxocephalus polyacanthocephalus.

Head $2\frac{1}{2}$ in length; depth $4\frac{1}{4}$; D. IX or X–13 to 16; A. 11 to 13. Body rather elongate. Head long and narrow, somewhat compressed, concave between the orbits, the orbital rim being elevated; lower jaw included; nasal spines strong; a strong ridge above eye, with a blunt, compressed spine behind it; behind this a small digitate cluster of ridges ending in low spines; behind these an irregular, broken ridge on each side of the vertex, extending to the occiput; outside of this another ragged ridge; suborbital stay strong, striate; upper preopercular spine very long, straight, simple, striate at base, longer than eye; a similar but shorter spine below it, not one-half as long, and the usual downward-directed spine at lower edge of preopercle and subopercle; opercular spine moderate. Skin of top of head thin, with

small, smooth warts, not hiding the occipital ridges; no cirri. Mouth rather large, the maxillary reaching beyond eye, one-half length of head; skin of body with some scattered, rough tubercles, usually nearly smooth. Dorsals not very high; dorsal spines slender; pectorals reaching anal; ventrals moderate, I, 3. A minute pore usually present behind last gill, this sometimes wholly wanting. Lateral line complete. Dark olive above, much variegated with darker and reddish; belly mostly whitish; sides and belly (in males) with numerous blackish reticulations surrounding large white spots; jaws dusky, mottled with whitish; membrane joining maxillary to preorbital black, with round white spots in the adult, more or less plain in the young; fins, all but the ventrals, mottled and barred with blackish and yellowish. Length 1½ to 2½ feet. Alaska to Kamchatka; abundant throughout Bering Sea, and southward along the islands to Puget Sound; one of the largest sculpins and everywhere familiar to fishermen. Recorded from Robben Island, Unalaska, Bristol Bay, Chignik Harbor, the Pribilof and Commander islands, and at Petropaulski.

(πολύς, many; ἄκανθα, spine; κεφαλή, head.)

22. MYOXOCEPHALUS JAOK (Cuvier and Valenciennes).

Cottus jaok Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 172; Kamchatka (Coll. Pallas; specimen in Mus. Berl. called *Cottus scorpius* by Pallas).—Günther, Cat., II, 1860, p. 165.—Jordan and Gilbert, Synopsis Fish. N. Amer., 1883, p. 705.

Myoxocephalus jaok Jordan and Gilbert, Rept. Fur Seal Comm. for 1896–97, 1899, p. 462; Petropaulski, Robben Island.—Jordan and Evermann, Fish N. and M. Amer., II, 1898, p. 1977.—Schofield, Rept. Fur Seal Comm., III, 1898, p. 499; Port Clarence; Grantley Harbor.

Cottus humilis Bean, Proc. U. S. Nat. Mus., IV, 1881, p. 149; Chamisso Island, Bering Straits (Coll. T. H. Bean); D. X, 16; A. 13.—Jordan and Gilbert, Synopsis Fish. N. Amer., 1883, p. 705; St. Michael, Eschscholtz Bay, Point Belcher.)

Cottus polyacanthocephalus Kner, Sitzb. Akad. Wiss. Wien, LVIII, 1868, p. 21, pl. IV, fig. 11; Decastris Bay; not of Pallas.

Cottus taeniopterus Bean and Bean, Proc. U. S. Nat. Mus., 1896, p. 384; not of Kner.

D. VIII to X–15 to 17; A. 13 to 15 (usually D. IX–16; A. 14). This species has a very slender body and an extremely wide, flat head, the latter strikingly triangular when viewed from above, on account of the regular way in which it tapers toward the snout. The species is further distinguished by possessing but 9 dorsal spines and by the presence in the adult of an irregular series of circular spinous plates above the lateral line, these plates wanting in very young individuals. They begin to make their appearance in specimens 6 inches long, and are invariably present in larger specimens. In adults, the region below the lateral line contains strong spinous prickles mostly concealed in the skin and directed backward. Some of the anterior ones

may be broader and may have more than one point, but none is circular with a rosette of short spinous points, as is the case with the dorsal series. Lower jaw included; top of head covered with small warts; scapular spine short and sharp; humeral spine obscure; upper preopercular spine very long, nearly as long as eye, low, sharp, 3 times length of next spine, not quite reaching tip of opercular spine. Occipital crests long, gently converging behind, suddenly diverging near their posterior ends. Distance from supraorbital to occipital tubercle 1½ times the distance between the 2 supraorbital tubercles (the 2 measurements about equal in *M. polyacanthocephalus*); 2 or 3 low digitate ridges behind supraocular spine; a sharp ethmoidal ridge extends backward from level of small spines to above front of pupil; mouth very large, the maxillary extending to posterior border of eye; the pore always present behind last gill arch; spinous dorsal low, the interval between dorsals unusually long; fins moderate; pectoral barely reaching anal; ventrals not to vent. Color olive grayish, mottled with darker, paler than in related species; back with 4 dark cross bands, made up of blackish spots; lower side of head and belly plain white; membrane of upper jaw unspotted; fins, all except the ventrals, with oblique dark bars, fainter than in most species. In the adult, the dark cross bands break up into sharply defined black spots, with vermiculating blotches and lines which closely cover the back. Length 12 to 18 inches. (Jordan and Gilbert.) Bering Sea, shallow water; everywhere common on both coasts, extending into the Arctic and south to the Amur River and Unalaska. Our specimens from Unalaska, Bristol Bay, Petropaulski, Robben Reef, Port Clarence, and Grantley Harbor; one of the most characteristic fishes of Bering Sea.

(*jaok*, the vernacular name in Kamchatka.)

23. MYOXOCEPHALUS EDOMIUS Jordan and Starks, new species.

Head 2½ in length, without caudal; depth 5⅔. Dorsal VIII or IX–14 to 16; anal 13. Lateral line 41. Eye 5⅔ in head; interobital 7⅕; snout 3⅗; maxillary 2⅕; upper preopercular spine 5; pectoral 1⅘; first dorsal spine 4⅕; third dorsal spine 3½; longest dorsal rays 2⅔; longest anal rays 3⅔; ventral 2½; caudal 2.

Head and anterior part of body depressed; body round posteriorly, nowhere compressed. Interorbital space uniformly concave, a very slight median ridge anteriorly. Mouth large; lower jaw included; maxillary reaching to under posterior orbital margin. Very small conical teeth in bands on jaws and vomer; the band on mandible not widened anteriorly; the vomerine patch rather strongly curved, the greatest width across is greater than the vertical diameter of eye, scarcely equal to horizontal diameter. Nasal spines strong Ridges on each side of vertex high and rather broken up, converging back-

ward and ending in strong backward-directed spines, which are higher than the ridges, though not so high as the ocular spines. Outside of this ridge is a shorter ragged ridge. The highest spines on top of head are the ocular spines, just over posterior fourth of orbit; they are much higher than in *M. polyacanthocephalus*. Digitate spines all directed backward, the anterior part of ridge behind eye forming one, inside of which there is a very small one, and outside 2 small ones. Post-temporal spine long and sharp, not reaching to end of opercular flap; humeral spine shorter, in a line with opercular spine. Operele with a strong ridge ending in a sharp spine. Lower anterior end of subopercle with a small but very acute spine directed backward and downward. Preopercular spine long, straight and strong, nearly reaching to edge of gill opening; the spine below it not half so long; the usual downward-directed spine at lower edge of preopercle, above which the edge of preopercle is straight and smooth without a trace of

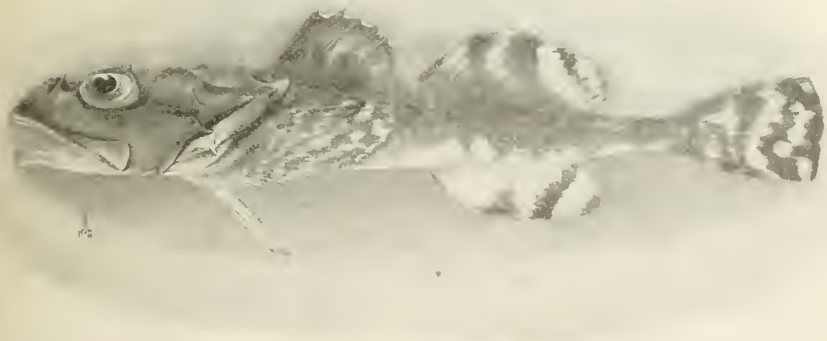


Fig. 18.—Myoxocephalus thomius.

a fourth spine. Suborbital stay keeled. Top of head sparsely covered with conspicuous warts, which do not at all obscure the spines or ridges. Skin entirely naked and with no trace of plates.

Depressed spinous dorsal just reaches to first dorsal ray. Soft dorsal highest anteriorly, the rays growing only slightly lower backward. Tips of last anal and dorsal rays on the same vertical. Pectorals rather broadly rounded, reaching to opposite front of soft dorsal. Ventrals reaching a little over half the distance from their base to front of anal. Caudal truncate.

Color light brown above, without bars or stripes; lower parts white; lower lip dusky, under part of head otherwise white; spinous dorsal with some dusky mottling in front and behind; soft dorsal dusky with transparent spots regularly placed indicating cross bars; caudal crossed with 2 or 3 rather wide, wavy dark bands; anal white, partly crossed by 4 black spots; ventrals white.

This species is nearest to *M. polyacanthocephalus* of Kamchatka and Alaska, but differs in color; in having much higher, sharper ridges and spines on top of head, a larger eye, and in the more scattered warts on head.

This description is taken from the type which was collected at the Aino village of Edomo, near Mororan. A single cotype was collected at Hakodate, No. 50919, U.S.N.M.

The type is 19 cm. in length and is numbered 7707, Ichthyological Collections, Leland Stanford Junior University Museum.

24. MYOXOCEPHALUS NIVOSUS (Herzenstein).

Cottus nivosus Herzenstein, Mélanges Biologiques du Bull. Acad. Imp. Sci. Petersb., XII, 1890, p. 113; St. Olga Bay.

Myxocephalus nivosus Jordan and Gilbert, Fish. Bering Sea, in Rept. Fur Seal Invest. for 1896–97, 1899, p. 461.—Jordan and Evermann, Fish. N. and M. Amer., II, 1898, p. 1984; Iturup Island.

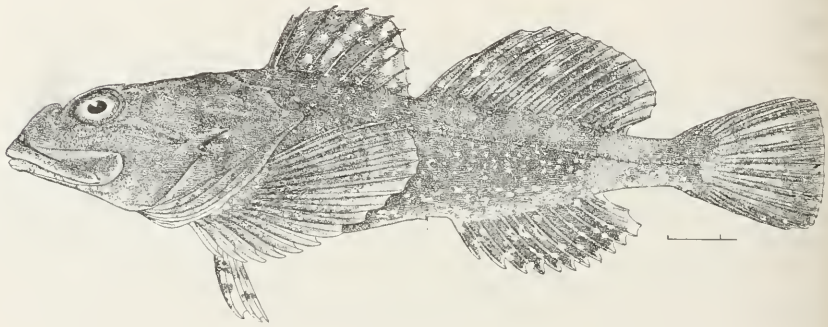


Fig. 19.—Myoxocephalus nivosus.

Head $2\frac{1}{4}$ in length without caudal; depth $4\frac{1}{3}$. Dorsal IX–15; anal 12; lateral line 36. Eye $5\frac{1}{2}$ in head; interorbital width 8; snout $4\frac{1}{3}$; maxillary $2\frac{1}{3}$; upper preopercular spine $7\frac{1}{2}$; pectoral $1\frac{2}{3}$; first dorsal spine $4\frac{2}{3}$; third dorsal spine 3; longest dorsal rays $2\frac{3}{5}$; longest anal rays $3\frac{1}{6}$; ventral $2\frac{1}{5}$; caudal 2.

Head long and comparatively narrow, not depressed; about as deep as wide; body a little compressed behind tip of pectoral. Postorbital part of head equal to twice length of snout and once vertical diameter of eye. Interorbital space wide and rather deeply concave. Maxillary reaching to posterior border of eye. Lower jaw included; a knob developed at symphysis. Teeth small, conical, in rather wide bands on jaw and vomer; the distance across vomerine patch equal to vertical diameter of eye. Nasal spines moderate, not very sharp. Ridges on each side of vertex continuous, slightly broken but without tubercles; they converge toward occiput. Top of head between ridges rather deeply concave. The usual ridges outside of these are low and short. There is no trace of a superorbital spine, of digitate spines behind eye, or of occipital spines. A pair of short, simple

filaments at occiput on angle of ridge, and a pair on outer edge of ridge a short distance behind eye. Preopercular spine very short; its tip not reaching over two-fifths of distance from its base to end of opercular flap; it is very slightly curved upward. The spine next below is not half as long; it points backward and slightly downward; the lower end of preopercle bears the usual forward-directed spine; the spine on subopercle is very small; opercular ridge rather low and rounded, ending in a spine. Posttemporal spine long and sharp, scarcely reaching to above tip of opercular spine. Humeral spine scarcely developed; completely covered by opercular flap. Suborbital stay low; not keeled. Top of head rather thickly covered with large warts; skin of body with very much scattered, fine spines, sometimes double, not at all of the nature of the rough, bony plates sometimes found in other species.

Tips of dorsal spines, when fin is depressed, reach to base of second or third dorsal ray. Soft dorsal moderately high; not at all connected with spinous dorsal; the last ray adnate to caudal peduncle; tips of last rays reach beyond those of anal. Pectoral broadly rounded, reaching to opposite front of soft dorsal. Ventrals reaching three-fifths of distance from their base to front of anal. Caudal slightly convex, either closed or open.

Color light brown above, white below; no crossbars or radiating lines about eye; branchiostegal region and under part of mandible very slightly dusky, mottled with round white spots; pectoral dusky, somewhat barred with white spots; dorsals irregularly mottled with light dusky; anal light dusky, obliquely crossed with faint light lines; caudal dark, crossed with very narrow faint white lines; ventrals white.

Our specimens of this species were collected by Messrs. Jordan and Snyder, at Same, Mororan, and Hakodate. A specimen was obtained in 1896 at Iturup Island by the U. S. Fish Commission steamer *Albatross*. Here described from a specimen from Same, 27 cm. in length.

Dr. Schmidt writes me that he regards this species as a color-variant of *Myoxocephalus brandti* (Steindachner), described from the mouth of the Amur.

(*nivosus*, snowy.)

25. MYOXOCEPHALUS RANINUS Jordan and Starks, new species.

GISUKAJIKA.

Head $2\frac{2}{5}$ in length without caudal; depth $4\frac{1}{3}$; dorsal IX–13; anal 11; lateral line 40. Eye $6\frac{1}{2}$ in head; interorbital 6; snout $4\frac{1}{5}$; maxillary $2\frac{1}{5}$; upper preopercular spine 8; first dorsal spine $9\frac{1}{2}$; third dorsal spine $4\frac{3}{4}$; longest dorsal ray $2\frac{2}{3}$; longest anal ray $3\frac{1}{3}$; pectoral $1\frac{3}{4}$; ventral $2\frac{1}{4}$; caudal 2.

Head very short, broad, depressed, and evenly rounded from side to side; the sides of head not at an angle with top, as in *Minocottus*

ensiger. Body slightly compressed posterior to tips of pectoral. Interorbital space very wide and very shallowly concave, at once distinguishing it from all other known Japanese forms. Maxillary reaching to posterior border of eye. Lower jaw included; knob at symphysis scarcely developed. Sharp, small, conical teeth in bands on jaws and vomer; the greatest width across vomerine patch a little greater than length of eye. Nasal spines very small, covered by the skin. Ridges on top of head scarcely developed, covered with thick, warty skin; top of head not concave. No spines above orbit or occipital. Low digitate processes may be felt under the skin. A pair of short, simple filaments behind eye. Preopercular spine very short and stout, reaching one-third of the distance between its base and end of opercular flap; it is straight along its upper edge and slightly curved along its lower. Next spine below about a third of the length of the large spine; it is inclined somewhat downward. The usual spine on lower edge of preopercle inclined forward; above it the edge of preopercle is straight and smooth to the second spine. Spine on

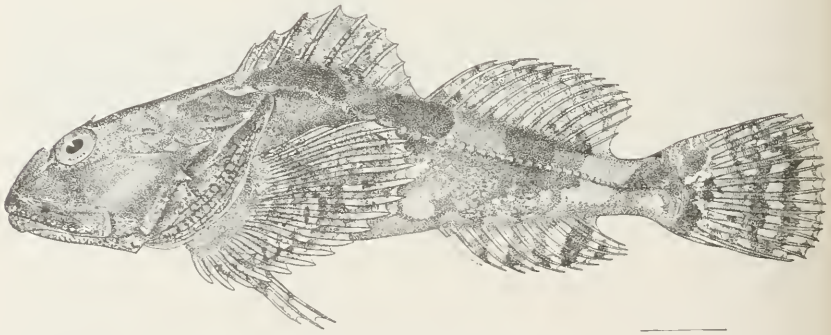


FIG. 20.—MYOXOCEPHALUS RANINUS.

anterior edge of subopercle very short and blunt. Ridge on opercle low and ending in a blunt spine. Posttemporal spine short and sharp, not produced through the skin; its tip does not reach so far posteriorly as opercular spine. Humeral spine not developed. Suborbital stay very low. Skin nowhere with plates. Top of head thickly covered with large, rather soft warts.

Dorsals low, well separated; tips of spines when fin is depressed do not reach soft dorsal by a distance equal to length of pupil. Tips of last dorsal and anal rays on the same vertical. Pectoral with 18 rays; its tip reaching to opposite front of soft dorsal. Ventrals reaching two-thirds of distance from their base to front of anal. Caudal truncate; the outer rays rounded.

Color, brown above, lighter below; a very conspicuous, sharp-cut, white cross band runs obliquely downward and forward across caudal peduncle just behind base of last dorsal ray; its width equal to height of caudal peduncle; sides of belly with large, round, white spots nearly

as large as eye, separated narrowly by the light-brown ground color; many of the spots are run together; lips, under part of mandible, chin, and branchiostegals spotted and specked, snowflake-like, with irregular white spots; dorsals and pectorals irregularly and finely mottled; the lower edge of pectoral bordered with white; ventral white, crossed with 2 dark spots, and with alternate irregular bands of white and dark brown; a white spot on lower edge of caudal peduncle; a white bar across base of caudal rays, behind which are two or three wavy dark bands across rays.

This species somewhat resembles *Myoxocephalus niger* of the Pribilof Islands, though not closely. The warts on head do not terminate in filaments. The color is very different, resembling more closely *M. stelleri*, of Kamchatka, and the patch of vomerine teeth is very much larger. It may be known from *M. stelleri* (= *Cottus decastrensis* Kner), the nearest species, by the flatter interorbital and scarcely developed ridges on head, by the less spotted membrane behind maxillary and preopercle, and especially by the white membrane connecting lower lip with maxillary. In *M. stelleri* the dorsal rays are never less than IX–15.

The above description is of the type which was taken by Jordan and Snyder at Aomori. It is 24 cm. in length. Cotypes were taken at Same, Mororan, Aomori, and Hakodate.

The type is numbered 7708, Ichthyological Collections, Leland Stanford Junior University Museum. Cotypes are No. 50920, U.S.N.M.

(*raninus*, frog-like, from the markings of the throat.)

26. MYOXOCEPHALUS STELLERI Tilesius.

Myoxocephalus stelleri Tilesius, Mém. Acad. Petersb., IV, 1811, p. 273 with plate, not referred to in text; Petropaulski (Coll. G. W. Steller).—Jordan and Gilbert, Rept. Invest. Fur Seal Islands, III, 1898, p. 463, pl. lxiv*a*; Bering Island.—Jordan and Evermann, Fish. N. and M. Amer., II, 1898, p. 1981; Petropaulski.—Schmidt, Faune Mer Japon, 1903, p. 115; Japan Sea, Okhotsk Sea.

Cottus decastrensis Kner, Denk. Kais. Akad. Wissen., XXIV, 1865, p. 2, pl. II, figs. 1, 1*a*; Decastris Bay, near mouth of the Amur.

? Cottus marmoratus Cuvier and Valenciennes, Hist. Nat. Poiss., VIII, 1831, p. 497; Petropaulski; on a drawing by Mertens.

D. IX (rarely VIII)–15 (rarely 16); A. 12 (11 to 13). Resembling in shape *M. polyacanthocephalus*, the head less depressed and the snout deeper than in *M. jaok*. Characteristic features are the thickened papillose lips, the presence of a supraocular tentacle, and the peculiar coloration. Skin naked, or with a few scattered small plates in adult males, the interorbital deeply concave, and the occipital and parietal ridges heavy and more or less broken or rugose. Head $2\frac{2}{3}$ to $2\frac{2}{5}$ in length; depth 4; least depth of caudal peduncle $1\frac{1}{2}$ in snout; greatest width of head equaling distance from tip of snout to base of

preopercular spine; depth of head at occiput equaling one-half its length. Mouth large, the lower jaw included, but less conspicuously overlapped than in *M. jaok*, the maxillary reaching beyond the eye, $2\frac{1}{4}$ in head. Lips very thick and fleshy in adults, the inner margin of each with a dense band of fine papillæ; lower lip may also bear externally a few papillæ or short filaments; a fleshy slip or filament often present on upper posterior angle of maxilla. Nasal spines pungent, rather short; preopercle with two diverging spines at angle and a third remote one below directed downward and forward; the upper spine varying in length, but extending usually about halfway to tip of opercular spine; opercle with a strong rib and spine; humeral and subopercular spines strong; interorbital width $5\frac{1}{2}$ to 6 in head, gently concave, its floor usually with traces of two low ridges; a definite supraorbital tentacle borne on the anterior end of the occipital ridge, its basal tubercle never conspicuous; slender occipital tentacle often present, especially in the young, but not infrequently absent; ridges

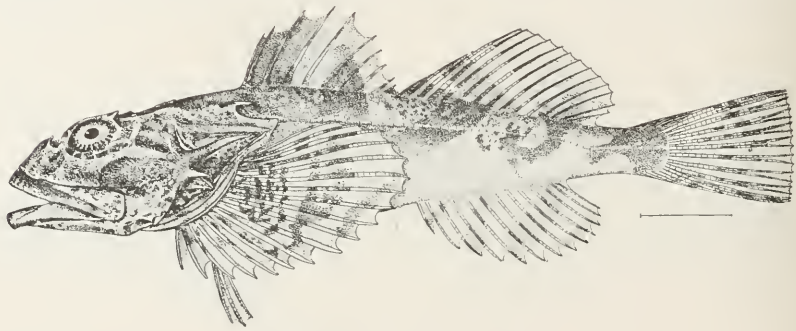


FIG. 21.—MYOXOCEPHALUS STELLERI.

on occiput strong, often irregular or partly interrupted, their surface roughened with lengthwise lines or with clusters of granules; occiput more deeply concave than in *M. polycanthocephalus;* usually a cluster of short digitate ridges behind the eye; top and sides of head with small, warty protuberances. A minute pore behind last gill, to be detected with difficulty in the young. Dorsals with short interspace or none, the membrane from last spine usually joining base of first soft ray; spinous dorsal very high in adult males, the fifth spine highest, one-half as long as head, longest soft ray $2\frac{1}{5}$ in head; pectorals reaching front of anal, the ventrals not to vent; vertical fins much lower in the young. Skin smooth, without plates or spines in young 7 or 8 inches long; 1 adult male of 14 inches with scattered small subcircular spinous plates, all but a few of which are below the lateral line. In the young, the maxillary and mandibular membranes are whitish, very conspicuously marked with irregular, jet-black spots and blotches; branchiostegal and gular membranes and the membrane behind the preopercle crossed with narrow dark streaks; entire under

side of head faintly dusky, mottled and maculated with white "like a frog's belly;" iris with small black spots and blotches; these colors fainter in our adult specimen, where the under side of head is nearly uniform whitish; the maxillary membranes, however, conspicuously black spotted; body brownish, with 3 light-gray saddles, the most conspicuous crossing the back of the caudal peduncle immediately behind the dorsal fin; the second below the dorsal notch, and the third, often obscure or wanting, forming a V-shaped area on top of head, the 2 arms diverging from interorbital space toward the base of opercular spine; the dark areas often lighter centrally, and variously blotched and mottled with brown or dusky; dorsals very irregular in the marking; anal usually with 3 or 4 oblique dark bars; caudal usually with a basal translucent bar followed by varying alternations of translucent and black; ventrals showing 2 black crossbars; pectorals with no definite color pattern on their outer face, but crossed on their inner face by a few irregular black bars. Males show the usual round white spots on sides of abdomen. It is well distinguished by the speckled throat and belly, aptly compared by Steller to the speckled color of a frog. Western shore of Bering Sea and Okhotsk Sea; not recorded from Alaska or the Aleutian Islands. This description from 11 specimens from Petropaulski and Bering Island, taken by the U. S. Fish Commission steamer *Albatross*. This species is now recorded from Bering and Medni Islands, Petropaulski, and the mouth of the Amur River. Recorded by Dr. Peter Schmidt from near Vladivostok and from Saghalin.

(Named for Georg Wilhelm Steller.)

27. MYOXOCEPHALUS BRANDTI (Steindachner).

Cottus brandti Steindachner, Ichth. Notizen, V, 1867, p. 6, pl. III, figs. 1, 2; mouth of the Amur River. (Type, in Vienna Mus.)

Myoxocephalus brandti Jordan and Evermann, Fish. N. and M. Amer., II, p. 1984, 1898 (copied).—Schmidt, Faune de la Mer du Japon, etc., 1903, p. 15; Japan Sea.

Head $2\frac{2}{3}$; depth 5. D. IX–13; A. 11; P. 17. Head narrowed forward, the lower jaw included. Eye 6 in head, a little larger than snout; interorbital space strongly concave, $1\frac{1}{2}$ in eye. A rather long tentacle above eye posteriorly; behind this a ridge, low and rather sharp, converging with its fellow, and inclosing a depressed quadrangular area; no spine at its posterior end; nasal spines prominent; preorpercle with 3 spines, the upper shorter than eye, the second not one-half its length, the third short, blunt, and turned downward; opercular spine, blunt, concealed; suprascapula with a single long spine. Top of head covered with small rounded warts. Lateral line with thin, bony concealed plates, its pores sending numerous simple branches above and below; below the lateral line 2 rows of small cross plates, tube-like, apparently connected with the system of tubes of

the lateral line; no rounded bony plates or scales. Longest dorsal spine 3 in head; pectoral moderate, a little more than one-half head; ventral 2½ in head. Head bluish violet above; sides of body reddish yellow; violet marblings on the lower lip and on the sides of the lower jaw, leaving the ground color to form ocellated spots; fins violet with yellow spots, the ventrals uniform yellowish. Known from 1 specimen 13 inches long from the mouth of the Amur River. (Steindachner.) Also recorded by Dr. Schmidt from Peter the Great Bay, Vladivostok.

19. MEGALOCOTTUS Gill.

Megalocottus Gill, Proc. Ac. Nat. Sci. Phila., 1861, p. 166 (*platycephalus*).

This genus includes large sculpins, with broad, flat heads, differing from *Myoxocephalus* chiefly in the sharp projecting lower jaw; the preopercle has 3 spines, the upper short and straight, the lowermost turned downward; dentation as in *Myoxocephalus;* suprascapula with 2 spinous projections; top of head warty; sides with rounded tubercles in the adult; lateral line of separated pores; a large pore behind last gill. North Pacific.

(μεγαλός great; *Cottus.*)

28. MEGALOCOTTUS PLATYCEPHALUS (Pallas).

Cottus platycephalus Pallas, Zoogr. Rosso-Asiat., III, 1811, p. 135; Kamchatka, after Steller.—Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 177.

Cottus taeniopterus Kner, Sitzber Ak. Wiss. Wien, LVIII, 1868, p. 18, pl. xiv, fig. 10; Decastris Bay, near mouth of Amur River. (No. 5574, Mus. Wien.)

Megalocottus platycephalus Gill, Proc. Ac. Nat. Sci. Phila., 1861, p. 166.—Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, 1898, p. 469.—Jordan and Evermann, Fishes N. M. Amer., II, 1898, p. 1987, fig. 725, St. Michael.—Schmidt, Faune Mer, Japon, 1903, p. 15; Japan Sea, Okhotsk Sea.

Head 3 in length, D. VIII—13; A. 12; V. 1, 3; P. 16 or 17; lateral line 40. Lower jaw somewhat longer than upper; eye 5 in head, as long as snout; nasal spines distinct; orbital rim moderately prominent; a low ridge behind it toward the occiput, without spines or points. Top of head between these ridges forming a quadrangular depression, as broad as the eye in front, but narrower behind. Top of head covered with naked, warty skin. Preopercle with 4 spines, the upper as long as eye, directed upward and backward, the second much shorter, the others directed downward. Opercle with a long, forked ridge, ending in two short diverging spines; a spine directed downward on subopercle; two sharp spines on scapular region, the lower the longer and touching the first tube of the lateral line. Lateral line complete, above, its numerous rounded bony plates armed with spines as in *M. laticeps;* these in 2 rows anteriorly and 1 posteriorly; a few similar plates below lateral line. Fins all high, the soft dorsal especially so. Color dark, with many dark shades and spots on throat and belly,

especially on gill membranes; sides and belly (in males) with irregular, round white spots; first dorsal with round, pale spots, the membranes otherwise largely dusky; soft dorsal with 3 or 4 dark oblique cross shades, between which are rows of pale spots; anal with 4 dark oblique cross shades; between which are rows of pale spots; first dorsal with round pale spots, the membranes otherwise largely dusky; soft dorsal with 3 or 4 dark oblique cross shades, between which are rows of pale spots; anal with 4 dark oblique cross shades; caudal with 3 narrower dark stripes; pectoral with 4; ventrals dusky with pale spots. Okhotsk Sea and western and northern parts of Bering Sea. This description (after Knerr) from a single specimen, 7½ inches long, from Decastris Bay, near the mouth of the Amur. We have not seen the species, but Dr. Schmidt lists it as from the Japan Sea, his collections

FIG. 22.—MEGALOCOTTUS PLATYCEPHALUS.

being made in Peter the Great Bay, near Vladivostok. The plate, from Jordan and Evermann, was drawn from a specimen collected at St. Michaels, Alaska, by Mr. L. M. Turner. It seems to belong to this species.

(*πλατύς*, broad; *κεφαλή*, head.)

20. AINOCOTTUS Jordan and Starks.

Ainocottus JORDAN and STARKS, new genus (*ensiger*).

This genus is allied to *Myoxocephalus*, having the general form and appearance of the large sculpins. It has, however, four preopercular spines, as in *Porocottus*, but the upper is very long and straight, and not hooked as in *Porocottus*. There is no slit behind the last gill, a character which separates *Ainocottus* from *Oncocottus*, to which it is technically nearest in relationship. *Ainocottus* lacks also the high fins and the comb-like crest of the males of *Oncocottus*.

(*aino*, the white aborigines of the island of Hokkaido; *Cottus*.)

29. AINOCOTTUS ENSIGER Jordan and Starks, new species.

Head 2⅕ in length without caudal; depth 5. Dorsal X-14; anal 12. Lateral line 38. Eye 6 in head; interorbital 7¼; snout 2⅔; maxillary

2; upper preopercular spine $6\frac{3}{4}$; pectoral 2; first dorsal spine $4\frac{2}{5}$; third dorsal spine $3\frac{3}{4}$, longest dorsal rays $3\frac{1}{5}$; longest anal rays $3\frac{3}{5}$; ventral $2\frac{3}{4}$; caudal $2\frac{1}{3}$.

Head long and but little depressed; the sides forming an angle with the top. Body nowhere compressed. Postorbital part of head equal to snout and twice the verticle diameter of eye. Interorbital space wide and uniformly concave. Maxillary reaching the diameter of pupil beyond eye. Lower jaw but slightly included; a knob developed at symphysis. Teeth small, conical, in rather wide bands on jaws and vomer; the band strongly curved on the latter; its greatest width equal to length of orbit. Nasal spines strong, not very sharp. Ridges on each side of vertex not continuous, represented by a short double spine behind orbital spine (first digitate spine), and a longer one at occiput, between which there is a rounded raised area, but

FIG. 23.—AINOCOTTUS ENSIGER.

scarcely a ridge. The ridge outside of this is low and uneven. The highest spine on top of head is the superorbital spine, which is situated over posterior fifth of orbit; behind it are two digitate spines, both directed backward. Preopercular spine long, straight and sharp, nearly reaching edge of opercle; below it are three spines, the upper one the largest, scarcely a third as long as the large spine, the lower one is directed forward and downward as usual, while the one between is more obtuse than the others, and is directed downward and slightly backward. Opercle with a long, strong ridge ending in a spine; the length of ridge and spine equal to twice the vertical diameter of eye. Lower end of subopercle and upper end of interopercle each with a sharp spine, their points converging and nearly touching; the upper one pointing downward and backward, the lower one upward and backward. Posttemporal spine long and sharp, ending about on a vertical with preopercular spine. Humeral spine triangular and

blunt, not nearly reaching as far as long opercular flap. Suborbital stay scarcely keeled, but produced in a rounded ridge. Top of head comparatively rather sparsely covered with very hard warts. Skin everywhere naked, with no trace of plates anywhere. No slit behind last gill.

Spinous dorsal when depressed does not reach to first ray of soft dorsal. Soft dorsal high and short. Last rays of dorsal and anal slightly adnate to body, the latter at base only; tips last rays on the same vertical. Pectoral broadly rounded, the rays just below the third or fourth from the top the longest, reaching to opposite tips of last dorsal spines when depressed. Ventrals reaching half the distance from their base to front of anal. Caudal truncate, or very slightly rounded when spread, a little concave when partly closed.

Color very light, slaty brown on back and upper part of sides; white below; a dark cross band on back under posterior end of spinous dorsal, and one under each end of soft dorsal; a dark bar at base of caudal and one across caudal toward posterior end, leaving a broad white margin at tips of rays; head light, somewhat mottled; no bars from eyes; lips with alternate white and light dusky spots; underpart of head and belly white; spinous dorsal with an irregular large, dusky blotch at each end; soft dorsal with 2 or 3 dusky, irregular, oblique cross bands; upper part of pectoral mottled with white spots on a dusky ground, which changes to light and dark crossbars below; anal white, crossed by 2 dusky, oblique bands; ventrals white.

This species somewhat resembles *Myoxocephalus verrucosus* and *M. jaok*, but may be known at once by the lack of plates on body and by the presence of four preopercular spines.

The above description from the type, which was taken at Hakodate by Jordan and Snyder. It is 30 cm. in length. Three cotypes were taken at the same locality.

The type is numbered 7709 Ichthyological Collections, Leland Stanford Junior University Museum. Cotypes are 50921 U.S.N.M.

(*ensiger*, sword bearing.)

21. POROCOTTUS Gill.

Porocottus Gill, Proc. Ac. Nat. Sci. Phila., 1859, p. 166 (*quadrifilis*).

This genus is near *Myoxocephalus*, differing in the presence of 4 preopercular spines, the uppermost hooked upward. Lower jaw included. Lateral line modified, giving off pairs of divergent branches with pores at their ends. Cirri present above eye and on nape. Northern Pacific.

(πόρος, pore; *Cottus*.)

30. POROCOTTUS TENTACULATUS (Kner).

Cottus tentaculatus KNER, Sitzber. Akad. Wiss. Wien, LVIII, 1868, p. 22, pl. v, fig. 12; "Singapore;" evidently an error. (No. 5591a Wien. Mus.)—JORDAN and EVERMANN, Fish. N. and M. Amer., II, 1898, p. 2000; after Kner.

Head 3½. D. VI–16 or 17; A. 14 or 15; V. I, 13. P. 14 or 15. Head small, mouth small, the lower jaw included; eye large, 3 in head, longer than snout; interorbital space channel-like, less than one-half diameter of eye; a sharp spine before each eye, on which is a fringed tentacle; supraocular ridge ending in a blunt, forked, bony knob, on which is a small thread-like tentacle; the quadrangular interspace between these two sets of tentacles is excavated; preopercular spine long, curved upward, two-thirds diameter of eye; the second spine much shorter and turned backward; 2 spines lower, turned downward; subopercle with a spine turned downward; a similar one on opercle; maxillary reaching to middle of eye; lower jaw with large pores. Dorsal fins low, the rays flexible, the two close together; ventrals reaching vent; pectorals past beginning of anal. Skin of body wholly naked; lateral line complete, bending downward on caudal peduncle. Color clear brown, darker above, the head above with a few large dark-brown spots, which form obscure bands, 1 of these from front of eye across upper lip, second broader from eye across subopercle; lower jaw speckled; throat and breast plain yellowish; back with about 6 dark cross bands, those most anterior the broadest; sides of body with a network of brown streaks around pale spots; a large bright yellow spot at base of caudal; fins all finely spotted with whitish and dotted with dark, the caudal with 5 or 6 dark cross bands; pectorals faintly barred. (Kner.) A single specimen, 2 inches long, said to be from Singapore, which is of course an error. It probably came from the Pacific coast of Asia, perhaps from Yezo or Decastris Bay.

(*tentaculatus*, having tentacles.)

22. ARGYROCOTTUS Herzenstein.

Argyrocottus HERZENSTEIN, Mélanges Biol. Ac. Imp. Sci., XIII, 1892, p. 219; St. Petersburg.

Spinous dorsal short; ventrals extremely long, their tips extending beyond front of anal fin; gill membranes scarcely united to the isthmus, forming a broad fold across it, no slit behind the last gill; teeth on the vomer, none on the palatines; skin entirely naked, without scales or bony plates; preopercles with 3 small spines. North Pacific.

(ἄργυρος, silver; *Cottus*.)

31. ARGYROCOTTUS ZANDERI Herzenstein.

Argyrocottus zanderi Herzenstein, Mélanges Biol. Ac. Imp. Sci., XIII, 1892, p. 219; Korsakow, Sakhalin. (Type No. 9679, Mus. St. Petersburg. Coll. Dr. Zander.)—Jordan and Gilbert, Fish. Bering Sea, in Rept. Fur Seal Invest. for 1896–97, III, 1899, p. 460, pl. LX; Iturup Island.—Jordan and Evermann, Fish. N. and M. Amer., II, 1898, p. 1995; Iturup Island.

Head $3\frac{1}{5}$; depth $4\frac{5}{6}$. D. VIII–15; A. 13; P. 14; V. 3; C. 18; lateral line with 35 tubes. Eye $3\frac{5}{9}$ in length of head; interorbital space $1\frac{5}{9}$ in eye; 2 well-developed crests at the vertex; maxillary reaching middle of eye; lower jaw slightly projecting; 2 anal spines; 3 small spines on preopercle, the upper half as long as the eye, turned upward, the others directed downward; longest dorsal spine one-half length of head; pectoral reaching ninth ray of soft dorsal; ventrals reaching to the next to the last ray of anal. Color brownish, dark above, with numerous silvery spots bordered with darker, a silvery

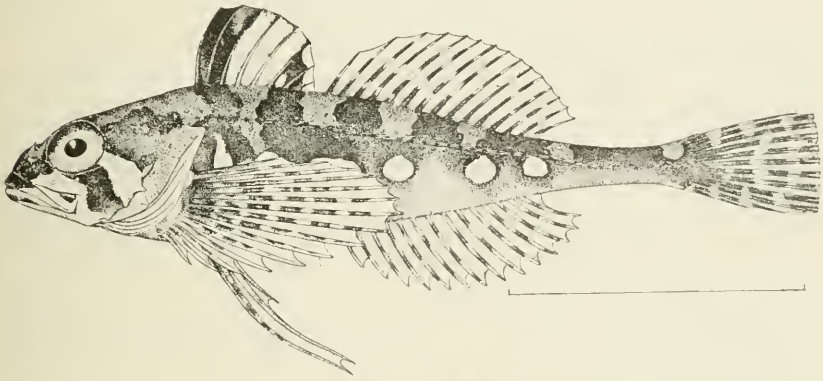


Fig. 24.—Argyrocottus zanderi.

stripe from below the eye to the base of the lower jaw; another from eye to angle of preopercle; a row of 6 large irregular spots along middle of sides, many smaller ones below these; 2 smaller irregular spots behind these; a bell-shaped spot with a point directed upward on the belly between the ventrals; the first dorsal with its upper margin blackish, with milk-white spots dotted with black; a transparent spot at base of fourth and sixth rays; a small transparent spot near base of fourth ray; another behind sixth; about these spots the coloration is darker; soft dorsal almost uniformly dark; anal colorless, its border dark, with 2 or 3 dark spots on each ray; caudal uniformly dusky, the upper and lower rays blackish, with clear spots; ventral with darker cross streaks; pectorals with dark rings and streaks. Ventral in female probably much shorter than in male, the color less marked. Three specimens of this beautifully marked Cottoid taken in Shana Bay, Iturup Island, show the following characters: The branchiostegal membranes are widely joined across the throat, narrowly united in

front of the middle line of isthmus, with a rather wide free margin behind; lateral line without plates; nasal spines small; 4 short spines on preopercular margin. These specimens answer well to the detailed description of the type, but are still more ornate, in that they possess along the back a number of broad dark bars alternating with lighter bars, the former confluent below, with the ground color of the sides. In the largest specimen, 7 cm. long, the ventral fins extend only to base of third anal ray. There are no tubercles on the rays, and the membranes extend nearly to tips of the 2 outer rays, and two-thirds length of the inner ray. The ventral spine is slender, nearly as long as the inner ray, and is firmly adnate to outer ray. The smaller specimens are, respectively, 4 cm. and 3.5 cm. long, the ventrals reaching in one to front of anal, in the other to vent; fins are finely cross barred, more variegated than in the type. (Jordan and Gilbert.) Known only from Sakhalin Island, 1 specimen 92 mm. long (Herzenstein), and Iturup Island, where 3 specimens were obtained by the U. S. Fish Commission steamer *Albatross* in 1896; our description from the latter.

(Named for its discoverer, Dr. Zander.)

23. ZESTICELUS Jordan and Evermann.

Zesticelus Jordan and Evermann, Check-List Fishes, 1896, p. 443 (*profundorum*).

Deep-sea sculpins, closely allied to *Porocottus*, but with the skeleton little developed, the head soft and spongy, filled with mucous channels, the skin perfectly smooth, the lateral line reduced to a series of separate open pores, the vertical fins few-rayed and weak. Preopercular spine slender, curved upward. Deep seas; 2 species known; probably degraded from *Porocottus*, the soft skeleton and feeble structure being results of deep-sea life.

(ζεστός, soft-boiled; *Icelus*, a son of the god of sleep.)

32. ZESTICELUS BATHYBIUS (Gunther).

Cottus bathybius Günther, Rept. Fishes Challenger, 1887, p. 62, pl. x, fig. C; off Tokyo.

This species is thus described by Dr. Günther:

D. 5 to 10; A. 7; P. 17, V. 3. The preoperculum is very strongly armed. There are two spines arising from the same root at the angle, one in front of the other, the posterior being longer than the eye; three other shorter spines along the lower edge of the preoperculum; operculum with a small spine at its antero-inferior angle. A pair of spines on the occiput behind a deep depression occupying nearly the whole of the vertex. Eyes longer than the snout, close together. Minute teeth on the vomer, but none on the palatine bones. Tail much attenuated. Pectoral fin extending beyond the origin of anal; ventrals not reaching the vent. Second dorsal fin higher than first; length of the caudal two-fifths of that of the body (without head). Muciferous system much developed, opening by wide pores along the lower jaw, the preoperculum, the infraorbital ring and the lateral line. Grayish-brown; throat and all the fins black.

Habitat.—South of Yeddo, Japan, Station 235; depth 565 fathoms. One specimen, 2½ inches long.

A small specimen from off Misaki was seen in one of the museums in Tokyo, but our notes in regard to it are mislaid.

(*βαθύς*, deep; *βιός*, living.)

24 COTTUNCULUS Collett.

Cottunculus Collett, Norges Fiske, 1875, p. 20 (*microps*).

Body tadpole-shaped, the head extremely large, the body tapering rapidly from the shoulders to the slender tail; mouth rather large, terminal, oblique, the jaws about equal; villiform teeth in the jaws; a double patch on vomer; no teeth on the palatines; no spines on the head, the tubercular surface of the skull covered by skin; skull thin, its bones not firm. Gills 3½, no slit behind the last arch; gill membranes broadly joined to the isthmus, their union extending to above the lower edge of the base of the pectorals. Pseudobranchiæ very small; no cirri, scales, or prickles; the skin thin and movable, smooth, or roughened with small warts. Spinous dorsal little developed, the 2 fins usually continuous; spines very slender, flexible, embedded in the skin; pectorals short, procurrent below; ventrals very short, well separated, their rays I, 3; caudal rounded. Deeper parts of the Atlantic.

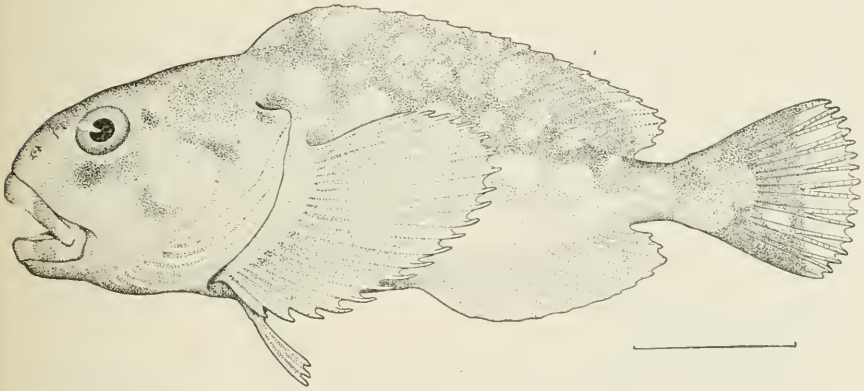


Fig. 25.—Cottunculus brephocephalus.

(A diminutive of *Cottus*.)

33. COTTUNCULUS BREPHOCEPHALUS [a] Jordan and Starks.

Head 2⅔ in length without caudal; depth 3¼. Dorsal VI–16; anal 12. Eye 4½ in head; maxillary 2⅔.

This species may be known by the absence of blunt spines and by the coloration.

[a] This species is described in detail and figured in the Proceedings of the U. S. National Museum, XXVI, 1903, p. 689.

The type was dredged by the U. S. Fish Commission steamer *Albatross* in Suruga Bay in 94 fathoms, Station 3704. It is 13 cm. in length, and bears the number 50591, U.S.N.M.

(*βρέφος*, baby; *κεφαλή*, head, from its resemblance in feature to the shaven-fronted babies (kishibozu) in Japan.

25. GYMNOCANTHUS Swainson.

Gymnocanthus Swainson, Class. Fish., etc., II, 1839, p. 271 (*ventralis*).
Phobetor Kröyer, Naturh. Tidschr., I, 1844, p. 263 (*tricuspis*).
Elaphocottus Sauvage, Nouv. Arch. Mus. Paris, (2), I, 1878, p. 142 (*pistilliger*).

Body slender or robust, subfusiform, covered with thick skin in which are sometimes embedded prickly plates; deciduous, granular, or stellate tubercles also sometimes present, but no true scales. Head large; mouth terminal, large, the lower jaw always included, the uppermost the longer; villiform teeth on jaws, none on palatines or vomer; suborbital stay strong; preopercle with 4 spines, the upper very strong and armed above with 2 to 5 antler-like processes; opercle nasal bones, orbital rim, and shoulder girdle more or less armed; gill membranes forming a fold across the rather narrow isthmus; slit behind last gill small or wanting, if present reduced to a mere pore; vertebræ about 28. Branchiostegals mostly 6. Dorsal fins 2, separate, the first short, its spines rather slender; ventral rays I, 3; caudal fin moderate; pectoral fin broad, its lower rays procurrent. Lateral line well developed, its tubes sometimes provided with bony or cartilaginous plates.

(*γυμνός*, naked; *ἄκανθα*.)

a. Interorbital space not armed with bony plates; pectoral fin with fringes on the inner side of the rays. D. IX–14; A. 16 ..... *pistilliger*, 34.
aa. Interorbital space armed with bony plates; no fringes on pectoral.
b. D. IX or X–14 or 15; A. 15 ..... *intermedius*, 35.
bb. D. X or XI–17; A. 18; mouth very large ..... *merzensteini*, 36.

34. GYMNOCANTHUS PISTILLIGER (Pallas).

Cottus pistilliger Pallas, Zoogr. Rosso-Asiat., III, 1811, p. 43; Unalaska.—Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 193.—Günther, Cat., II, 1860, p. 167.

Cottus ventralis Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 194; Kamchatka (Coll. Mr. Collée, type in Brit. Mus.).—Günther, Cat., II, 1860, p. 167.

Cottus cephaloides Gray, in Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 194; Kamchatka. (Type of *C. ventralis*.)

Elaphocottus pistilliger Sauvage, Nouv. Archiv. Mus., 1878, p. 142.

Gymnocanthus pistilliger Gilbert, Rept. U. S. Fish Comm., 1893 (1896), p. 424.—Scofield, Rept. Fur Seal Comm., III, 1898, p. 503; Grantley Harbor—Jordan and Evermann, Fish. N. and M. Amer., II, 1898, p. 2006—Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, 1898, p. 460; Petropaulski, Robben Island, Bristol Bay, Kyska, Point Belcher, Cape Tchaplins, Bering Island.

D. IX–14; A. 16. The dorsal fins are widely separated, the interspace equal to one-half or more than one-half the diameter of the

pupil. The vertebræ 12 + 24. An obtuse prominence above hinder margin of orbit bears in young individuals a slender cirrus, which frequently disappears in adults. Behind the eye a continuous occipital ridge bears 3 smaller bony prominences, the first immediately behind the eye, the second and third approximated at posterior end of ridge; these bear no cirri. In males the post axial region is furnished with a number of very slender filaments, each of which is expanded at tip into a compressed frond-like lamina, having the free edge more or less laciniate or fringed. These expanded tips are bright white and very conspicuous. No trace of them is present in females, but they develop in males at a very early age. These agree with the structures described by Pallas, on which he based the name *pistilliger*. The upper preopercular spine is sharply bifurcate in even our smallest specimens (50 mm.), but in these no trace of a second medial upwardly

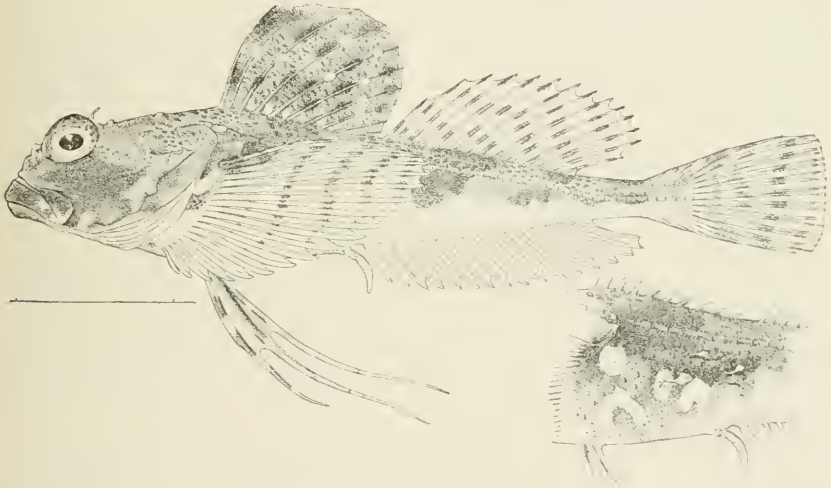


FIG. 26.—GYMNOCANTHUS PISTILLIGER.

directed spine is present. The latter is evident in specimens 70 mm. and more in length, and a small concealed prominence representing a third spine is exceptionally present. No trace of slit behind last gill.

Very young examples show no groups of granulations on head or nape, these being usually wanting in specimens less than 100 mm. long. In older examples they are variously developed, the degree of armature dependent neither on age nor sex. They are never armed on interorbital space, the granulations being confined to the occipital and nuchal regions, with an additional elongate patch on the upper part of the opercle. In highly developed males the dorsal and ventral rays are accompanied with series of tubercles. The color is brown above, with very narrow vermiculating lines of lighter; a black blotch on cheek, more conspicuous in males, and 4 inconspicuous cross bars on back; the darker dorsal area is bounded below lateral line by an

irregular series of dark streaks or blotches. In males, the lower jaw and preopercle is cross-banded with black and light yellow; the abdomen, lower half of sides in front of anus, and prepectoral region, with large roundish white spots, separated by vermiculating areas, rendered dusky by aggregations of coarse black dots; ventrals dusky and silvery, the latter frequently forming cross bands; spinous dorsal dusky or black, with irregular series of white spots not confined to basal parts of fin. In both sexes the pectorals, second dorsal, and caudal are translucent or yellowish, crossed by narrow black bars. The females are more numerous than the males in our collection, but the disparity in number is not so great as has been found by other writers. In 45 specimens examined as to this, 17 are males, 28 females. Among specimens obtained at Petropaulski and at the U. S. Fish Commission steamer *Albatross* station 3646, off Robben Island, in 18 fathoms, no males are included. (Gilbert.)

Coasts of Alaska; taken abundantly in Bristol Bay in 4½ to 26 fathoms, and about Robben Island and the coast of Kamchatka.

(*pistilla*, pistil; *gero*, I bear; in allusion to the axillary papillæ of the male.)

35. GYMNOCANTHUS INTERMEDIUS (Schlegel).

Cottus intermedius Schlegel, Fauna Japonica, Poiss., 1843, p. 38; coast of Jezo.—Günther, Cat. Fish, II, 1860, p. 167; copied.

Gymnocanthus intermedius Gilbert, Rept. U. S. Fish Comm. for 1893, 1896, p. 424.

Cottus filamentosus Sauvage, Rev. Mag. Zool., III, 1875, p. 279; Hawaiian Islands (by error).

Head 2⅞ in length without caudal; depth 4½. Dorsal IX or X–14 or 15; anal 15; lateral line 37. Eye 4 in head; interorbital space (bone) 11; snout 4; maxillary 2⅗.

Upper profile of head straight and gently sloping from dorsal to eye, thence rounded to front of eye and slanting straight and steep at snout. Interorbital concave, shallow, without ridges or channels. Top of head concave between a pair of slight rounded ridges that run back from each eye. Suborbital stay rather prominent. Lower jaw included; maxillary reaching to below middle of eye, or varying from that point to below posterior margin of pupil. Very small conical sharp teeth on jaws; the bands wider in front; no teeth on vomer or palatines.

Angle of preopercle with a long sharp spine, which reaches just past edge of opercle; above it bears 3 or 4 sharp antler-like processes. Edge of preopercle below with 3 moderate, sharp spines of about equal size; the upper one directed downward and backward, the other two directed downward and forward. Nasal spines well developed. Over posterior margin of eye is a blunt tubercle which bears a rather large simple tentacle. Top of head without bony tubercles as in *G. pistilliger*. A prominent sharp humeral spine just above base of pectoral.

Lateral line with concealed bony plates. A very few scattered ctenoid plates behind pectoral base present in both sexes. No axillary tentacles. Top of head with close set, rough plates, which usually extend between eyes nearly to nasal spines; no plates on upper part of preopercle or opercle.

Third dorsal spine the highest, $1\frac{3}{4}$ in head in females, in males $1\frac{2}{5}$; the first spine $2\frac{1}{5}$ in females; $1\frac{3}{4}$ in males; the spines behind the fourth rapidly decrease in length, so that the posterior border of the fin is nearly vertical; the last spine one-third eye in length. Dorsals separated by an interval equal to that between spines at base. Soft dorsal lower than spinous; the longest rays $2\frac{1}{5}$ in head in female, 2 in male; the last ray is not adnate; tips of last rays do not reach nearly so far back as those of anal, which do not reach nearly to base of caudal; pectoral with 19 rays, 3 or 4 below the third are the longest; they reach to above base of fourth anal ray in the female and are $1\frac{1}{6}$ in head; in the male they reach to above fifth or sixth anal ray and are equal to the head's length.

The inner ray of the ventral is the longest; it reaches to the vent in the female, to the base of the seventh anal ray in the male. Caudal almost imperceptibly concave when the fin is closed, truncate or slightly convex when spread; its length is $1\frac{4}{5}$ in the female, $1\frac{3}{5}$ in the male.

Color slaty, profusely spotted with small, irregular dark spots, with or without obscure cross bars; when present there is 1 under middle of spinous dorsal, 2 under soft dorsal, and 1 halfway across caudal peduncle; lower part of sides and belly white; a large black blotch occupies cheek below suborbital stay; opercle below preopercle spine black; membrane between upper branchiostegal rays dark, the rays white; spinous dorsal dark and irregularly mottled, or with a couple of transparent oblique streaks; soft dorsal transparent and with 2 or 3 conspicuous black streaks obliquely across the rays; pectoral white, crossed toward posterior end with 3 or 4 nearly vertical black streaks; caudal white, crossed with 3 or 4 curved black bands; ventrals and anal white. The following color was taken from a fresh specimen: Olive, finely mottled with brown, salmon red shades on sides; fins barred; the dorsal, anal, caudal, and pectoral washed with salmon red, brightest on pectoral and caudal; ventral white, faintly barred with salmon; lower side of head more or less yellow.

Here described from specimens from 18 to 22 cm. in length from Hakodate.

This species may be known from *G. pistilliger* by the longer, better armed preopercle spine, the wider and shallower interorbital space which is rough with plates, the absence of axial tentacles or fringes on inner side of pectoral rays, the absence of bony tubercles on top of head, and by the presence of the superorbital tentacle in all ages.

Specimens were taken at Hakodate, Same, and Otaru. A small specimen from Hokkaido (858 in his preliminary catalogue) was received from Ishikawa.

Dr. Sauvage describes a species of *Gymnocanthus* from the impossible locality of the Hawaiian Islands. It is probably based on a Japanese specimen of *Gymnocanthus intermedius*.

D. IX-16; A. 13; P. 15. No teeth on vomer. Two strong spines at the end of the snout; no spines at the orbit; space between the eyes concave, very narrow; nape rounded, without spines or tubercles. A strong bifid preopercular spine. Gill openings separated by an isthmus. Lateral line almost straight. Color yellowish, maculate, with small black spots; a black band at the base of the caudal; fins with black lines, formed of small points. (Sauvage.)

The mixing of Japanese and Hawaiian species in collections has frequently occurred, as most steamers bound from San Francisco to Japan stop at Honolulu.

36. GYMNOCANTHUS HERZENSTEINI Jordan and Starks, new species.

Head $2\frac{3}{4}$ in length without caudal; depth $4\frac{2}{3}$ to 5. Dorsal X or XI–17; anal 18; lateral line 40. Eye $4\frac{2}{3}$ to $4\frac{3}{4}$ in head; interorbital width

FIG. 27.—GYMNOCANTHUS HERZENSTEINI.

10; snout $3\frac{1}{2}$; maxillary $2\frac{1}{4}$. Length of fin rays of female: first dorsal spine $2\frac{1}{6}$ in head; third spine 2; ninth spine $4\frac{1}{2}$; last spine 8; fourth dorsal ray $2\frac{3}{4}$; middle pectoral rays $1\frac{2}{3}$; ventrals 2; caudal $2\frac{1}{5}$. Fin rays of male: first dorsal spine $2\frac{1}{3}$; third spine $1\frac{3}{4}$; ninth spine $2\frac{1}{2}$; last spine $7\frac{1}{2}$; fourth dorsal ray $2\frac{1}{5}$; pectoral $1\frac{2}{5}$; ventrals $1\frac{1}{2}$; caudal $1\frac{4}{5}$.

Head and body everywhere about as deep as wide; body round in section; head flat or slightly concave above, the sides joining at an angle; snout steep. Mouth large, the maxillary reaching to below posterior orbital rim; interorbital shallow, concave, without ridges or channels. Lower jaw the shorter. Sharp conical teeth in bands on jaws; the band on lower jaw narrow, not widened in front; much wider in front on premaxillary; vomer and palatines toothless. Angle of preopercle with a long stout spine, not reaching edge of operele, armed above with 3 sharp anther-like processes; lower edge of

preopercle with 3 sharp subequal spines, the upper one directed downward and backward, the middle one downward, and the lower one hooked forward. Nasal spines well developed. On top of head from eye running backward is a low, rounded ridge, which is scarcely broken, though shows slight indications of tubercles.

Over posterior margin of eye is a prominent blunt tubercle which does not bear a tentacle. Top of head thickly covered with rough bony plates which extend forward on interorbital space to front of eye. Similar plates on opercle, top of preopercle and on cheek behind eye. Humeral spine very short and blunt, not nearly so long as in *G. intermedius*.

Lateral line with concealed bony plates. A few rough scattered plates behind pectoral base much more numerous and regular in the male than in the female; no axial tentacles.

Middle dorsal spines the longest; spinous dorsal rather high in front, the spines growing rapidly shorter behind the middle in the female, holding their length nearly to the last in the male. Dorsals well separated. Soft dorsal highest anteriorly, the rays growing gradually shorter posteriorly; the last ray not adnate; tips of the last rays not reaching so far posteriorly as do those of anal, which do not reach to within a diameter of the eye of the base of the caudal. Pectorals with 19 rays, its posterior outline broadly rounded, reaching to above base of second anal ray in the female, to above fourth anal ray in the male. Middle ventral ray the longest, not reaching vent in female, reaching past vent nearly to anal in male. Caudal rather deeply concave, even when fin is spread; the outer rays half the diameter of the eye longer than the middle ones.

Color nearly uniform light slaty brown above, in spirits, without spots or crossbars, changing abruptly to silvery white just below middle of sides; a diffused dusky blotch on cheek; membrane behind maxillary dark slate-color; branchiostegals dusky in male; silvery white in female; spinous dorsal with 3 black or dark brown bands following the upper outline of the fin, the upper one bordering the upper edge; posteriorly the bands are broken; in the female they are narrow and diffused, and in the male they are broad, conspicuous, and wider than the white interspaces; similar bands on soft dorsal showing the same modifications in both sexes, but running obliquely downward and backward; 2 dark cross bands on caudal; 3 and the beginning of a fourth vertical dark cross bands on pectoral, wider on male; anal and ventrals white in female; the former with an indistinct dusky longitudinal band in male.

In life the body is largely cherry-red, the pectorals golden, with whitish tips and black bands bordered with bright orange; maxillary orange; chin and belly white; orange bars on back; a brick-red band across top of head.

This species may be known from *G. intermedius*, which it most resembles, by the increased number of fin rays, the longer maxillary (longer than in any of the known northern Pacific forms) and by the shorter humeral spine, and by many minor characters.

Two specimens, a male and a female, were taken by Jordan and Snyder at Hakodate. The male is the type: it is 26 cm. in length and is numbered 7710, Ichthyological Collections, Leland Stanford Junior University Museum.

(Named for the late Dr. Solomon Herzenstein, of St. Petersburg, in recognition of his excellent work on the fishes of the Hokkaido.)

26. CROSSIAS Jordan and Starks.

Crossias Jordan and Starks, new genus (*allisi*).

This genus is related to *Pseudoblennius* and *Bero*, probably closer to the latter. It differs from them in having 3 ventral rays; no palatine teeth; a single pair of multifid flaps on top of head behind orbital flaps; the tip of each dorsal spine fringed with cirri; and in having no external intromittent organ. Lateral line pores arranged in pairs above and below main sensory canal, which is not protected by concealed plates, and does not form a double curve anteriorly. Japan.

(κρόσσος, fringes.)

37. CROSSIAS ALLISI Jordan and Starks, new species.

Head $2\frac{4}{5}$ in length without caudal; depth $3\frac{3}{4}$. Dorsal VII–16 or 17; anal 13; lateral line 34; eye $4\frac{1}{5}$ in head; interorbital width 7; snout 4; maxillary $2\frac{1}{2}$; height of caudal peduncle $4\frac{1}{3}$.

Body not much compressed; behind head the width is four-fifths of the depth. Snout not very steep. Mouth little oblique; the upper jaw the longer; the anterior end of the maxillary on a level with the lower margin of eye or a little below; the maxillary reaches posteriorly to below the middle of eye. Small villiform teeth in bands on jaws and vomer; none on palatines; the vomerine patch rather short and but slightly curved; the bands widened in front on jaws. Interorbital space narrow and concave. Nasal spines well developed, although scarcely protruding through skin. A moderate spine at angle of preopercle but slightly hooked; below it a smaller triangular spine; next below a very small, blunt tubercle; lower anterior edge with a small spine directed forward. A multifid superorbital flap divided to its base into 5 or 6 parts; and a similar one at posterior end of parietal region.

Skin everywhere naked; no rough plates behind axil. Lateral line a nearly straight main tube, unprotected by concealed plates, only slightly curved anteriorly, and not undulating; very short branches above and below, opposite to each other and ending in small pores.

The tip of each dorsal spine fringed with 5 or 6 tentacles. Spinous

dorsal rather low; the third spine the highest, though but little higher than the second and fourth, its length $4\frac{1}{3}$ in head. The dorsals very slightly connected at extreme base. Soft dorsal much higher than spinous; the longest rays $2\frac{1}{2}$ in head; the last ray adnate to caudal peduncle; its tip reaches well beyond that of last anal ray, but scarcely to above base of caudal rays. Anal lower than soft dorsal, its longest rays 3 in head. Pectoral with 15 rays, the longest the sixth from the top; it barely reaches past front of anal, and is equal to length of head. Ventral with a concealed spine and 3 soft rays, the middle ray the longest; the others equal; its tip does not reach quite to vent. Caudal somewhat rounded.

Color brownish on sides and upper parts, white below; 5 dark spots on back above lateral line; 1 under spinous dorsal, 3 under soft dorsal and 1 on caudal peduncle; these sometimes conspicuous, sometimes so broken up and mixed in with the general mottling of the

FIG. 28.—CROSSIAS ALLISI.

back and sides as to be obscure; dark brown of lower part of sides with many round light spots cut into it, these unpigmented or milk white; a white spot at base of middle caudal rays; obscure bars radiate from eye, 1 to each side of snout, 1 across end of maxillary, and 1 down and back across cheek; spinous dorsal irregularly mottled; soft dorsal nearly uniform light dusky showing faint traces of mottlings; each ray of anal with 5 or 6 dark conspicuous points, so wide apart as scarcely to form lines across fin, but giving fin a uniform spotted appearance; pectoral dusky above, lower rays light; a dark blotch at base of middle rays and sometimes a dark dot on base of lower rays; ventrals colorless or sometimes with faint cross lines; caudal with faint dusky, wavy cross lines.

Here described from the type and a cotype from Hakodate, 75 mm.

and 68 mm. in length. A large number of much smaller cotypes were collected at Hakodate, and a couple at Same.

The type is numbered 7711, Ichthyological Collections, Leland Stanford Junior University Museum. Cotypes are No. 50922, U.S.N.M.

(Named for Edward Phelps Allis, of Milwaukee.)

27. COTTIUSCULUS Schmidt.

Cottiusculus SCHMIDT, Manuscript (*gonez*).

This genus resembles *Gymnocanthus* in the armature of the preopercle, but has a depressed head and body; teeth on vomer and palatines; skin on head and body entirely naked; no concealed lateral line plates; no superorbital tubercles; no external intromittent organ. Ventral rays I, 3.

(Name a quasi diminutive of *Cottus*.)

a. Gill membranes forming a broad fold across the isthmus; nasal spine simple. *gonez*, 38.

aa. Gill membranes forming a narrow fold across the isthmus; nasal spine forked. *schmidti*, 39.

FIG. 29.—COTTIUSCULUS GONEZ.

38. COTTIUSCULUS GONEZ Schmidt.

Cottiusculus gonez SCHMIDT, Manuscript: Vladivostok, Aniva Bay, Sakhalin.

Head 2¼ in length without caudal; depth 3. Dorsal VII–12; anal 13; lateral line with 31 pores. Eye 4 in head; snout 4; maxillary 2½; interorbital space 3 in eye.

Head and anterior part of body depressed; body nowhere compressed; as wide as deep posteriorly. Small villiform teeth in narrow bands on jaws, vomer, and palatines. Maxillary reaching to below anterior margin of pupil; jaws even, or the lower very slightly included. Eyes very narrowly separated; interorbital space concave. Nasal spines simple, small, and sharp, not double as in *Gymnocanthus*

schmidti. Spine at angle of preopercle long and rather stout; reaching beyond edge of opercle; armed above with a large anther-like process near its end and usually a very small one near its middle. Lower edge of preopercle with 3 short spines; the upper one directed backward; the middle downward and slightly forward. Large pores scattered over head and along lower edge of mandible. Branchiostegal membrane with a fold across isthmus, which is broad in comparison with that of *C. schmidti*. Body entirely naked. Lateral line pores large and conspicuous.

Pectoral with 22 rays; its tip reaches a little past front of anal, and reaching a little farther posteriorly than soft dorsal, but not nearly to caudal. Caudal slightly rounded. Ventral with 1 spine and 3 rays; the inner ray the longest, reaching three-fourths of the distance from its base to vent.

Color greyish brown on back and top of head; somewhat mottled; small irregular dark spots along side; usually the beginning of 3 cross bands on back; one under spinous dorsal, one under soft dorsal, and one on caudal peduncle; spinous dorsal with a dark edge above; rays of soft dorsal, caudal, and pectoral crossed by dusky, irregular lines; belly and under parts white; ventrals and anal white.

Here described from 5 cotypes collected by Peter Schmidt at Aneiva Bay, Saghalin. (No. 7713, Ichthyological Collections Leland Stanford Junior University.) The largest is 57 mm. in length. This species was also taken in Peter the Great Bay, near Vladivostok. We have Dr. Schmidt's kind permission to include this interesting species in the present review.

39. COTTIUSCULUS SCHMIDTI Jordan and Starks, new species.

Head $2\frac{1}{2}$ in length without caudal; depth $4\frac{1}{2}$. Dorsal VII–13; anal 12. Lateral line 27. Eye $3\frac{1}{2}$ in head; snout $3\frac{3}{4}$. Interorbital space (bone only) $\frac{1}{4}$ eye. Maxillary 3 in head; longest pectoral ray $1\frac{1}{8}$; third dorsal spine $3\frac{1}{6}$; longest dorsal rays $2\frac{2}{3}$; longest anal rays 4; length of ventrals $2\frac{1}{6}$; length of caudal $1\frac{3}{4}$; height of caudal peduncle 6.

Head and body anteriorly depressed; body growing round posteriorly, nowhere compressed. Mouth small, maxillary reaching slightly past front of eye; lower jaw included. Villiform teeth in rather narrow bands on jaws and vomer; in a very small patch on palatines. Nasal spine forked; the forks rather sharp and subequal in size. Angle of preopercle with a long, strong, slightly curved spine, which reaches beyond edge of opercle and is armed above with 2 or 3 sharp, antler-like processes; lower edge of preopercle with 3 spines, the middle one the smallest, the lowest one pointing forward, the upper one just at base of long spine, pointing backward and slightly downward. Lower corner of subopercle angulated and rather sharp.

Posterior nostril ending in a tube. Head covered with pores having raised rims. Male with a large, simple, superorbital tentacle,

which is entirely absent in the female. Interorbital space very narrow and concave.

Gill membranes connected and attached to isthmus, leaving a slight ridge, but no broad fold across isthmus, as in *Cottiusculus gonez*. Skin everywhere naked.

Pectoral with 21 rays; the sixth or seventh from the top the longest, reaching to above base of second or third anal ray. Ventrals with a concealed spine and 3 soft rays each; the inner ray the longest, reaching scarcely to vent. Soft dorsal much higher than spinous; the last ray not adnate. Tips of last anal rays reaching slightly past those of dorsal, but not to base of caudal. Caudal broadly rounded.

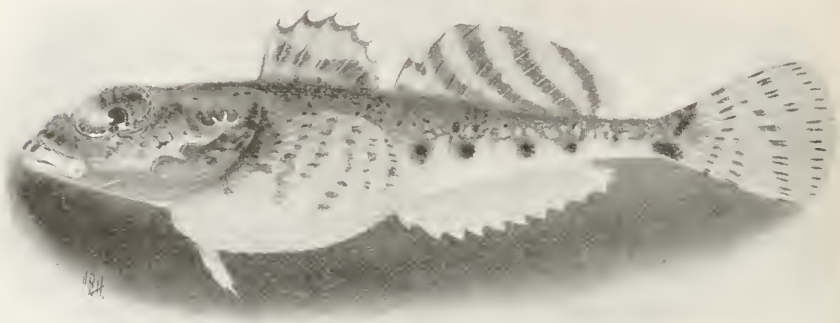


FIG. 30.—COTTIUSCULUS SCHMIDTI.

The above description is of a female. The male differs in having longer fin rays; some of the anterior dorsal spines filamentous and reaching past middle of base of soft dorsal; tips of last dorsal rays on the same vertical with those of anal; pectorals reaching to above fourth or fifth anal ray. No external intromittent organ.

Color brown above lateral line, slightly mottled with small irregular light spots; below lateral line white, spotted with a few brown spots following along lower edge of lateral line; no cross bars or radiating lines from eye; a dark spot on last dorsal spines; pectoral with fine spots in the female, with large spots in the male; soft dorsal with oblique cross bands, much wider and blacker in the male; caudal with 3 or 4 wavy cross bands; anal and ventrals white.

This species resembles *Cottiusculus gonez* Schmidt, but differs from it in having the nasal spine forked and in not having a broad fold across isthmus.

The type and several cotypes were dredged by the U. S. Fish Commission steamer *Albatross*, at stations 3772 and 3773, off Kinkazwan Island in Matsushima Bay. The largest is 92 mm. in length.

The type is in the U. S. National Museum and is numbered 50923. A cotype is No. 7714, Leland Stanford Junior Ichthyological Collections.

(Named for Dr. Peter Schmidt, of St. Petersburg, who collected in Japan and Siberia in 1900.)

28. ELAPHICHTHYS Jordan and Starks.

Elaphichthys JORDAN and STARKS, new genus (*elongatus*).

This genus differs from *Gymnocanthus* and *Cottiusculus* in having teeth on vomer and palatines, in having but 2 ventral rays, and in having the skin of the head smooth, not covered with rough plates as in the former genus. From *Furcina* it differs in the armature of the preopercle and in the absence of tentacles on top of head (resembling in these characters *Gymnocanthus* and *Cottiusculus*). Coasts of Japan.

(ἐλάθος, stag; ἰχθύς, fish.)

40. ELAPHICHTHYS ELONGATUS (Steindachner).

UMIKAJIKA (SEA SCULPIN).

Centridermichthys elongatus STEINDACHNER, Ich. Beitr., X, 1881, p. 86; Strielok, Japan Sea (near Vladivostok). The plate, taf. VI, fig. 2, named *Centridermichthys glaber*.—STEINDACHNER and DÖDERLEIN, Fische Japans, IV, 1887, p. 259.

Head 3 in length; depth 6. Dorsal X–17 or 18; anal 16; ventral I, 2.

Body elongate, mouth rather long; maxillary scarcely reaches to below posterior orbital rim. Jaws, vomer, and palatines with sharp teeth in bands. Eye oval; its long diameter equal to length of snout, or is contained four times in head.

Preopercle spine long, sharp, curved, and compressed, bearing on its upper edge one or two sharp processes. Top of head without tentacles. Gill membranes connected, free from isthmus.

Skin on head thin. A row of toothed plates along the lateral line and a few rough scattered plates on anterior part of body under lateral line. Skin above lateral line smooth, or thickly set with diminutive spines, as in *Trachidermus* Heckel.

Color.—Back gray-violet with dark red-violet, curved wavy, long spots, which sometimes run together; seldom dark cross bands on the lower half of body as in *Bero elegans*. (Steindachner.)

This species is not represented in our collections.

(*elongatus*, lengthened.)

29. ALCICHTHYS Jordan and Starks.

Alcichthys JORDAN and STARKS, new genus (*alcicornis*).

This genus differs from *Pseudoblennius* and *Bero* in having the large preopercular spine flat, broad, and divided into many points; and in having the cirri on top of head usually simple.

Seas of northern Japan.

(*alce*, elk; ἰχθύς, fish.)

41. ALCICHTHYS ALCICORNIS (Herzenstein).

BEROKAJIKA.

Centridermichthys alcicornis Herzenstein, Zool. Mus. Kais. Akad. Wiss. St. Petersburg, XIII, 1890, p. 115; Yeso (Hokkaido).

Head $2\frac{2}{4}$ in length without caudal; depth $5\frac{1}{4}$. Dorsal X–17; anal 13; lateral line 36. Eye 6 in head; interorbital width 10; maxillary 2; snout $3\frac{1}{2}$; first dorsal spine $3\frac{1}{6}$; third dorsal spine $2\frac{1}{2}$; longest dorsal rays $2\frac{1}{3}$; longest anal rays 3; pectoral $1\frac{1}{3}$; ventral $3\frac{1}{6}$; caudal $1\frac{5}{6}$.

Head not depressed, about as wide as deep; body slender, slightly compressed posteriorly. Mouth large; lower jaw included; maxillary reaching to below posterior margin of eye. Small, sharp, conical teeth on jaws, vomer and palatines; the palatine patch about as wide as that on mandible; the vomerine patch narrower. Interorbital space

Fig. 31.—Alcichthys alcicornis.

moderately concave. A slight low ridge runs back from interorbital and curves outward on top of head to occiput. Processes from premaxillary strongly produced; nasal spines on each side of it well developed, triangular, not very sharp. Preopercle spine spreading out flat and wide, and divided into from 3 to 5 diverging points directed more or less upward; below it are 3 sharp points, growing larger downward, and all directed downward. Lower end of subopercle angulated and rather sharp. A wide multifid flap over posterior part of eye, a simple tentacle on middle of ridge on top of head, and a similar one at end of ridge on occiput. These are usually simple but frequently one or more of them are bifid.

Dorsals close together but not connected. Tips of spines when fin is depressed reach slightly past first dorsal ray. Tips of last dorsal rays

reach well past those of anal, but not to above base of dorsal. Pectoral with 16 rays; its tip reaching to opposite front of anal. Ventral short; once concealed spine and 2 soft rays; reaching half the distance from their base to anal papilla. Lateral line with small imbedded plates; a few scattered plates, with rough posterior edges behind axil. Skin otherwise naked and smooth.

Color light brown on back, somewhat mottled, shading lighter below to white on lower parts; spinous dorsal light; an irregular dusky blotch at each end; anal and soft dorsal crossed by oblique, dark bands, less oblique and more conspicuous on the former; pectoral with dusky cross bands and narrow white interspaces; base of caudal dusky.

Here described from a specimen 26 cm. in length, from Same in Rikuchu. Other specimens are from Hakodate.

(*alce*, elk; *cornu*, horn.)

30. FURCINA Jordan and Starks.

Furcina JORDAN and STARKS, new genus (*ishikawæ*).

This genus differs from *Pseudoblennius* in having 2 spines at angle of preopercle, the upper one forked; and in having a pair of very small simple cirri usually present at the nape. Ventral rays I. 2.

Small fishes of the coasts of Japan.

(*furca*, a fork.)

a Dorsal rays X–19 or 20; anal rays 17 or 18; preopercular spine narrowly forked; spinous dorsal notched ..... *ishikawæ*, 42.

aa Dorsal rays X–17 or 18; anal rays 14 or 15; preopercular spine broadly forked; spinous dorsal slightly notched ..... *osimæ*, 43.

42. FURCINA ISHIKAWÆ Jordan and Starks, new species.

Head $2\frac{5}{6}$ to $3\frac{1}{6}$ in length without caudal; depth 4. Dorsal X–19 or 20; anal 17 or 18; pores in lateral line 39; V. I, 2. Eye 4 in head; snout $3\frac{3}{4}$ to 4; maxillary $2\frac{1}{4}$ to $2\frac{3}{8}$; interorbital width 8; height of caudal peduncle 5.

Snout rather bluntly rounded and steep; jaws even, or the upper a little longer; maxillary reaching to below posterior margin of pupil. Villiform teeth on jaws, vomer and palatines; the band or premaxillary widened in front; that on mandible scarcely, or but very little widened; the palatine band short and rather wide. Interorbital narrow and moderately concave. Preorbital with 2 spines at its angle; the upper one divided at its tip and very narrowly forked; it is somewhat hooked upward; the lower one is simple, sharp, but little if any shorter, its tip directed straight backward. Anterior lower edge of preopercle with a very small blunt spine or tubercle, directed forward; posterior edge sometimes with a couple of small tubercles, sometimes smooth. Nasal spines small but sharp. A pair of multifid flaps over posterior margin of eye, and a pair of simple, or sometimes

bifid, tentacles at occipital region; a small simple tentacle sometimes presented at end of maxillary.

Lateral line forming a double curve anteriorly; each anterior pore usually with a simple tentacle. Sides under anterior part of lateral line with a few scattered rough plates; body otherwise naked.

Pectoral with 15 rays, the lower 8 swollen, the upper of which is the longest, reaching beyond the rays just above it and to above base of fourth or fifth anal ray; it is as long or sometimes exceeds the length of head. Bases of first and second dorsal spines in contact; third spine sometimes a little shorter than the first and fourth, making a shallow notch in upper outline of fin; the notch never so deep as in *F. osimæ;* usually third spine is as long or sometimes longer than first; first spine $2\frac{1}{3}$ to $2\frac{2}{3}$ in head; last spine as long as eye, and connected to soft dorsal for nearly its whole length. Soft dorsal higher than spinous, its longest rays $1\frac{5}{6}$ to $2\frac{1}{6}$ in head; posterior ray adnate

FIG. 32.—FURCINA ISHIKAWÆ.

to caudal peduncle; tips of last rays reach beyond those of anal to above base of caudal rays. Anal lower than soft dorsal, its longest rays $2\frac{1}{6}$ to $2\frac{2}{6}$ in head. Ventrals with a concealed spine and two soft rays each; the inner ray the longer, 3 in head. When the caudal is closed its posterior outline is very slightly concave; when spread it is truncate or feebly convex; its length $1\frac{1}{2}$ in head.

Color brownish above; white on belly and under parts; back with 4 cross bars; the first under middle of spinous dorsal extending forward to base of pectoral; the second under front of soft dorsal; the third under middle of soft dorsal, and the fourth under third and fourth rays from end of soft dorsal; below are a series of connected, inverted U-shaped marks, reaching above lateral line behind its curve, and connected more or less with cross bars on back; between these are smaller irregular spots mottling the sides; indefinite bars radiating from eye; a small dark spot on end of maxillary; a dark bar on base of middle

pectoral rays running backward and downward and becoming diffused toward ends of rays; a similar smaller one on lower rays; each ray of pectoral often with several small spots forming irregular cross streaks; an irregular dark blotch on first dorsal spines and one on middle spines; soft dorsal and anal with oblique dark streaks across the rays; anal sometimes uniformly dusky toward ends of rays, the tips of the rays white; caudal crossed with dark wavy streaks.

Numerous specimens taken at Myiako in Rikuchu, at Wakanoura, and at Hakodate. The type is from Myiako; it is 87 mm. in length, and is numbered 7715, Ichthyological Collections, Leland Stanford Junior University Museum. Cotypes on No. 50924, U.S.N.M.

(Named for Dr. Chiyonatsu Ishikawa.)

43. FURCINA OSIMÆ Jordan and Starks, new species.

Head 3 in length without caudal; depth 4. Dorsal X–17 or 18; anal 14 or 15; lateral line with 37 pores. V. I, 2. Eye 4 in head; interorbital width 7; snout 4; maxillary 3; height of caudal peduncle $4\frac{1}{2}$.

FIG. 33.—FURCINA OSIMÆ.

Lower jaw included. Mouth small, the maxillary reaching to anterior margin of pupil. Villiform teeth in bands on jaws, vomer, and palatines; the palatine band rather wide. Preopercle with 2 spines at its angle, the upper spine hooked and divided into 2 points; much more widely forked than in *F. ishikawæ*; the notch between the points rounded; the lower spine simple, much smaller, and directed straight backward. A small blunt spine under the skin on lower anterior edge of preopercle, directed forward. Posterior edge of preopercle nearly smooth, or with a couple of scarcely developed tubercles. Nasal spines well developed and sharp. The usual multifid flap present above posterior border of eye; a forked flap at posterior end of parietal region; a smaller one at nasal spines, and a smaller simple one at posterior end of maxillary.

Anterior part of lateral line double curved and sparsely fringed with small tentacles; below it and above pectoral are 1 or 2 rows of small rough plates which do not extend posterior to pectoral.

Pectoral with 14 rays, the lower 8 swollen; its tip reaches to above base of second or third anal ray. The anterior 3 dorsal spines shorter than those just behind; the third spine shorter than the first, notching the outline of the fin; first spine $3\frac{1}{3}$ in head, the third $3\frac{2}{3}$; the fourth 3. Behind the fifth the spines rapidly decrease in length; the dorsals joined at the base, but not nearly so broadly as in *F. ishikawæ*. Second dorsal higher than first; the longest rays $2\frac{1}{6}$ in head; the last ray is adnate to caudal peduncle; the tips of the last rays reach past those of anal, usually scarcely reaching to above base of caudal. Anal lower; the last ray free from caudal peduncle; the longest rays 3 in head. Caudal more rounded than in *F. ishikawæ;* the middle rays of the closed fin reaching beyond the outer rays, its length is $1\frac{2}{3}$ in head.

Color much as in *F. ishikawæ;* the cross markings the same, though more broken up, and the lower part of the sides more finely mottled; pectoral similar; spinous dorsal uniformly mottled, cross bands, soft dorsal, anal, and caudal wider and darker; the anal never uniformly dusky toward tips of rays; the branchiostegal rays usually strikingly marked with a streak of milk white along each ray, in strong contrast with the unpigmented breast; a small area in front of them white; the membrane between each ray is often black.

This species may be at once known from *F. ishikawæ* by the fewer fin rays, the more widely forked preopercular spine, and by the deeper notch in spinous dorsal. Of the 10 specimens of this species and 30 or 40 of *F. ishikawæ* that were examined, no variation of fin rays was found outside of the limits here given.

This species is probably less common than *F. ishikawæ*. Specimens were taken at Hakodate and Misaki. The type is from the former place; it is 77 mm. in length and is numbered 7716, Ichthyological Collections, Leland Stanford Junior University Museum. A cotype is No. 50925, U.S.N.M.

(From *Oshima*, great island, the province of Hokkaido, of which Hakodate is the capital.)

31. OCYNECTES Jordan and Starks.

Ocynectes Jordan and Starks, new genus (*maschalis*).

This genus is closely related to *Bero*, but differs particularly in the character of the lateral line, which is not undulating anteriorly and is not protected by concealed plates, but usually has a small tentacle at each pore. The pectorals are very large, half the length of body without head, or exceeding the length of head.

This genus resembles *Blennicottus* of the California coast, but it has only two ventral rays, as do all of the Japanese genera that closely center about *Pseudoblennius*.

Small fishes of the Japanese rock pools.

(ὀκύς, swift; νεκτής, swimmer.)

44. OCYNECTES MASCHALIS Jordan and Starks, new species.

Head $3\frac{2}{5}$ in length without caudal; depth $4\frac{1}{2}$ to $4\frac{4}{5}$. Dorsal IX–13 or 14; anal 10; lateral line pores 34. Eye $4\frac{1}{2}$ in head; snout $3\frac{3}{4}$, maxillary $2\frac{3}{5}$; height of caudal peduncle $3\frac{1}{4}$. Bony interorbital width half eye.

Profile of head very slightly convex and gently sloping to snout; snout steep; lower jaw included. Mouth small, little oblique, anterior end of maxillary well below level of eye; maxillary reaching posteriorly to below middle of eye. Interorbital space narrow and deeply

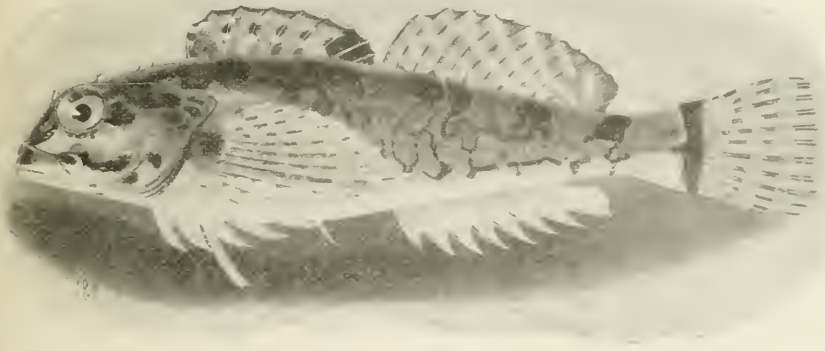


FIG. 34.—OCYNECTES MASCHALIS.

concave. Teeth fine villiform, in bands on jaws, vomer, and palatines; the premaxillary band much widened in front, that on mandible but little widened; the palatine patch rather broad and short. Top of head with 3 pairs of multifid flaps; the first pair over posterior orbital rim; the posterior pair at occipital region; the middle pair closer to each other than the others are, and closer to the posterior pair than to the orbital pair. Head otherwise without tentacles. Nasal spines prominent; the hooked spine at angle of preopercle is rather small and blunt, its tip not projecting through skin; below it on edge of preopercle are a couple of blunt, bony tubercles.

Lateral line curved up anteriorly, but not undulating in species of *Pseudoblennius* and *Bero;* anteriorly each pore usually bears a small tentacle. Skin everywhere naked.

Pectoral with 15 simple rays, the lower 8 swollen; the upper swollen ray much longer than any of the others; the rays rapidly becoming

shorter above and below it; the fin very large and sharply pointed behind, reaching to above base of second of third anal ray; its greatest length $2\frac{4}{5}$ in length without caudal. Ventrals short, with a concealed spine and 2 soft rays, the inner ray the longer, scarcely reaching to vent; their length $2\frac{1}{6}$ in head. Spinous dorsal low and long, rounded at each end, very gently rounded above, nearly level; spines scarcely varying in length from third to seventh, their length $3\frac{3}{5}$ in head. Dorsals barely separated. Soft dorsal much higher than spinous; the highest rays just behind the third or fourth; their length $2\frac{1}{2}$ of head; last ray adnate to caudal peduncle; the tips of last rays about on a vertical with those of anal, and ending in front of base of caudal a distance equal to diameter of eye. Caudal truncate, the outer angles very slightly rounded, its length $1\frac{2}{5}$ in head. Longest anal rays near posterior end of fin, their length $2\frac{1}{4}$ in head, the last ray free from caudal peduncle.

Color slaty brown on back and sides, mottled with darker; 5 irregular blotches on back above lateral line, 2 under each dorsal, and one across caudal peduncle; a dark crossbar at base of caudal; a dark spot at posterior end of spinous dorsal; the fin mottled with dusky, growing dark toward edge, and narrowly bordered with white; the rays of pectoral and caudal crossed with dusky irregular bands, the color not involving the membrane; the soft dorsal with oblique, dusky bands running back and down across rays, sometimes on membrane, sometimes on rays only; a few dark dots on rays of anal, but so sparse as to scarcely indicate bands; ventrals colorless; a single conspicuous black dot always present on axil; underpart of head creamy white in contrast with the unpigmented underparts of body.

A few specimens taken at Enoshima, and 2, one of them the type, taken at Wakanoura. The type is 55 mm. in length; the others do not exceed that length.

The type is numbered 7717, Leland Stanford Junior University Museum. Cotypes are No. 50926, U.S.N.M.

(*μασχάλη*, the armpit.)

32. PSEUDOBLENNIUS Schlegel.

Pseudoblennius Schlegel, Fauna Japonica, 1850, p. 313 (*percoides*).
Pseudoclinus Schlegel, Fauna Japonica, pl. lxxix *a*, same type.

Body and head compressed; skin naked, or with a few scattered small plates under pectoral; preopercle with a single hooked spine at angle; gill membrane connected, but free from isthmus; small sharp teeth in bands on jaws, vomer, and palatines; mouth large; a tentacle above eye; no slit behind last gill arch; branchiostegals 6; dorsal with about 10 spines, separated from the soft portion or connected at extreme end only; pectoral rays all simple, the lower ones swollen; ventrals very small, a concealed spine, and 2 soft rays; copulating

organ of male large and trilobate at its end;[a] lateral line forming a double curve anteriorly. Coasts of Japan.

(*ψευδής*, false; *blennius*, the form and bright coloration resembling that of some clinoid blennies.)

a Edge of spinous dorsal even and entire, without a notch.
b Teeth sharp and conical; small nasal spines present.
c Maxillary reaching slightly beyond eye; snout long and sharp....*percoides*, 45.
cc Maxillary not reaching beyond eye; snout shorter and blunter....*cottoides*, 46.
bb Teeth villiform; nasal spines obsolete.....*zonostigma*, 47.
aa Spinous dorsal with a notch above.
d Anterior dorsal spines elevated; dorsal IX–20; anal, 17.....*marmoratus*, 48.
dd Anterior dorsal spines not elevated; dorsal IX–16; anal, 13....*lgtomius*, 49.

45. PSEUDOBLENNIUS PERCOIDES Günther.

ANAHAZE[b] (ROCK POOL GOBY); YANAGI HAZE (WILLOW GOBY).

Pseudoblennius SCHLEGEL, Fauna Japonica, Poiss., 1850, p. 313, pl. LXXIX*a*, figs. 2, 3, called *Pseudoclinus;* Omura, near Nagasaki.
Pseudoblennius percoides GÜNTHER Cat. Fish, II, 1860, p. 297, after Schlegel.
Centridermichthys percoides STEINDACHNER and DÖDERLEIN, Fische Japans, III, 1884, p. 209; Tokyo.—ISHIKAWA, Prel. Cat., 1897, p. 48; Hokkaido, Boshu.
Psudoblennius anahaze BLEEKER, Poissons Connues du Japon, 1879, p. 11, after Schlegel.
Centridermichthys schlegeli DÖDERLEIN, Fische Japans, III, 1884, p. 210; Tokyo.
Centridermichthys argenteus DÖDERLEIN, Fische Japans, IV, 1887, p. 257; Tokyo.

Head $2\frac{2}{3}$ to $2\frac{3}{4}$ in length without caudal; depth $4\frac{1}{2}$. Dorsal X-18; anal 17; pores of lateral line 36. Eye $5\frac{1}{2}$ in head; interorbital space 8; snout $3\frac{1}{4}$; maxillary 2; height of caudal peduncle 4. Upper profile of head rather evenly and gently curved to tip of snout; the premaxillary processes very slightly produced, making a small blunt angle behind middle of snout. Mouth large; the maxillary terminating just past posterior border of eye. Lower jaw included. Small sharp, conic, depressible teeth in bands on jaws, vomer, and palatines; those on palatines much smaller than elsewhere; the bands on premaxillaries very much widened in front, on mandible only a little widened; the

[a] Mr. Michitaro Sindo has examined the reproductive organs of this genus and reports as follows: "The copulatory organ of the male is placed immediately behind the vent. It is a long, large, rod-like external process, divided at the end into two lateral knob-like processes and one slender posterior process, which is hooked anteriorly between the lateral ones. The posterior process arises from a firm round body embedded at the root of the lateral papillæ within a membranous fold, and distally terminates in a glandular sac. The seminal duct pierces through the rod and bifurcate laterally beneath the root of the posterior process, each branch opening externally at the end of the lateral papilla. In the female the oviduct forms a thick walled muscular vestibule which is lobulated and opens to the exterior just behind a rather firm dermal papilla, immediately behind the vent. The cloacal opening thus formed is in the resting stage, and is covered over by a thin membrane. The proximal end of the vestibule is divided into two muscular horns which are prolonged into the anterodorsal part of the body cavity and come into relation with the ovary of each side. The impregnation is evidently intrauterine, the eggs developing in the uterine horns."

[b] *Ana*, means crevice; *haze*, goby.

vomer projects conspicuously below the level of the palatines. Interorbital width two-fifths of length of orbit; it is slightly and evenly concave, and with a small median canal which is not evident until the skin is pressed into it. Superorbital tentacle thin and flat, about as long as pupil; a very small nasal tentacle present. Snout long, narrow, and rather sharp, $1\frac{1}{2}$ or $1\frac{3}{5}$ in postorbital part of head. A small sharp spine at edge of preopercle opposite end of suborbital stay; below it edge of preopercle is apparently smooth, though at anterior lower edge under the skin there is a small tubercle of bone hooked downward, with usually a smaller one above it, nasal spines very small but evident. Skin everywhere smooth.

Pectoral reaches to front of anal; it has 15 simple rays, the ninth from the top the longest, $1\frac{3}{5}$ in head, the lower 7 rays swollen; the rays above the longest are truncated slightly obliquely, those below decrease rapidly in length. Ventrals with 2 rays, the inner slightly the longer; they reach half of the distance between their base and vent. Spinous dorsal rather low, rounded posteriorly, level and straight above, not elevated anteriorly, the first spine but little shorter than the second, which equals in length 4 or 5 spines behind it, 3 to $3\frac{1}{2}$ in head. Soft dorsal higher than spinous, the highest rays $2\frac{2}{3}$ to 3 in head. Third anal ray $3\frac{1}{2}$ in head. Caudal truncate or slightly rounded, its length $1\frac{5}{6}$ to 2 in head.

Color in spirits brown above, lighter below, back and sides with 6 usually inconspicuous blended crossbars, broken at lateral line; sometimes below lateral line alternating with those above; 2 under spinous dorsal, 3 under soft dorsal, and 1 at caudal peduncle; a dark bar present across nape, a dark irregular streak backwards from eye, and a row of 5 or 6 dark spots across maxillary and cheek below suborbital stay. All of the above bars sometimes very conspicuous, very inconspicuous or entirely absent. Sides usually with many small round dark spots, which are ringed with white where they cut into the dark crossbars; sides of head on some specimens with reticulated dark lines; dorsal spines dark, 4 or 5 with a dark blotch across membrane, behind them membrane is transparent, but edged above and behind with dark; soft dorsal usually uniformly dark, but sometimes with faint light lines across rays; anal sometimes white, pectoral with dark blotch on base of middle rays and a smaller one on lower 1 or 2 rays; a dark spot just at base of upper ray; a row of dark spots ocellated with white along upper and lower edges of caudal. In life, the ground color is subject to variations, usually olive brown; it is sometimes green and often red.

Here described from specimens from 13 to 18 cm. in length. Specimens were taken at Tokyo, Matsushima, Misaki, Wakanoura, Nagasaki, Hiroshima, and Tsuruga. It is one of the commonest fishes of the coast of Japan, daily in the markets, but little valued as food.

($\pi\acute{\epsilon}\rho\kappa\eta$, perch; $\epsilon\tilde{\imath}\delta\omega\varsigma$, likness.)

46. PSEUDOBLENNIUS COTTOIDES (Richardson).

Podabrus cottoides RICHARDSON, Voy. Samarang, Fishes, p. 13, pl. 1, figs. 1–6. (Sea of China).—GÜNTHER, Cat. Fish, II, 1860, p. 152; same specimens.

Centridermichthys japonicus STEINDACHNER, Ichth. Beitr., X, 1881, p. 187; Kanagawa, near Yokohama, Japan.—STEINDACHNER and DÖDERLEIN, Fische Japans, IV, 1887, p. 259.

Centridermichthys affinis, STEINDACHNER and DÖDERLEIN, Fische Japans, IV, 1887, p. 257; Tango, Kanagawa.

Head $2\frac{4}{5}$ to 3 in length without caudal; depth $4\frac{1}{4}$ to $4\frac{1}{2}$. Dorsal X–19 or 20; anal 17 or 18; pores in lateral line 42. Eye $4\frac{1}{2}$ to 5 in head (4 in specimens 8 cm. long); interorbital space $7\frac{1}{2}$ to 8; snout $3\frac{1}{2}$ to $3\frac{3}{4}$; maxillary $2\frac{4}{5}$; height of caudle peduncle 5.

Shape of head and body much as in *P. percoides;* the snout shorter, the body tapering into a more slender, less compressed caudal peduncle. Mouth rather large, the maxillary usually scarcely reaching to posterior border of eye. Lower jaw included. Teeth as in *P. percoides.* Interorbital space with a narrow canal, hidden by the skin. Superorbital tentacle flat; its length usually exceeding that of pupil; a small nasal tentacle present. Snout longer than eye by about half the diameter of the latter, $1\frac{2}{3}$ to 2 in postorbital part of the head. Preopercle with a small, sharp, hooked spine at its edge opposite end of suborbital stay and a very small spine hooked forward at its lower anterior edge, completely covered by the skin. Nasal spines present, but very small. A few small, rough, bony plates beneath and just above pectoral. Skin otherwise perfectly smooth.

Pectoral rays all simple, tip of fin reaching to front of anal; its length $1\frac{2}{5}$ in head. Ventrals with 2 rays; their length 4 in head. First and second spines of dorsal equal in length and slightly higher than other spines, their length 3 in head; spinous dorsal rounded posteriorly. Caudal very slightly concave, its length $1\frac{4}{5}$ in head.

Color brown on back, lighter below, belly and lower parts white; sides with 6 rather conspicuous dark cross bars; usually there are 2 rows of clear cut white spots, somewhat larger than pupil along the sides below the lateral line; many of the spots in the upper row run together, those in the lower row frequently half spots or running into the white of lower parts; lateral line running through a light streak; on its upper edge are conspicuous small, dark, brown spots irregularly placed; 2 or 3 dark spots below eye on cheek, 1 maxillary under front of eye; chin with dark spots around its edge; snout dark; spinous dorsal transparent behind second or third spine, bordered above and behind with dusky; anal and soft dorsal white with 5 or 6 black dots on each ray forming lines of dots obliquely across the fin running backward and upward toward the body; membrane transparent; pectoral rays with similar spots, the lower rays white; a dark spot at base of middle rays and a similar smaller one on lower rays;

caudal dusky, the upper and lower rays with 4 or 5 half-round spots open outward; each of the rays between with smaller white spots.

This species may be known from *P. percoides* by the shorter maxillary, the narrower caudal peduncle, the shorter snout, and by the color. It is here described from specimens from 12 to 15 cm. in length. Specimens were taken in abundance at Misaki, Matsushima, Onomichi, Aomori, Enoshima, Yokohama, Tokyo, Tsuruga, and Hakodate. The species is scarcely less common than *Pseudoblennius percoides*. There can be no doubt of the identity of *P. cottoides*, *japonicus*, and *affinis*.

(*cottus*, sculpin; *εἶσως*, resemblance.)

47. PSEUDOBLENNIUS ZONOSTIGMA Jordan and Starks, new species.

Head $2\frac{3}{5}$ in length without caudal; depth 4. Dorsal X–19; anal 17; pores in lateral line 39. Eye $4\frac{1}{2}$ to 5 in head; interorbital space 6, bone only 9; snout $3\frac{1}{2}$; maxillary 2; height of caudal peduncle $4\frac{1}{2}$.

Head rather large; body deepest under middle of spinous dorsal, tapering into a moderately deep caudal peduncle. Mouth large, a little oblique, the maxillary reaching to below posterior orbital margin. Lower jaw scarcely as long as upper. Teeth villiform, finer than in any other Japanese member of the genus except *P. totomius*, in narrow bands on jaws, vomer, and palatines; the palatine patch very narrow. Interorbital space rather wide and shallow. A small sharp spine at angle of preopercle, hooked upward, its posterior edge scarcely forming an angle with edge of preopercle; a very small spine directed downward at anterior lower edge of preopercle; otherwise edge of preopercle is even and smooth. Nasal spine obsolete.

A small flat superorbital tentacle and a very small nasal tentacle present; anterior nasal ending in a tube. Skin everywhere smooth and naked; no plates under anterior part of lateral line.

Pectoral with 15 rays, the lower 8 swollen, the uppermost of which is the longest, reaching a little past front of anal and is equal to two-thirds the length of the head. Length of ventrals 4 in head. Spinous dorsal rather high and evenly rounded; the third spine $2\frac{3}{4}$ in head; it is entirely separated from soft dorsal; interval between equal to the space between soft rays at base. The soft dorsal only a little higher than spinous, the longest rays $2\frac{1}{2}$ in head; the last ray is not connected by membrane to caudal peduncle; the tips of the last rays reach to opposite those of anal and end at a distance from base of median caudal rays equal to the diameter of iris. Longest anal rays equal to those of soft dorsal. Caudal truncate, or very slightly convex when fin is spread.

Color dark brown on top of head and back, shading gradually downward to the white of lower parts; body entirely crossed by 6 double rows of small brown spots, about as large as pupil, these somewhat broken at lateral line and not arranged so regularly on back as below;

in the type specimen they are somewhat run together, forming double cross-streaks with uneven edges; a pair of rows across caudal peduncle, 3 pairs under soft dorsal, and 2 pairs under spinous dorsal; chin and snout dark; sometimes there is a dark band from eye along each side of snout and across chin; a dark spot on maxillary below eye; traces of a dark streak running back from eye to edge of opercle; a small dark spot on base of middle pectoral rays, sometimes shading downward and growing wider on lower rays; spinous dorsal with a jet-black spot on first and last spines; the fin bordered with dusky; soft dorsal with wavy dark stripes running backwards and downwards obliquely across the rays, these involving the membrane more than the ray; anal obliquely marked with broader bands which spring from the termination of the double body stripes at base of fin but run together toward edge of fin; caudal irregularly dusky; ventrals white.

FIG. 35.—PSEUDOBLENNIUS ZONOSTIGMA.

This species may be separated from the other known Japanese species *Pseudoblennius* by the color markings; from *P. percoides* and *P. japonicus* by the finer teeth and lack of nasal spines; from *P. marmoratus* by the wider caudal peduncle and by the spinous dorsal.

Two specimens were taken at Nagasaki, and one, the type, from Misaki. The type is 105 mm. in length; the larger of the cotypes is 120 mm.

The type is numbered 7718, Ichthyological Collections, Leland Stanford Junior University Museum. A cotype is No. 50927, U.S.N.M.

(ζονός, band; στίγμα, spot.)

48. PSEUDOBLENNIUS MARMORATUS (Döderlein.)

Centridermichthys marmoratus DÖDERLEIN, Fische Japans, III, 1884, p. 210; Tokyo.—STEINDACHNER, Fische Japans, IV, 1887, p. 259.

Head 3 in length, without caudal; depth $4\frac{1}{3}$. Dorsal IX–20; anal 17; pores of lateral line 37. Eye 5 in head; interorbital space $7\frac{1}{2}$, bone only 12; snout $3\frac{3}{4}$; maxillary $2\frac{1}{4}$; height of caudal peduncle $5\frac{2}{3}$.

Lower jaw included, snout $1\frac{1}{3}$ to $1\frac{1}{2}$ times longer than eye; maxillary reaching to behind pupil, scarcely to posterior border of orbit. Small, conical, sharp teeth in narrow bands on jaws, vomer, and palatines, smaller than in *P. japonicus* or *P. percoides;* the premaxillary band not so much widened in front; slightly than the bands on mandible; teeth on vomer and palatines equal in size; the vomer projects below the level of the palatines. Preopercle with a small sharp spine at angle, a very small, blunt, antrorse spine, covered by the skin, at lower anterior edge, and a couple of slight scollops on posterior edge. Nasal spines obsolete. Superorbital tentacle small and flat, shorter than pupil; small nasal tentacles present. Interorbital space rather narrow and deep.

Spinous dorsal elevated in front and with a rounded notch at its middle; the first and second spines much closer together at their base than are the others, the latter higher than the other spines, its length $2\frac{2}{3}$ in head, the first, the next highest, only slightly higher than the third, $3\frac{1}{6}$; the fourth much shorter, $3\frac{5}{6}$; the fifth and sixth slightly higher; the fin rounded behind. The soft dorsal higher than the spinous, the longest rays $2\frac{2}{5}$ in head; the last ray is connected to caudal peduncle by a membrane; the tips of the last ray reach slightly past those of anal. Anal much lower than soft dorsal, the longest rays $3\frac{2}{5}$ in head. Pectoral with 13 rays, the lower 8 swollen, the uppermost of which is the longest, and reaches a little past front of anal, its length $1\frac{1}{4}$ in head. Caudal rounded, its length $1\frac{4}{5}$ in head Lateral line with a strong double curve anteriorly, stronger than in other species. A row of small bony plates sometimes present above pectoral; skin otherwise naked.

Color.—Brown above, belly and under parts white; back above lateral line with dark cross bands; the first at front of spinous dorsal; the second just behind middle of spinous dorsal, the third under front of soft dorsal, the fourth under middle of soft dorsal, the fifth under sixteenth to eighteenth rays on the caudal peduncle; the sides below lateral lines mottled with irregular dark blotches; a dark band running anteriorly from nape through eye across maxillary, involving the iris; a dark band less conspicuous and more broken, running from eye backward across cheek following upper edge of suborbital stay; spinous dorsal dusky except on area at center, which is transparent; soft dorsal and anal with 6 to 7 dark cross bands running obliquely across rays from their tips slightly backward and upward toward

body, those on anal more conspicuous and regular; caudal dusky, outer rays with 3 white spots, inner rays with smaller, less conspicuous spots; a dusky blotch at base of middle pectoral rays, and a smaller one at lower rays; behind these are three or four dusky bars across the rays; ventrals white or sometimes with a dusky spot on their anterior half; all dark markings on body have a purplish or violet cast. Another specimen is much darker; the head is dark, with sharp-cut, irregular blotches separated by light lines; the bars across soft dorsal are broken up into many black streaks, and the bars on anal run together chain-like; the other fins are marked as before described, but the dusky is here black, making the contrast with the light much greater; the sides are very dark mottled with sharp-cut, irregular, and round white spots; chin and branchiostegals with round white spots.

This species may be known by the elevated first dorsal spine, the round notch in the spinous dorsal behind them, and by the slender caudal peduncle. It is evidently not so common as *P. percoides* and *P. japonicus*. Specimens were taken at Misaki and Enoshima. The longest 15 cm. in length.

(*marmoratus*, marbled.)

49. PSEUDOBLENNIUS TOTOMIUS Jordan and Starks, new species.

Head $2\frac{3}{4}$ in length without caudal; depth 4. Dorsal IX–16; anal 13; lateral line pores 37. Eye 4 in head; interorbital width 9, bony part only 12; snout $3\frac{1}{2}$; maxillary $2\frac{3}{5}$; height of caudal peduncle $5\frac{3}{4}$.

Jaws even. Mouth low, little oblique. Maxillary scarcely reaching to below middle of eye; its anterior end a little below the level of eye. Villiform teeth on jaws, vomer, and palatines, the bands on front of premaxillaries wider than elsewhere; the bands on vomer and palatines about equal in width. Interorbital narrower and concave, without a median channel. A sharp, strongly hooked spine at angle of preopercle, and a smaller one at lower anterior edge, directed forward, edge of preopercle between spines smooth and even. Nasal spines well developed. Superocular tentacle present.

Pectoral with 14 rays, the lower 7 swollen, the upper swollen ray projecting slightly beyond the others; reaching to above second anal ray; its length $1\frac{1}{3}$ in head. Ventrals with 2 rays, the inner the longer, reaching two-fifths of the distance from their base to front of anal. The first 3 dorsal spines slightly separated from the others by a very shallow notch; the first and fourth subequal. $2\frac{3}{4}$ in head, the second and third gradually and slightly shortened. The dorsals separated by an interval equal to the space between dorsal rays at base. The soft dorsal higher than spinous, the longest rays $2\frac{2}{5}$ in head; the last ray is free from the caudal peduncle; the tips of the last rays do not nearly reach to the base of the caudal rays, but project slightly beyond those of anal. Anal lower than soft dorsal, its longest rays 3 in head.

Caudal rounded, its length $1\frac{2}{3}$ in head. Skin, under a strong lens, appears rough with very small papillæ, but smooth to the touch; to the naked eye, when specimen is dry on the surface, not appearing smooth and polished as in other members of the genus. The concealed lateral line plates smooth, but well developed.

Color.—Brown on back and sides; under parts white; 5 large dark brown spots on back above lateral line, the posterior 3 widely forked below and each fork terminating at lateral line in a conspicuous small dark-brown spot; the forking of the spots rather obscure; no color on lateral line; below lateral line there is a fringe of 7 or 8 triangular brown marks extending the whole length of body, their apex downward, their bases connected, the posterior 5 or 6 end below in a small, round, conspicuous brown spot above anal fin; a dark bar from eye

FIG. 36.—PSEUDOBLENNIUS TOTOMIUS.

running anteriorly to each side of snout across maxillary and forming a small spot on each side of chin; another streak from eye across posterior end of maxillary; a dark blotch on cheek below eye; a dark blotch on first 3 dorsal spines, a light dusky spot on last spines; a faint dusky spot at base of middle pectoral rays; pectoral otherwise colorless; other fins all colorless; soft dorsal showing the faintest trace of dusky markings scarcely to be made out. The body is nowhere mottled with irregular spots.

This species may be known by its short dorsal and anal, its shallow notch in dorsal, its small mouth, and by its color.

The single specimen is a female 72 mm. in length, and was dredged by the U. S. Fish Commission steamer *Albatross*, off Omi Saki (Point), in Totomi Bay, Japan, in 34 fathoms of water. Station 3729.

The type is numbered 50928, U.S.N M.

33. BERO Jordan and Starks.

Bero JORDAN and STARKS, new genus (*elegans*).

This genus differs from *Pseudoblennius* in having the form of the body wider, not compressed, in having 3 pairs of multifid flaps on top of head, and also in having the anal papilla or intromittent organ simple and tapering, not trilobate and cylindrical as in typical species of *Pseudoblennius*.

(*bero*, vernacular name of *Bero elegans* at Aomori. In southern Japan, *bero* means tongue.)

50. BERO ELEGANS (Steindachner).

BERO.

Centridermichthys elegans STEINDACHNER, Ich. Beiträge, X., 1881, p. 7; Strielok, near Vladivostok, Japan Sea.

Head $2\frac{3}{4}$ in length without caudal; depth $3\frac{1}{5}$. Dorsal X–16; anal 14; lateral line with 37 pores. Eye 5 in head; interorbital space 8; snout 4; maxillary 2; height of caudal peduncle 4 to $4\frac{1}{2}$.

Body anteriorly as wide as deep; head wider than deep. Nape slightly produced above occipital region; a conspicuous notch in profile in front of eyes, formed by the produced nasal spines. Mouth large; maxillary reaching to below posterior rim of orbit. Teeth villiform, in rather narrow bands in jaws, vomer, and palatines. Preopercle with a strongly hooked sharp spine at angle, an anteriorly directed spine at lower anterior edge, and a couple of slight bony tubercles on edge between spines. Nasal spines large and rather sharp, though their tips scarcely project through the skin. Top of head with 3 pairs of multifid flaps; the first over posterior border of eye, a little larger and usually more divided than the others; the other 2 pairs (occasionally 3 pairs) behind and in a line with the superorbital pair, the last at occiput; very rarely some of the posterior flaps are simple. A small simple tentacle on front of nasal spine near tip; a similar one at end of maxillary; 2 or 3 very small ones on edge of preopercle below hooked spine. Lateral line with small concealed plates, the posterior edges of the anterior ones free and rough; behind base of pectoral and just above pectoral are usually 2 or 3 short straight rows of similar rough plates; the upper row the longest; not extending past tip of pectoral.

Pectoral with 15 simple rays; the lower 9 swollen; the upper swollen one the longest, reaching to opposite front of anal; its length $1\frac{1}{4}$ in head. Spinous dorsal rather low and evenly rounded; the fourth spine the highest, $2\frac{5}{6}$ in head. Soft dorsal higher, the longest rays $2\frac{1}{3}$ in head; the last ray is free from caudal peduncle; tips of last rays not reaching to base of auxiliary caudal rays. Anal equal in height to spinous dorsal; its origin under that of soft dorsal; its termination

(at base) in front of that of dorsal a distance equal to diameter of eye. Caudal rounded, its length $1\frac{4}{5}$ in head.

Color.—Back and sides mottled dusky or brown, growing lighter below; white on belly and under parts; 6 quadrate, clear-cut black blotches on back; the anterior 4 reach little over halfway from dorsal to lateral line; 2 under soft (the first obscure); 3 under soft dorsal, and one on caudal peduncle; below lateral line these markings are repeated, though they are usually out of line with those above; spinous dorsal slightly and irregularly mottled; soft dorsal with 6 or 7 very irregular crossbars running back and down obliquely across the rays to body; anal with 7 or 8 similarly placed bars, but more conspicuous and regular in outline and position; pectoral with irregular dusky bars, following somewhat the contour of the fin; caudal dusky and crossed with 4 or 5 irregular white bars; across tips of rays is a more regular white bar, bordered on each side with black.

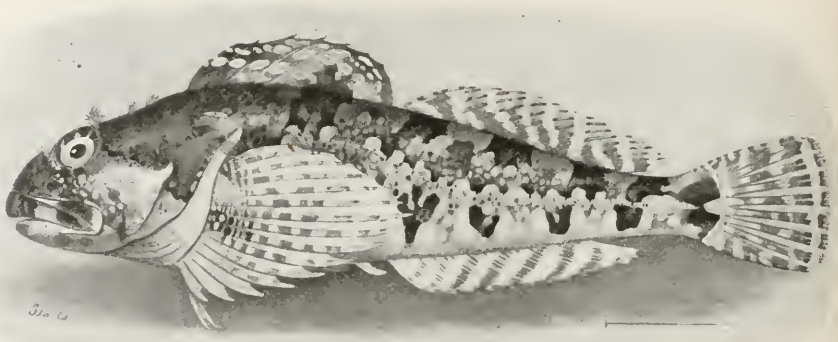


FIG. 37.—BERO ELEGANS.

The following color note is taken from a fresh specimen: Light brownish cherry red; highly mottled with dusky shades and round spots of whitish; the spots smaller on head; fins with blackish and paler orange and whitish cross bands; pectoral and caudal brighter than other fins; ventrals pale.

Numerous specimens were taken at Tokyo, Aomori, Kitami, and Hakodate, the longest 15 cm. in length. In life it is one of the handsomest of the Cottidæ. It is especially abundant about Aomori, in the straits of Tsugaru.

(*elegans*, neat.)

34. VELLITOR Jordan and Starks.

Podabrus RICHARDSON, Voyage of the Samarang, Fishes, 1850, p. 11 (*centropomus*); name preoccupied by *Podabrus* Fischer, a genus of beetles.

Vellitor JORDAN and STARKS, new genus (*centropomus*).

This genus is characterized by the long pike-like head, suggesting the genus *Centropomus*, the profile sloping straight or slightly concave above to the tip of the long, sharp snout; the deep compressed

body, tapering to a very slender caudal peduncle; the fins high, and with slender rays; the first spine of dorsal produced, the middle spines very long, rapidly diminishing in length before and behind; the caudal long and conspicuously forked; the preopercular spine very short, sharp, and straight, not hooked; the palatines with a narrow band of teeth at their posterior end, remote from the vomer; the flat or slightly convex interorbital space; the lateral line without concealed plates; the head without tentacles.

Otherwise it resembles *Pseudoblennius*. Gill membranes connected, free from isthmus; no slit behind last gill arch; pectoral rays simple; ventrals very small, each with one concealed spine and two soft rays; lateral line undulating anteriorly; copulating organ of male constructed as in *Pseudoblennius*, though less conspicuously trilobate at its termination.

(*vellitor*, one who plucks or tears.)

51. VELLITOR CENTROPOMUS (Richardson).

SUI.

Podabrus centropomus Richardson, Voyage of the Samarang, Fishes, 1850, p. 11, pl. 1, figs. 7–11; Quelpart, Straits of Korea.—Günther, Cat. Fish., II, 1860, p. 152 (copied).

Centridermichthys nudus Döderlein, Fische Japans, IV, 1887, p. 258; Bay of Tokyo.—Ishikawa, Prel. Cat., 1897, p. 48; Boshu.

Head $2\frac{3}{5}$ in length without caudal; depth 4. Dorsal X–20; anal 19; lateral line 41 pores. Eye 5 in head; interorbital width $6\frac{1}{2}$; snout $2\frac{3}{4}$; maxillary $2\frac{1}{2}$; height of caudal peduncle $6\frac{1}{2}$.

Body strongly compressed and somewhat elevated, highest under spinous dorsal; from first dorsal spine to tip of snout the upper profile is slightly concave and gently sloping; from chin to anal the lower profile is nearly straight and more nearly horizontal than above; posteriorly the body tapers into a slender caudal peduncle. Snout long and sharply pointed, as viewed laterally. Lower jaw strongly projecting. Mouth rather large, little oblique, the maxillary reaching to just past front of orbit. Teeth villiform, small, but rather sharp; the bands on jaws widened in front, slightly wider on upper jaw; the palatine with a narrow band on its posterior end remote from the vomerine patch, which is U-shaped. Preopercle with a short, sharp spine at angle, usually straight and directed nearly straight backward or very slightly upward, sometimes slightly curved, never hooked as in related forms; no secondary spines below this. Head otherwise without spines or tentacles.

Dorsal spines very slender and flexible; the first produced, usually longer than the other spines, though sometimes a little shorter; the second spine usually shorter than third, forming a notch at the fin; the middle spines very high, the fifth the highest, $1\frac{3}{5}$ to 2 in head; the spines behind it rapidly shortened to the last, which is half the

diameter of the eye; the posterior outline of the fin slightly concave; the second spine $2\frac{1}{4}$ to $2\frac{1}{2}$ in head; behind it the spines gradually lengthened to the highest. Soft dorsal and anal similar in form and height, beginning and ending opposite to each other; the highest rays $2\frac{1}{2}$ in head; the last rays not adnate to caudal peduncle; their tips not reaching to base of caudal rays. The caudal rays are the only divided rays; they are divided once and are widely forked; caudal fin forked, or very deeply concave when fin is spread; the longest rays $1\frac{1}{4}$ to $1\frac{1}{2}$ in head, the middle rays $1\frac{2}{3}$ to 2. Ventral with 1 concealed spine and 2 soft rays; its tip does not reach vent; its length 4 in head. Pectoral with 14 rays; the lower 5 slightly swollen; tip of fin reaches to above base of second or third anal ray, its length $1\frac{2}{3}$ in head.

Color nearly uniform dark brown above, olive green in life, shading lighter below, green shaded in life; belly white; occasionally back and sides are mottled with an irregular network of dark-brown lines;

FIG. 38.—VELLITOR CENTROPOMUS.

one or two of the mottled specimens show a couple of white vertical spots on side under posterior third of pectoral; lips dark; under parts of head white; spinous dorsal dusky, sometimes showing traces of darker irregular lines obliquely across spines; usually there is a transparent spot at base of last 2 spines; soft dorsal and anal uniform dusky, and without markings; pectoral colorless or slightly dusky; ventrals white; caudal dusky, crossed with several irregular darker lines, sometimes uniform dusky. We note that in the specimens most mottled, as is the case with the one figured, the caudal is plain. In the specimens which are plain olive the caudal is usually faintly barred with dark. These differences may be sexual.

Numerous specimens were taken at Misaki, in the shallow bays near the shore. The largest is 12 cm. in length. A specimen was also sent by Mr. Otaki from the market of Tokyo.

(*centropomus*, the Robalo, from the likeness in form as seen from the side.)

35. HISTIOCOTTUS Gill.

Peropus Lay and Bennett, Beechey's Voy., Zool., Fish., 1839, p. 59 (*bilobus*); name preoccupied.

Histiocottus Gill, Proc. U. S. Nat. Mus., 1888, p. 573 (*bilobus*).

This genus is very close to *Blepsias*, from which it differs in the absence of smooth areas on the body; the fins are lower, the dorsal not emarginate, and the pectoral much larger, perhaps capable of being used for flight. North Pacific.

(*ἱστίον*, sail; *Cottus*.)

52. HISTIOCOTTUS BILOBUS (Cuvier and Valenciennes).

Blepsias bilobus Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 379, Kamchatka (Coll. M. Collée, Brit. Mus.).—Günther, Cat., II, 1860, p. 153.—Jordan and Gilbert, Synopsis, 1883, p. 720.

Peropus bilobus Bennett, Beechey's Voy., Zool., Fish., 1839, p. 59.

Histiocottus bilobus Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, p. 468.—Jordan and Evermann, Fish. N. and M. Amer., II, 1898, p. 2018; Kadiak.—Schmidt, Faune mer Japon, 1903, p. 15; Sea of Japan.

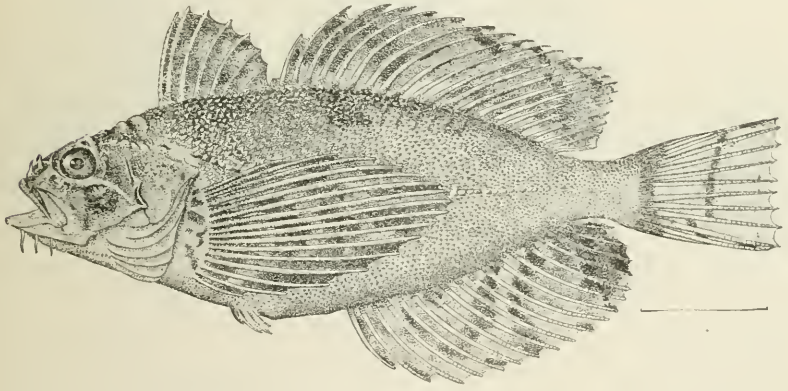


Fig. 39.—Histiocottus bilobus.

D. IX–21; A. 18; P. 16. Body shorter and deeper than in *Blepsias cirrhosus*, with thicker caudal peduncle and heavier head, the bones less firm; snout short, obtuse, interorbital space very wide, concave, ½ wider than the small eye; short occipital ridges present, besides several bluntish tubercles. Mouth broad, oblique, the maxillary reaching pupil; teeth small, distant; barbels as in *cirrhosus*. Head and body covered with prickles, larger and blunter than in *cirrhosus;* no naked patches on body; fins less developed than in *cirrhosus;* first 5 or 6 spines of dorsal subequal, the last 3 abruptly shorter; pectorals longer and much broader than in *cirrhosus*, reaching seventh anal ray; caudal short, much shorter than head. Olivaceous, paler below; dorsal region with 4 or 5 black bars, reaching one-third the distance to the lateral line, and somewhat continued on the fins; caudal with a black

bar at base, otherwise plain; pectorals and anal blotched with black. Coast of Alaska and Kamchatka, not very common; the specimen here described from Kadiak; recorded by Schmidt from near Vladivostok.

(*bilobus*, two lobed.)

36. BLEPSIAS Cuvier.

Blepsias Cuvier, Règne Animal, 2d ed., 1829 (*cirrhosus*).

Head and body compressed; skin hispid with stiffish villiform prickles, and with definitely naked areas; snout and chin with several rather long barbels; mouth small; teeth villiform, on jaws, vomer, and palatines; preopercle with 2 short blunt spines; gill membranes free from the isthmus; gills 4, a slit behind the fourth; top of head with bony ridges; suborbital stay narrow; first dorsal short, elevated in front, emarginate, the spines slender; second dorsal large; anal similar, lower; ventrals very short, I, 3; pectorals long. North Pacific.

(An old name of some fish; from βλέπω, look.)

53. BLEPSIAS DRACISCUS Jordan and Starks, new species.

SACHIKO;[a] ISOBATENGU.

Head $3\frac{5}{6}$ in length without caudal; depth $3\frac{1}{3}$; dorsal IX (IV, 1, IV)–24; anal 20; lateral line 50. Eye $4\frac{1}{4}$ in head; snout $4\frac{1}{2}$; maxillary $2\frac{1}{2}$; interorbital space 4; second dorsal spine $1\frac{1}{6}$; longest soft ray $1\frac{1}{3}$; longest anal ray $1\frac{2}{5}$; length of pectoral $\frac{3}{4}$; ventral $2\frac{3}{4}$; caudal 1.

Body much compressed. Mouth rather oblique. Anterior end of maxillary on a level with lower fourth of eye; posterior end reaching to below middle of eye. Rather narrow bands of villiform teeth on jaws, vomer, and palatines. Nasal spines well developed, at each side of the produced process from the premaxillary. Superorbital rim raised, making the wide interorbital space deeply concave. A pair of low ridges near middle of interorbital space, diverging posteriorly and each having a short flap opposite middle of eye. Parietal ridges strong, rather uneven, continuous with a ridge apparently on upper limb of posttemporal. A slight transverse ridge in front of parietal ridges bounding a quadrate pit. A ridge on side of head running backward from upper fourth of eye. Suborbitals with a slight ridge continuous on suborbital stay. Four prominent but blunt spines on edge of preopercle; the one next to the top the longest. Nostrils ending in a tube. A pair of long tentacles at tip of snout, and a single median one just above them; a similar tentacle on superorbital rim over posterior third of eye; 3 tentacles on each side of mandible; a short one near end of maxillary.

[a] *Sachiko* means child of the Sachi, the Agonoid fish *Dracisicus sachi;* Isobatengu is "Nosey of the Surf." Tengu (Nosey) is a long-nosed comical being in Japanese mythology.

Body entirely hispid with small prickles, except an area on side of caudal peduncle (which does not extend anterior to base of last anal ray), and a subcircular area behind base of pectoral about the size of eye. Prickles more scattered on head; a few behind end of maxillary, some on cheek and opercle, a few on top and side of head behind eye, and some between mandibles. No naked area following lateral line. Fins naked.

Spinous dorsal divided into 3 portions and slightly connected to soft dorsal. The first 4 spines very high; the last one not decreased greatly in length; the membrane between them scarcely incised; the next portion a single spine; shorter than the spines on each side of it; the membrane deeply incised before and behind it; its upper half free; the third portion elevated in front but decreasing rapidly in height to its fourth spine, which is not as long as pupil. The longest dorsal rays behind the middle of the fin; the last 4 or 5 rays decreasing

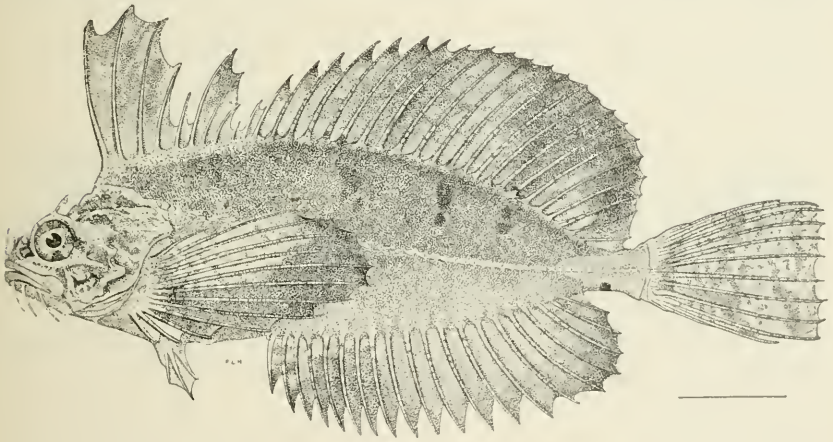


FIG. 40.—BLEPSIAS DRACISCUS.

rapidly in length, so that their tips do not reach so far back as those anterior to them, which reach a little past base of caudal when depressed; last ray adnate to caudal peduncle for nearly its whole length. Anal similar to soft dorsal, but lower; its rays just reaching caudal; its last ray adnate for only half its length. Pectoral long and rounded posteriorly; its tip reaching to above base of fifth or sixth anal ray. Ventrals with 3 rays each; the middle ray the longest; barely reaching to vent. Caudal long and truncate; its angles rounded.

Color dark brown, growing lighter below; top of head and nape blackish; six irregular narrow black bars on back not reaching to lateral line; naked area under pectoral light, and a light area a little behind it; belly, throat, and chin pale; the tentacles on chin sometimes dusky. A dark vertical bar from eye to end of maxillary, and another from eye across cheek; cheek and opercle otherwise mottled with brown; spinous dorsal uniformly dusky; soft dorsal and anal irregu-

larly blotched with dusky, and with fine lines across the rays; caudal marbled, and with 2 or 3 very irregular crossbars. Pectoral dark and mottled; a large light area on its upper basal portion.

In life the color is blackish green or dusky red, according to the color of the seaweeds about it; silvery area white.

This species may be known from *Blepsias cirrhosus*, its representative farther northward and eastward, by its having no naked area following the lateral line, by the single naked spot behind pectoral, by the prominent tentacle on superorbital rim, and by the form of the spinous dorsal.

The specimens from Iturup Island in the Kuriles that have been referred to *Blepsias cirrhosus* belong to this species. Specimens were taken by Jordan and Snyder at Hakodate and Aomori.

The type is from Aomori; it is 19 cm. in length, and is numbered 7720, Ichthyological Collection, Leland Stanford Junior University Museum. Others, cotypes, are numbered 50929, U.S.N.M.

(*dracisc*us, a high-finned Agonoid fish of Japan, of which *Blepsias* is fabled to be the child.)

37. NAUTISCUS Jordan and Evermann.

Nautiscus Jordan and Evermann, Fish. N. and M. Amer., II, 1898, p. 2019 (*pribilorius*).

This genus is closely allied to *Nautichthys*, having the same gill structures and dentition, but the first dorsal is only moderately elevated, its height being less than depth of body. There are no cirri on the head, and there is no marked depression at the occiput, the base of the dorsal being little raised above the nape; preopercle with four obsolete spines.

54. NAUTISCUS PRIBILOVIUS (Jordan and Gilbert).

Nautichthys oculofasciatus Gilbert, Rept. U. S. Fish Comm. 1893, (1896), p. 434; not of Girard.

Nautichthys pribilovius Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, p. 468, pl. LXIX, 1898; off St. George Island. (Type, No. 48237, U.S.N.M. Coll. Jordan.)—Jordan and Evermann, Fish. N. and M. Amer., p. 2019; St. George, Bristol Bay, Alaska Peninsula.—Schmidt, Faune Mer. Japan, 1903, p. 16; Okotsk Sea.

D. VIII–23; A. 15.

Shape of head and body much as in *Nautichthys oculofasciatus;* head short, the snout rather sharp, the anterior profile steep; nasal spines prominent, a short ocular cirrus, shorter than pupil; interobital space narrow, about one-half eye, deeply concave; a blunt triangular ridge above each orbit, with a deep cross furrow behind it which deepens to a pit at the vertex; nuchal ridges, each with a coarse tubercle, lower and larger than in the other species. From the nuchal depression, the

base of first dorsal spines rises much less abruptly. Preopercle with 4 blunt prominences, the upper often longer and more spine-like. Mouth nearly horizontal, the lower jaw included; a slender filament at end of maxillary; teeth small, a few on vomer and a narrow band on palatines. Gill membranes broadly united to isthmus, the gill opening extending a little below the lower edge of pectoral. Skin covered with close-set villous prickles, among which large ones are frequently seen arranged in rather definite longitudinal series, of which there may be 2 or 3 parallel with the back, and 1 running near lower line of tail. No smooth areas on sides. Lateral line conspicuous, the plates with short spines directed backward. Dorsals separate, the first not notched, comparatively low, the first spine highest, $1\frac{2}{3}$ in head in type; in other specimens $1\frac{1}{4}$ to $1\frac{1}{6}$ in head; soft dorsal and anal also low, none of the rays reaching base of caudal when depressed; pectoral longer than head; ventrals $1\frac{1}{2}$ to 2 in head. Color, dull light olivaceous, mottled

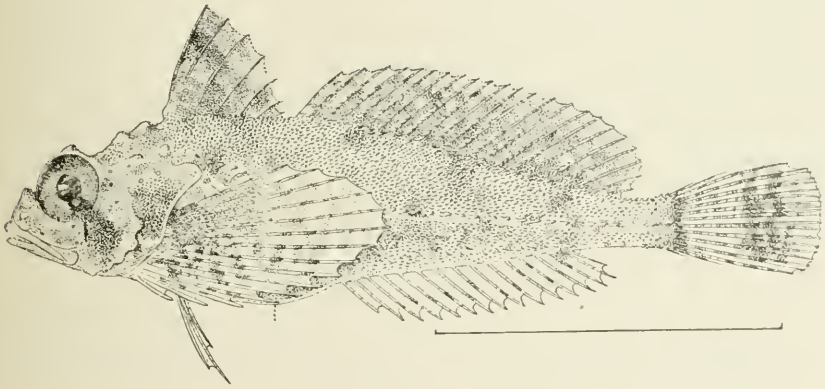


FIG. 41.—NAUTISCUS PRIBILOVIUS.

with darker; 3 or 4 dark bands below soft dorsal, 1 below spinous dorsal; a black band through eyes and across cheeks, extending onto branchiostegal membranes; 7 dusky spots along lateral line, a conspicuous pink blotch, rather larger than pupil, between first and second blotch; first dorsal dusky; second dorsal, anal, and pectoral dotted and checked; caudal with faint finely checked cross lines, which deepen to form a dark bar at its base and a broader one toward its tip; ventrals pale; belly mottled. Bering Sea, the type from St. George Island, one of the Pribilof Islands, in 23 fathoms; Unalaska, Bristol Bay, and south of the Alaskan Peninsula. Recorded from Aneiva Bay, Saghalin, by Dr. Schmidt.

(*pribilovius*, from the Pribilof Islands, named for their discoverer, Gerassim Pribilof, 1786.)

38. HEMITRIPTERUS Cuvier.

Hemitripterus Cuvier, Règne. Anim., 2d ed., II, 1829, p. 164 (*americanus*).

Body moderately elongate, scaleless, but the skin covered with prickles and bony protuberances of various sizes and forms. Head large, with numerous bony humps and ridges and fleshy slips above; orbital rim much elevated, the interorbital space deeply concave; a depressed area at the occiput, behind which are 2 blunt spines on each side. Mouth very wide; jaws, vomer, and palatines with broad bands of teeth; no slit behind last gill; gill membranes broadly united, free from isthmus; preopercle with stout, blunt spines; suborbital stay very strong, forming a sharp ridge. Spinous dorsal much longer than the soft part, of 16 to 18 spines, of which the first 2 are the highest, and the fourth and fifth shorter than the succeeding ones, the fin thus deeply emarginate; pectoral fins very broad, much procurrent; ventrals I, 3. Large fishes of singular appearance, inhabiting the North Atlantic and Pacific. Dr. Gill makes of them a distinct family on account of the great length of the spinous dorsal and the peculiar development of the myodome. The genus is, however, related to *Blepsias* and *Nautichthys*, and the spinous dorsal is as long in *Jordania* as in *Hemitripterus*, while the two genera stand as extremes in the Cottoid group.

(ἡμι—, half; τρεῖς, three; πτερόν, fin.)

55. HEMITRIPTERUS VILLOSUS (Pallas).

Cottus villosus Pallas, Zoogr. Ross. Asiat., III, 1811, p. 129; Cape Kronok, Kamchatka; mouth of Itscha R. after MS. of Steller.—Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 196 (copied).—Jordan and Evermann, Fish. N. and M. Amer., II, 1898, p. 2022 (copied).

Hemitripterus carifrons Lockington, Proc. Ac. Nat. Sci. Phila., 1880, p. 233; Kadiak Island.—Jordan and Evermann, Fish. N. and M. Amer., II, 1898, p. 2023 (same specimen).

Head $2\frac{4}{5}$ in length to base of caudal; depth $4\frac{1}{4}$. Dorsal III, 14 or 15–13; anal 14; p. 20; scales 42. Eye (not orbital cavity) $6\frac{2}{3}$ in head; snout $4\frac{1}{6}$; maxillary $1\frac{2}{3}$; interorbital space 3.

Upper profile of head much broken up into bony tubercles; the orbital rim and premaxillary process strongly produced. Mouth large; the maxillary reaching to behind posterior margin of eye a distance equal to a diameter of pupil. Lower jaw blunt and projecting. Teeth sharp, conical, rather long, and slightly hooked backward. Interorbital space wide and deeply concave; a large triangular pit at its middle, the sides of which are a little convex. Two prominent ridges, and a short one between them, diverge outward on superorbital region from a point at posterior angle of interorbital pit. A quadrate pit at vertex; narrow behind; bounded on each side by a ridge which bears 3 blunt tubercles. A pair of blunt tubercles a short distance behind superor-

bital rim, and another on posttemporal in line with them, but a distance behind them nearly equal to diameter of eye. An uneven ridge along suborbitals which divides into 3 or 4 diverging ridges on cheek; these more conspicuous in large examples. A pair of short sharp ridges on preorbital diverge downward to edge of premaxillary. Four blunt spines on edge of preopercle; the upper one directed upward and backward, the next backward and a little downward; the next downward and a little forward, or in an opposite direction from the upper one; the lower one downward and forward. The lower one is only a slight round angle. The angular region of mandible is produced and prominent. Opercle with a prominent ridge. Nasal spines well developed and rather sharp. The premaxillary processes work in a deep cavity which is bounded around its posterior portion by a low sharp ridge curving from one nasal spine to the other. There are many tentacles about head, many of them multifid; 1 in front of nasal spine; 1 at each side of front of upper jaw above edge of premaxillary; 1 at each posterior corner of interorbital pit; 1 at pterotic region; 1 on cheek behind posterior end of suborbital ridge, and another on opercle in line with it; 1 near posterior end of maxillary, and a much smaller one at middle of maxillary; 1 at each side of front of lower lip; 4 along lower edge of each side of mandible.

Skin of body covered with small tubercles which feel rather harsh to the touch; those on back, especially anteriorly, larger and harder than elsewhere. Lateral line armed with small bony tubercles, many of which bear flaps at irregular intervals.

First three dorsal spines connected by a membrane which is not deeply incised. The first and second spines by far longer than any of the others, the second only slightly shorter than the first; the length of the first equal to post-orbital part of head. The fourth spine three-fourths as long as the third, which is contained $3\frac{1}{5}$ times in the head. The membrane of the second portion of the spinous dorsal is very deeply incised. Each spine with a long bifid tentacle at its tip. The longest soft dorsal rays a little longer than the longest spines in the portion of the fin. The tips of the last dorsal rays do not reach so far posteriorly as do those of the anal, which just reach to the base of the lower axillary caudal rays. Caudal slightly rounded in outline. Pectoral with 19 rays, the sixth or seventh from the top the longest; they fail to reach the first anal ray by a distance equal to the diameter of the eye; the rays below the longest are swollen. Ventrals 3 rayed; the middle ray the longest; not quite reaching to the vent.

Color grayish, mottled with large, irregular, dark spots, which are clear cut and are usually outlined with light gray; fins all mottled with dark brown or dark gray; in some of the smaller specimens the spinous dorsal is nearly black; mandible, maxillary, and sides of head finely mottled; belly and branchiostegal region white.

The following is a note of the colors of a fresh specimen: Dull olive, rather pale, belly still paler; dorsal and caudal dull crimson, with lighter and duller shades; chin speckled with white; no bright colors.

The above description is of a specimen 26 cm. in length from Hokodate. Other large specimens were obtained at Nemuro and Mororan. Some small specimens were dredged by the U. S. Fish Commission steamer *Albatross* off Kinkwazan Island, in Matsushima bay, stations 3770 and 3771.

This species is evidently the early described *Cottus villosus* of Pallas. *Hemitripterus cavifrons* of Lockington, from Kadiak, agrees in all respects noted by the author. This species is extremely close to its ally of the Atlantic coast shores of Canada and New England, *Hemitripterus americanus*. The head is perhaps a little rougher in the Japanese species. Dr. Schmidt regards it as identical with *H. americanus*.

(*villosus*, hairy.)

39. PSYCHROLUTES Günther.

Psychrolutes Günther, Cat., III, 1861, p. 516 (*paradoxus*.)

Body tadpole-shaped, tapering from the head to the very slender tail, covered with very loose, naked, movable skin. Head large, depressed, flattish above; snout obtuse, rounded; interocular space very broad, the ocular ridges obsolete; mouth very large; mandible short, little cavernous, its forms broadly U-shaped; maxillary entirely adnate to the skin of the preorbital; jaws with bands of villiform teeth; no teeth on vomer or palatines; no spines or cirri about the head; suborbital stay narrow. Gill membranes united to the isthmus; gills 3½, no slit behind the fourth. Branchiostegals 7. Fins connected; spinous dorsal of short, slender, flexible spines entirely embedded in the skin and not visible without dissection as the spines do not rise above level of the muscles; soft dorsal short, high, the rays close together, the total number 12 to 24; anal low, of 9 rays; caudal separate; pectoral fins long, with a broad, procurrent base. Ventrals I, 3, close together, distinct, the inner edge adnate to the body. Small fishes, very closely allied to *Cottunculus* and *Malacocottus* on the one hand and to the *Liparididæ* on the other, their characters, like those of the latter family, arising from degeneration of the *Cottidæ*. The extension of the lax skin over the spinous dorsal and the bones of the head afford the only tangible diagnostic character of the subfamily *Psychrolutinæ*. From the *Liparididæ*, their separate ventrals distinguish them sufficiently. Small shore fishes of the North Pacific; only a single species known.

(ψυχρολούτης, one who bathes in cold water.)

56. PSYCHROLUTES PARADOXUS Günther.

Psychrolutes paradoxus Günther, Cat., III, 1861, p. 516; Gulf of Georgia, Vancouver Island (Coll. H. M. S. *Plumper*).—Jordan and Gilbert, Synopsis Fish. N. Amer., 1883, p. 687.—Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, 1898, p. 469; St. Paul Island, Iturup Island, Karluk.—Jordan and Evermann, Fish. N. and M. Amer., II, 1898, p. 2026; Unalaska.

Psychrolutes zebra Bean, Proc. U. S. Nat. Mus., 1890, p. 43; Aleutian Islands, between Unga and Nagai islands, at Albatross Station 2848, 55° 10′ N., 160° 18′ W., in 110 fathoms.—Jordan and Stark, Proc. Cal. Ac. Sci., 1895, p. 811, pl. lxxxv.—Gilbert, Rept. U. S. Fish Comm., 1893 (1896), p. 410.

Head $3\frac{2}{3}$ in length; depth $4\frac{1}{2}$, equal to head without snout. D. IX, 15 to 17, only 12 rays seen without dissection; A. 12 or 13; V. I, 3; branchiostegals 7. Head large, very broad, tapering suddenly to caudle peduncle. Eye $4\frac{1}{4}$ in head, a little shorter than snout, a little less than width of interorbital space. Maxillary extending to below middle of eye. Interocular space flat, not concave; jaws equal, the

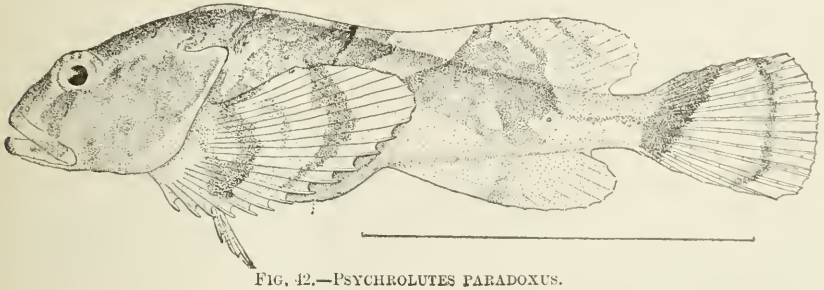


Fig. 42.—Psychrolutes paradoxus.

lower ⌒-shaped, its arch not narrowed behind. Pectoral reaching to slightly above origin of anal, $2\frac{2}{3}$ in body; ventrals very small, one-third length head. Vent about midway between ventral and anal origin, the second dorsal beginning nearly over tip of pectoral; first dorsal entirely buried in the skin, its short, stiffish spines to be found only by dissection. Color light chocolate brown above, with minute spots of dark; whitish below; a pale stripe from eye downward and forward, between 2 dark ones; body with 3 very irregular dark cross bands, the third extending on dorsal and anal, the first 2 largely confluent and all very irregular in form; an oblique dark band on base of caudal, a narrow dark band behind it; pectoral with 2 or 3 cross bands; all fins, except the ventral, with traces of bands. Length $2\frac{1}{2}$ inches. A specimen, 50 mm. long, taken by the U. S. Fish Commission steamer *Albatross* off St. Paul Island, Bering Sea, in 1896, shows the following characters: Head $2\frac{3}{5}$; depth 3. D. IX, 15; A. 13; P. 19; eye 4 in head; width of mouth, from angle to angle, $1\frac{1}{2}$; snout $3\frac{1}{3}$; interorbital $3\frac{1}{5}$. Body short, broad, thick, tadpole-shape, the texture soft like that of a Liparid, especially about the head; the skin is limp and smooth, covered with little soft dermal warts, that of head especially lax, the

cheeks tumid and translucent. No trace of spines on head, the bones all thin and weak; nostrils each in a short tube; mouth broad, its cleft chiefly anterior, the jaws equal; teeth very minute, none on vomer or palatines; lower jaw with 8 large open pores. Gill membranes broadly united to the isthmus, the gill opening extending to slightly below base of pectoral. Lateral line obsolete. Dorsals united, with a slight notch between, the first buried in a ridge of skin so that its delicate spines can not be counted from without; second dorsal low, similar to anal, both of them free from the caudal; lower pectoral rays progressively shortened, the longest $1\frac{1}{5}$ in head; ventrals moderate, I, 3, reaching vent, $2\frac{1}{3}$ in head; caudal rounded. Color creamy white, with blackish cross bands, irregular in form and broken by whitish patches; 5 black spots on lower jaw; top of head blackish; a narrow blotch at shoulder; a wider one across first dorsal; a broad one on second dorsal abruptly broadened on body, then narrowed, extending across anal; an irregular bar at base of caudal; a narrow bar and some spots and streaks on the fin; pectoral with 2 curved bars, the inner concave, the outer convex backward, the two inclosing a rounded pinkish or deep orange area. (Jordan and Gilbert.) Alaska to Puget Sound, rather common in water of moderate depth; a remarkable little fish, evidently a degraded Cottoid. Here described from specimens from Unalaska. This species is taken abundantly in shallow water about Kadiak, south of the Alaskan Peninsula, thence westward through Unimak Pass, along the northern shore of Unalaska Island to Iturup Island, and the Pribilof Islands and in Bristol Bay. The depths range from 38 to 121 fathoms. It has been also dredged by Dr. Schmidt off Cape Pestschuzoff, coast of Korea.

(*παράδοξος*, unaccountable.)

40. EREUNIAS Jordan and Snyder.

Ereunias JORDAN and SNYDER, Proc. Cal. Ac. Sci., (3d ser.), II, 1901, p. 377 (*grallator*).

Body moderately elongate, tapering into a long and slender tail, the nuchal region elevated. Head large, not compressed or depressed. Eye very large. Preorbital broad. Mouth horizontal, lower jaw included, maxillary extending a little beyond anterior margin of pupil. Teeth in villiform bands on jaws, vomer, and palatines. Gill openings wide, the gill membranes broadly united, free from the isthmus. Gill rakers short, club-shaped; a small oval slit behind last gill arch. Suborbital stay distinct, covered by the rough skin. Nasal spines present; a stout spine before eye; a much larger one on upper rim of orbit; a divided spine at nape; 2 small ones on lower margin of preorbital; a large hooked spine at angle of preopercle; 2 smaller sharp spines below the latter; a blunt spine on upper edge of opercle. Skin close set with velvety prickles. Lateral line distinct,

armed with spines which are strong and curved anteriorly. Sides with 2 series of stout curved spines, besides 3 series of smaller ones. Dorsal fins separate, of moderate height, with 10 slender spines; rays, 1, 12. Anal low, of 12 rays, opposite soft dorsal. Caudal small, truncate. Pectoral short, of 11 united rays, below which are 4 simple, free ones, similar to those of *Prionotus* and *Trigla*. Ventrals entirely wanting.

The relations of the genus are at once with Cottidæ and Triglidæ. We place it provisionally as a subfamily, Ereuniinæ, Cottidæ. It is not unlikely that the absence of ventrals and the singular form of the pectoral will demand for it a distinct family.

(*ἐρευνάω*; to explore.)

57. EREUNIAS GRALLATOR Jordan and Snyder.

Ereunias grallator Jordan and Snyder, Proc. Cal. Ac. Sci., (3d ser.), II, 1901, p. 378; Misaki.

Head, measured to end of opercular flap, $2\frac{2}{3}$ in length; depth $4\frac{3}{4}$; eye $3\frac{1}{3}$ in head; maxillary $2\frac{1}{2}$. D. X, I–12; A. 12; P. 11 + 4; lateral line 42. Length of type 305 mm.

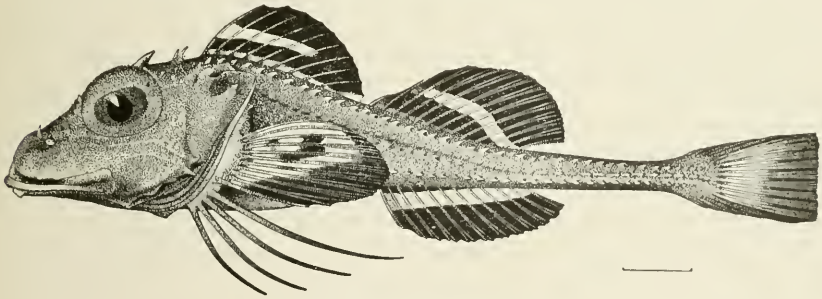


Fig. 43.—Ereunias grallator.

Body moderately elongate, tapering into a long, slender, quadrate, caudal peduncle, the length of which is contained $1\frac{1}{2}$ times in the head, its depth 6 in its length. Vent slightly in front of middle of body. Eye very large, placed high, its upper margin projecting above outline of head, its diameter about equal to length of snout, its upper part covered with rough skin. Mouth horizontal, the lower jaw included, the maxillary reaching slightly beyond line of front of pupil. Teeth villiform on jaws, vomer, and palatines; those on palatines in a long narrow band. Gill openings broadly united over the isthmus; a small oval slit behind last arch. Gill rakers short, club-shaped, about 3 + 11 on first arch. Pseudobranchiæ large, of long filaments. Branchiostegals 6. Suborbital stay short, triangular.

Head and body covered with a velvety shagreen. Nasal spines short and sharp; upper rim of orbit with spines, the posterior of which is large and strong, its length contained about $4\frac{1}{2}$ times in eye; side of

nape with a large double spine; some small spines on temporal region; opercular spine obscure; preopercle above with a curved spine, the length of which is contained about 6 times in eye; 2 sharp spines below the latter, the upper of which is the longer; 2 small spines on lower edge of preorbital. Maxillary rugose, without barbels. Sides of body with rows of slender hooked spines, the uppermost row extending from nape to tail; the second row of smaller spines along lateral line; the third, below the curved part of lateral line, coalescent with it on the straight part; the fourth row of strong spines, beginning above vent and extending to base of caudal; a few spines below this, constituting a fifth row along base of anal. Lower edge of caudal peduncle with a long groove.

First dorsal low, of slender spines, the longest about 3 times in head. Dorsals separate, but close together, the longest soft ray $1\frac{2}{5}$ in head. Anal similar, its longest ray $3\frac{3}{5}$ in head. Caudal fin short, truncate, $2\frac{1}{2}$ in head. Pectoral fin of two parts; the upper of 11 rays, mostly branched, the longest ray $1\frac{3}{4}$ in head; lower part of fin of 4 separate, simple rays similar to the free appendages in Triglidæ; the uppermost longest, $1\frac{1}{3}$ in head; the lowermost shorter, $2\frac{1}{6}$ in head.

Color blackish, lining membranes of body dusky. Dorsals black, with a broad, whitish median band which disappears posteriorly on the spinous dorsal and anteriorly on the soft dorsal; membrane posterior to last dorsal spine white. Anal black, with a broad, white, longitudinal band near its base. Caudal dusky at base, broadly suffused with blackish posteriorly, middle part whitish. Pectoral dusky, the upper anterior part whitish, blotched with black; free rays black.

Of this very remarkable fish two specimens are known; they were taken in the Kuro Shiwo, or Black Current, at a depth of 290 fathoms off the coast of Misaki, Sagami Province, Japan, by Prof. Kakichi Mitsukuri. One of these specimens is in the Imperial University of Tokyo, the other was presented by Professor Mitsukuri to Leland Stanford Junior University, where it is registered as Type No. 6432.

The specimen in the Imperial Museum has, according to our notes, a conspicuous barbel at the tip of the maxillary. No trace of such a barbel is to be found on the type.

(*grallator*, one who walks on stilts.)

SUMMARY.

Family COTTIDÆ.

1. *Stlengis* Jordan and Starks.

1. *osensis* Jordan and Starks; Suruga Bay.

2. *Schmidtia* Jordan and Starks.

2. *misakia* Jordan and Starks; Sagami Bay.

3. *Archistes* Jordan and Gilbert.

3. *plumarius* Jordan and Gilbert; Ushishir Island.

4. *Daruma* Jordan and Starks.

4. *sagamia* Jordan and Starks; Sagami Bay, Owari Bay, Totomi Bay.

5. *Ricuzenius* Jordan and Starks.

5. *pinetorum* Jordan and Starks; Matsushima Bay.

6. *Artediellus* Jordan.

6. *pacificus* Gilbert.

7. *Icelus* Krøyer.

7. *spiniger* Gilbert.

8. *Stelgistrum* Jordan and Gilbert.

8. *stejnegeri* Jordan and Gilbert; Robben Island, Peter the Great Bay.

9. *Triglops* Reinhardt.

9. *beani* Gilbert; Robben Island.

10. *Prionistius* (Bean).

10. *jordani* Schmidt; Peter the Great Bay (Vladivostok).

11. *Hemilepidotus* Cuvier.

11. *gilberti* Jordan and Starks; Hakodate.

12. *Enophrys* Swainson.

12. *claviger* (Cuvier and Valenciennes); Robben Island.

13. *Ceratocottus* Gill.

13. *diceraus* (Pallas); Robben Island.
14. *namiyei* Jordan and Starks; Nemuro, Soya.

14. *Trachidermus* Heckel.

15. *ansatus* (Richardson); Chikugo R.

15. *Cottus* Linnæus.

16. *kazika* Jordan and Starks; Niigata.
17. *pollux* Günther; Tana R., Semida R., Kitakami R., Kami R., Niigata, Aomori, Kamashiro.

16. *Uranidea* De Kay.

18. *reinii* (Hilgendorf).
19. *dybowskii* (Hilgendorf).

17. *Rheopresbe* Jordan and Starks.

20. *fujiyamæ* Jordan and Starks; Odawara.

18. *Myoxocephalus* Steller.

21. *polyacanthocephalus* (Pallas); Robben Island.
22. *jaok* (Cuvier and Valenciennes); Robben Island.
23. *edomius* Jordan and Starks; Mororan, Hakodate.

24. *nivosus* (Herzenstein); Same, Mororan, Hakodate, Iturup.
25. *raninus* Jordan and Starks; Aomori, Mororan, Hakodate.
26. *stelleri* Tilesius.
27. *brandti* (Steindachner).

19. *Megalocottus* Gill.

28. *platycephalus* (Pallas).

20. *Ainocottus* Jordan and Starks.

29. *easiger* Jordan and Starks; Hakodate.

21. *Porocottus* Gill.

30. *tentaculatus* (Kner).

22. *Argyrocottus* Herzenstein.

31. *zanderi* Herzenstein; Iturup Island.

23. *Zesticelus* Jordan and Evermann.

32. *bathybius* (Günther); off Misaki.

24. *Cottunculus* Collett.

33. *brephocephalus* Jordan and Starks; Suruga Bay.

25. *Gymnocanthus* Swainson.

34. *pistilliger* (Pallas); Robben Island.
35. *intermedius* (Schlegel); Hakodate; Same, Otaru.
36. *herzensteini* Jordan and Starks; Hakodate.

26. *Crossias* Jordan and Starks.

37. *allisi* Jordan and Starks; Hakodate, Same.

27. *Cottiusculus* Schmidt.

38. *gonez* Schmidt; Peter the Great Bay.
39. *schmidti* Jordan and Starks; Matsushima Bay.

28. *Elaphichthys* Jordan and Starks.

40. *elongatus* (Steindachner).

29. *Alcichthys* Jordan and Starks.

41. *alcicornis* (Herzenstein); Same, Hakodate.

30. *Furcina* Jordan and Starks.

42. *ishikawæ* Jordan and Starks; Myiako, Wakanoura, Hakodate.
43. *osimæ* Jordan and Starks; Hakodate, Misaki.

31. *Ocynectes* Jordan and Starks.

44. *maschalis* Jordan and Starks; Enoshima, Wakanoura.

32. *Pseudoblennius* Schlegel.

45. *percoides* Günther; Tokyo, Matsushima, Misaki, Wakanoura, Tsuruga, Hiroshima, Nagasaki.

46. *cottoides* (Richardson); Misaki, Matsushima, Onomichi, Aomori, Enoshima, Tokyo, Yokohama; Tsuruga, Hakodate.
47. *zonostigma* Jordan and Starks; Misaki, Nagasaki.
48. *marmoratus* (Döderlein); Misaki, Enoshima.
49. *totomius* Jordan and Starks; Totomi Bay.

33. *Bero* Jordan and Starks.

50. *elegans* (Steindachner); Tokyo, Aomori, Kitami, Hakodate.

34. *Vellitor* Jordan and Starks.

51. *centropomus* (Richardson); Misaki, Tokyo.

35. *Histiocottus* Gill.

52. *bilobus* (Cuvier and Valenciennes).

36. *Blepsias* Cuvier.

53. *draciscus* Jordan and Starks; Aomori, Hakodate, Iturup Island.

37. *Nautiscus* Jordan and Evermann.

54. *pribilovius* (Jordan and Gilbert).

38. *Hemitripterus* Cuvier.

55. *villosus* (Pallas); Hakodate; Mororan, Nemuro, Matsushima Bay.

39. *Psychrolutes* Günther.

56. *paradoxus* Günther.

40. *Ereunias* Jordan and Snyder.

57. *grallator* Jordan and Snyder; Misaki.

NOTES ON THE BATS COLLECTED BY WILLIAM PALMER IN CUBA.

By Gerrit S. Miller, Jr.,
Assistant Curator, Division of Mammals.

Two important collections of Cuban bats have recently been made by Mr. William Palmer, of the United States National Museum. The first, numbering 449 specimens, was brought together during February, March, April, May, June, and July, 1900, in the region south and west of Habana, and on the Isle of Pines.[a] During this expedition Mr. Palmer was accompanied by Mr. J. H. Riley. The second collection, 184 specimens, was made in February, 1902, at the extreme eastern end of Cuba.[b] Fifteen species were obtained in all, several of which prove to be of unusual interest. In the following account of this material the field observations made by Mr. Palmer are given in full, each note signed with its author's name.

VESPERTILIO CUBENSIS (Gray).

1839. *Scotophilus cubensis* Gray, Ann. Nat. Hist., IV, p. 7, September, 1839; Cuba.

1892. *Vesperugo fuscus cubensis* Chapman, Bull. Amer. Mus. Nat. Hist., IV, p. 316, December 29, 1892.

1897. *Vespertilio fuscus cubensis* Miller, North American Fauna, no. 13, p. 102, October 16, 1897.

A skin from Pinar del Rio and a specimen in alcohol, and one skin each from El Guama and El Cobre. The three skins show that the color of the Cuban animal is practically identical with that of the large Mexican *Vespertilio miradorensis*. It is therefore much darker than in *V. fuscus*. For measurement see table, page 338.

Field notes.—One of the few species seen flying at dusk. Besides the five specimens taken, three or four others were seen. One was captured in a net set at the eaves of a tile roof. Others were seen about tobacco houses and palm trees. One was netted in the center of a natural rock tunnel, which was the home of a barn owl, a bird that fed largely on bats.—W. Palmer.

[a] The localities at which bats were taken are as follows: Cabañas, El Guama, Guanajay, Mariel, Pinar del Rio, and San Diego de los Baños on the mainland, and Nueva Gerona on the Isle of Pines.

[b] Exact localities, Baracoa and El Cobre.

NYCTICEIUS CUBANUS (Gundlach).

1861. *Vesperus cubanus* GUNDLACH, Monatsber. k. Preuss. Akad. Wissensch. Berlin, p. 150; near Cardenas, Cuba.

1897. *Nycticeius humeralis cubanus* MILLER, North America Fauna, no. 13, p. 120, October 16, 1897.

Twenty-six specimens (16 skins) from Pinar del Rio, and one skin from Cabanas. This series makes a satisfactory comparison of the Cuban *Nycticeius* with its mainland representative for the first time possible. The Cuban animal proves to be, as Gundlach's description indicates, considerably smaller than *Nycticeius humeralis*, but in color the two species are identical, and in external form the only difference that I can detect is the slightly less breadth of the ear and tragus in *N. cubanus*. The skull and teeth are conspicuously smaller in the Cuban bat, but in form there appears to be perfect agreement. For measurements see table below.

Field notes.—The specimens from Pinar del Rio were all taken from the eaves of a tiled roof where several species of bats of different genera spent the day. In the evening they usually began to fly when it was quite dark, so that one was seldom seen on the wing. The single specimen from Cabañas was captured in a ruined house.—W. PALMER.

Measurements of Vespertilio cubensis, Nycticeius cubanus, and N. humeralis.

Name.	Locality.	Number.	Sex.	Total length.	Tail.	Tibia.	Foot.	Forearm.	First digit.	Second digit.	Third digit.	Fourth digit.	Fifth digit.	Ear from meatus.	Ear from crown.	Width of ear.
				mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*
Vespertilio cubensis.	Pinar del Rio.	103809	Female.	105	47.0	19.0	10.0	47.0	9.0	45.0	80	70	60	....	....	....
Do	El Guama.	103810	Male ...	117	47.0	19.0	9.8	45.0	8.0	45.0	77	67	55	....	....	....
Do	....do	103807	....do ...	103	44.0	18.8	9.0	43.6	8.0	41.0	75	66	58	15.4	13.0	11.0
Do	El Cobre ..	113851	....do ...	104	45.0	20.0	10.0	44.0	7.4	44.0	81	70	57	....	....	....
Nycticeius cubanus.	Cabañas ..	103797	Female.	....	....	12.0	6.0	32.0	6.0	30.0	55	45	40	....	....	....
Do	Pinar del Rio.	103781	....do ...	78	26.0	10.0	6.2	31.0	6.0	29.0	56	47	40	....	....	....
Do	.....do	103782	....do ...	77	28.0	11.0	7.0	31.0	6.0	30.0	54	47	38	....	....	....
Do	.....do	103783	....do ...	83	31.0	11.6	7.0	31.0	6.4	30.0	57	48	39	....	....	....
Do	.....do	103786	....do ...	81	29.0	11.0	7.0	30.6	5.0	30.0	54	48	39	....	....	....
Do	.....do	103789	....do ...	79	28.0	10.0	7.0	32.0	6.0	28.0	55	47	38	....	....	....
Do	.....do	103784	Male ...	80	30.0	11.0	7.0	30.0	5.0	27.0	54	48	39	....	....	....
Do	.....do	103785	....do ...	80	30.0	11.0	6.0	29.0	5.0	27.0	52	46	37	....	....	....
Do	.....do	103787	....do ...	73	25.0	11.0	6.4	29.0	5.4	28.0	55	47	35	....	....	....
Do	.....do	103788	....do ...	75	27.0	11.0	6.8	30.0	5.0	28.0	55	47	38	....	....	....
Do	.....do	103799	....do ...	80	29.0	10.6	6.0	28.6	5.4	28.6	52	44	37	....	....	....
Do	.....do	103801	....do ...	78	29.0	9.0	6.4	32.0	5.4	28.0	55	50	42	11.0	8.0	7.0
Do	.....do	103802	....do ...	74	30.0	10.0	5.6	29.6	5.0	31.0	51	46	39	12.0	9.0	8.0
Do	.....do	103798	Female.	75	32 0	10.0	5.6	31.0	4.4	28.0	55	48	40	11.0	8.2	7.4
Do	.....do	103799	....do ...	8.	33.0	11.4	6.0	32.4	6.0	29.0	59	52	44	10.4	8.8	8.0
Do	.....do	103800	....do ...	80	31.0	11.0	6.4	32.0	5.8	31.0	58	52	43	11.0	9.0	8.0
Do	.....do	103803	....do ...	80	33.0	11.0	5.4	31.0	5.6	29.0	56	48	39	11.8	10.0	7.4
Do	.....do	103804	....do ...	79	29.0	10.6	5.6	32.0	5.0	30.6	56	49	42	11.0	9.0	7.6
Do	.....do	103805	....do ...	78	30.0	10.4	6.0	32.0	6.0	28.0	55	49	42	12.0	9.4	8.0
Nycticeius humeralis.	Lemon City, Fla.	102710	Male ...	95	39.0	12.0	8.0	36.0	6.6	35.0	67	58	49	13.0	10.6	10.0
Do	.....do	102711	....do ...	90	35.0	12.0	7.8	33.6	6.0	34.0	63	54	45	15.0	10.0	9.8
Do	.....do	102712	....do ...	87	35.0	11.6	7.4	....	7.0	35.0	63	....	....	13.0	10.0	10.0
Do	.....do	102713	....do ...	91	35.0	12.0	7.0	35.0	6.0	33.0	65	58	49	13.0	10.0	10.0
Do	.....do	102709	Female.	95	39.0	12.4	7.4	36.0	6.2	34.0	67	58	50	14.0	10.0	10.0

MOLOSSUS TROPIDORHYNCHUS Gray.

1839. *Molossus tropidorhynchus* Gray, Ann. Nat. Hist., IV, p. 6, September, 1839.

Fourteen skins and eleven alcoholic specimens from Pinar del Rio, and five (3 skins) from El Cobre. This is the Cuban representative of *Molossus obscurus*. It is readily distinguishable from the South American species by its much smaller size. For measurements see table, page 340.

Field notes.—Probably the most abundant of the species living together under a tile roof at Pinar del Rio. Like the others they emerge suddenly from their roosting place very late in the dusk of evening, and after flitting a few times about the roof are gone. At El Cobre the specimens were likewise collected under the tiles of a roof.—W. Palmer.

PROMOPS GLAUCINUS (Wagner).

1843. *Dysopes glaucinus* Wagner, Wiegmann's Archiv für Naturgesch., 1843, I, p. 368.

1861. *Molossus ferox* Gundlach, Monatsber. k. Preuss. Akad. Wissensch. Berlin, p. 149 (not of Tschudi, 1844–1846); Cuba.

One specimen (in alcohol) was taken under a tile roof at Pinar del Rio, February 27, 1900. For measurements see table, page 340.

NYCTINOMUS MUSCULUS Gundlach.

1861. *Nyctinomus musculus* Gundlach, Monatsber. k. Preuss. Akad. Wissensch. Berlin, p. 149.

1902. *Nyctinomus musculus* Miller, Proc. Biol. Soc. Washington, XV, p. 248, December 16, 1902.

Three in alcohol and five skins from El Guama, one skin from Cabañas, and one (in alcohol) from Pinar del Rio.

This species is readily distinguishable from both *Nyctinomus basiliensis* and *N. cynocephalus* by its small size, the character pointed out by Gundlach in the original description. A further peculiarity of the Cuban animal, apparently shared by all the West Indian members of the group, is the minute size and rudimentary structure of the first upper premolar. In the continental species this tooth is well developed and provided with a distinct cingulum, while in the insular forms it is a mere terete spicule. For measurements see table, page 340.

Field notes.—Occasionally seen about dark among the hard limestone hills of the mountainous districts. Here it spends the day in the smaller crevices of the caves, with *Artibeus parvipes*. We could find none during the day, although the *Artibeus* was common and conspicuous, but by closing all but one of the entrances to a cave and hanging a fine net over this opening at night we usually obtained one or more of these little bats the next morning. The specimen from Cabañas was captured in a house.—W. Palmer.

Measurements of Cuban molossidæ.

Name.	Locality.	Number.	Sex.	Total length.	Tail.	Tibia.	Foot.	Forearm.	First digit.	Second digit.	Third digit.	Fourth digit.	Fifth digit.	Ear from meatus.	Ear from crown.	Width of ear.
				mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*
Molossus tropidorhynchus.	Pinar del Rio.	103760	Male	88	31.0	10.2	7.8	34.0	6.0	35	69	54	38	11.0	8.0	11.6
Do	do	103763	do	89	32.0	11.0	8.0	34.0	6.0	34	69	53	37	11.0	9.0	12.0
Do	do	103761	Female	87	30.0	11.0	7.6	34.0	6.2	34	69	53	37	11.8	9.0	13.0
Do	do	103762	do	85	29.0	11.0	7.4	34.0	6.2	35	70	54	37	11.8	9.0	12.0
Do	do	103764	do	86	29.6	10.0	7.6	33.6	6.0	34	67	51	35	11.0	8.0	11.0
Do	do	103765	do	88	33.0	10.0	7.0	33.0	6.0	33	66	49	35	10.2	8.4	12.0
Do	do	103766	do	87	32.0	10.4	7.0	34.0	6.4	35	67	52	37	12.0	9.8	13.0
Do	do	103767	do	84	31.0	10.4	7.0	33.4	6.0	34	67	50	37	11.8	9.0	13.0
Do	do	103768	do	86	32.0	10.2	7.2	33.0	6.0	35	66	50	36	11.0	8.0	12.0
Do	do	103769	do	90	31.0	10.6	7.4	34.0	6.2	34	68	51	37	12.0	8.8	13.0
Promops glaucinus.	do	103827	Male	133	49.0	20.0	10.4	59.0	9.0	61	115	87	60	25.0	16.4	24.0
Nyctinomus musculus.	El Guama.	103775	do	81	28.0	10.0	8.0	38.0	7.0	37	72	58	37	....	....	....
Do	do	103776	do	85	29.0	10.4	8.4	40.0	6.8	38	75	58	39	....	....	....
Do	do	103777	do	86	31.0	11.0	8.0	39.0	6.6	37	71	54	37	....	....	....
Do	do	103778	Female	86	34.0	12.0	8.8	39.0	6.6	37	70	55	38	....	....	....
Do	do	103779	do	89	33.0	12.0	8.6	38.8	7.0	36	70	54	37	....	....	....
Do	do	103771	do	86	30.0	10.4	7.0	38.0	6.4	37	72	59	39	16.0	11.4	16.0
Do	do	103772	do	91	35.0	11.0	7.0	39.0	6.6	36	73	60	40	17.0	12.0	17.0
Do	do	103773	Male	83	30.0	11.0	7.8	39.0	6.8	37	71	58	40	16.4	12.4	16.4
Do	Pinar del Rio.	103774	do	87	31.0	12.0	7.0	39.0	6.0	36	73	60	39	16.0	12.0	16.0
Do	Cabañas	103780	Female	....	....	13.0	8.4	38.6	6.0	36	68	55	39	....	....	....

CHILONATALUS MICROPUS (Dobson).

1880. *Natalus micropus* Dobson, Proc. Zool. Soc. London, p. 443; Environs of Kingston, Jamaica.

A single specimen (in alcohol) was taken at Baracoa. It is in bad condition, but there is no question as to its generic identity. For measurements see table, page 343.

Field notes.—This little bat, the only one of the kind that I found in Cuba, was captured in a butterfly net after dark on the evening of February 6, 1902, as it emerged from a cave in company with many other bats of other species. Its identity was not noticed at the time, and it was hurriedly placed, while yet alive, in a bag with other bats. Later it was found that one of the others, probably an *Artibeus*, had bitten its body in two. None of the people to whom I showed it had ever seen so small a bat.—W. Palmer.

NYCTIELLUS LEPIDUS (Gervais).

1838. *Vespertilio lepidus* Gervais, in La Sagra's Hist. Fisica. Politica y Natural de la Isla de Cuba, Pt. 2, III (Mamm.), p. 32; Cuba.

1855. *Nyctiellus lepidus* Gervais, Expéd. du Comte de Castelnau, Zool., Mamm., p. 84.

An adult female (skin and skull) was taken at Nueva Gerona, Isle of Pines, on July 11, 1900. For measurements, see table, page 343.

This specimen shows that the genus *Nyctiellus*, founded by Gervais for the reception of his *Vespertilio lepidus*, is distinct from *Natalus*, with which it is commonly united. *Nyctiellus lepidus* is a small bat about equal to *Pipistrellus hesperus* or *Thyroptera discifera* in size, though of more slender, delicate form than either of these. The legs are proportioned to the body about as in the two animals just mentioned, and therefore show none of the elongation characteristic of the posterior extremities in *Natalus*. The ear is small in size and simple in structure, closely resembling that of *Pipistrellus hesperus* in general outline, though somewhat shorter and broader. The anterior border of the ear conch arises directly over the eye, therefore slightly farther forward than in *Natalus*, and the posterior border terminates behind base of tragus instead of noticeably in front. As a result the ear opens outward with scarcely a trace of the peculiar funnel form noticeable in the other members of the family *Natalidæ*. The tragus, however, appears to be much like that of *Natalus*. So far as can be determined from the dried specimen the lips are simple and there is no glandular outgrowth on forehead. Color, light raw-sienna throughout, the dorsal surface distinctly clouded with sepia.

Skull (Plate IX, fig. 2) essentially as in *Natalus*, but with brain case reduced in size and rostrum so greatly broadened that the lachrymal width is nearly equal to the width of brain case above roots of zygomata. A suggestion of this broadening of the rostrum is found in *Natalus tumidirostris*, though in this animal the general proportions of the *Natalus* skull are not departed from. Dentition as in *Natalus*, but anterior premolar, both above and below, smaller than in any species of the genus with which I am acquainted. In the upper jaw this tooth is distinctly smaller than the outer incisor.

Field notes.—About a dozen were seen, late in the evenings, along the shore of the river at Nueva Gerona, Isle of Pines. This bat flies very low, about bushes, and close to buildings. Therefore, it is rarely seen for more than an instant as it rises against a light background. All efforts to shoot one were unsuccessful, but one was finally captured in a butterfly net as it was traversing the length of a porch.—W. PALMER.

CHILONYCTERIS BOOTHI Gundlach.

1861. *Chilonycteris boothi* GUNDLACH, Monatsber. k. Preuss. Akad. Wissensch. Berlin, p. 154; Fundador, Cuba.

1902. *Chilonycteris boothi* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 401, September 12, 1902.

Four specimens (2 skins) from Baracoa. These, as I have recently pointed out, differ from the Jamaican *Chilonycteris parnellii* in the noticeably less crowding of the lower premolars. In the Jamaican animal the first lower premolar is in contact with the third and the

second is crowded quite out of the tooth row on lingual side. In *C. boothi* the first premolar is separated from the third by a distinct interval, in which lies the slightly displaced second. Otherwise the two species appear to be closely similar. For measurements see table, page 343.

Field notes.—Four specimens were obtained at the mouth of the cave near Baracoa, described under the next species. They did not emerge until well after dark, and none were captured while any trace of daylight remained.—W. PALMER.

CHILONYCTERIS MACLEAYII Gray.

1839. *Chilonycteris macleayii* GRAY, Ann. Nat. Hist., IV, p. 5, September, 1839; Cuba.

Eight (6 skins) from Guanajay and fifty (6 skins) from Baracoa.

In both series, as shown by the table of measurements (page 343), a larger and smaller form may be distinguished, the differences between which are fairly constant and quite independent of age and sex. Mr. Oldfield Thomas, who kindly compared some of Mr. Palmer's skins with the type in the British Museum, writes me that the name was originally based on a large specimen.

Field notes.—At Guanajay this was evidently a rare species. We found it in only one locality, a deep, damp cave in Guanajay Mountain, where it lived in company with thousands of *Phyllonycteris poeyi*. The white bat was somewhat readily captured with a dip net, and occasionally, but rarely, we secured a specimen of the smaller animal.

A few miles east of Baracoa, on a broad, well-wooded hill, is a hole in the porous limestone some 8 feet in diameter and 20 in depth. At the bottom, on one side, is the opening to a cave which extends an unknown distance, as I could find no one who had ever explored it. At the time of my visits, late on two afternoons, a slight column of mist was rising from the openings, showing that it was a damp cave similar to the one visited at Guanajay. Leading to the mouth of the cave is an irregular trough in the surface of the rock. This extends some distance back into the woods, and shows that the cave furnishes the natural drainage for the immediate region. The people living near knew of the existence of three kinds of bats in great abundance in this cave. Armed with an ordinary butterfly net, during two evenings I was able to secure no less than 142 bats, representing six species (*Chilonatalus micropus*, *Mormoops cinnamomea*, *Chilonycteris boothi*, *C. macleayii*, *Monophyllus cubanus*, and *Phyllonycteris poeyi*), as they emerged from the perpendicular opening. Before dark, while there was still light enough to see distinctly, the small *Chilonycteris* began to come out, at first singly or a few at a time, often hesitating and returning below again for another effort, then in greater num-

bers, and finally, as it became darker, in an almost continuous stream, so that with a few quick sweeps of the net it was possible to secure several specimens. At first no other species occurred with them, but as the gloom thickened and it became impossible to see the bats other kinds emerged and were captured by random strokes of the net.—W. PALMER.

Measurements of Chilonatalus, Nyctiellus, Chilonycteris, and Mormoops.

Name.	Locality.	Number.	Sex.	Total length.	Tail.	Tibia.	Foot.	Forearm.	First digit.	Second digit.	Third digit.	Fourth digit.	Fifth digit.	Ear from meatus.	Ear from crown.	Width of ear.
				mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*
Chilonatalus micropus.	Baracoa...	113724	Female.	....	....	20.0	8.0	32.0	4.0	33	....	....	....	14.0	11.4	15.0
Nyctiellus lepidus.	Nueva Gerona.	103898	...do....	66	27.0	13.0	6.0	29.6	4.0	25	47.0	35	35	10.0	8.0	9.0
Chilonycteris boothi.	Baracoa...	113767	Male ...	83	22.0	20.0	10.0	52.4	7.0	44	87.0	68	66	23.0	18.0	14.0
Do	....do....	113768	...do....	83	21.4	20.0	10.0	52.0	7.0	43	90.0	68	67	24.0	18.8	13.0
Do	....do....	113769	...do....	78	21.0	19.8	11.0	51.6	8.0	45	87.0	67	66	....	....	....
Do	....do....	113770	...do....	76	....	19.8	11.0	52.0	7.0	45	92.0	66	63	....	....	....
Chilonycteris macleayii.	Guanajay .	103813	...do....	66	21.0	16.4	8.0	42.0	5.4	38	76.0	54	51	17.4	15.0	10.0
Do	....do....	103814	...do....	70	22.0	16.0	9.0	41.6	6.0	38	74.0	53	52	18.0	15.0	10.0
Do	....do....	103812	...do....	67	20.0	15.6	8.0	40.6	6.4	37	74.0	54	50	....	....	....
Do	....do....	103820	...do....	....	....	15.0	8.4	37.0	6.4	33	66.0	45	44	....	....	....
Do	....do....	103822	...do....	....	....	16.0	7.8	37.0	7.0	35	63.0	45	43	....	....	....
Do	....do....	103823	...do....	....	....	17.0	8.0	37.0	6.4	34	62.0	44	42	....	....	....
Do	Baracoa...	113777	Female.	65	19.4	15.0	8.0	36.4	5.8	35	65.0	46	43	16.4	13.4	9.0
Do	....do....	113778	...do....	65	19.0	15.0	7.0	37.0	5.8	34	64.0	46	43	16.0	13.0	9.0
Do	....do....	113779	...do....	60	20.0	14.8	8.0	37.0	5.4	35	66.0	48	44	16.0	12.6	9.0
Do	....do....	113784	...do....	63	19.6	16.0	7.8	38.0	5.6	34	63.0	45	44	16.0	12.0	8.8
Do	....do....	113785	...do....	65	20.6	15.0	7.6	36.4	5.8	33	64.0	46	43	16.0	12.0	9.0
Do	....do....	113780	Male ...	64	19.0	15.0	8.0	37.0	6.0	32	65.0	46	44	16.0	13.0	9.0
Do	....do....	113781	...do....	67	21.0	15.6	8.2	38.0	6.4	36	67.0	50	46	17.0	13.0	9.0
Do	....do....	113782	...do....	60	20.0	16.0	7.4	37.0	6.0	35	67.0	47	43	15.6	12.0	8.4
Do	....do....	113783	...do....	64	19.0	15.0	7.8	36.6	6.0	33	67.6	48	43	16.4	13.0	7.8
Do	....do....	113788	...do....	65	21.0	15.0	8.6	36.0	6.0	35	68.0	46	44	17.0	13.0	8.4
Do	....do....	113796	Female.	68	25.4	15.2	7.6	41.0	6.2	40	73.0	52	51	16.0	14.0	9.0
Do	....do....	113797	...do....	74	23.0	16.6	8.6	43.0	6.0	39	76.0	53	51	17.4	11.0	9.0
Do	....do....	113798	...do....	69	24.0	17.4	7.6	42.0	5.4	40	76.0	54	52	18.0	14.0	10.0
Do	....do....	113799	...do....	68	24.0	16.0	8.0	42.4	5.0	39	73.0	54	52	18.0	14.0	9.6
Do	....do....	113806	...do....	67	27.0	16.4	9.0	41.0	5.0	39	73.0	55	51	17.0	14.0	9.0
Do	....do....	113794	Male ...	69	26.0	17.0	8.8	42.0	6.0	41	77.0	53	50	18.0	14.0	9.0
Do	....do....	113795	...do....	65	23.0	17.0	7.0	42.0	5.4	38	73.0	52	50	19.0	15.0	10.0
Do	....do....	113800	...do....	72	27.0	17.0	9.0	43.0	7.0	39	76.0	52	51	19.0	14.0	9.0
Do	....do....	113801	...do....	68	27.0	17.0	9.0	42.4	6.0	40	74.0	53	51	18.0	14.6	10.0
Do	....do....	113802	...do....	68	20.0	17.0	8.0	42.0	6.0	39	71.0	52	50	18.0	15.0	10.0
Mormoops cinnamomea.	....do....	113762	...do....	78	30.0	19.0	8.6	45.0	6.4	41	84.0	61	55	....	....	....
Do	....do....	113763	Female.	75	27.0	19.0	9.0	41.0	6.0	43	86.0	61	54	....	....	....
Do	....do....	113764	...do....	78	26.0	19.0	8.0	45.0	7.0	42	82.0	62	55	....	....	....
Do	....do....	113765	...do....	82	32.0	19.0	9.0	44.0	6.0	43	86.0	63	58	10.0	8.0	11.0
Do	....do....	113766	...do....	81	29.0	19.0	8.0	44.0	6.6	42	90.0	62	55	11.0	8.0	15.0

MORMOOPS CINNAMOMEA (Gundlach).

1840. *L[obostoma] cinnamomeum* GUNDLACH, Wiegmann's Archiv für Naturgeschichte, 1840, I, p. 357; Cafetal St. Antonio el Fundador, Cuba.

1902. *Mormoops blainvillii cinnamomea* REHN, Proc. Acad. Nat. Sci. Philadelphia, p. 165. Issued June 11, 1902.

Five specimens (3 skins) from Baracoa. These have been recorded by Mr. Rehn in his recent revision of the genus *Mormoops*. I can see no necessity, however, for applying to this well marked form a trinomial name. For measurements see table above.

Field notes.—Among the 142 bats captured in two evenings at the mouth of the cave described in my account of *Chilonycteris macleayii* were five of this species. They were among the last to leave the cave as none were taken while it was light enough to see the orifice.—W. PALMER.

MACROTUS WATERHOUSII Gray.

1843. *Macrotus waterhousii* GRAY, Proc. Zool. Soc. London, p. 21; Haiti.

Eight specimens from the following localities: Guanajay, 3 (1 skin); El Cobre, 2 (1 skin); Nueva Gerona, Isle of Pines, 3 (2 skins).

In the absence of the material required for a revision of the West Indian forms of *Macrotus* the Cuban species may stand as *M. waterhousii*. The reasons for rejecting the generic name *Otopterus* have been given by Dr. F. W. True in Harrison Allen's Monograph of the Bats of North America (p. 33, March 14, 1894).

Field notes.—Two were driven out of a large cave, inhabited principally by *Artibeus*, on Guanajay Mountain, April 27, 1900, and captured in a dip net. While in the net one of these gave birth to a single young.

On the Isle of Pines a large cave was visited on the mountain side near Nueva Gerona, July 3, 1900. We were told that an abundance of bats had often been seen there, but all our efforts could frighten out only five, three of which were this species.

The only ones seen in eastern Cuba were captured in an old runway of a copper mine at El Cobre. They were with many individuals of *Artibeus*, and in the dim light of our lamps it was difficult to detect and capture the smaller species.—W. PALMER.

MONOPHYLLUS CUBANUS Miller.

1902. *Monophyllus cubanus* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 410. Issued September 12, 1902; Baracoa, Cuba.

Fifty-six specimens were taken at Baracoa. For measurements see table, page 346.

Field notes.—This bat was abundant in the damp cave described under *Chilonycteris macleayi*. It was the second species to leave the cave, and in numbers was probably about equal to the *Chilonycteris*. It is a strong, muscular bat, and very hard to kill, especially when one is in a great hurry, as we were during our visits to the cave.—W. PALMER.

PHYLLONYCTERIS POEYI Gundlach.

1861. *Ph[yllonycteris] poeyi* GUNDLACH, Monatsber. k. Preuss. Akad. Wissensch. Berlin, (1860), p. 817; Cafetal St. Antonio el Fundador, Cuba.

Two hundred and twenty-six (74 skins) from a cave near Guanajay, four skulls found in owl pellets at El Guama, and twenty-six specimens (7 skins) from Baracoa. For measurements see table, page 346.

As may be seen from the figure (Plate IX) Gundlach's description of the noseleaf and calcar of this bat was correct. Dobson's suggestion that the type was mutilated[a] is therefore quite unwarranted. Unfortunately *P. sezekorni* is still unrepresented in recent collections, though related forms are known from the Bahamas, Jamaica, Santo Domingo, and Porto Rico. No representative of *P. poeyi* has been taken outside of Cuba.

In color the skins are so uniform that the description of one will answer for the entire series. Fur everywhere grayish white, the hairs of crown and back distinctly washed with clay color at tip, those of the shoulders very slightly so; on under parts the wash is pale cream-buff, with a suggestion of ecru-drab. Ears and membranes light brown, the outermost phalanges and neighboring portion of membrane whitish. Throughout the pelage, but more particularly on the back, the hairs have a silky texture which produces silvery reflections in certain lights.

Field notes.—Very abundant in a wet, ill-ventilated cavern on Guanajay Mountain. On entering this cave, the vertical opening of which, about 12 feet across, was concealed by bushes, we descended about 25 feet, and were then standing some 20 feet above the lowest level. The slight noise which we made disturbed the bats in the inner chambers, and we could distinctly hear the rumbling made by their wings. As we proceeded this sound increased, until, when we reached the inner and thickly populated chambers, it became a grand, rushing, roar of thousands on thousands of wildly flying animals. To reach the inner chamber it was necessary for us to descend from the first landing to the real floor of the cavern, and there light our candles, for not a ray of light and very little fresh air penetrated so far. From the floor we worked our way over many guano-covered, damp bowlders and through arches and narrow passages up to a sloping shelf, where, owing to the low roof, a man could not stand upright. By this time the bad air and excessive warmth was telling on us, and we were in a most profuse perspiration. The bats were now thoroughly aroused, and the noise of their wings was astounding. Many were darting out through the passage by which we had entered. Placing our candles where they would be somewhat protected and partially blocking some of the openings with nets, we began swinging a dip net in every direction, trusting to chance to secure specimens. About fifteen minutes of such work usally resulted in the capture of 20 to 30 bats, nearly all of this species, and also in our complete exhaustion, our clothing soaked with perspiration and filth and our lungs scarcely able to breath in the foul air. By this time the bats would have passed into inner chambers and inaccessible recesses where very few could be followed and taken. Before June 7, all the females were big with a single young, but after this

[a] Catal. Chiropt. Brit. Mus., 1878, p. 502.

date we found the pink, almost hairless little ones of different sizes hanging to the roof and scattered over much of its surface. On our last visit, late in June, the cave was so hot as to be unbearable. This bat was not seen at Pinar del Rio, but from pellets of the Cuban barn owl we procured several skulls.

Among the specimens captured at the mouth of the damp cave near Baracoa (described under *Chilonycteris macleayii*) were many of this species. It was among the last to leave the cave, and we were quite unable to see them as they emerged, depending on chance and rapid movements of the net to secure them. On one side of the vertical opening of this cave grew a large tree whose roots descended like a stream into the cavity. The people of the neighborhood assured me that the majas (the Cuban boa, *Epicrates angulifer*) coil themselves among these roots and grab at the bats as they fly out. I was told that a snake frequently secures a bat in this manner.—W. PALMER.

Measurements of Monophyllus and Phyllonycteris.

Name.	Locality.	Number.	Sex.	Total length.	Tail.	Tibia.	Foot.	Forearm.	First digit.	Second digit.	Third digit.	Fourth digit.	Fifth digit.	Ear from meatus.	Ear from crown.	Width of ear.
				mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*
Monophyllus cubanus.	Baracoa ..	113674	Male ...	67	8.0	16.0	11.0	38.6	11.0	35	80	57	50	13.0	11.4	7.6
Do	....do	113681	....do ...	72	9.0	17.0	11.0	40.0	10.4	36	84	60	55	13.6	11.0	8.0
Do	....do	113683	....do ...	67	9.0	17.0	10.4	40.0	11.0	34	81	60	54	14.0	11.0	9.0
Do	....do	113685	....do ...	72	8.0	16.0	9.0	39.0	9.0	36	80	57	51	14.0	11.0	10.0
Do	....do	113686	....do ...	64	8.0	16.6	10.0	39.4	10.6	37	74	56	51	14.4	10.0	8.6
Do	....do	113689	....do ...	70	10.0	17.0	10.4	40.0	9.8	37	84	62	53	14.6	11.0	9.0
Do	....do	113692	....do ...	64	8.0	17.0	10.0	40.0	10.4	35	85	62	54	14.0	10.0	9.6
Do	....do	113693	....do ...	69	10.0	16.0	11.0	38.0	10.4	36	81	57	50	14.0	11.0	9.6
Do	....do	113679	Female.	72	9.0	17.0	11.0	39.0	9.6	35	81	57	51	13.0	11.0	10.0
Do	....do	113687	....do ...	69	10.0	17.6	10.0	38.0	9.4	36	77	55	49	14.0	11.4	10.0
Do	....do	113688	....do ...	67	9.0	17.0	10.0	40.0	10.0	37	78	57	51	16.0	11.6	10.0
Do	....do	113690	....do ...	....	....	16.0	10.0	38.0	8.0	34	76	53	48	14.6	12.0	10.0
Do	....do	113696	....do ...	66	9.0	17.6	11.0	40.0	10.0	36	80	59	52	15.0	11.0	9.0
Do	....do	113697	....do ...	69	9.0	16.0	10.4	38.6	10.0	36	78	55	49	14.0	12.4	9.0
Do	....do	113698	....do ...	64	9.0	16.4	11.0	39.6	10.0	34	79	56	49	15.6	11.0	10.0
Phyllonycteris poeyi.	Guanajay.	103518	Male ...	82	9.0	27.0	15.0	47.0	13.0	38	84	65	64	20.4	15.0	12.0
Do	....do	103519	....do ...	84	9.0	24.0	15.0	46.6	12.0	36	82	62	62	19.4	14.0	12.0
Do	....do	103531	....do ...	79	11.0	26.0	15.0	47.0	13.0	38	84	65	64	19.0	13.6	12.0
Do	....do	103532	....do ...	80	12.0	25.4	15.0	47.0	13.0	36	83	65	64	19.8	15.0	12.6
Do	....do	103533	....do ...	87	12.4	24.0	16.0	45.4	13.0	36	79	63	64	19.0	15.0	12.0
Do	....do	103534	....do ...	80	10.0	25.4	15.0	45.0	12.6	37	76	63	63	19.0	14.0	11.0
Do	....do	103536	....do ...	83	11.4	24.6	14.0	46.0	11.6	34	79	64	63	18.0	13.0	11.0
Do	....do	103438	Female.	81	13.0	25.0	15.0	47.0	13.0	32	78	63	64	19.0	15.0	12.0
Do	....do	103450	....do ...	80	12.0	25.0	15.0	49.0	13.0	33	83	68	66	19.0	15.0	12.0
Do	....do	103452	....do ...	75	10.0	24.6	13.6	46.6	12.4	36	78	62	62	18.0	14.0	12.0
Do	....do	103455	....do ...	80	12.0	25.4	15.6	49.0	12.0	37	84	65	67	19.0	15.0	11.0
Do	....do	103456	....do ...	80	12.0	22.6	13.6	46.0	12.4	32	77	60	58	17.8	13.0	11.6
Do	....do	103457	....do ...	80	11.0	22.4	15.0	45.0	12.0	34	76	61	61	18 2	14.0	12.2
Do	....do	103458	....do ...	82	12.0	25.0	14.6	45.0	11.0	36	76	61	62	18.0	14.0	11.6
Do	....do	103461	....do ...	79	9.0	25.0	14.6	47.0	11.0	38	68	64	63	18.4	14.6	11.8
Do	Baracoa ..	113727	Male ...	85	12.0	27.0	15.0	46.0	13.0	37	77	62	62	....	....	....
Do	....do	113728	....do ...	70	11.0	24.0	14.0	43.0	13.0	36	74	58	59	....	....	....
Do	....do	113740	....do ...	81	11.0	26.4	15.4	46.4	13.0	37	80	63	63	19.0	15.0	12.0
Do	....do	113743	....do ...	78	12.0	25.4	16.0	46.0	12.0	37	83	65	65	18.0	15.0	11.8
Do	....do	113745	....do ...	82	14.0	25.0	14.0	45.0	13.0	37	81	65	63	19.0	14.6	11.4
Do	....do	113732	Female.	80	13.0	24.0	15.6	45.0	13.4	37	80	60	60	17.8	14.6	12.0
Do	....do	113735	....do ...	80	12.0	23.6	13.2	47.0	13.0	37	80	60	60	17.4	14.6	11.0
Do	....do	113741	....do ...	82	8.0	25.0	17.0	47.0	13.0	36	80	64	64	18 4	14.0	11.6
Do	....do	113749	....do ...	85	12.0	25.0	15.6	45.0	12.0	37	78	61	61	17.4	14.2	11.6
Do	....do	113750	....do ...	80	11.0	23.0	15.0	45.6	12.0	35	77	61	61	19.0	15.0	11.0

BRACHYPHYLLA NANA Miller.

1902. *Brachyphylla nana* Miller, Proc. Acad. Nat. Sci. Philadelphia, p. 409. Issued September 12, 1902; El Guama, Cuba. (Skull.)

1902. *Brachyphylla nana* Miller, Proc. Biol. Soc. Washington, XV, p. 249. December 16, 1902. (External characters.)

A single imperfect skull was found in an owl pellet procured at El Guama.

Field notes.—In a little valley at El Guama, among the mountains north of Pinar del Rio, is a rocky mass through which the waters of the valley once flowed, leaving now a large opening through which a man can readily walk. It is a favorite custom of the bats to fly through this opening, and a net placed there often entangled a specimen or two, though it failed to secure this species. A Cuban barn owl had its roosting place on a small shelf of rock, and on the ground beneath were many disgorged pellets. These contained the bones of several species of birds, numerous rats (*Mus alexandrinus*), and a few bats, among them a single skull of this species.—W. Palmer.

ARTIBEUS PARVIPES Rehn.

1902. *Artibeus parvipes* Rehn, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 639. December 12, 1902; Santiago de Cuba.

One hundred and seventy specimens from the following localities: El Guama, 26 (14 skins); Pinar del Rio, 1; San Diego de los Baños, 17 (7 skins); Guanajay, 83 (32 skins); Mariel, 8 (4 skins); Nueva Gerona, Isle of Pines, 1; Baracoa, 11 (4 skins); El Cobre, 23 (3 skins).

The Jamaican material at hand is not sufficiently extensive to furnish a satisfactory basis for comparison of the Cuban specimens with true *Artibeus jamaicensis*, but I see no reason to question Mr. Rehn's conclusions. For measurements see table, page 348.

Field notes.—In western Cuba this is the commonest bat; found everywhere in the limestone caves of the mountains, where they can be seen hanging from the roof singly or in bunches. One was caught in a net placed over the edge of a tile roof at Pinar del Rio, where it had spent the day with many individuals of other species. These bats are also common in places remote from caves, as in the dilapidated warehouses at Mariel and Caloma, on the north and south coasts, respectively. Two were found in a cave on a mountain side on the Isle of Pines. We saw none of these bats roosting in trees, but they evidently capture much of their food among flowering trees, as their fur often contains pollen and parts of flowers. These are also found abundantly on the floors of caves where the bats roost.

In eastern Cuba *Artibeus parvipes* is common in all the drier rock openings about Baracoa, but it does not occur in the damp cave

described under *Chilonycteris macleayii*. At El Cobre it is a common inhabitant of the old runways and shafts of the copper workings. It rarely emerges until after dark, but several were one evening seen to leave a cave on a hillside and return after a short trip abroad. Their flight is strong, and one often hears the rush of their wings as they swiftly curve by in the darkness.—W. PALMER.

Measurements of Artibeus parvipes.

Locality.	Number.	Sex.	Head and body.	Tibia.	Foot.	Forearm.	First digit.	Second digit.	Third digit.	Fourth digit.	Fifth digit.	Ear from meatus.	Ear from crown.	Width of ear.
			mm	*mm.*	*mm.*	*mm.*	*mm.*	*mm*	*mm.*	*mm*	*mm*	*mm.*	*mm.*	*mm.*
Guanajay	103696	Female.	75	21.0	13.0	54.0	11.0	44	112	89	81	20.0	13.0	14.0
Do	103697	....do...	73	23.0	13.0	.....	13.0	48	117	86	79	21.0	14.0	14.6
Do	103699	....do...	75	21.0	13.0	53.0	13.0	44	110	82	76	20.6	14.6	13.0
Do	103713	....do...	78	22.4	15.0	57.0	12.6	50	125	95	87	21.0	14.0	14.0
Do	103714	....do...	70	23.0	14.0	55.0	13.0	47	114	88	79	19.0	13.0	14.0
Do	103715	....do...	71	21.0	14.0	54.0	12.0	46	116	88	80	20.0	15.0	14.0
Do	103716	....do...	76	22.6	15.0	57.0	13.0	46	117	90	82	21.0	14.0	14.0
Do	103717	....do...	73	23.4	14.0	55.0	12.0	47	116	88	83	21.0	16.0	14.0
Do	103698	Male ...	74	23.0	14.0	57.0	14.0	47	120	89	78	21.0	14.6	14.0
Do	103700	....do...	72	21.0	13.4	55.0	13.4	45	115	87	80	20.0	14.0	13.4
Do	103701	....do...	73	21.4	15.0	55.4	13.0	47	120	87	80	21.4	15.6	14.6
Do	103702	....do...	76	22.0	14.0	54.6	13.4	44	113	85	77	20.0	14.0	13.0
Do	103703	....do...	73	20.0	15.0	54.0	13.6	46	114	83	77	20.0	14.0	14.0
Do	103704	....do...	70	22.0	13.6	56.0	14.0	47	118	87	82	21.0	13.6	13.6
Do	103705	....do...	74	22.0	12.0	53.0	12.0	47	113	85	80	20.0	14.4	14.0
El Cobre	113821	Female.	76	20.4	13.0	53.0	14.0	47	116	87	80	21.0	15.0	14.0
Do	113822	....do...	76	21.4	13.4	55.0	14.4	46	114	83	79	20.0	15.0	14.0
Do	113825	....do...	75	20.4	13.6	53.0	13.0	45	112	82	78	20.4	14.0	12.4
Do	113828	....do...	76	23.0	13.0	58.0	15.4	47	120	90	86	22.0	14.0	13.0
Do	113829	....do...	78	21.4	14.4	55.0	13.0	47	117	85	80	21.4	15.0	13.6
Do	113823	Male ...	73	21.0	13.0	53.0	12.6	44	107	80	75	20.0	14.0	12.0
Do	113824	....do...	76	22.8	13.6	56.0	13.4	45	116	86	79	19.0	13.4	13.6
Do	113826	....do...	71	21.4	14.0	54.0	12.0	45	113	85	77	20.0	12.6	13.6
Do	113827	....do...	71	21.0	14.0	55.0	13.0	48	120	88	82	20.0	14.0	14.0
Do	113834	....do...	75	22.0	13.0	54.0	13.0	43	110	83	76	19.6	13.8	13.0

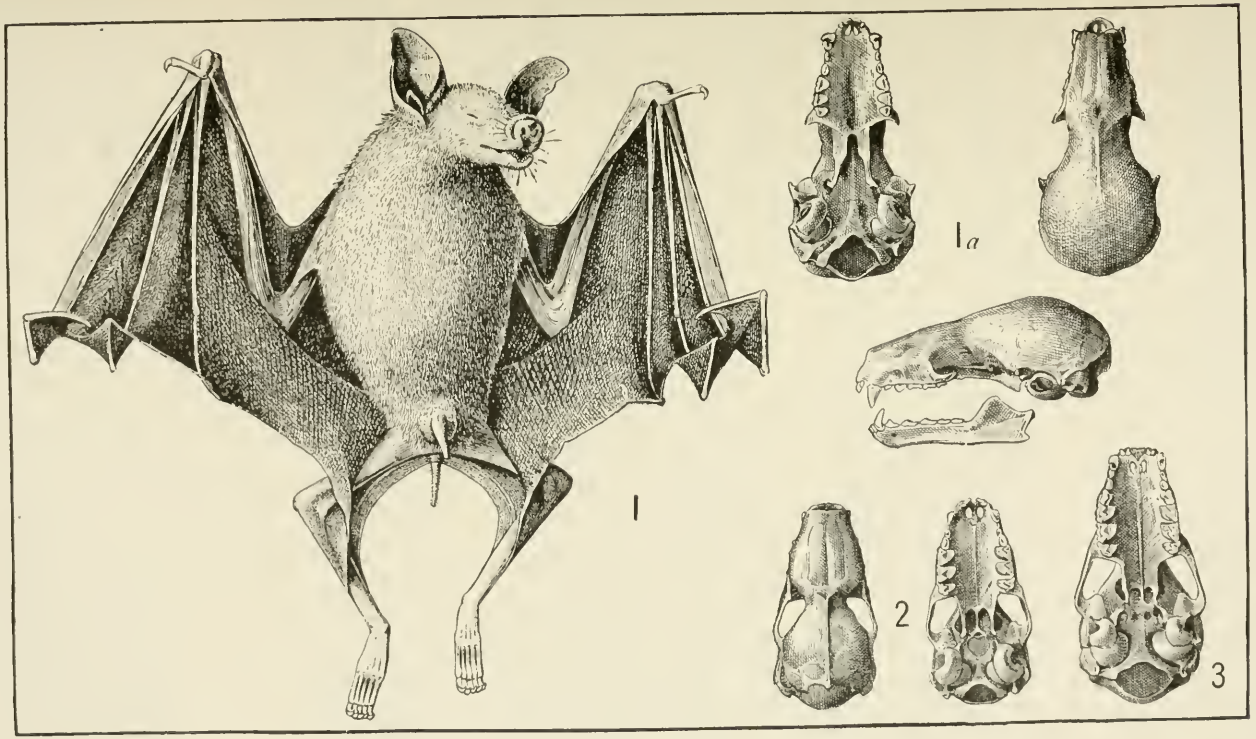
EXPLANATION OF PLATE.

FIG. 1. *Phyllonycteris poeyi* Gundlach. Adult male, No. 103527, collected at Guanajay, Cuba.

1a. Skull of *Phyllonycteris poyei* Gundlach. Adult female, No. 103585, collected at Guanajay, Cuba.

2. Skull of *Nyctiellus lepidus* (Gervais). Adult female, No. 103898, collected at Nueva Gerona, Isle of Pines.

3. Skull of *Natalus mexicanus* Miller. Adult female, No. 102509, collected at Morelos, Mexico.



SOME CUBAN BATS.

FOR EXPLANATION OF PLATE SEE PAGE 348.

LIST OF HEMIPTERA—HETEROPTERA OF LAS VEGAS HOT SPRINGS, NEW MEXICO, COLLECTED BY MESSRS. E. A. SCHWARZ AND HERBERT S. BARBER.

By Philip R. Uhler,
Provost of the Peabody Institute, Baltimore, Maryland.

This small but instructive collection, now in the United States National Museum, from a restricted locality hitherto neglected adds another link in the chain of evidence explaining the œcology and sources of distribution of a considerable number of local and widely dispersed forms of Hemiptera. I am informed by Mr. E. A. Schwarz that all specimens were collected in the vicinity of the Montezuma Hotel, which is situated at the mouth of the Gallinas River canyon, at an altitude of 6,770 feet.

Viewing the materials here presented, I am impressed by the mixed character of the collection. In the genus Homœmus are the Mexican upland *H. proteus* Stål. and the Rocky Mountain *H. bijugis* Uhler. *Corimelæna* is represented by only the far western *C. extensa* Uhler. Two species of *Podisus* appear, the *P. cynicus* Say, an Alleghanian form, and the Canadian *C. bracteatus* Fitch, which by the aid of a larger series of recently collected specimens seems to be a sufficiently distinct species. The interesting genus *Dendrocoris* is signalized by the presence of the Californian-desert species, *D. fruticosus* Bergroth, and by the eastern *D. humeralis* Uhler.

The collection when broadly considered, is seen to consist of widely distributed Rocky Mountain forms with a mixture of some far western and a few eastern species. The usual number of North American genera appear here as is generally the case in western collections, but the aquatic, riparian, and hypogean forms are scarcely represented.

Family PACHYCORIDÆ.

HOMÆMUS PROTEUS Stål.

Homœmus proteus Stål, Stett. Ent. Zeit., XXIII, 1862, p. 32.

A common insect in many parts of eastern Mexico, extending over the boundary into Texas and Arizona, and now for the first time found at Las Vegas Hot Springs, New Mexico, August 6–9. The writer has examined, also, specimens from the vicinity of Matamoras, from Tepic in southwestern Mexico, and from the vicinity of Cape St. Lucas, Lower California. It is everywhere exceptionally variable, both in form and pattern of markings.

HOMÆMUS BIJUGIS Uhler.

Homæmus bijugis UHLER, Hayden, Bull. Geol. Surv. Terr., Montana, 1872, p. 393.

One specimen was secured September 8. This is also a variable species in size and ornamentation. It has been collected near and on the foothills and also at considerable elevations in the Rocky Mountains of Colorado and farther north.

Family CORIMELÆNIDÆ.

CORIMELÆNA EXTENSA.

Corimelæna extensa UHLER, Proc. Ent. Soc., Phila., II, 1867, p. 155.

One specimen was caught August 7. It is a common species near the Pacific coast, being found from Oregon to Lower California. Its affinities are so close with *C. albipennis* Eschscholtz, of Chile, that it may prove to be only a modified form of that species. Some of the specimens from California and Oregon have the stripe on the corium tinged with rufous.

Family CYDNIDÆ.

AMNESTUS PUSILLUS Uhler.

Amnestus pusillus UHLER, Hayden, Bull. Geol. Surv. Terr., 1875, p. 278.

Two specimens were collected August 13. This is a common lowland species in Texas and the Southern States.

Family PENTATOMIDÆ.

PODISUS CYNICUS Say.

Podisus cynicus SAY, Heteropt. Hemipt., N. Amer., 1831, p. 3.

A male of this species was secured on August 11, and a female on August 14.

It has been found previously in Massachusetts, New York, Pennsylvania, northern New Jersey, Ohio, Indiana, Illinois, upper Maryland, Missouri, Virginia, and Colorado.

PODISUS BRACTEATUS Fitch.

Podisus bracteatus FITCH, Third N. Y. Report, 1859, p. 18.

Four specimens, one a female, were collected August 3 and 11. This species is shorter and proportionally broader than the preceding one, and it seems to be intermediate between *P. cynicus* Say and *P. crocatus* Uhler. All the species vary in color, and somewhat in degree of punctation on the upper surface. The middle of the sinuated margin of the segment just anterior to the genitalia (male) is more incised than in the preceding species.

BANASA VARIANS Stål.

Banasa varians Stål, Rio Hemipt., I, p. 11 (*R. dimidiatus* Stål).

Three specimens with immature colors were found on August 7. Two others with more mature integuments were taken on the same day.

THYANTA CASTA Stål.

Thyanta casta Stål, Stett. Ent. Zeit., XXIII, 1862, p. 104.

One specimen was secured August 3.

DENDROCORIS HUMERALIS Uhler.

Dendrocoris humeralis Uhler, Hayden, Bull. Geol. Surv. Terr., 1877, p. 400.

Four specimens were taken August 6. The specimens of this species brought together from the Northern, Eastern, Middle, and Southern States show a moderate amount of modification of the lateral thoracic angles and some deviation in grouping of punctures, as well as more or less suffusion of rufous on the pronotum and hemelytra.

DENDROCORIS FRUTICICOLA Bergroth.

Dendrocoris fruticicola Bergroth, Revue d'Ent., 1891, p. 228.

Two specimens of the plain colored variety were captured August 13.

This species extends in distribution, locally, from arid southern California through Arizona to the vicinity of Las Vegas, New Mexico.

PERIBALUS LIMBOLARIUS Stål.

Peribalus limbolarius Stål, Enum. Hemipt., II, 1872, p. 34.

One specimen was taken August 6.

This species is reported to have been taken in California and Mexico. The writer has examined specimens from Lower California, Colorado, Texas, most of the States east of the Mississippi River, New England, and Lower Canada.

Family COREIDÆ.

CORYNOCORIS DISTINCTUS Dallas.

Corynocoris distinctus Dallas, Brit. Mus. List, II, p. 119.

One specimen was secured August 12.

CHARIESTERUS ANTENNATOR Fabricius.

Chariesterus antennator Fabricius, Syst. Rhyng., p. 198.

Only a single specimen, taken August 8, is in the collection.

ARCHIMERUS CALCARATOR Fabricius.

Archimerus calcarator FABRICIUS, Syst. Rhyng., p. 192.

One specimen of fresh, pale color was captured August 2.

LEPTOGLOSSUS CORCULUS Say.

Leptoglossus corculus SAY, Heteropt. Hemipt. N. Amer., p. 12.

One specimen and a nympha were taken August 13.

ALYDUS PLUTO Uhler.

Alydus pluto UHLER, Hayden, Geol. Surv. Montana, 1872, p. 401.

A male specimen was secured September 7. It is paler colored than the fully matured state usually presents.

MARGUS INCONSPICUUS Herrich-Schaeffer.

Margus inconspicuus HERRICH-SCHAEFFER, Wanz. Insekt., VI, p. 14, fig. 570.

Four specimens of the dark, mature state are in the collection. They were taken August 11.

HARMOSTES REFLEXULUS Say.

Harmostes reflexulus SAY, Heteropt. Hemipt. N. Amer., p. 10.

A specimen of the common greenish stage of color was secured August 3.

CORIZUS HYALINUS Fabricius.

Corizus hyalinus FABRICIUS, Ent. Syst., II, p. 168.

The less mature, greenish state was found August 3. This is a cosmopolitan species which inhabits a considerable part of the more temperate regions of every one of the continents, not even excluding Australia. Strange to say, it has not yet become domiciled in any part of the Atlantic region, although it occurs in Florida, the Gulf States, Texas, the West Indies, and Mexico. A single specimen of the pale state was caught near Baltimore, Maryland, and a few others have been reported from Massachusetts. Among the many collections that I have made in most parts of New Jersey, I have thus far failed to secure specimens of this species. It appeared to me in considerable numbers on small plants at various places along the coastal plateau of Santo Domingo, West Indies, in the spring months. In the Antilles the darker colored and rufous varieties appear in moderate numbers.

Family BERYTIDÆ.

ACANTHOPHYSA ECHINATA Uhler.

Acanthophysa echinata UHLER, North Amer. Fauna, VII, Pt. 2, p. 261 (1893).

One specimen was secured August 3.

Family LYGÆIDÆ.

OXYCARENUS SCABROSUS, new species.

Elongate-ovate, with the head moderately long, acute; color above mostly pale straw yellow, the head rufous and the under side of the body paler. Surface generally dull, not conspicuously pubescent anywhere, somewhat powdered with white on sternum in mature specimens. Head long, tapering to tip, not distinctly punctate. Antennæ piceous, paler at base, moderately short. Rostrum reaching behind the middle coxæ, piceous. Legs piceous, short, the femora thick. Pronotum tinged with piceous, broad. The posterior lobe somewhat scabrous, much larger than the anterior lobe, with the surface very moderately convex and the posterior margin nearly straight, transverse suture shallow. Scutellum long, a little tinged with rufous, the middle bearing a prominent granule. Hemelytra very moderately convex, spread with numerous sparse dark granules on the straw-yellow ground. Under side piceous black, the venter highly polished.

Length 3 mm; width 1 mm.

Three specimens were taken August 12.

This species is less cylindrical than the other species. It is possible that when a fuller series of this species is collected, including both sexes, that it will be seen to constitute a new genus.

LIGYROCORIS SYLVESTRIS Stål.

Ligyrocoris sylvestris Stål, Enum. Hemipt., IV, p. 145.

Two specimens of this very common insect were found August 2.

PTOCHIOMERA CLAVIGERA Uhler.

Ptochiomera clavigera Uhler, Bull. Col. Exper. Station, No. 31, p. 24.

One specimen was captured August 6.

TRAPEZONOTUS NEBULOSUS Fallen.

Trapezonotus nebulosus Fallen, Mon. Cim., 1807, p. 65.

Two specimens were secured August 4.

This common European insect is now widely distributed in the United States, as it has been taken in most of the States from Maine to Texas. It occurs on the foothills and plains of Colorado in many localities, and it is found also in lower Canada.

EMBLETHIS ARENARIUS Fieber.

Emblethis arenarius Fieber, Eur. Hemipt., p. 198.

One specimen was found August 2.

PERITRECHUS FRATERNUS Uhler.

Peritrechus fraternus UHLER, Proc. Boston Soc. Nat. Hist., 1871, p. 103.

One specimen was taken August 12.

EREMOCORIS FERUS Say.

Eremocoris ferus SAY, Hemipt. Heteropt. N. Amer., p. 16.

Two specimens of the dark variety were secured August 2.

CRYPHULA PARALLELOGRAMMA Stål.

Cryphula parallelogramma STÅL, Enum. Hem., IV, p. 165.

Two specimens were taken August 3.

LYGÆUS RECLIVATUS Say.

Lygæus reclivatus SAY, Journ. Acad. Phila., IV, 1825, p. 321.

One specimen was taken August 13.

LYGÆUS ADMIRABILIS Uhler.

Lygæus admirabilis UHLER, Hayden, Report Geol. Montana, p. 405.

Several specimens were secured August 12.

LYGÆUS FACETUS Say.

Lygæus facetus SAY, Heterop. Hemipt., p. 13.

Five specimens of this pretty insect were collected August 14.

RHYPAROCHROMUS COMPACTUS, new species.

Elongate subquadrate oval, black, cydniform. Head much narrower than the front of pronotum, polished, the tylus narrow, prominent, sharply defined. Rostrum long and slender, reaching to the intermediate coxæ. Antennæ piceous black, moderately slender, about one and a half times as long as the pronotum, the basal joint shorter than the head, the second a little longer, the third a little shorter, the fourth about the same length as the third. Pronotum highly polished, moderately convex, the lateral margins gently curving, the anterior angles rounded, lateral margin slenderly recurved. Scutellum dull blackish, scabrous before the base to the tip. Corium dull piceo-flavous, minutely scabrous, the sutures deeply punctate. Legs piceous, paler on tibiæ and tarsi. Venter hardly polished, dull black. Length to tip of abdomen 3½ mm. Width of pronotum 1 mm. Width behind middle of abdomen 1½ mm.

Type.—Cat. No. 6849, U. S. N. M.

A single specimen was taken August 3.

Family LARGIDÆ.

LARGUS CINCTUS Herrich-Schaeffer.

Largus cinctus Herrich-Schaeffer, Wanz. Insekt., VII, p. 6, fig. 683.

Several specimens of this robust dark variety were taken August 2, 6, and 11.

Family CAPSIDÆ.

MIRIS INSTABILIS Uhler.

Miris instabilis Uhler, Proc. Boston Soc. Nat. Hist., 1871, p. 104.
Miris affinis Reuter, Caps. ex Bor. Amer., p. 59.

One specimen of the large variety was secured August 4, and a freshly excluded male on August 3.

CLIVINEMA RUBIDA, new species.

Form of *C. villosa* Reuter but compact and stouter, dull red with black markings, the under side mostly black, shining. Head broad, black, polished, short as seen from above, convex between the eyes, not excavated as in *C. villosa*, the face nearly vertical. Base of tylus prominent, polished. Basal joint of antennæ short, stout, the second joint thick, cylindrical subclavate, about twice as long as the first, both black, the third and fourth short, abruptly more slender, almost setaceous, piceous. Rostrum stout, black, extending to behind middle coxæ. Gula sunken, short. Pronotum broad, convex, dull rufous, the surface coarsely, confluently granulate-punctate, the callosities confluent, black, polished, tumidly elevated, the hood a little produced over the base of head, the humeral angles broadly curved. Scutellum small, convex, black, a little longer than wide, roughly punctate. Corium dull rufous, minutely scabrous, with the border across the base of cuneus indented, clavus like the corium, but discolored brownish, membrane smoke black, projecting considerably behind tip of abdomen. Legs stout, black.

Length to tip of abdomen 4 mm. Width of pronotum 1¼ mm.

Type.—Cat. No. 6848, U.S.N.M.

Two specimens were secured August 4 and 16. Faint traces of caducous pubescence seem to show that hairs were present when the specimens were fresh, but the species is not at all hirsute, as in *C. villosa* Reuter.

HADRONEMA MILITARIS Uhler.

Hadronema militaris Uhler, Hayden, Report Geol. Surv. Montana, p. 412.

Two specimens of this very common species were taken August 12.

PHYTOCORIS EXIMIUS Reuter.

Phytocoris eximius REUTER, Caps. ex Am. Bor., 1875, p. 67.

Seventeen specimens in different stages of maturity were captured August 4 to 14.

COMPSOCEROCORIS ANNULICORNIS Reuter.

Compsocerocoris annulicornis REUTER, Caps. ex Am. Bor., 1875, p. 70.

Five specimens of different sizes were taken August 12.

NEUROCOLPUS NUBILIS Say.

Neurocolpus nubilis SAY, Heteropt. N. Amer., p. 22.

Two specimens of this continental species were secured August 3. In the region east of the Mississippi River this species occurs on the elder, *Sambucus racemosa*, near the borders of streams, but on the great plains of Colorado, etc., it is common on small plants in damp situations.

CALOCORIS TINCTUS Uhler.

Calocoris tinctus UHLER, Col. Report, Bull. 31, p. 34.

Two specimens of this variable species were found August 4.

MELINNA MODESTA Uhler.

Melinna modesta UHLER, Entom. Amer., III, 1887, p. 69.

Two specimens of this widely distributed insect were secured August 6.

DICHROOSCYTUS ELEGANS, new species.

A miniature representative of *D. ruficennis* Fallen. Oblong ovate, light green, sometimes tinged with rufus above, opaque, integuments thick and firm, minutely pubescent but appearing bald. Head broad, large, vertex a little convex, a little indented at base, front almost flat, steeply sloping. Antennæ slender, pale green at base, darker toward the tip, the basal joint short, stouter than the others, the second and third much longer, subequal, the fourth most slender, very short. Rostrum pale green, fuscous at the tip, the basal joint stout, the following one slender and tapering toward the apex, reaching upon the middle coxæ. Pronotum subquadrangular, much wider than long, moderately convex, minutely wrinkled, the lateral margins oblique, the callosities not prominent and feebly defined, the humeral angles rounded. Scutellum almost flat, longer than wide, acutely triangular, minutely wrinkled. Corium varying from light green to wine red, but rarely of the darker color, ample, wide, minutely scabrous, the membrane large, very pale green. Underside and legs pale. No part of the surface is distinctly hairy, and the wing-covers widely spread beyond the abdomen.

Length to tip of hemelytra 2¾ mm.; width of pronotum ¾ mm.

Type.—Cat. No. 6850, U.S.N.M.

One specimen was secured August 16.

My friend Mr. Otto Heidemann found this insect in considerable numbers at Washington, District of Columbia, on June 16, upon *Juniperus virginianus.*[a]

The pale-colored stage of this species has also been taken near Lansing, Michigan, by Prof. H. Osborn.

When freshly excluded from the nympha these insects are very delicate, and of a dilute greenish tint. As whole broods of this species have been detected, of which all the specimens conformed to this small size, it seems difficult to regard this form as a mere dwarf of *D. rufipennis* Fallen.

POECILOCAPSUS LINEATUS Fabricius.

Poecilocapsus lineatus FABRICIUS, Syst. Rhyng., p. 234.
Capsus 4-vittatus SAY, Heteropt. N. Amer., p. 20.

A single specimen was secured August 7.

SYSTRATIOTUS AMERICANUS Reuter.

Systratiotus americanus REUTER, Caps. ex. Bor. Amer., p. 73.

One specimen was secured August 6. The range of this species is now seen to be from the uplands of Texas and New Mexico, along the lower elevations of eastern Colorado, northward into British Columbia, and from thence eastwardly to the province of Quebec and northern Maine.

HADRODEMA PULVERULENTA Uhler.

Hadrodema pulverulenta UHLER, Trans. Maryland Acad. Sci., 1892, p. 183.

Pale dull yellowish, sometimes tinged with fuscous, minutely pubescent, and spread with whitish powder when fully matured; the upper surface generally minutely scabrous. Head moderately convex, somewhat narrowing anteriorly, sometimes paler than the general surface, eyes black, the tylus not deeply bounded at the basal suture, the antennæ slender and short, pale, but infuscated on the fourth joint and apex of the third, rostrum yellowish or greenish, infuscated at tip reaching to behind the anterior coxæ, the basal joint thick, a little longer than the throat, the following joints tapering slenderly to the tip. Pronotum moderately short, convex, the posterior margin a little curved, acute, slenderly bordered with white, pleura pale like the sternum. Legs pale yellowish, sometimes speckled with rufous. Scutellum and wing-covers usually pale fulvo-testaceous concurrently with most of the pronotum, the membrane pale testaceous, somewhat

[a] Proc. Ent. Soc. Wash., II, p. 225.

dusky at tip. Venter sometimes flecked or flushed with rufous, but usually testaceous when freshly extruded from nympha. Outer margins of venter pale and smooth.

Length to tip of hemelytra, 4½–5 mm. Width of pronotum, 1¾ mm.

Two or three specimens were secured August 12. Mr. B. D. Walsh sent specimens to me from Rock Island, Illinois, and I have examined others from eastern Colorado, from Buffalo, New York, taken by Mr. E. P. Van Duzee, and from Massachusetts, Pennsylvania, Maryland, and North Carolina. It is closely related to *H. rubicunda* Fallen of Switzerland and Bavaria.

MYCTEROCORIS, new genus.

Robust, broadly oval, with thick and hard shell, polished, irregularly punctate, the sparse pubescence inconspicuous. The head small, acutely triangular above, much narrower than the front of pronotum, the eyes prominent, subglobular, placed distant from the pronotum. The occipital collar distinctly prominent, bounded anteriorly by an incised line, separated behind by an angular depressed space. Face sloping curvedly forward, the tylus narrow, tapering apically, bounded at base and each side by deep sutures. Cheeks short, nearly vertical. Antennæ slender, placed beneath the eyes, the basal joint short, not much longer than the thickness of the head, thickest apically, cylindrical, one grade thinner than the basal one, a little longer than the pronotum, the following joints concurrently filiform, much more slender, short, each one hardly as long as the basal joint. Rostrum long, slender, the basal joint broad, flattened, a little longer than the gula, the following ones much more slender, the apex reaching behind the posterior coxæ. Pronotum prominently convex, wider than long, with a high collum and prominent callosities, the lateral margins curving steeply downward and curvedly narrowing toward the anterior angles, the posterior margin acute edged and curved. The prosternum broadly and deeply scooped out. Fore-femora stout, fusiform. Scutellum small, polished, prominent, the basal portion tumidly convex. Corium broad, convex, strongly curved on the costal border, the cuneus broad, bluntly curvedly, triangular, flat, and depressed, the membrane long and wide, wrinkled at base, with the vein of the cell very coarse, and the inner areole not defined.

This genus comes between *Euramosus* Reuter and *Camptobrochis* Fieber, and it goes far toward connecting the divisions Capsaria and Bryocoraria as now recognized.

MYCTEROCORIS CERACHATES Uhler.

Derwocoris cerachates Uhler, Heteropt. Lower California, California Acad., IV, 1894, p. 265.

Two specimens of this remarkable insect were secured August 12 and 16. It comes very near to Camptobrochis Fieber, but deviates therefrom in the composition of the head and antennæ.

CAMPTOBROCHIS NEBULOSUS Uhler.

Camptobrochis nebulosus UHLER, Hayden, Report Geol. Surv. Montana, 1872, p. 417.

Two specimens of this widely distributed species were taken August 20.

CAMPTOBROCHIS GRANDIS Uhler.

Camptobrochis grandis UHLER, Entom. Amer., II, 1887, p. 230.

Five specimens were secured August 2, 5, 7, and 11. These specimens show well the individual variations.

CAMPTOBROCHIS BREVIS, new species.

Medium in size, robust, ground color dark piceous in clean specimens, marked with black, highly polished, black beneath. Head short, strongly contracted before the pronotum, coal black, highly polished, the antennæ long and slender, the basal joint a little longer than the vertex, second joint cylindrical, slightly thickened at tip, more than twice the length of the basal one, picco-testaceous darker at base and tip, the third and fourth a little more slender, dark piceous, the two subequal, together shorter than the second. Rostrum black, reaching to near the posterior coxæ. Pronotum black, polished, very convex, coarsely, unevenly transverse rugulose and punctate, the lateral margins curvedly oblique, steep, the collum and callosities sharply defined. Pleurites coarsely rugose punctate, deep black. Humeral angles moderately rounded, the adjoining impression nearly obsolete. Scutellum black, moderately convex, irregularly and unevenly punctate, the apical division lower than the basal. Clavus black, coarsely and roughly punctate, the sutures deeply defined, the corium less coarsely and not so closely punctate, piceous or black, the cuneus shagreened and punctate, membrane soiled white, the basal areole broad, with the outer vein strongly curved. Legs black, polished. Venter black, polished, minutely obsoletely punctate.

Length to tip of membrane, 4 mm. Width of pronotum, 1¼ mm.

Type.—Cat. No. 6851, U.S.N.M.

Four specimens were secured August 10.

NEOBORUS SAXEUS Distant.

Neoborus saxeus DISTANT, Biol. Cent.-Amer., I, p. 276, pl. XXVII, fig. 5.

A single damaged example was taken August 5. This species in one or more of its varieties inhabits the greater part of the United States, excepting, perhaps, the high mountains, and it spreads over the border into the Provinces of Quebec, Ontario, and British Columbia. It is found also in Mexico and on the peninsula of Lower California.

PILOPHORUS AMŒNUS Uhler.

Pilophorus amœnus Uhler, Ent. Amer., III, 1887, p. 30.

Three specimens were taken August 12. This species inhabits the scrub pine on the coastal plain of the Atlantic States in June and July.

ILNACORA VIRIDIS Uhler.

Ilnacora viridis Uhler, Gillette and Baker, Report Col. Exper. Station, 1895, p. 41.

Two distorted flabby specimens were found August 10.

STHENAROPS CHLORIS Uhler.

Sthenarops chloris Uhler, Hayden, Bull. Geol. Survey, III, No. 2, p. 419.

Two specimens were taken August 10.

MALACOCORIS sp?

Two specimens were secured, but they are not good enough for description.

ONCOTYLUS LONGIPENNIS Uhler.

Oncotylus longipennis Uhler, Gillette and Baker, Col. Report Exper. Station, 1895, p. 43.

Three specimens were taken August 10 and 11.

HALTICUS INTERMEDIUS, new species.

Coal black, highly polished, broadly ovate, triangularly narrowing from base of hemelytra to front of head, and of medium convexity. Head narrow, highly polished, with deep sutures bounding the rough occiput and the inner margin of the eyes, the face very convex, narrow, triangular, the tylus prominent. Antennæ mostly testaceous, long and very slender, reaching to about the base of the cuneus, the basal joint a little thicker than the following one, dark in the middle, short, projecting a little in front of the eyes, the second nearly as long as the pronotum, the third and fourth still more slender, the two together about as long as the second. Rostrum black, reaching the middle coxæ. Pronotum triangularly narrowing toward the head, the lateral margins very slenderly reflexed, the surface very moderately convex, feebly wrinkled anteriorly, the callosities obsolete, and the posterior margin a little curved. Scutellum moderately convex, obsoletely scabrous, acute at tip. Corium convexly inflated posteriorly, more polished and less scabrous on that part, sutures deep, the costal margin strongly curved, thick, prominent, but not steeply curved down, membrane smoky white, broad, with the cuneus depressed. Legs coal black, the knees, tibiæ, and tarsi pale testaceous. Pleurites scabrous, the venter highly polished. Length to tip of membrane 2½–3 mm. Width of pronotum about 1 mm. Width across hemelytra 1½ to 1¾ mm.

Type.—Cat. No. 6852, U.S.N.M.

A pair of these insects were secured August 12 in the canyon near Las Vegas.

This species is less convex than *H. nitidus* Uhler, but more so than *H. bractatus* Say.

STIPHROSOMA ATRATA Uhler.

Stiphrosoma atrata Uhler, Cal. Acad. Sci. Trans., IV, 1894, p. 268.

Two specimens were taken in the canyon near Las Vegas Hot Springs, August 12.

This species comes very near to the eastern *S. stygica* Say, which lives on the *Baccharis halimifolia* on our Atlantic tidewater beaches, in Maryland, Virginia, North Carolina, New Jersey, etc.

BOLTERIA AMICTA Uhler.

Bolteria amicta Uhler, Entom. Amer., III, 1887, p. 34.

Three specimens were captured August 16. The species is a very variable one.

AGALLIASTES ASSOCIATUS Uhler.

Agalliastes associatus Uhler, Hayden, Report Geol. Surv. Montana, 1872, p. 419.

Several specimens were taken near Las Vegas, Hot Springs, August 4, 12, 17.

ATOMOSCELIS SERIATUS Reuter.

Atomoscelis seriatus Reuter, Caps. ex Bor. Amer., p. 91.

Two or more specimens of this neat little insect were secured August 5 and 10.

Family CERATOCOMBIDÆ.

CERATOCOMBUS BRASILIENSIS Reuter.

Ceratocombus brasiliensis Reuter, Monog. Ceratocomb., 1871, p. 7, no. 3.

One specimen, which appears to belong to this species, was found August 14.

It is smaller than normal, and the white spots of the corium seem relatively large.

CERATOCOMBUS NIGER, new species.

Form nearly like *C. brasiliensis* Reuter, black, almost opaque, minutely, indistinctly pilose. Head a little more robust than in the species cited above, the antennæ long and thick, the rostrum stout, reaching to the posterior coxæ. Pronotum very moderately convex above, the transverse line distinctly defined and deeply impressed on the lateral margins, humeri prominent; the sternum and pleura piceous, dull bluish black, with the coxal areas dull testaceous. Legs dull

yellowish. Hemelytra dull black, coriaceous almost to the tip, not greatly elongated, a little wider than in the preceding species. The scutellum is small, but tumidly convex.

Length to tip of hemelytra 1¼ mm. Humeral width ⅔ mm.

Type. Cat. No. 6846, U.S.N.M.

Two specimens were found August 3 and 7.

One specimen is much stouter than the other, and it has shorter hemelytra, but it has been somewhat distorted by compression.

CERATOCOMBUS LATIPENNIS, new species.

Body black, polished, shining; hemelytra dull testaceous, excepting the base. Head narrow, polished, black, antennæ piceous black, rostrum black, reaching to the middle coxæ. Pronotum almost flat, a little wider than long, black, polished, the humeri slightly prominent, the incised line more distinct at the lateral margins. Legs piceous. Underside piceous black. Scutellum small, prominently convex, black, polished. Hemelytra broad, flat, obscurely, testaceous, excepting the base, broadly rounded at tip, moderately coriaceous. Length to tip of hemelytra 1½ mm. Width of pronotum ¾ mm.

Type.—Cat. No. 6847, U.S.N.M.

Two specimens were secured August 13 and 17.

The insufficiency of specimens for analysis in this genus has made it impossible for me to recognize various elements of structure which might render more distinct the separation of these supposed new species. Possibly this last form may constitute a new genus.

Family TINGITIDÆ.

TELEONEMIA NIGRINA Champion.

Teleonemia nigrina Champion, Biol. Centr.-Amer., Rhynchota, II, 1898, p. 41, pl. III, fig. 13.

Several specimens were collected August 1, 13, and 14.

CORYTHUCA DECENS Stål.

Corythuca decens Stål, Stettin. Ent. Zeit., XXIII, p. 324.

Three specimens were taken August 6.

GALEATUS-PECKHAMI Ashmead.

Galeatus peckhami Ashmead, Ent. Amer., III, p. 156.

One specimen of this singular species was secured August 3. This is another unexpected addition to the Heteroptera of New Mexico. The wide interval between Massachusetts and Muskoka, Canada, and from thence to Las Vegas, New Mexico, has not yet been covered by collectors, but 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. The winds both seaward and landward do this work on a vast scale along the Atlantic coast, from southern Florida to Long Island, New York, at frequent intervals, especially in the tidal estuaries of rivers and on shores of bays.

Family ARADIDÆ.

BRACHYRHYNCHUS EMARGINATUS Say.

Brachyrhynchus emarginatus SAY, Heteropt. N. Amer., p. 30.

One specimen was found August 6.

ARADUS AMERICANUS Herrich-Schæffer.

Aradus americanus HERRICH-SCHÆFFER, Wanz. Ins., VIII, p. 115, fig. 889.

One adult specimen and three larvæ were found August 6 and 9.

ARADUS LUGUBRIS Fallen.

Aradus lugubris FALLEN, Hemipt. Suec, p. 139.

Two specimens were taken August 3 and 11.

Family ANTHOCORIDÆ.

ANTHOCORIS NIGRIPES Reuter.

Anthocoris nigripes REUTER, Monog. Anthoc., p. 69.

Four or five specimens in different states of coloring were found August 2, 6, and 12.

ANTHOCORIS FULVIPENNIS Reuter.

Anthocoris fulvipennis REUTER, Monog. Anthoc., p. 69.

A few specimens of this very variable species were taken August 5 and 13. Much uncertainty attends the determination of these specimens. They deviate from the description, and all differ from one type of color and marking.

PIEZOSTETHUS CALIFORNICUS Reuter.

Piezostethus californicus REUTER, Monog. Anthoc., p. 46.

Two specimens were secured August 13. They agree with the type as it appears in California.

Subfamily CORISCIDÆ.

CORISCUS SERICANS Reuter.

Coriscus sericans REUTER, Monog. Corisc., Oefv. Vet. Akad. Förhandl., 1872, p. 83.

One specimen was taken August 2.

Family REDUVIIDÆ.

ACHOLLA AMPLIATA Stål.

Acholla ampliata STÅL, Enum. Hemipt., II, p. 72.

Several examples were secured August 8, 10, 13, and 14.

ZELUS LURIDUS Stål.

Zelus luridus STÅL, Stett. Entom. Zeit., 1862, XXIII, p. 148.

One specimen and a larva were found August 6 and 11.

APIOMERUS PICTIPES Herrich-Schæffer.

Apiomerus pictipes HERRICH-SCHAEFFER, Wanz. Ins., VIII, p. 75, fig. 843.

One specimen of the dark variety was taken August 7.

Family SALDIDÆ.

SALDA PALLIPES Fabricius.

Salda pallipes FABRICIUS, Syst. Rhyng., p. 115, no. 12.

Two specimens of the dark variety of this species were found August 2.

Family NOTONECTIDÆ.

NOTONECTA INSULATA Kirby.

Notonecta insulata KIRBY, Faun. Bor. Amer., IV, p. 285.

One specimen of this common form was secured August 7.

ANISOPS CARINATUS Champion.

Anisops carinatus CHAMPION, Biol. Centr.-Amer., II, p. 372, pl. XXII, fig. 12.

One specimen, apparently a male, was taken August 14.

A REVISION OF AMERICAN SIPHONAPTERA, OR FLEAS, TOGETHER WITH A COMPETE LIST AND BIBLIOGRAPHY OF THE GROUP.

By Carl F. Baker,

Of the Leland Stanford Junior University.

INTRODUCTION.

The present work was begun in 1890 at the suggestion of my friend and former teacher, Prof. A. J. Cook. His advice then was that usual to the thorough-going scientist, not to publish until some phase of the work had reached completion so far as circumstances permitted. At that time nothing whatever had been done on the group in America in a systematic way. It was supposed that this fact would make the taxonomic work at least "plain sailing." But the condition of the group in Europe had not been reckoned with. However, anatomical studies were begun and an attempt made to get together material and the literature. It was found that few collections contained more than an occasional dog flea, and the literature proved to be more extensive than was supposed.

The impossibility of finding names for more than a very few of the species attracted attention to the need of systematic work very early, and an attempt was made to classify the few species then in the collection. This work was based on Taschenberg's Die Flöhe, and the results were published in 1895 as Preliminary Studies. It was evidently a step in the right direction, for while many of the results were merely tentative, yet it attracted much attention to a badly neglected group, and material came in much more rapidly afterward and from many quarters. Here should be mentioned particularly those whose interest in the subject has made possible our far fuller present knowledge of the American species:

Prof. J. M. Aldrich, Moscow, Idaho; Dr. C. Berg, Buenos Ayres, Argentina; Prof. Lawrence Bruner, Lincoln, Nebraska; Prof. A. B. Cordley, Corvallis, Oregon; Dr. A. Dugès, Guanajuato, Mexico; Mr. Edward Ehrhorn, Mountain View, California; Dr. A. K. Fisher,

Department of Agriculture, Washington City; Dr. J. Fletcher, Ottawa, Canada; Prof. C. P. Gillette, Fort Collins, Colorado; Dr. L. O. Howard, Washington City; Rev. J. H. Keen, Masset, Queen Charlotte Islands; Dr. A. Lutz, São Paulo, Brazil; Mr. G. S. Miller, jr., U. S. National Museum, Washington City; Prof. A. P. Morse, Wellesley, Massachusetts; Prof. Herbert Osborn, Columbus, Ohio; Mrs. A. T. Slosson, Franconia, New Hampshire; Mr. J. O. Snyder, Stanford University, California; Mr. H. F. Wickham, Iowa City, Iowa; Mr. D. B. Young, Newport, New York.

The late Professors Harvey and Hubbard also made valuable contributions. I do not believe that too much credit can be given those who are active collectors in biological work or who inspire active accumulation of material.

Having already become convinced of the inadequacy of the Taschenberg classification the work of Wagner came as no surprise. It, together with the considerable accumulations of new material, made imperative a revision of the American species. It was hoped this time to make the work far more complete, embracing some comparative morphological and embryological studies, which are much needed. The work as laid out would have been sufficient to consume the time available for such work during three years. Unforeseen contingencies made it imperative that work on this subject for the time being should be confined to one year or less. The logical course under the circumstances being the completion of work already in progress, the following paper, relating only to the taxonomy of the group, is presented as the direct result of part of one year's work (1902).

I have Dr. Kellogg to thank for a place to work during my stay at Stanford University.

The plates were all prepared by the author.

The paper is based upon material in the United States National Museum and all of the types are deposited in that Museum. The names of hosts have been revised by Mr. Gerrit S. Miller, jr. Concordance between the current nomenclature and the names used by previous writers on fleas is established in the list of Siphonaptera of the World (pp. 433 to 457), where the former will be found under the special heading *Hosts*, and the latter are given after the references in the synonymy.

HISTORY.

The history of the Siphonaptera, taxonomically speaking, begins with the recognition of *Pulex irritans* in 1746 and of *Pulex penetrans* in 1767. In the following years various scattering descriptions of species and notes on anatomy and affinities were given by Bosc, Dugès, Westwood, Bouché, Haliday, and others, until 1857 when the Siphonaptera received their first systematic treatment at the hands of

Kolenati. In his Die Parasiten der Chiropteren, Kolenati describes six species of *Ceratopsyllus* and one of *Pulex*, parasitic on bats, placing them in the Diptera under Latreille's group Phthiriomyiæ. A similar account of the bat fleas was also published the same year by the same author in the Wiener Entomologische Monatsschrift.

In 1863 appeared Kolenati's epoch-marking Beiträge zur Kenntnis der Phthiriomyiarien, in Horæ Societæ Entomologicæ Rossicæ. On this work our modern classification of the Siphonaptera is largely based. It includes, besides the treatment of this group, also a monograph of the parasitic flies of the families Nycteribiidæ and Streblidæ.

Some of Kolenati's work is difficult to decipher on account of the very meager descriptions and the extremely poor illustrations presented. Fortunately, some of the specimens on which his work was based still exist in St. Petersburg, where they have been studied by Dr. Wagner with very important results. Kolenati used eight generic names, of which we now apply six to valid groups. For many years this work remained the most complete systematic account of the group.

Between the years 1860 and 1880 but little was done on systematic work, collecting, and comparative studies. But during that period there appeared several monumental anatomical papers which have done much toward raising the standard of work in the group and dignifying the study of these very remarkable but much despised insects. Notable among these are Karsten's study of *Sarcopsylla penetrans*, Landois' anatomy of the dog flea, and Berté's careful work on the antennæ of fleas. During this period also we first have careful studies of the habits and development of fleas.

In 1880 appeared the second epoch-marking monograph of the group by Dr. Otto Taschenberg. This was intended to be a summary of everything known on the group, together with a systematic rearrangement of the species, and with carefully drawn figures of each species. Dr. Taschenberg recognized 2 families and 5 genera, and lists 33 species, most of which he considers valid.

The period from 1880 to the present time has been one of great activity in the study of this group, as was to be expected after the work of Karsten, Landois, Berté, Kraepelin, and Taschenberg. Besides numerous scattering papers, we have the very important contributions, both anatomical and systematic, first of Wagner and later of Rothschild. The results from these two authors represent the highest grade of work yet done on the group, and give promise of as complete and scientific treatment as has been given any group of animals.

HABITS.

An excellent summary of the breeding habits of the cat and dog flea has been given in Bulletin No. 4, n. s., Division of Entomology, 1896.

That article relates to the larval and pupal stages and the conditions under which they live. These facts will not be restated here, as we have nothing new to add, but there are certain other aspects of the habits of fleas which very much need a fuller discussion.

In recent discussions of the relations of parasitic and other insects to the transmission of disease, much space has been given to flies, especially mosquitoes, and but little to fleas. While as a matter of fact the latter may be of even greater importance, not only because of their more insidious attacks, but also because of their association with some of the most terrible diseases.

The whole matter rests upon the host relations of the various species. It is a well known fact that the cat and dog flea will take very readily to the human being. It is to be noted that the cat and dog flea is closely related to *Pulex irritans* and similar to it in the more important details of structure. Some of the rabbit fleas, which are likewise closely related to *P. irritans*, will also readily attack the human being, which I had occasion to learn as a youth. While these fleas will remain on a human being for some little time and bite frequently while there, still they do not habitually frequent that host and his clothing and bed as does *P. irritans*.

Among closely related animals or animals of very similar habits one species of flea may have a number of normal hosts. But our knowledge of this matter is exceedingly fragmentary and uncertain. Cases of temporary hosts being as common as they are, it becomes very probable that many of our records refer merely to the temporary host. A rabbit running into a badger hole, a mouse into a mole burrow, an owl eating a mouse, a cat devouring a rat—these and many other fortuitous circumstances furnish conditions favorable for at least temporary transference. I have referred to a number of these cases in the account of the separate species.

The character of the hair and thickness of skin was at first considered as controlling the range of parasites, due to the close relation these conditions must have to the structure of the flea, especially the length of mouth parts and covering of bristles. Exceptions were soon found to this rule, though in general such relations may be said to exist.

Excluding the accidental records on carnivorous animals, we may say that in the United States the cat, dog, and rabbit fleas are closely related to *P. irritans* and will readily attack the human being, while the mouse, rat, squirrel, mole, and shrew fleas are not closely related to *P. irritans* and have never been known to bite the human being. Mr. F. H. Chittenden wrote me that he believed rat fleas sometimes bit human beings in Washington, but he has not yet verified this statement by the actual capture of specimens in the act. Nor do I know of any such records.

South of the United States conditions are wholly different, and present an aspect of considerable economic importance, for here we

find fleas of the genus *Pulex* much more nearly related to *P. irritans* than even the cat and dog flea, living on rats and mice and other small rodents. Dr. Dugés had found, a number of years ago, one such species to be abundant on a spermophile in Mexico. Later I had several letters relative to this matter from Dr. Lutz, director of the bacteriological laboratory at Sao Paulo, Brazil. He outlined briefly the importance of the facts to be determined, and sent material of the greatest significance—typical *Pulex* from rats and mice. We shall look with great interest for the full elucidation of this subject by the experimental work from Dr. Lutz's laboratory.

As to the other tropical regions we know practically nothing. I have no records of fleas from India. However, from Asia north of India come true *Pulex* from the smaller rodents, and from the island of Socotra we have *Pulex pallidus* described as occurring on *Mus albipes*, so that we may expect to find true *Pulex* on rats in the Indian region.

ANATOMY.

The classical works of Karsten, Landois, and Berté covered the gross anatomy of the Siphonaptera very fully. It has remained, however, for Wagner and Rothschild to examine into the more minute details and more especially from the comparative point of view. Indeed, in comparative anatomy the work has just begun. The facts relative to the anatomy of fleas will not be recapitulated here as they are referred to extensively in the accounts of families, genera, and species. It may be well, however, to refer to certain special usages in the classification of the group.

Kolenati paid almost no attention to chætotaxy in his works, sometimes scarcely giving a clear account of the ctenidia. Taschenberg was far clearer in that respect. Wagner and Rothschild have attached to it an importance equaling that it bears in the Diptera, and very properly so. In the present paper the term "spines" is applied to the ctenidial armature, and to the larger members of the leg and body armature; those of medium size are termed bristles and this includes most of the body armature; the finest and flexible ones are termed hairs. A few minute teeth often occur on the hind margins of some of the dorsal segments. Some of the bristles are, in general, very constant in position, notably those on the genæ, hind margin of head, and abdominal segments, except the last. Others are very variable in position among the various species and consequently very useful in classification, especially those on hind margin of antennal groove, vertex (this term here applied to that portion of head back of antennal grooves), last abdominal segments, genital organs, femora, tibiæ, and last joints of tarsi. The number of ctenidial spines on the head is usually very constant in any one species, while the number of spines

in thoracic or abdominal ctenidia is quite likely to vary two or even four in some species, especially in those species in which the ctenidia are laterally reduced.

The exact homologies of the genital organs have yet to be worked out, though Rothschild has taken a long step in the right direction. In the present paper the terms "lateral portion of ninth tergite" and "tenth tergite" are used as applied by Rothschild. The upper and most conspicuous pair of genital appendages are called "upper claspers" and the paired organs, immediately below these, but more inconspicuous and retractile, "lower claspers."

Of the later authors each has had a different method of stating the comparative lengths of the tarsal joints. It is a matter in which minute exactness is not only undesirable but impracticable, owing to the unevenness of the ends of the joints. In the present paper the proportion is given in terms of the fourth joint, which is given the empirical value of 5, due to its great similarity in size in the different legs and in different species. The measurements were taken by a camera lucida and the results reduced to the terms mentioned above. In the author's practice this has greatly simplified the comparison of species.

It may be noted that the rather strongly chitinized seminal vesicle in the females, which retains its shape after treatment with caustic potash, possesses a very characteristic form in many of the species. After mounting, it rests in various positions and this makes its comparative study very difficult.

CLASSIFICATION.

Linnæus began with one genus, *Pulex*, and one species, *irritans*, which will represent the type of *Pulex* always. Linnæus afterwards described *P. penetrans*. The first separation of *penetrans* as a distinct genus occurred in 1815[a] under the name *Rhynchoprion*. I do not know why this name has been rejected. If there is no question as to its application, then it must be used instead of *Sarcopsylla* and the family name will also change.

The dismembering of *Pulex* began in 1832 with the *Ceratophyllus* of Curtis, and seven generic names were proposed by Kolenati. Most of these names represented somewhat artificial groups and were poorly defined. The reaction came with Taschenberg, who disregarded all the latter genera and returned to the Linnæan *Pulex* for the greater portion of the species. Taschenberg is not, however, altogether consistent, although one can readily understand why he was tempted to reject all the inadequate work of his predecessors. However, Taschenberg describes *Hystrichopsylla* and establishes a new genus, *Typhlopsylla*, for three groups combined, each of which had previously received a generic name.

[a] Oken, Naturg. f. alle Stände, III, p. 402.

The Siphonaptera seem to have suffered especially from the disregard of all laws of priority. *Rhynchoprion* and *Hectopsylla* were disregarded and new names given the same groups. Species names were discarded for all sorts of reasons, often simply because they were more or less inappropriate. In this paper the attempt has been made to apply the rules of priority strictly, though it has been impossible to investigate fully such special cases as *Rhynchoprion*, *Monopsyllus*, etc.

No writer on the fleas in the past has made any attempt to designate generic types, and this fact has given rise to the greatest difficulties. I have tried to determine this matter for all the genera, and the results are given below for the Pulicidæ. With the other, later genera, there is no difficulty.

Pulex Linnæus 1695; type, *irritans* Linnæus.

Ctenocephalus Kolenati 1859; type, *canis* Curtis (*canis* = *norvegicus* Kolenati).

Ceratophyllus Curtis 1832; type, *gallinæ* Schrank. = *Ctenonotus* Kolenati 1863; type, *fasciatus* Bosc (*fasciatus* = *octodecimdentatus* Kolenati). = *Trichopsylla* Kolenati 1863; type, *penicilliger* Grube.

Ctenophthalmus Kolenati 1863; type, *bisoctodentatus* Kolenati.

Ctenopsyllus Kolenati 1863; type, *musculi* Duges (*musculi* = *quadridentatus* Kolenati).

Ceratopsyllus Kolenati 1863; type, *pentactenus* Kolenati = *Typhlopsylla* Taschenberg 1880; type, *octactenus* Kolenati.

Penicilliger, *fasciatus*, and *gallinæ* are clearly congeneric. Taschenberg does not especially indicate a type for *Typhlopsylla*, but no matter which is taken for the type the genus becomes synonymous with some other. I have indicated the first species under his genus as the type, thus throwing it into *Ceratopsyllus*. The two others of the three groups in Taschenberg's *Typhlopsylla* fall into *Ctenopsyllus* and *Ctenophthalmus*, respectively. It is to be noted that Wagner and Rothschild still use *Typhlopsylla* for the same group to which the earlier name *Ctenophthalmus* was applied. *Ctenophthalmus* and some of the other genera may be artificial groups, but *Typhlopsylla* is still more so, founded as it was principally on the absence of eyes. This character has proven of scarcely more than specific value, every possible gradation occurring from *Pulex* to *Ceratopsyllus*.

On the other hand, it is certain that Wagner's reseparation and recharacterization of these genera will have to be much modified, due to reasons which are dilated upon in the discussions of genera.

The synopsis used herein has been adopted simply as a matter of expediency in the study of the American species, as it was impossible to separate them either according to the scheme of Taschenberg or of Wagner. So the two have been combined.

One hundred and thirty-five species are listed in this paper for the world. I have not the least doubt but that many hundreds will eventually be found, and that these will fall into at least twenty-five or thirty

clearly defined generic groups. As it is, every new lot of specimens which comes in changes one's idea of the existing genera, making very evident the great danger in a too rapid increase of generic divisions. Species are now pouring into the collections in great numbers. Where large series from all over the world can be gathered together, there, within the next few years, must be accomplished the total recasting of the whole group on largely new and original lines. Logically this should be done at St. Petersburg, where the types of Kolenati and a large additional collection are to be found under the care of our most experienced siphonapterologist, and to him we relegate this work.

SYSTEMATIC ARRANGEMENT AND DESCRIPTION OF AMERICAN SPECIES.

Order SIPHONAPTERA Latreille.

1798. Schellenberg, Helvetische Entom., I, p. 15 (*Rophoteira* pt.).
1801. Lamarck, Syst. d. Anim. s. Vert., p. 313 (*Aptera* pt.).
1805. Latreille, Hist. nat. des Crust. et des Insect., XIV (*Suctoria*, preoc.).
1825. Latreille, Fam. nat. du Règne Animal (*Siphonaptera*).
1826. Kirby and Spence, Introd. to Entom., IV (*Aphaniptera*).
1840. Westwood, Introd. to Mod. Class. of Ins., II, p. 488 (*Aphaniptera*).

Body of adult, except in some gravid females, strongly compressed. Thorax composed dorsally of three separate, entire, simple, subequal sclerites.

Mouth parts suctorial, consisting of stylate hypopharynx and mandibles resting between 1–13 jointed labial palpi; outside of these are usually laminate maxillæ with four-jointed palpi; labrum and clypeus not distinctly separated.

Eyes usually present as simple pigment masses in a chitinous framework on anterior border of antennal groove.

Antennæ immersed in grooves, three-jointed, the third joint with usually 9 more or less completely separated pseudojoints.

Wings entirely absent. Metanotum on either side with a rounded epiphysis which is connate with the first abdominal segment.

Tarsi five-jointed. The coxa is usually the longest joint of the leg and the trochanters are well developed. The middle and posterior coxæ usually have a foliaceous epiphysis on posterior border.

Alimentary canal composed of a slender œsophagus, a suboval proventriculus which is lined with numerous chitinous ridges which may project as free teeth, an elongate saccate stomach at the base of which are four slender malpighian tubules, and a rectum provided with tracheated glands.

Larva footless, with a well-developed head which possesses biting mandibles, rudimentary maxillæ, a well-formed labrum, and three-jointed antennæ.

Pupa inactive, but with free legs, and sometimes at least resting within a cocoon.

Imago parasitic on mammals and birds. Larva free-living, subsisting on dead organic matter.

SYNOPSIS OF FAMILIES.

a. Thoracic segments strongly shortened and constricted; labial palpi without pseudo articulations; third joint of antennæ without clearly separated pseudojoints.

b. Maxillæ without or with very short and broad projecting laminæ, their palpi extending beyond anterior coxæ; head strongly angulated anteriorly in both sexes; metathoracic epiphyses extending over nearly two or even three abdominal segments; the female becoming endoparasitic when gravid, with globose, enormously dilated abdomen, in which the original chitinous sclerites are mostly obliterated ..... SARCOPSYLLIDÆ (p. 373).

bb. Maxillæ with a long, narrow, curved lamina which projects downward and backward, their palpi equaling the anterior coxæ; head evenly rounded in both sexes; metathoracic epiphyses extending over but one abdominal segment; gravid female with abdomen vermiform .... HECTOPSYLLIDÆ (p. 375).

aa. Thoracic segments not strongly shortened and constricted, their epiphyses extending over but one abdominal segment; labial palpi with three or more pseudojoints; maxillary palpi almost always shorter than anterior coxæ; third joint of antennæ with nine more or less distinctly separated pseudojoints.

b. Labial palpi with 11–13 pseudojoints; abdomen of gravid female much swollen; antepygidial bristles absent ..... VERMIPSYLLIDÆ (p. 376).

bb. Labial palpi with 3–5 pseudojoints; antepygidial bristles always present.

c. Fore tibiæ armed on posterior border with few, single, very large, black teeth; fifth tarsal joint greatly enlarged, those on forelegs as long as rest of tarsus, on all legs with the claws nearly as long as the fifth joint; fore coxæ nearly nude, with but few long spines; body of gravid female considerably swollen ..... MEGAPSYLLIDÆ (p. 376).

cc. Fore tibiæ armed on posterior border with slender spines; fifth tarsal joint never greatly enlarged, never as long as rest of tarsus; the claws shorter; fore coxæ always clothed on outside with several to numerous oblique rows of bristles; body of gravid female never swollen so as to expose extensive areas of connective membrane ..... PULICIDÆ (p. 377).

Family SARCOPSYLLIDÆ Taschenberg.

1880. TASCHENBERG, Die Flöhe, p. 43.
1895. BAKER, Canad. Ent., XXVII, p. 20.

This is the most highly specialized family of the order. The reduced condition of the maxillæ, labial palpi, third joint of antennæ, thorax, and coxæ are distinctive.

SYNOPSIS OF GENERA.

a. Maxillæ without projecting lamina; angle of head produced; metathoracic epiphyses of great size, extending over three abdominal segments; fifth tarsal joint without lateral heavy spines, and rest of legs almost spineless.
Sarcopsylla (p. 374).

aa. Maxillæ with a very short and broad projecting lamina; angle of head not produced; metathoracic epiphyses of medium size, extending over scarcely two abdominal segments; fifth tarsal joint normally armed, as are also the other joints of the legs ..... *Vestopsylla* (p. 374).

Genus SARCOPSYLLA Westwood.

1815. *Rhynchoprion* Oken, Naturgesch. f. alle Stände, III, p. 402.
1829. *Dermatophilus* Guérin, Iconograph. d. règne animal. Insects, p. 12.
1836–40. *Sarcopsylla* Westwood, Trans. Ent. Soc. Lond., III, p. 199.
1862. *Sarcopsylla* Kolenati, Horæ Soc. Ent. Ross., II, p. 28.
1880. *Sarcopsylla* Taschenberg, Die Flöhe, p. 44.
1895. *Sarcopsylla* Baker, Canad. Ent., XXVII, p. 20.

SARCOPSYLLA PENETRANS Linnæus.

There seems to be little doubt that as this name has been used, it is a composite species—an aggregate of several distinct forms. All forms having females with the peculiar habits of the original *penetrans*, have been previously referred to this species without question and usually without study. For the proper study of a species in this genus the student should have especially the male and the free female. The encysted female is of comparatively little value, and this is especially true of the material usually preserved in collections in which head, legs, and thorax are very likely to be torn away in consequence of lack of care in the removal from the cyst. It is probable that the common form of the American tropics which attacks the domestic animals and man is to be regarded as the true *penetrans*.

But a variety of wild animals which never associate with the domestic, possess similar forms, and the males and free females of these should be carefully collected and studied. Westwood notes that Pohl and Kollar consider the Bicho de Cachorro or dog chigoe distinct from the Bicho de pie or *S. penetrans*.

Variously known as Jigger,[a] Chique, Chigoe, Tique, Bicho, Pico, Pique, Sico, Tschike, Nigua, Tunga, Tû Ton, Tûngay or Aagrani (see Taschenberg), *S. penetrans* (sens. lat.) is a troublesome pest in some parts of Mexico, West Indies, and Central and South America, as well as in some tropical regions elsewhere. There is no authentic record of its occurrence within the borders of the United States, though it may be expected in Florida and southern Texas. In attacking man it seems to generally affect the feet, getting under the toe nails and producing painful sores which become serious by neglect. A sharp knife point and an antiseptic wash furnish the required treatment.

Genus XESTOPSYLLA, new genus.

Type, *Sarcopsylla gallinacea* Westwood.

This form seems so out of place in Sarcopsylla that it is here separated as a distinct genus. It differs from *S. penetrans* very widely in structure.

[a] This name is commonly applied in the United States to our very troublesome red mite.

XESTOPSYLLA GALLINACEA (Westwood) Baker.

This species was first described from Ceylon, but the common hen flea of our Southern States, which was undoubtedly introduced, appears to be the same thing. It is a common pest from Florida to Texas. It was also found in large numbers on horses at Orangeburg, South Carolina. Perhaps a near-by hen roost would explain this latter occurrence. The collection does not contain specimens from outside the Southern States.

Judge Lawrence C. Johnson presents a very full and interesting account of the habits of this insect.[a] He says it affects not only hens, but turkeys, cats, dogs, cattle, horses, and children. He also gives the first lucid account of the exact manner in which encystment takes place. This matter was formerly dismissed with the statement that the insect "burrowed into" or "penetrated" the skin. Judge Johnson says that the great irritation produced by the female fastening itself at one spot finally produces a surrounding welt or tumefaction which closes over it, though the inclosure is apparently never wholly complete.

Family HECTOPSYLLIDÆ, new family.

The genus Hectopsylla is here separated as constituting a group equivalent in value to the other families. In some respects it is the most remarkably distinct group of the order.

Genus HECTOPSYLLA Frauenfeld.

1860. *Hectopsylla* Frauenfeld, Artzungab. d. k. Acad. d. Wiss. Wien, XL, p. 462.
1880. *Rhynchopsylla* Haller, Archiv. f. Naturgesch. Jahrg., XLVI, p. 72, pl. iv.
1880. *Rhynchopsylla* Taschenberg, Die Flöhe, p. 56.
1895. *Hectopsylla* Baker, Canad. Ent., XXVII, p. 21.

If, as Taschenberg indicates, there can be no question as to the identity of Rhynchopsylla and Hectopsylla, then there can also be no question as to which name we must use.

HECTOPSYLLA PSITTACI Frauenfeld.

This remarkable insect was first described from Ceylon as occurring on a parrot (*Psittacus* sp.). Later it was also found on an alcoholic specimen of a *Nyctinomus*. One of the two occurrences was probably accidental, but which, remains to be determined. Except for the reports of Frauenfeld and of Haller, it has remained unknown, though it may not be infrequent on its proper host.

[a] Proc. Ent. Soc. Wash., I, p. 59.

Family VERMIPSYLLIDÆ Wagner.

1889. *Vermipsyllidæ* Wagner, Horæ Soc. Ent. Ross., XXIII, No. 1–2, p. 205.
1895. *Vermipsyllidæ* Baker, Canad. Ent., XXVII, p. 22.

This family is characterized especially by the extreme development of labial palpi.

Genus VERMIPSYLLA Schimkewitsch.

1885. *Vermipsylla* Schimkewitsch, Zool. Anz., No. 87.
1889. *Vermipsylla* Wagner, Horæ Soc. Ent. Ross., XXIII, Nos. 1–2, p. 205.
1895. *Vermipsylla* Baker, Canad. Ent., XXVII, p. 22.

Contains but one species (*V. alacurt* Schimkewitsch). Found only on Ungulates in Turkestan.

Family MEGAPSYLLIDÆ Baker.

1898. *Megapsyllidæ* Baker, Journ. N. Y. Ent. Soc., IV, p. 53.

Recognizing the remarkable distinctness of the *Pulex grossiventris* of Weyenberg from any Pulicidæ, it was referred to in the Preliminary Studies as a good species of *Sarcopsylla*. Later, a study of specimens kindly sent by Dr. Berg, of Buenos Ayres, showed this to be a very erroneous reference, the species really being a much closer relative of *Pulex*. As it represented a group equivalent to Vermipsyllidæ, or Sarcopsyllidæ, it was made the type of a new family. The fifth tarsal joint is very closely inserted into the fourth, and beneath the apex of that joint, this giving the subconnate appearance as described. The enormous claws and spines of fore tibiæ are distinctive. In the somewhat reduced maxillæ it resembles the Sarcopsyllidæ, but the female abdomen does not become swollen to the extent found in the Sarcopsyllidæ or even in the Vermipsyllidæ.

Genus MEGAPSYLLA Baker.

1898. *Megapsylla* Baker, Journ N. Y. Ent. Soc., IV, p. 53.

Head evenly rounded above in female; uneven and unituberculate in front in the male. Prothorax in the female with five or seven remote, short, stout, dark-brown teeth; in the male unarmed. Fore tibiæ very small and short, but swollen. Maxillæ small, extending only to one-half of second joint of maxillary palpi. Labial palpi 5-jointed.

MEGAPSYLLA GROSSIVENTRIS (Weyenberg) Baker.

Lives on *Zaëdyus minutus* in Argentina. One of the largest (male, 2.5–3.25 mm.; gravid female, 6–6.5 mm.) and most distinctly marked of the known fleas.

Family PULICIDÆ Stephens.

1829. *Pulicidæ* Stephens, Syst. Cat. British Insects.
1880. *Pulicida* Taschenberg, Die Flöhe, p. 62.
1895. *Pulicida* Baker, Canad. Ent., XXVII, p. 20.

As used by Stephens for the British species, this is its first application to that group of which the genus *Pulex* is the type genus.

TABLE OF GENERA.

a. Maxillæ long triangular, acute at apex.
b. Abdominal tergites never with ctenidia.
c. Posterior tibial spines in pairs and not in a very close-set row.
d. Last tarsal joint on all the tarsi with a marginal row of four stout spines on each side beneath; eyes always large and well developed; hind coxal epiphysis narrowing distally into the coxa, forming a poorly defined notch or none; female with but one antepygidial bridle on each side.
e. Head without ctenidia ..... *Pulex* (p. 378).
ee. Head and prothorax with ctenidia ..... *Ctenocephalus* (p. 384.)
dd. Last tarsal joint with five pairs of stout spines beneath, at least on anterior tarsi; sometimes only four on middle or hind tarsi and then eyes wanting.
e. Maxillary palpi rarely extending to half or three-fourths of anterior coxæ; prothorax with a ctenidium; hind coxal epiphysis forming distally with the coxa a shallow notch; female with three antepygidial bristles on each side.
f. Head without ctenidia; eyes usually well developed.
Ceratophyllus (p. 385).
ff. Head with ctenidia; eyes usually very rudimentary.
Ctenophthalmus (p. 420).
ee. Maxillary palpi exceeding anterior coxæ; eyes totally wanting; head and prothorax without ctenidia; hind coxal epiphysis forming distally with the coxa a deep notch, subtended outwardly by a produced acute limb; female with one antepygidial bristle on each side.
Anomiopsyllus (p. 425).
cc. Posterior tibial spines mostly single and in a close-set row; face sloping down and back from the forehead, thus the whole head more or less conical; eyes wanting.
d. Head of female without a cap-like patella in front, but with or without nearly perpendicular ctenidia on genæ; the normal female with three or four antepygidial bristles on each side ..... *Ctenopsyllus* (p. 426).
dd. Head of female with cap-like patella armed with a ctenidium on its posterior border; genæ with subperpendicular ctenidia; mandibles extremely slender; female with but one antepygidial bristle on each side ..... *Stephanocircus* (p. 430.)
bb. Abdominal tergites with one or more ctenidia; posterior tibial spines in numerous, short, close-set transverse rows on posterior border, with about four spines in each row; female with four antepygidial bristles on each side ..... *Hystrichopsylla* (p. 432).
aa. Maxillæ clavate or subquadrangular; face strongly sloping forward and recurved just above the mouth, where there are two tooth-like plates on each side; eyes absent; pronotum and usually abdomen with ctenidia; confined to bats ..... *Ceratopsyllus* (p. 432).

Genus PULEX Linnæus.

1758. *Pulex* Linnæus, Systema Naturæ, 10th ed., I, p. 614.
1840. *Pulex* Westwood, Introd. to Mod. Classif. of Ins., II, Gen. Synop., p. 124.
1857. *?Monopsyllus* Kolenati, Wiener Entom. Monats., I, p. 65.
1863. *Pulex* and *Trichopsyllus* Kolenati, Horæ Soc. Ent. Ross., II, p. 29.
1898. *Pulex* Wagner, Horæ Soc. Ent. Ross., XXXI, p. 21.

Though *irritans* is the type of this genus, still we have included three species possessing pronotal ctenidia. In one of these, however, the number of spines is unusually reduced, showing a transition in this respect toward *irritans*.

SYNOPSIS OF AMERICAN SPECIES.

a. Prothorax without ctenidial spines.
b. Abdominal tergites with but one distinct transverse row of bristles, and without minute teeth; inner side of hind coxa distally with an oblique row of minute teeth; vertex without transverse rows of bristles; hind margin of antennal groove with a few weak hairs.
c. Teeth on inner side of hind coxa numerous and in an irregular row; labial palpi apparently 3-jointed; fifth tarsal joint without minute hairs on disk.
d. Labial palpi extending about one-half the length of anterior coxæ. *irritans* (p. 379).
dd. Labial palpi extending three-fourths the length of anterior coxæ or more ..... *dugesii* (p. 379).
cc. Teeth on inner side of hind coxæ six in number and in a regular row; labial palpi as long or longer than the anterior coxæ, and apparently 4-jointed; fifth tarsal joint with minute hairs on disk ..... *brasiliensis* (p. 379).
bb. Abdominal tergites with two distinct rows of bristles; hind margin of metanotum, and first, second, and third tergites with small teeth; inner side of hind coxæ without minute teeth; vertex with two transverse rows of bristles; hind margin of antennal groove with a close-set row of numerous minute teeth.
c. Abdominal tergites all with a second row of numerous small bristles; hind margin of antennal groove with about a dozen minute teeth; maxillary palpi with second and fourth joints nearly equal and longer than the first, which is longer than the third; first three abdominal tergites with minute teeth, the first with about 11 on each side, the last with about three on each side; hind tibiæ with spineson hind margin short and weak and with many short bristles on the outer side in several longitudinal rows ..... *bohlsii* (p. 380).
cc. Abdominal tergites without a distinct second row of bristles excepting on first two, the remainder with but one or two bristles on each side in place of second row; hind margin of antennal groove with a thick-set row of about 25 minute but well-developed teeth; maxillary palpi with first and third joints nearly equal and second longer than fourth; first abdominal tergite only with minute teeth; hind tibiæ with long, strong spines on the hind margin and about eight stout bristles on the outer side ..... *lutzii* (p. 380).
aa. Prothorax with a ctenidium.
b. Pronotal ctenidium with about 9 spines ..... *anomalus* (p. 381).
bb. Pronotal ctenidium with about 17 spines.
c. Vestiture of spines and bristles rather heavy; a spine on hind distal angle of second joint of hind tarsi as long as joints 3 and 4 and three-fourths of 5 together; upper male claspers short and stout, lower claspers shaggy, with hairs ..... *affinis* (p. 382).
cc. Vestiture comparatively light; a spine on hind distal angle of second joint of hind tarsi as long as joints 3 and 4 and scarcely one-fourth of 5, together; upper male claspers long and slender, lower claspers with few hairs. *lynx* (p. 383).

PULEX IRRITANS Linnæus.

Plate XI, figs. 3–6.

This, the earliest described member of the order, is the best known species of the world next to the cat and dog flea, and appears to be nearly cosmopolitan in the warmer temperate and in the tropical regions. It is the specific flea of human beings, but it will readily attack a variety of other animals which may happen in its way, as a transient parasite. It is common in dwelling houses within its range, and is also common in other places frequented by human beings, like parks, picnic grounds, and sea beaches. The collection contains specimens from California, Queen Charlotte Islands, Texas, and the Southeastern States. It has been taken from *Didelphis virginiana* (this form the variety *simulans*), and Mr. J. O. Snyder contributes specimens taken on a fox at San Diego, California. Both of these latter occurrences are to be considered as accidental.

PULEX DUGESII Baker.

First described as a variety of *irritans*, this form is now given the rank of a species. The examination of a large series shows the characters to be uniform and thoroughly distinctive. Dr. Dugès kindly sent a second lot from Guanajuato, Mexico, also taken from *Citellus macrourus*. This is its only known locality and host. The proportional lengths of hind tarsal joints are about 21–13–8–5–15, or nearly the same as in *irritans*.

PULEX BRASILIENSIS, new species.

Dr. Lutz sends a very distinct form occurring on *Mus rattus* and *Mus norvegicus* at Sao Paulo, Brazil.

The abdominal segments each bear but one transverse row of bristles; those on tergites, with about fourteen bristles each; those on sternites, with about eight each. On the inner side of hind coxa there are only six teeth in a short transverse row. The hind femora are provided laterally with a longitudinal row of about eight well-developed bristles. The proportional lengths of hind tarsal joints are about 28–18–9–5–11. Antepygidial spines, one on each side; prothorax, with about eight bristles near posterior border; mesothorax, with about twelve, and metathorax, with about fourteen.

Mandibles and labial palpi slender and nearly reaching end of anterior coxæ. Labial palpi apparently composed of 4 joints. Below the eye the gena is somewhat laminately extended over the antennal groove. Gena with two stout spines, one in front of upper extremity of eye, the other on lower edge over base of maxilla. Vertex with a row of five or six small bristles on either side along posterior margin, a stout one at lateral angle, a stout one at midway of antennal groove, and a small one above this last.

Style in female rather slender, tapering distally, and armed only with one long apical bristle. Substylar flap triangular, obtuse at apex, two or three bristles at apex, and four to six on upper margin. Caudal margin of eighth segment laterally with about eight to twelve large, stout spines, just before which are a similar number of smaller ones, and some distance behind which are two parallel rows of similar but fewer spines.

In the male the antepygidial bristles are elevated on well-developed tubercles. The upper claspers are small, slender, elliptical, and armed on outer surface with about six large spines as long as the whole organ, their bases close together and occupying about a third of the outer surface.

Length, female 5.5 mm.; male, 3.5 mm. Color, light brown.

Type.—Cat. No. 6895, U.S.N.M.

PULEX BOHLSII Wagner.

Dr. Wagner described this species from a single specimen sent him by Herr Poppe. It is an American species collected in Paraguay by Dr. Bohls, but the host is unknown. Wagner presents a drawing of the whole insect, excepting the legs, and gives a thorough description, so that it may be readily recognized when rediscovered. The vestiture is very dense for this section of the genus. The distinctive characters are given as far as possible in the synopsis. Wagner does not describe the armature on hind margin of antennal groove, so that this character was taken from his drawing. Neither does he figure the stylet of the female, although the individual illustrated was of this sex The proportional lengths of hind tarsal joints are about 29–19–10–5–10.

The median projection of the seventh abdominal tergite is a very noteworthy character, but slightly foreshadowed in *irritans*. It is very distinct in the drawing of *bohlsii*, in which, however, it does not reach beyond one-half the length of eighth tergite.

PULEX LUTZII, new species.

Nearly related to *P. bohlsii*, which it was at first taken to be. A detailed comparison proves it abundantly distinct according to the description and figure of *bohlsii* given by Wagner. Dr. Lutz found this species on *Grison vittata* at São Paulo in Brazil.

The following characters are noted in addition to those given in the synopsis.

On all the abdominal tergites there is a median dorsal spine, which is stouter than the others on these segments. The pro-, meso-, and metanotum have two transverse rows of bristles, those of the anterior rows much weaker, the number in each row about 14–16. The metathoracic scale has two rows of 4 spines each. Only the first and second abdominal tergites have the second row of smaller bristles,

the remainder having each but a single row of about 13 bristles. The sternites have single rows of 8–10 bristles each. The seventh tergite is medially produced caudad, so that it extends entirely over the eighth tergite. Antepygidial bristles, 1 on each side, mounted on distinct tubercles.

Labial palpi about equaling anterior coxæ and apparently six-jointed. In the maxillary palpi joint 3 is longer than 1, and 2 is longer than 4. Head with a very well-developed frontal notch, a very unusual character for this genus. Genæ with 2 oblique rows of bristles, the upper of 4 smaller, the lower of 3 much larger, in normal positions. Vertex with the usual row of bristles on hind margin, the lowest large and long, but the disc with two transverse rows parallel with hind margin, the first of about 12, the second of about 16 bristles. The armature of hind margin of antennal groove is very distinctive.

Hind coxæ without minute teeth on inner surface. The proportional lengths of hind tarsal joints are about 20–16–10–5–17.

The male has the lateral portion of the ninth tergite large and conical in outline and armed at the tip with three stout close-set spines. The upper claspers are long, slender, slightly enlarged toward the tip and there obliquely truncate backward where it is also armed with one longer, stouter, and several shorter weaker bristles.

Abdomen of female very bristly; posteriorly the bristles are stout and thick set, far more numerous than figured for *bohlsii*, the outlines of tenth tergite and hind margin of eighth being obscured by the numerous bristles. The style is almost perfectly cylindrical, rather stout and armed only with one stout spine at tip.

Length, male, 5.5 mm.; female, 6 mm.; color, very dark brown.

Type.—Cat. No. 6896, U.S.N.M.

PULEX ANOMALUS, new species.

*Plate X, figs. 1–6.

In 1899 I collected at Arboles, in southern Colorado, two specimens of a remarkable flea on a large gray-brown spermophile frequent in that region. It is in many respects congeneric with *irritans*, but it possesses a strong pronotal ctenidium of about nine spines.

The abdominal segments each possess but a single transverse row of bristles, eleven or twelve bristles in each row on the tergites, four or six in each on the abdominal sternites. The tergites are apparently without minute teeth. On the thorax the lateral spines are considerably the strongest. There are two antepygidial spines of medium size, one on each side.

The head is normal in the female, but in the male is flattened and thickened on top after the manner of *Ctenophyllus*. The frontal notch is completely absent. The gena possesses but two large heavy spines, one in front of the medium sized eye, the other near lower

margin over the maxilla. The vertex possesses the usual row (ten to twelve in this case) of bristles near hind margin, but they are gradually enlarged from above to the very large one at lower angle. Disc of vertex with two medium-sized spines back of middle of antennal grooves, one below and posterior to the other. Gena below eye not laminately projecting over antennal groove. Bristles on second joint of antennæ considerably exceeding third joint. In both sexes the antennal groove is connected by a chitinous thickening with the upper margin of the head. Hind margin of antennal groove with only two small bristles below. Mandibles reaching scarcely half of anterior coxæ. Maxillæ short, but long acuminate at apex.

Fore coxæ with comparatively few rather large spines. On inner side of hind coxa there is an oblique row of ten to twelve minute teeth. Hind femora with a row of six to eight bristles on the side. One of the apical spines on joint 2 of hind tarsi is longer than joints 3 and 4 together. The proportional lengths of hind tarsal joints are about 26–16–8–5–13. Eighth abdominal segment in both male and female laterally with two stout spines on each side. In the female the eighth tergite is clothed on hind margin laterally with numerous spines and bristles. The tenth tergite has two long apical spines and back of this several shorter. The style is very short and thick, somewhat narrowed apically, with one stout apical spine and two smaller spines back of apex beneath.

In the male the lateral portion of the ninth tergite is a large sclerite, rounded only above, with a stout tooth at posterior upper angle and numerous bristles along the upper margin. The upper claspers are of an elongate inverted plowshare shape, with the point dissected cephalad and with a few weak hairs on posterior border.

Length of male 1.5 mm., female 2.5 mm. Color, very dark reddish brown.

Type.—Cat. No. 6897, U.S.N.M.

PULEX AFFINIS, new species.

Prof. A. B. Cordley collected on a small *Lepus*, near the Grand Canyon in Arizona, two perfectly distinct species of fleas, one a *Pulex*, the other a *Ctenocephalus*, both represented by males and females. However, *glacialis* represents a general type like *avium*, *fasciatus*, etc., from which in late years many perfectly distinct forms have been separated. So it becomes necessary to give this the standing of a separate species. So very little is known of the fleas living on rabbits and hares in America, especially in northern North America, that nothing further can be said at present than that this is a relative of *glacialis*.

The pronotal ctenidium contains 16 to 18 spines. Abdominal segments, each with but one transverse row of bristles, about 14 in each

row on most of the tergites, 4 on most of the sternites. Antepygidial bristles two, and of medium size. Metathoracic epiphysis with two rows of six or seven bristles each. Thoracic segments with singles rows of about twelve bristles each, the bristles strongest laterally.

Head of female broadly rounded from occiput to mouth in female, flattened above somewhat in male. Gena without a lamina extending over antennal groove, but armed with two spines, one front of the middle of the large eye, the other on lower margin of head over maxilla. Vertex with the usual bristles and spine on hind border and two spines on disc back of antennal groove. Hind margin of antennal groove with a few minute hairs below. Mandibles extending to three-fourths length of anterior coxæ.

Fore coxæ normally clothed, fore femora with a number of scattering bristles on side, middle femora with scarcely any, hind femora with a lateral row of about six large bristles. Hind coxa with an oblique row of about ten rather stout but minute teeth on inside. The hind legs are large, unusually stout, and heavily spined. One of the apical spines on second joint reaches nearly to end of fifth joint. Proportional lengths of tarsal joints are about 25–16–9–5–16.

In the female the eighth abdominal segment has a lateral row of about five stout spines, the hind margin of this segment being plentifully clothed with long and short spines. Tenth tergite with a few long bristles. Style about twice as long as wide at base, narrowed to the apex, where there is a long, stout spine, and on the lower side are two slender bristles.

In the male the lateral portion of the ninth tergite is extended in a large, round lobe, about the apical border of which are placed six to eight large, stout spines. Upper claspers about twice longer than wide, somewhat narrowed to the apex, in which rests a short but very thick and stout black tooth. The lower claspers large triangular, extended fan-like, apical and lower margins bristly on upper portion of apical border, with a short, stout, deflexed spine.

Length, male, 2 mm.; female, 2.5 mm. Color, clear brown.

Type.—Cat. No. 6898, U.S.N.M.

PULEX LYNX, new species.

Plate X, figs. 7–11, and Plate XI, figs. 1–2.

Prof. J. M. Aldrich sends from Moscow, Idaho, a large series of a flea closely related to *affinis* but taken on lynx (*Lynx canadensis*).

In general, the vestiture and proportions are very close to those of *affinis*, but this species is more delicately constructed in both respects. The toothed upper male clasper is about four times as broad as long instead of only twice, and the lateral lobe of the ninth tergite is much narrower than in *affinis*. The lower claspers are not so sharply triangular and have far fewer bristles.

It seems something of an anomaly to find two species so closely related on such different hosts. If but one or a few specimens had been found on the lynx, I should have considered the occurrence accidental and surmised that these specimens were originally from some rabbit, but Professor Aldrich took a large series. Much more collecting will be necessary to throw any definite light on the matter.

Type.—Cat. No. 6899, U.S.N.M.

Genus CTENOCEPHALUS Kolenati.

1859. *Ctenocephalus* Kolenati, Fauna V. Altvaters, p. 65.
1863. *Ctenocephalus* Kolenti, Horæ Soc. Ent. Ross., II, p. 44.

The species grouped under this heading are essentially *Pulex* with etenidia on the genæ. The presence of the etenidium on the head may, perhaps, be an artificial character, but it is at least a definite one. That the grouping is an artificial one there is no question. The new *anomalus* must go into *Pulex*, but it is more closely related in many ways to *simplex* and *inæqualis*, also rabbit fleas. Every lot of new species alters one's ideas of the relationships. We know, as yet, but a lamentably small proportion of existing species. I would not care to attempt a recasting of these groups on such very fragmentary data, especially when this present arrangement can be well employed for the time being.

SYNOPSIS OF SPECIES.

a. Spines of head etenidia in longitudinal rows on lower margins of genæ; head not tuberculate in front.....*canis* (p. 384).
aa. Spines of head etenidia in oblique rows on hind margins of genæ; head tuberculate in front.
b. Mandibles reaching three-fourths of anterior coxæ; head etenidia in male with eight spines on each side.....*simplex* (p. 385).
bb. Mandibles slightly exceeding anterior coxæ; head etenidia in male with four or five spines on each side.....*inæqualis* (p. 385).

CTENOCEPHALUS CANIS Curtis.

The common cat and dog flea is probably the most widely distributed member of the order, occurring practically wherever cats and dogs occur. Dr. Lutz sends specimens from Brazil. It seems to be a normal and abundant parasite of cats and dogs, but has been found on a variety of other animals. It occurs commonly as a transient guest on almost all of the domesticated, semidomesticated, or caged animals, and will bite human beings whenever opportunity offers. Many reported cases of infestation of houses have been found to be due to this species, rather than to *Pulex irritans*. The case of a lot of fleas collected by Mr. Snyder from a fox at San Diego, California, offers a peculiar instance of unusual occurrence. A part of this lot proved to be *Pulex irritans* and the rest this species.

Taschenberg used the later name *serraticeps*, of Gervais, and I at first followed him in this as in other matters, though the ordinary rules of zoological nomenclature do not permit of its use.

I believed most heartily in Mr. Rothschild's much-needed segregation of the composite species *canis*, but his similar attempt in the case of *canis* and *felis* can not, it seems to me, possibly stand. He himself says that any constant distinctive character is lacking in the females. The difference in the males which he indicates would be very slight at best; they relate principally to the number and arrangement of the bristles on the discs of the male claspers. In America this is certainly widely variable. It can only be said that if his definition of these two species must be accepted, then a number more should be described from dogs and cats in this country, and, as in the first two, so the females of all would be practically indistinguishable.

CTENOCEPHALUS SIMPLEX Baker.

This form, originally described as a variety of *inæqualis*, is a distinct species. It occurs on *Lepus* in Michigan.

CTENOCEPHALUS INÆQUALIS Baker.

This was originally described from part of the material obtained by Prof. A. B. Cordly on *Lepus* near the Grand Canyon, in Arizona. Afterwards I collected the same thing on a *Lepus* at Arboles, Colorado, and Professor Aldrich sent me specimens from Moscow, Idaho.

Genus CERATOPHYLLUS Curtis.

1832. *Ceratophyllus* CURTIS, British Entomology, IX, No. 147.
1898. *Ceratophyllus* WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 557.

This is the largest genus in the order, containing many nearly related and very puzzling forms. Most of the species are very closely confined to their especial hosts, and none are cosmopolitan. *C. gallinæ*, or some of the European species affecting house rats or house mice, would be the most likely to become so. We have no record as yet of the occurrence of any of these in America, though it is almost impossible that they should not have been brought here. The fact is that no systematic attempt has been made to collect them. This is much to be regretted, and it is hoped that opportunity will soon offer to supply the necessary data.

In his very proper rehabilitation of this genus, Dr. Wagner uses the arrangement of the spines on the under side of the fifth tarsal joint as a distinctive character of special importance. It has been impossible for me to apply this to the many American species. As defined by him, these spines in *Ceratophyllus* are confined to 2 rows of 5 each on either margin, in *Ctenophthalmus* the first pair being

dislocated toward the median line and directed straight backward. Some of our species (*idahoensis*, *canadensis*, *petiolatus*, *arizonensis*, *bruneri*, *arctomys*, *tuberculatus*, and *hirsutus*) are typical *Ceratophyllus* as defined by Wagner. Some were found which, like *proximus*, had the first pair of spines only slightly dislocated and bent inward, and it was puzzling indeed to find that *lucidus* and *charlottensis* were typical *Ctenophthalmus* on the fore legs, while the former was a genuine *Ceratophyllus* on the hind legs and the latter a *Pulex!* Then occurred the peculiar aberrant *perpinnatus* with a middle pair of the spines dislocated toward the center.

After all this I was prepared for the group of certainly Ceratophyllus species, which had the first pair of spines dislocated, as in *labiatus*, *keeni*, *pseudarctomys*, *californicus*, *ciliatus*, *wagneri*, *ignotus*, *divisus*, *coloradensis*, *oculatus*, *wickhami*, and *sexdentatus*, all of which are certainly to be regarded as more clearly congeneric with the type of *Ceratophyllus* rather than with that of *Ctenophthalmus*. For the time being there was but the one recourse of falling back upon the artificial (?) character of the presence or absence of a genal ctenidium, and so far as my studies have progressed it is the sole means by which I can separate these numerous species into two more or less homogeneous groups about the original types. The only alternative would seem to be the establishment of numerous genera, which will eventually have to be done, but which would seem to be unwise in the present very fragmentary condition of our knowledge of the existing species of the world.

All of the species of *Ceratophyllus*, so far as I have examined them, have on the inferior disk of the fifth tarsal joint numerous very minute hairs, and between the hind coxa and its epiphysis distally there is always formed a more or less deeply excavated emargination. In some other genera there are wide departures from these conditions though their uniformity has yet to be tested for all the species.

SYNOPSIS OF AMERICAN SPECIES.

a. Hind coxæ with one or more rows of minute teeth on inside distally.
  b. Eyes well developed; teeth on inside of hind coxæ in several rows.
    c. Pronotal ctenidium of 40 spines ..... *multispinosus* (p. 389).
    cc. Pronotal ctenidium of 24 spines ..... *dentatus* (p. 390).
  bb. Eyes rudimentary; teeth on inside of hind coxæ in one row; pronotal ctenidium of 14 spines ..... *charlottensis* (p. 390).
aa. Hind coxæ without minute teeth on inside.
  b. Fifth tarsal joint with the middle pair of lateral spines dislocated toward median line and replaced by two supernumerary spines; pronotal ctenidium of 36 spines ..... *perpinnatus* (p. 391).
  bb. Fifth tarsal joint never with middle pair of spines dislocated; pronotal ctenidium of 26 spines or less.
    c. Males without a strongly developed style projecting over pygidium; size medium to small; eyes usually present.

d. Hind tarsal joint I about equalling II and III together, rarely little more; never with a spine on apex of joint I of hind tarsi which exceeds joint II; head always with a distinct notch on the front.

e. Abdominal tergites with 3 distinctly marked rows of unusually numerous bristles; labial palpi nearly equalling anterior femora.

f. Frontal notch so reduced as to be almost absent; pronotal ctenidium of twenty-four spines ..... *alaskensis* (p. 394).

ff. Frontal notch very distinct; pronotal ctenidium of eighteen to twenty spines.

g. Frontal notch normal; antepygidial bristles, two on each side and of about equal length ..... *hirsutus* (p. 392).

gg. Frontal notch with the upper lip in the form of a strong tubercle; antepygidial bristles 3 on each side, the inner quite small, the middle largest ..... *tuberculatus* (p. 393)

ee. Abdominal tergites each with two normal transverse rows of bristles.

f. Hind tarsal joint II with apical spine scarcely exceeding joint III or shorter.

g. Lateral spines on last joint of hind tarsi with first pair distinctly dislocated toward median line, not merely bent inward, and always so on middle and fore tarsi.

h. Abdominal sternites with always more than two bristles on each side on at least five segments.

i. Hind femora with a longitudinal row on side of a number of bristles; pronotal ctenidium of eighteen spines.

j. First joint in middle tarsi distinctly longer than second or fifth; female style with a single very minute bristle on upper side ..... *californicus* (p. 395)

jj. First joint in middle tarsi about equal in length to second, and also to fifth.

k. Labial palpi scarcely equalling anterior coxæ. *oculatus* (p. 396).

kk. Labial palpi slightly exceeding anterior coxæ. *ciliatus* (p. 397).

ii. Hind femora without a longitudinal row of bristles on side, though one or two may occur there.

j. Pronotal ctenidium of twenty-four to twenty-six spines.

k. Upper clasper of male with one black tooth at upper and one at lower end ..... *pseudarctomys* (p. 399).

kk. Upper clasper of male with two black teeth at middle of hind margin ..... *keeni* (p. 400).

jj. Pronotal ctenidium of sixteen to eighteen spines; labial palpi equaling or shorter than anterior coxæ.

k. Fifth joint of middle tarsi much less than twice length of fourth, the second longer than fifth, and the first little longer than third ..... *leucopus* (p. 401).

kk. Fifth joint of middle tarsi always twice fourth in length or more, and other proportions different from above.

l. Labial palpi abnormally slender ..... *labiatus* (p. 402)

ll. Labial palpi normally stout.

m. Upper male claspers each with four black teeth *wickhami* (p. 403).

mm. Upper male claspers each with six black teeth. *sexdentatus* (403).

hh. Abdominal sternites with but two bristles on each side; upper claspers of male each with three stout black teeth on expanded middle portion of hind margin ..... *wagneri* (p. 405).

gg. Spines on last joint of hind tarsi in two rows on lateral margins, but with first pair slightly bent inward; labial palpi equaling or a little exceeding fore coxæ.

h. Disk of vertex back of antennal groove with six stout bristles. *asio* (p. 406).

hh. Disk of vertex back of antennal groove with but one to three stout bristles.

i. Pronotal ctenidium of twenty spines.

j. Joint III of hind tarsi with but two sets of spines on either margin ..... *canadensis* (p. 407).

jj. Joint III of hind tarsi with three sets of spines on either margin ..... *vison* (p. 408).

ii. Pronotal ctenidium of sixteen spines ..... *lucidus* (p. 410).

ff. Hind tarsal joint II with an apical spine exceeding joints III and IV together; hind femur with a row of minute bristles on side.

g. Eyes well developed; spines on fifth tarsal joint confined to two rows on lateral margins, though the first pair may be slightly bent inward.

h. Labial palpi nearly equaling anterior femora.

i. Gena below eye obtusely pointed posteriorily; length, female 2.75, male 1.75 ..... *montanus* (p. 411).

ii. Gena below eye subtruncate posteriorily; length, female 3.75, male 2.75 ..... *arctomys* (p. 411).

hh. Labial palpi equaling or a little exceeding anterior trochanters.

i. First pair of spines on last tarsal joint slightly bent inward ..... *proximus* (p. 412).

ii. First pair of spines on last tarsal joint curved outward, same as others.

j. Upper male claspers at upper extremity obliquely truncate toward body. The hind margin with one long and several short bristles ..... *bruneri* (p. 413).

jj. Upper male claspers obliquely truncate away from body or narrowed to a point above; hind margin with four long and several short bristles.

k. Genæ broadly truncate posteriorly below eye; upper male claspers distally gradually narrowed to a point. *idahoensis* (p. 413.)

kk. Genæ pointed posteriorly below eye; upper male claspers obliquely truncate away from body.

l. End of male abdomen with comparatively few long bristles ..... *arizonensis* (p. 415).

ll. End of male abdomen with a thick brush of long bristles on eighth segment ..... *petiolatus* (p. 415).

gg. Eyes rudimentary; first pair of spines on last tarsal joint dislocated toward median line.

h. Labal palpi not equaling anterior coxæ ..... *ignotus* (p. 416).

hh. Labal palpi exceeding anterior trochanters ..... *dirisus* (p. 416).

dd. Hind tarsal joint I equaling II, III, and V together.

e. A spine on apex of hind tarsal joint I much longer than joint II; front without the usual minute notch ..... *coloradensis* (p. 417).

ee. Spines on apex of hind tarsal joint I much shorter than II; front with the usual notch ..... *eremicus* (p. 417).

cc. Males with a stout style projecting from seventh tergite over at least one-third length of pygidium; size enormous; eyes absent ..... *stylosus* (p. 418).

CERATOPHYLLUS MULTISPINOSUS Baker.

Plate XII, figs. 1–5.

This flea, from *Lepus floridanus mallurus* at Raleigh, North Carolina, well illustrates some of my remarks under the genus. By all the characters which have been used to define the genus this species is a *Ceratophyllus*, yet I have no hesitation in saying that its strongest affinities are with the other rabbit fleas, *glacialis*, *affinis*, *inaequalis*, and *simplex*. The heavy posterior legs, the numerous minute teeth on inside of hind coxæ and the general habitus of the whole insect prove this unmistakably. But the last tarsal joint has five equal spines on either margin, and the prothorax only, possesses a ctenidium, which is unusually well developed. The original description is so incomplete that the species is here redescribed.

The single type specimen is a male, with head flattened above and thickened, and with a distinct frontal notch. The eye is large, rather low down, and not fully pigmented except around the margin. Gena with two oblique rows of spines, the upper of about six smaller, the lower of three much larger spines, the first of the latter being above and in front of the eye. Gena below eye posteriorly acute. First joint of antenna with numerous small bristles near the upper extremity, the second bearing about six heavy bristles, which are not as long as third joint. The antennal groove is connected with upper margin of head by a chitinous thickening. Hind margin of antennal groove sharply prominent below, where there are numerous small bristles on the margin; above this the margin is not clearly defined and the minute bristles are scattered. Hind margin of vertex, with the usual marginal row of about sixteen bristles, and there are two stout unequal spines at each lower angle. Just behind middle of antennal groove there are two small and one large spine. Mandibles about equaling fore coxæ. The pronotum has two rows of few weak bristles on disk, and on hind margin a row of about forty rather short and slender ctenidial spines, and a long stout spine at extreme lateral angle. The meso- and metanotum have a row of about 14–16 larger bristles behind and three or four rather irregular rows of numerous minute bristles on disk. Metathoracic scale with three spines near anterior border, an irregular row of six stouter ones across middle and one near hind margin. Abdominal tergites with one transverse row of about twenty-four large bristles and about two rows each of numerous minute bristles, though these latter are very irregularly placed. There are also two minute median black teeth on first seven tergites, and lateral teeth as follows: two on each side of first two segments, and one on each side of next five. On each side there are two antepygidial bristles, one of which exceeds tenth segment and is twice the length of the other. The tenth tergite is covered with a brushy mass of bristles,

and the lateral portions of the ninth with about a dozen stout bristles. Middle abdominal sternites each with a transverse row of six to eight bristles.

The hind tibiæ are stout and heavily bristled. Second joint of hind tarsi with one apical spine about equaling joint III. Hind femora with several bristles on lower margin proximally, three on lower margin distally, but only two minute bristles on side. Hind coxæ unusually heavily clothed with stiff bristles on outside anterior half; inside and below are several close-set irregular rows of numerous minute teeth.

Upper claspers nearly quadrangular, attached by one corner, the hind margin with a few weak hairs.

Length, 3.5 mm. Color, clear brown.

CERATOPHYLLUS DENTATUS, new species.

The single male specimen of this species in the collection was sent from Moscow, Idaho, by Prof. J. M. Aldrich, who found it on *Lynx canadensis*, associated with considerable numbers of another species. I regard this occurrence as purely accidental, and should not be surprised to learn eventually that its proper host was some species of *Lepus*, as its real affinities are with *multispinosus* and the other rabbit fleas.

This species is a very near relative of *multispinosus*, with distinguishing characters as follows: The pronotal ctenidium consists of about 26 close-set spines. The mandibles extend to about four-fifths the length of anterior coxæ. On each side of the vertex there are more than 3 spines. The black teeth on the abdominal tergites occur in pairs, one pair on each side near the dorsal line. The male claspers are twice longer than wide, narrowed on apical half below to a truncate apex; the margin with a number of scattering bristles and minute, weak hairs. One of the apical spines on joint II of hind tarsi is nearly as long as joints III and IV together. The minute teeth on inside of hind coxæ are even more numerous than in *multispinosus*.

Length, 3.5 mm. Color, rich brown.

Type.—Cat. No. 6900, U.S.N.M.

CERATOPHYLLUS CHARLOTTENSIS Baker.

Plate XII, figs. 6–10.

The Rev. J. H. Keen found this species in a mouse nest at Masset, Queen Charlotte Islands, and I described it as a Typhlopsylla on account of the reduced eyes. It possesses several remarkable characters not mentioned in the meager original description. It has the typical form of body of a Ceratophyllus. The spines of last tarsal joint on fore and middle legs are arranged as in *Ctenophthalmus*, those

on hindlegs as in *Pulex*. One of the most suggestive characters is the reduced group of teeth on inside of hind coxæ, composed of about eight teeth in one nearly even row. It is the only species of the true Ceratophyllus form in which I have seen these teeth. It should be noted that the second and third abdominal tergites possess four minute teeth each, and the fourth and fifth two each. There are three antepygidial spines on each side, one long one between two shorter.

The end of the female abdomen possesses comparatively few bristles. The style is twice longer than wide at base, gradually narrowed to the tip, where there is a long spine just before which on the upper margin is a minute bristle. The substylar flap has a few longer bristles at end and a few shorter on lower margin. Laterally the eighth tergite bears three long spines and a few bristles. Length, 2.5 mm. Color, pale brown. Only females are known.

CERATOPHYLLUS PERPINNATUS, new species.

Plate XIII, figs. 1–6.

From the Queen Charlotte Islands the Rev. J. H. Keen also sends a flea of remarkable aspect, but of which he does not give the host. It possesses one especially salient character not recorded for any other species of the order. The last tarsal joint has the middle pair of spines dislocated toward the median line, but these are replaced toward the outside by a supernumerary pair, making six pairs of the ordinary spines on the underside of the last tarsal joint on all the legs.

The single specimen is a male. The head is rather rounded and bulging in front, with a sharply defined frontal notch, though flattened and thickened on top after the usual manner. The eye is large and nearly circular. The gena is provided with three oblique rows of bristles, the upper row of about 8 small, short bristles, the second with four larger, and the lower with three long and stout bristles. The antennal groove extends nearly to the upper margin of the head, with which it is connected by a chitinous thickening. The bristles on second antennal joint are small and few, and much shorter than third joint. The hind margin of antennal groove is lined with minute scattering hairs. On the hind margin of the head occurs the usual row of about 14 bristles, those at the lower angles large and long. The disk of the vertex has two oblique rows of bristles on either side near the upper margin of the head, the upper row with about 4, the lower with about 6 bristles, all becoming smaller backward. The mandibles extend to a little more than two-thirds of anterior coxæ. The first joint of the maxillary palpi is somewhat longer than the second.

The pronotum is armed with a transverse row of about 12 small bristles on the disk and on the hind margin a ctenidium of about 36 rather slender and close-set spines. The mesonotum and metanotum have each a transverse row of about 12 bristles and cephalad of this

on each, several rows of somewhat scattered minute hairs. The metathoracic epiphysis has two rows of rather large bristles, about 3 in each row.

The abdominal tergites each have a transverse row of 14 to 16 larger bristles and a second row of much smaller ones. There is one antepygidial bristle on each side, and these do not equal the tenth tergite. Most of the middle abdominal sternites have each a single transverse row of 6 bristles.

The genitalia are of the general *Ceratophyllus* type and yet are quite unique in detail. The lateral portion of the ninth tergite is lobed above, the lobe as long as wide at base, tip obliquely rounded and provided with a bristle. The rounded portion beneath which the upper clasper is attached is provided, as is frequently the case, with two long bristles. The upper claspers are subquadrangular, attached by the lower inner angle, the upper inner angle somewhat produced and provided with three minute hairs, the upper angle broadly rounded, the lower angle considerably swollen and produced and provided with a large long tooth which is distorted near its tip; the hind margin is provided with a bristle at top, below this two short spines, and with two more short spines above the lower tooth.

Hind coxæ without minute teeth on inside. Hind femur with but one minute hair on the side. Spines on apex of second joint of hind tarsi all shorter than the third joint. Hind tarsal joints with lengths in following proportions: 20–15–9–5–10.

Length, 3 mm. Color, light brown.

Type.—Cat. No. 6901, U.S.N.M.

CERATOPHYLLUS HIRSUTUS Baker.

Plate XVII, figs. 1–4.

The prairie-dog flea, not uncommon in Colorado at least, is a very conspicuous species by reason of the great length of the labial palpi and inclosed organs, and the very heavy bristling of the abdomen, though the bristling of other parts is normal. Only females are represented in the collection.

The upper margin of the head slopes very strongly from base to mouth, the distinct frontal notch being very low down. The eye is very small in proportion to size of head. Just above the eye are a few minute hairs. The gena bears three heavy bristles below, the inner above and slightly in front of eye, the outer on lower margin; above these are two bristles, one larger on lower margin and one small one in center of gena. The gena below the eye is subtruncate posteriorly. The antennal groove is unusually broad for its length, extending to two-thirds the height of the head; the hind margin is provided with numerous small hairs. The numerous bristles on second antennal joint considerably exceed third joint. The usual bristles

occur on hind margin of head, though but a single rather stout bristle occurs on disk of vertex back of antennal groove. The labial palpi nearly equal the anterior femora. The maxillæ are unusually slender.

The prothoracic ctenidium contains about twenty spines. The metanotum and first three abdominal tergites have four minute but stout dark-colored teeth on hind margins. The abdominal tergites are provided with very numerous bristles in several rows, the principal rows with about 20 to 24 bristles each. Antepygidial spines, two on each side and of about equal length. Abdominal sternites third to sixth inclusive, each with a row of about 12 larger bristles and several smaller back of these; the seventh and eighth sternites with numerous bristles in several somewhat scattered rows. Style rather stout, with one long bristle at tip and with others nearly as heavy along the sides. Substylar flap nearly hidden in bristles.

The hind coxa without minute teeth inside. Hind femur with a straight row of about ten minute bristles on side. There are 2 apical spines on joint II of hind tarsi, which nearly equal joints iii and iv together. The spines on the last tarsal joints occur in the typical Ceratophyllus order. Lengths of hind tarsal joints in the proportions of 21–12.5–8.5–5–9.

Length, 2–3 mm. Color, light brown.

CERATOPHYLLUS TUBERCULATUS, new species.

Plate XIII, figs. 7–9.

Professor Aldrich has collected from *Citellus columbianus* at Moscow, Idaho, a species which is closely related to *hirsutus*, but which, however, shows striking specific differences. There are but two specimens—fortunately male and female.

Female: The head has the same strongly sloping upper margin as in *hirsutus*, but the upper lip of the frontal notch projects as a conspicuous tubercle. The gena bears the usual three heavy bristles below, with a small one between the first two, but the upper row is represented by only one, and that on the lower margin. Just above the eye are a number of minute hairs. This species also has the hind margin of the antennal groove provided with a number of minute bristles, and one large bristle occurs on disk of vertex behind middle of antennal groove. The gena below eye is acute posteriorly. The dozen close-set bristles on second joint of antenna are longer than third joint. The labial palpi extend to about three-fourths of anterior femora.

Thoracic nota with two transverse rows of bristles, the principal with about 10 good-sized bristles. The prothoracic ctenidium contains about 18 spines. The abdominal terga have about 16 to 18 large bristles in the principal row, and with numerous minute bristles in two more or less well-defined rows back of these. The minute hairs

which in most *Ceratophyllus* species occur in the same row between the larger bristles are here of very unusual size, being nearly half the size of the large bristles. In most other species they are quite inconspicuous.

There are three antepygidial bristles on each side, two quite unequal large ones and a small one behind and near the median line. The abdominal sternites are here more heavily clothed than in any species of the genus known to me, and the number of bristles increases caudad. There are two or three rows to each sternite, the principal row on the third segment numbering 18 and on the seventh 20. On the eighth sternite the bristles are rather short and scattering.

The style is rather stout with one long apical bristle and several smaller along the sides. The substylar flap has several long bristles at tip and a mass of short stout bristles on lower margin.

The hind coxæ lack minute teeth on inside. The hind femur has a row of about six bristles on the side. One of the apical spines on joint II of hind tarsus exceeds joints III and IV together. The spines on fifth tarsal joint occur in the typical *Ceratophyllus* order. Lengths of hind tarsal joints in the proportions of 20–16.5–7.5–5–10.

Length, 2.3 mm.

Male: The male before me is a most extraordinary looking creature, due to a malformation. The upper margin of head is evidently normally flattened in this species as usual in *Ceratophyllus*, but in this specimen is collapsed inward and deeply concave. The upper row of genal bristles is composed of three members. As in most males, the third antennal joint is somewhat extended so that the bristles on second joint are not as long as the third. The genitalia are entirely inclosed from view in this specimen, within the much extended and posteriorly truncated eighth segment which has on its surface a number of long, stout, rather distant bristles. The lateral portion of the ninth tergite is not lobed above, but is broadly rounded. The upper claspers are long, slightly curved sickle fashion, acute at tip, and armed on posterior border with about seven bristles.

Length, 2 mm. Color, rather darker brown dorsally.

Type.—Cat. No. 6902, U.S.N.M.

CERATOPHYLLUS ALASKENSIS, new species.

Dr. Kellogg presented me with some specimens of a species taken by Mr. McElhaney on *Citellus barrowensis* at Point Barrow, Alaska. This is the farthest north record for the order in America. This species is also the largest one known to occur on any spermophile.

Female: Head broadly evenly rounded from occiput to mouth, the frontal notch almost wanting. Gena with the usual three heavy bristles below, the upper row represented by one on the margin. The eye is small compared with size of head, and low down. Gena below eye

posteriorly truncate. Antennal groove reaching two-thirds the depth of the head, the hind margin with a number of scattering minute bristles. The hind margin of the head is provided with the usual bristles, the disk of the vertex with one heavy bristle behind middle of antennal groove. Second joint of antenna with about a dozen bristles which extend beyond third joint. Labial palpi extending to more than half of anterior femora.

Thoracic nota each with one row of 10 to 12 large bristles and one of smaller. The pronotal ctenidium contains 24 slender spines.

Abdominal tergites with three distinct rows of bristles, the principal row of 16 to 18 bristles, the minute hairs between these last very inconspicuous. Antepygidial spines three on each side, two larger unequal and one smaller near the median line. Abdominal sternites with three rows of bristles each, the far greater number occurring in the principal row, which has 18 to 20 bristles. The eighth tergite laterally bears numerous rather distant short bristles. Just beneath the pygidium on either side occur five strong bristles.

The style is very thick and swollen, with two long stout bristles on the apex, and four or five just before the apex. The substylar flap has several long bristles at tip and a number of short, stout ones on lower margin.

Hind coxæ without minute teeth inside. Hind femora with a row of about 10 minute bristles on the side. One of the apical spines on the second hind tarsal joint equals in length joint III and half of IV together. Spines on last tarsal joint of the typical *Ceratophyllus* type. Lengths of hind tarsal joints in the proportion 20–13–9–5–10. Length 4 mm.

Male: Head flattened on top as usual. Pronotal ctenidium of 22 spines. Eighth abdominal tergite with a number of heavy bristles on the upper posterior portion, in three rows of 4 each, and with the hind margin incurved. Lateral portion of the ninth tergite with a broad rounded upper lobe, with two widely separated long bristles over the attachment of claspers. Upper claspers more than twice longer than wide, somewhat sickle-shaped, but broad and obtuse at tip, the hind margin with a few weak bristles.

Length, 3.25 mm. Color, rich brown, darker dorsally.

Type.—Cat. No. 6903, U.S.N.M.

CERATOPHYLLUS CALIFORNICUS, new species.

Plate XVII, figs. 5–8.

There is in the collection one female specimen of a flea collected at Mountain View, California, on a field mouse, by Mr. Edward Ehrhorn, which differs from any other mouse flea yet described.

Head evenly rounded from occiput to mouth, the frontal notch rather low and inconspicuous. Gena with three stout bristles below, the upper row represented by two bristles, one smaller than the other,

above the eye. Eyes nearly round and of medium size. Gena below eye obtusely pointed posteriorly. Hind margin of antennal groove sharply prominent and with a number of minute hairs. Antennal groove extending to two-thirds the depth of the head. Bristles on second antennal joint not extending beyond third joint. Behind the middle of the antennal groove on the disk of the vertex there is one stout bristle. The usual bristles occur on hind margin of head. The labial palpi exceed slightly the anterior trochanters. Pronotum with a transverse row of about fourteen bristles on disk, and on hind margin a ctenidium of eighteen or twenty stout spines. Mesonotum and metanotum each with two rows of bristles, those in posterior row larger and fourteen in number, the anterior row with numerous smaller ones. Hind margin of metanotum with two small teeth on each side. First three abdominal tergites with one small tooth on each side. Abdominal tergites each with two rows of bristles, the posterior with about fourteen larger, the anterior with fewer smaller bristles. Antepygidial bristles three on each side, the inner smallest, the middle longest. Abdominal sternites each with a row of eight or ten rather stout bristles. Two stout bristles occur on each side just beneath the pygidium. Lateral portion of eighth tergite with three or four stout bristles on the hind margin.

Female style rather stout, narrowed to a point, where there is a long bristle; there is also a bristle on the lower margin, and one very minute one above. The substylar flap is pointed, possesses several long, slender bristles at apex, and a number of short, stout bristles on lower margin.

Hind coxæ without minute teeth on inside. Hind femur with a row of four to five small bristles on the side. Spines on the apex of second joint of hind tarsus shorter than third joint. First pair of spines on last joint of hind tarsus somewhat dislocated toward median line. Lengths of joints of hind tarsi in the proportion 21.5–13.5–8–5–9.

Length, 2.5 mm. Color, pale brown.

Type.—Cat. No. 6904, U.S.N.M.

CERATOPHYLLUS OCULATUS, new species.

Plate XIX, figs. 10–14.

This species is based on a single male specimen collected on mink in Washington, District of Columbia, by Mr. A. A. Harsall.

The head is flattened above as usual, the frontal notch very distinct and rather high. The lower row of genal bristles contains two large bristles with one small one between them. The superior row is represented by four or five bristles extending very obliquely from above the uppermost bristle on the upper margin of the eye to the upper fourth of the antennal groove. The antennal groove extends to the upper margin of the head, and is suddenly broadened in the

lower fourth. On the middle of hind margin of antennal groove occur a few minute hairs, while just back of the margin on disk of vertex stands one stout bristle. The usual bristles occur on hind margin of head, with a large long one at lower angle on either side. Labial palpi about equaling anterior coxae. The fourth joint of maxillary palpi is unusually slender.

Pronotum with a transverse row of twelve bristles and on hind margin a ctenidium of eighteen stout spines. Hind margin of metanotum with two small teeth on each side, first and second abdominal tergites the same, the third with only one on each side. Abdominal tergites with two rows of bristles each, the larger bristles, eighteen in number on each of the middle segments. Middle abdominal sternites with three or four bristles on each side. Antepygidial bristles three on each side, the middle one of each group very large, the other two small, though not reduced to hairs. Hind margin of lateral portions of eighth segment with about six stout bristles. Lateral portion of ninth tergite with a short, thick lobe, which is obliquely truncate and bears a hair at tip. The upper clasper is short and thick, almost crescentiform, with the hind margin rounded and the upper end acutely angled, but the base is broad; on the upper portion of the hind margin there are two bristles and two or three hairs.

Hind coxa without minute teeth inside. Hind femur with a row of four or five distant bristles on the side. Apical spines on second joint of hind tarsi shorter than third joint; first pair of spines on last joint distinctly dislocated toward median line. Length of middle tarsal joints in the proportion 12–12–9–5–12.

Length, 2.5 mm. Color, pale brown; middle of dorsum darker.

Type.—Cat. No. 6905, U.S.N.M.

CERATOPHYLLUS CILIATUS, new species.

Plate XVI, figs. 1–6.

Mr. Ehrhorn also contributes from Mountain View, California, the male and female of a species occurring on a chipmunk. It is closely related to *californicus*. Unfortunately the male of the latter is unknown, but the females differ in many characters.

Female: Head rather strongly rounded from occiput to mouth, the minute frontal notch rather low down. Lower row of genal bristles of three subequal bristles, the upper row of four or five much smaller. Eyes ovate and low down in head. Antennal groove rather small and reaching two-thirds the depth of the head. Bristles on second antennal joint much shorter than third joint. Hind margin of antennal groove with a few minute hairs, especially near the lower angle. Caudad of the middle of the antennal groove, on the disc of the vertex, are three bristles, two small and one large one, the latter situated almost on the margin of the groove. Hind margin of the head with the usual bris-

tles, the large one at lower angle somewhat raised and with a smaller one below it. Labial palpi considerably exceeding anterior trochanters.

Pronotum with one transverse row of about fourteen bristles on the disc, the one at each lateral angle large and long; hind margin with a ctenidium of eighteen stout spines. Meso- and metanotum each with three rows of bristles, the posterior row of twelve to fourteen larger bristles, those of the second more numerous but smaller, and the third of fewer and still smaller ones. Hind margin of metanotum with a small tooth on each side, first tergite with two, second with two, and third with one, on each side. Abdominal tergites each with twelve to fourteen large bristles in one row, and a less number of smaller bristles in the second row. Antepygidial bristles three on each side, the middle one in each group largest. Abdominal sternites each with two rows of bristles, the posterior of eight to ten larger, and the anterior with eight to twelve smaller, rather scattered ones. Beneath the pygidium on either side there is a group of five stout bristles. The style is rather short and thick, with one long bristle at apex, one on lower margin, and two on upper margin. The substylar flap is apically unusually broad, with the usual long bristles at extreme tip, the lower margin with a group of short, slender, dark-colored spines.

Hind coxæ without minute teeth on inside. Hind femur with a longitudinal row of four to five bristles on the side. None of the apical spines on second joint of hind tarsi exceed joint III. First pair of spines on last tarsal joint dislocated toward median line, though not so distinctly so on hind tarsi. Lengths of joints of hind tarsi in the proportion 23–15–9–5–10.

Length, 2.5 mm. Color, clear brown, darker dorsally.

Male: Head flattened above as usual, the frontal notch much higher on the front than in the female. Antennal groove reaching upper margin of head. Antepygidial bristles three on each side, but the outer two in each set aborted. Eighth tergite with two rows of four to five stout bristles on each side near hind margin.

Lateral portion of ninth tergite with a stout thumb-shaped lobe, and the two usual bristles over insertion of upper claspers. The upper claspers are long and slender, the upper end suddenly expanded, this latter portion being acute angled in front and rounded behind, with two short, blunt, dark-colored teeth; near base on hind margin is a stout straight bristle. The slender ventral style has a long and a short bristle at apex, which stand out nearly at right angles.

Length, 2.3 mm.

Type.—Cat. No. 6906, U.S.N.M.

CERATOPHYLLUS PSEUDARCTOMYS, new species.

Plate XXIV, figs. 1–7.

Two females and a male taken from *Arctomys monax* at Newport, Herkimer County, New York, were sent to me by Mr. D. B. Young. This species is one of the most unique forms in the American fauna, presenting several characters not before noted in the Siphonaptera.

Female: Head very broadly rounded from occiput to mouth. Three bristles in the lower row on gena, the middle bristle smaller, and between this and the outside ones a number of minute hairs in the same row. Upper genal row entirely lacking, although a number of minute hairs occur above the eye. Eye subelliptical, low in the head and rather small in proportion. Antennal groove not reaching two-thirds the depth of the head, the hind margin sharply marked and with a number of minute hairs scattered along it. Second antennal joint with four or five bristles which do not extend beyond the third joint. In the position of the stout bristle usually found back of the middle of the antennal groove there is here only a minute hair. Hind margin of head with the usual bristles, except that at each lower angle there are two stout bristles, the lower shorter than the upper. Labial palpi reaching to about half the length of anterior trochanters. Maxillæ unusually blunt.

Pronotum with a row of about fourteen bristles near the hind margin, which is provided with a ctenidium of about twenty-six close-set spines. Meso- and metanotum each with two rows of bristles, the posterior of about twelve larger ones, the anterior of about the same number of much smaller bristles. Metathoracic epiphysis with two longer and three shorter spines.

First and second abdominal tergites with three small teeth on each side, the third and fourth with two on each side. Abdominal tergites each with two rows of bristles, the posterior of fourteen to sixteen larger bristles, the anterior of fewer smaller ones. Antepygidial bristles three on each side and long and stout, the middle one in each group largest. Most of the abdominal tergites each with about five unusually stout bristles in one row, and with a second row of one to three smaller bristles. Immediately beneath pygidium on either side are two long and two shorter bristles. Lower posterior angle of lateral portion of eighth tergite with four stout bristles and cephalad of these two others. End of abdomen with comparatively light vestiture.

The style is long, becoming slender and slightly curved upward, with a long bristle at apex and one on lower margin. Substylar flap slender and with very large bristles at apex and several short, stout ones on lower margin.

Hind coxæ without minute teeth inside. Hind femur with but a single minute hair on inside. Apical spines on second joint of hind tarsi nor extending beyond third joint. First pair of spines on fifth joint of hind tarsi strongly dislocated toward the median line. Lengths of joints of hind tarsi in the proportion 25.5–15–8–5–9.

Length, 3.5 mm. Color, clear brown.

Male: Head flattened on top after the usual manner. Along the front margin of antennal groove, above the eye, are three or four small bristles. There are a far greater number of minute hairs on hind margin of antennal groove than in the female.

On the meso- and metanotum and first abdominal segment occurs an arrangement of bristles which is entirely unique in the whole order.

On the side of meso- and metanotum is a tongue-shaped area, pointed backward, and common to the two sclerites. About the margin of this are the bristles arranged—especially long and numerous on the upper margin. On the first abdominal segment is a similarly outlined area extending backward from metanotum, though much smaller and with but seven or eight bristles about its margin. Antepygidial bristles three on each side, the outer two in each set well developed, the inner aborted.

The genitalia are very strongly and uniquely developed. The posterior portion of the abdomen is characterized by numerous long, stout bristles, gathered into two brush-like lots below, while above, the hind margin of eighth segment laterally has a row of about twelve of these long bristles, just behind which are a greater number of small ones. The lateral portion of ninth tergite has the usual dorsal lobe, which is here long and slender; the portion bearing the two bristles just over insertion of upper claspers is here narrowly produced beyond the hind margin of the claspers—a very unique arrangement. The upper claspers are long and slender, the upper and lower posterior angles strongly roundly produced, and each armed with a stout dark tooth, the upper one long and bent, the lower short, straight, and accompanied by a short bristle which stands just above it.

Length, 2.75 mm.

Type.—Cat. No. 6907, U.S.N.M.

CERATOPHYLLUS KEENI Baker.

Plate XVI, figs. 7–12.

This species was described from specimens taken on *Peromyscus keeni* at Masset, Queen Charlotte Islands, by Rev. J. H. Keen. All of our records for the Queen Charlotte Islands are due to this gentleman, and his contributions have been most important ones. Additions and corrections to the original description will be evident in the figures and synopsis.

CERATOPHYLLUS LEUCOPUS, new species.

There is a single female in the collection, taken on *Peromyscus leucopus* at Peterboro, New York, by Gerrit S. Miller, jr., which differs widely from the species found on *Peromyscus* in the Southwest.

Head strongly rounded in from front to mouth, the frontal notch distinct and accompanied by a small chitinous fold. Gena with two oblique rows of bristles; of the lower three large bristles the middle is smallest; the upper row contains about six small bristles of varying sizes. A few small hairs occur just above the eye. Gena below the eye very obtusely angled posteriorly. The antennal groove extends to two-thirds the depth of the head; along its hind margin are scattered a number of small hairs, largest at the lower angle. The second antennal joint is provided with a few bristles which are shorter than the third joint. Disk of vertex back of middle of antennal groove provided with one large and two small bristles. Hind margin of head with the usual bristles, except that at the lower angle there are two stout bristles, the lower of which is the smaller. The labial palpi reach to about three-fourths the length of anterior coxæ.

Pronotum with a transverse row of about twelve bristles on posterior third and on hind margin a ctenidium of eighteen long, stout spines. Meso and metanotum each with two rows of bristles, the posterior with about ten long ones, the anterior of more numerous small ones. Metathoracic epiphysis with two large bristles behind, in front of these four smaller ones, and still in front of these one bristle. Metanotum and first four abdominal tergites each with a small tooth on either side.

Middle abdominal tergites with two rows of bristles, twelve to fourteen larger bristles each on the posterior, fewer and smaller ones on the anterior segments. Antepygidial spines three on each side, the middle one in each group largest, the inner smallest. The middle abdominal sternites each with a single row of about eight large bristles.

Vestiture of end of abdomen not heavy. Beneath the pygidium on either side are two long bristles. Style long and slender, gradually narrowed to the tip, where there is one long bristle; on the lower margin also stands a bristle. Substylar flap obtuse, with two long slender bristles at extremity, the lower margin armed with four or five short, stout bristles.

Hind coxæ lacking minute teeth inside. Hind femur with one or two small bristles on the side, proximally. Spines on apex of second joint of hind tarsi all shorter than the third joint. First pair of spines on last joint of hind tarsi strongly dislocated toward the median line and pointing straight distad. Lengths of joints of hind tarsi in the proportions 21–12–7.5–5–8.

Length, 2 mm. Color, pale brown.

Type.—Cat. No. 6908, U.S.N.M.

CERATOPHYLLUS LABIATUS, new species.

Plate XIX, figs. 6–9.

Of several species which Professor Aldrich found on *Lynx canadensis* at Moscow, Idaho, this is the most puzzling. It is represented by only one female. Probably its normal host is not *Lynx*, but some one of the small rodents inhabiting that region.

Head rounded, with an unusually even, rather strong, curve from occiput to mouth. Frontal notch minute. Gena with the usual lower row of three stout bristles, the middle bristle smaller. The second row is represented by a single small bristle above upper bristle of lower row. A few small hairs occur above the rather elliptical eye. Gena below eye truncated posteriorly. Antennal groove extending to two-thirds the depth of the head, with a few hairs scattered along its hind margin, these hairs being longer below. The second joint of antennæ has about five bristles which extend beyond the apex of the third. On the disk of the vertex behind the middle of the antennal groove occurs one large, stout spine and two far smaller ones. Hind margin of head with the usual bristles, but at each inferior angle there are two, the lower of which is smaller. The labial palpi are very slender and about equal anterior coxæ.

Pronotum with two rows of bristles—about twelve on the posterior third, about eight on the anterior third, and on the hind margin a ctenidium of about eighteen spines. Meso- and metanotum with two rows of bristles each, the posterior row having about ten bristles. Metanotum and first three abdominal tergites each with a small tooth on either side of hind margin. Metathoracic epiphysis with four bristles, two large and two small. Abdominal tergites each with two rows of bristles, the posterior of about fourteen larger ones, the anterior of fewer and smaller bristles. Middle abdominal sternites each with a row of eight long, strong bristles. The last few sternites are provided with second rows of smaller bristles. The antepygidial bristles are very strong and three in number on either side, the longer middle one in each group extending beyond the pygidium.

Beneath the pygidium on either side stand three bristles in a perpendicular row. The vestiture of the end of the abdomen is rather heavy. Style somewhat more than twice longer than wide at base and narrowing to a point where there is a long apical bristle. Back of apex below is inserted another smaller bristle. The substylar flap is obtuse, with two long bristles near the apex and four or five short, stout ones on the lower margin. The lower lateral portion of the eighth segment bears a number of normal bristles and also about seven short, stout, dark-colored bristles which are almost spines, in this latter respect differing widely from any nearly related species.

Hind coxæ without minute teeth inside. Hind femora with one minute bristle on the side, and the lower thin margin, which usually occurs only near apex, is in this case extended to the base. Apical spines on second joint of hind tarsi all shorter than third joint. First pair of spines on the fifth tarsal joint strongly dislocated toward middle and turned straight distad. Length of hind tarsal joints in the proportion 19–13–8–5–7.

Length, 2.6 mm. Color, clear brown.

Type.—Cat. No. 6909, U.S.N.M.

CERATOPHYLLUS WICKHAMI Baker.

Plate XXVI, figs. 1–7.

Later studies have convinced me that the three squirrel fleas which were described by me in the "Preliminary Studies" are one and the same. They were separated on characters, the value of which, at that early stage in the work and without precedent to follow, was impossible to correctly estimate. The above name, having priority over the others, is the one to be used. This name was originally applied to specimens taken from *Sciuropterus volans* at Iowa City, Iowa, by Mr. H. F. Wickham. There are now in the collection specimens from fox squirrel taken in Indian Territory (W. W. Cooke); from gray squirrel taken in Santa Cruz County, California (Edward Ehrhorn); from *Progne subis* at Wellesley, Massachusetts (A. P. Morse—and this occurrence unquestionably accidental); from *Peromyscus* at Franconia, New Hampshire (Mrs. A. T. Slosson), and from *Arctomys monax* at Newport, Herkimer County, New York (D. B. Young).

A very conspicuous and constant character is found in the armature of the upper claspers of the male. The four black teeth occurring there are thoroughly diagnostic. Other details not given in the original description may be had from the synopsis and figures.

CERATOPHYLLUS SEXDENTATUS, new species.

Plate XXVI, figs. 8–14.

A species very close to *wickhami*, and yet conspicuously distinct, is sent from Boulder Creek, California, where it was taken from *Neotoma* by Mr. Edward Ehrhorn. Mr. Ehrhorn tells me of finding with this a species of great size, but I have not seen it.

Female: Upper margin of head rapidly sloping forward from occiput, but rather strongly rounded in front. Frontal notch very inconspicuous. Lower row of genal bristles consisting of three, the middle smaller; the upper row of three or four small bristles is very oblique and not extended farther cephalad than above middle bristle of lower row. Several minute hairs occur above the rather small ovate eye. Antennal groove extending to two-thirds the depth of the head, the

prominent hind margin with a very few minute hairs. The second antennal joint with about seven bristles, which extend beyond the third joint. Behind the middle of antennal groove there are two small bristles—the usual large, stout bristle absent. Hind margin of head with the usual bristles, except that at lower angles there are two stouter ones, the lower smaller. Labial palpi nearly equaling the anterior coxæ.

Pronotum with a transverse row of ten or twelve bristles on the posterior third, the hind margin with a ctenidium of about twenty stout spines. The posterior row of bristles on meso and metanotum of ten rather long ones, the anterior row of more numerous and smaller ones. Hind margin of metanotum and first, second, and third abdominal tergites with a small tooth on either side. Metathoracic epiphysis with two large bristles near the hind margin, two smaller anterior to these, and two still smaller in front of these last. Middle tergites of abdomen each with twelve or fourteen larger bristles in the posterior row, fewer smaller ones in the anterior row. Antepygidia bristles three on each side, the middle one of each group largest, and reaching over pygidium, the inner smallest. Middle abdominal sternites each with a row of about eight stout bristles; posteriorly the sternites have a second row of few bristles. Beneath the pygidium laterally occur three large bristles. Hind margin of eighth segment laterally with about six strong bristles around the lower angle.

The style is about two times as long as wide at base, gradually narrowed to the tip, where there is a long bristle; another bristle occurs on lower margin just back of tip. Substylar flap obtuse at tip, near which are two long bristles, the lower margin with four or five short, stout bristles.

Hind coxæ without minute teeth inside. Hind femora with but one minute bristle on side. Apical bristles on second joint of hind tarsi shorter than third joint. First pair of spines on last tarsal joint strongly dislocated toward median line and directed straight distad. Lengths of hind tarsal joints in the following proportions: 21.5–12–8.5–5–8.

Length, 2.75 mm. Color, clear brown.

Male: Head flattened above as usual. Front strongly rounded above. Antennal groove reaching the top of the head. Upper row of bristles on genæ with about six small ones; the upper three or four on margin of antennal groove. Hind margin of head with but one large bristle at lower angle. Antepygidial bristles, two on each side, the normal inner one being reduced to a hair; the inner bristle in each group is very long, extending over pygidium, the outer about half as long. Hind margin of eighth segment laterally with but two strong bristles and a few small ones.

Lateral portion of ninth tergite with the lobe large and thumb-shaped, nearly equaling the claspers, and scarcely dilated where stand the usual two bristles over insertion of claspers. The upper clasper is a large, subtriangular stalked sclerite with the inner edge vertica and the angles rounded. The sloping hind margin is armed with six short, stout, black teeth, five below on the dilated portion and one above, where there are also three bristles on the margin. The lower claspers also each bear a single, stout, black, deflected tooth.

Length, 2.25 mm.

Type.—Cat. No. 6910, U.S.N.M.

CERATOPHYLLUS WAGNERI, new species.

Plate XV, figs. 3–7.

Two specimens of this unusually distinct species were collected by Professor Aldrich at Moscow, Idaho. Both were males, one coming from the white-footed mouse (*Peromyscus leucopus*), and one from the house mouse. This last is one of very few records for fleas on house mice or rats in America. But it is entirely different from any European species occurring on this animal.

The head is flattened above in the usual manner. The front is very roundly curved to the mouth, the frontal notch very distinct and rather high on the front. Gena with two oblique rows of bristles, the lower row of three, with the two outer quite heavy, the upper row of five or six considerably smaller. Gena below eye narrowed posteriorly to an obtuse point. The rather narrow antennal groove, reaching nearly to the upper margin of the head, with which it is connected by a chitinous thickening. Hind margin of antennal groove lined with about twenty small, short hairs. Back of antennal groove on disk of vertex there are three bristles, one large, and two smaller. Hind margin of head with the normal bristles, about ten smaller with the usual larger ones at lower angles. Labial palpi equaling anterior trochanters.

Pronotum with a transverse row of about twelve good-sized bristles, those at lateral angles far larger; on the hind margin occurs a ctenidium of eighteen stout spines. Meso- and metanotum each with two transverse rows of bristles, the posterior row with eight to ten larger ones. Metathoracic epiphysis with three rows of two bristles each. Abdominal tergites each with two rows of bristles, the larger rows with twelve to fourteen bristles each. Hind margin of metanotum with two small teeth on each side, first tergite with two on each side, and second and third tergites with one on each side. Only one well-developed antepygidial bristle occurs on each side, the other two being abortive. Abdominal sternites with two bristles only, on each side.

Lateral portion of ninth tergite with a thumb-shaped lobe, and the usual two bristles over insertion of claspers. The claspers are slender

above and round tipped, but suddenly and broadly dilated backward, below. On the hind margin of this dilation are three stout, black teeth, the two upper short, the lower of nearly same diameter, but four times as long. The ventral style is long and slender, but armed only with a single short bristle. Eighth tergite laterally with a number of stout bristles, a row of four or five heavier ones in middle of hind margin being especially noteworthy.

Hind coxæ without minute teeth inside. Hind femora with a row of about four bristles along the side. Spines on apex of second joint of hind tarsi shorter than third joint. Fifth tarsal joint with the first pair of spines dislocated toward median line, though not strongly so. Length of joints of hind tarsi in the proportions: 23–16.5–9–5–9.

Length, 2.2 mm. Color, pale brown.

Type.—Cat. No. 6911, U.S.N.M.

CERATOPHYLLUS ASIO, new species.

From Prof. A. P. Morse comes a single female specimen taken at Wellesley, Massachusetts, on *Megascops asio*. There can be little doubt that this occurrence is accidental and that the species is normally parasitic on some small rodent of that region. But so far this specimen is the only representative seen of a very distinct species.

Head rather strongly rounded from occiput to the distinct apical notch. Of the three stout bristles in the lower row in the gena the first and second are nearly equal in size and smaller than that on lower margin of head. The upper row of six small bristles extends from lower margin of head to high on antennal groove. Gena below eye rather acute posteriorly. Antennal groove extending to two-thirds depth of head, strongly narrowed below, the hind margin with numerous minute bristles especially near the lower angle. First antennal joint with two transverse rows of minute hairs, second with about five bristles which nearly equal the third joint. Back of the middle of antennal groove occurs one large bristle, and back and above this are about six smaller bristles; this arrangement alone clearly distinguishing this species from others nearly related. The bristles on hind margin of head are unusually strong. There are two at lateral angle, the lower smaller.

On the body all the bristles near the median dorsal line are unusually long and stout. Pronotum with two transverse rows of bristles, the one on posterior third of about twelve larger bristles, the anterior of fewer and smaller ones. The hind margin of pronotum with a ctenidium of about twenty stout spines. The meso and metanotum each have three rows of bristles, the posterior row of about twelve larger bristles, the second row about the same number of small bristles, and the third row with still fewer and smaller bristles. Metathoracic epiphysis with two heavy bristles on hind margin, two smaller anterior

to these, and a third row of three. Abdominal tergites each with two transverse rows of bristles, the posterior of sixteen or eighteen larger ones, the anterior of fewer and smaller bristles. Metanotum and first four abdominal tergites each with a small tooth on either side. Antepygidial spines three on each side, the middle one of each group scarcely extending over pygidium. Beneath pygidium on either side stand two short bristles. Hind margin of lateral portion of eighth segment with two stout bristles and anterior to these two smaller ones.

Style twice longer than wide at the somewhat swollen base, narrowing to a tip, where there is a long bristle; back of tip there is a bristle on upper margin and also one on lower margin.

Hind coxa without minute teeth on inner surface. Hind femur with one small bristle on side. Apical spines on second hind tarsal joint shorter than third joint. First pair of spines on last hind tarsal joint inserted nearly in a line with the others, but somewhat bent inward. Lengths of mid tarsal joints in the proportions 16–13–7.5–5–11.

Length, 3.25 mm. Color, clear brown.

Type.—Cat. No. 6912, U.S.N.M.

CERATOPHYLLUS CANADENSIS, new species.

Plate XX, figs. 1–4.

Several years ago Dr. J. Fletcher sent me a single female specimen from Ottawa, Canada, which could not be placed with any described species. I was loath to describe it at that time, not having made special studies of the female sexual characters, and especially because the host was not given. It is characterized here in the hope that the host will soon be determined and the male found.

Head rapidly roundly sloping from occiput to frontal notch, which is rather low down on the front. Eye large, nearly elliptical in outline. Gena with a lower row of three stout bristles, the middle smallest; the second row is represented by two small bristles in a line above upper bristle of lower row. Gena below eye obtusely pointed posteriorly. Antennal groove reaching two-thirds the depth of the head, rather strongly narrowed below, with a number of scattering minute hairs along the posterior margin. The bristles on second antennal joint are about five in number and nearly equal third joint. On disk of vertex back of antennal groove stands one stout bristle. Hind margin of head with the usual bristles, but with a single stout one at lower angle. Labial palpi nearly equaling anterior trochanters.

Pronotum with a transverse row of about twelve bristles on posterior third, the hind margin with a ctenidium of about twenty stout spines. Meso- and metanotum each with two distinct rows of bristles and some scattering small bristles in front of these; the posterior row contains about twelve larger bristles, the next more and smaller ones. Metanotum with two small teeth on either side of hind margin, the

first abdominal tergite with one, second with two, and third with one, on either side. Abdominal tergites each with two transverse rows of bristles, the posterior row of about fourteen stouter, the anterior of fewer and much smaller, while still in front of these latter may be found a few scattering bristles. Abdominal sternites each with about five bristles on either side. Antepygidial bristles three on each side, the middle one of each set longest, reaching over pygidium, the inner smallest. Below the pygidium laterally are two stout bristles. Hind margin of eighth segment laterally narrowly rounded and lined by about eight stout bristles.

Style stout, twice longer than wide at base, narrowing to the apex where there is a long bristle; proximad of apical bristle on under side is a smaller bristle. Substylar flap obtusely pointed, with some long bristles near the tip and a brush of shorter stouter ones on the lower margin.

Hind coxæ without minute teeth on the side. Hind femur with a longitudinal row of five or six small bristles on the side. Apical spines on second joint of hind tarsi shorter than the third joint. Third hind tarsal joint with but two groups of spines on each side. Fifth hind tarsal joint with first pair of spines inserted nearly in a line with the others, but bent inward. Joints of hind tarsi slender, their lengths in the proportion 22–14.5–9.5–5–9.

Length, 3 mm. Color, clear brown.

Type.—Cat. No. 6913, U.S.N.M.

CERATOPHYLLUS VISON, new species.

Mr. Gerrit S. Miller jr., took this species on *Putorius vison* at Peterboro, New York. Prof. F. L. Harvey also found one specimen of it at Orono, Maine, on *Sciurus hudsonicus*. It is closely related to other squirrel fleas, but a greater number of specimens were taken from *Putorius*. In this, as in some other cases, only a number of observations will determine the normal host. The specimens from *Putorius* furnish the types.

Female: Upper margin of head evenly rounded from occiput to frontal notch, which is rather low down on the front. The middle bristle in the lower row of three on gena is nearly as stout and long as the upper one. The upper oblique row of five small bristles extends from the margin of antennal groove to the lower margin of the head. A few minute hairs occur above the oval eye, which is of medium size and rather low down in the head. Gena below eye suddenly narrowed posteriorly from the rather broad portion immediately below eye to a somewhat acute point. Antennal groove extending to two-thirds the depth of the head, and but slightly narrowed below, its hind margin prominent and with scattering minute hairs. The first antennal joint with several transverse rows of minute hairs; the

five or six bristles on second antennal joint shorter than third joint. Disk of vertex back of middle of antennal groove with one large, stout bristle and two small ones. Hind margin of head with the usual bristles, a small supernumerary bristle occurring just below the large one at each lower angle. Labial palpi extending to one-fourth of anterior femora.

Pronotum with a transverse row of about twelve unusually stout bristles on posterior third and on hind margin a ctenidium of about twenty stout spines. Meso- and metanotum each with two rows of bristles on posterior half, the posterior row of about ten larger bristles, the anterior of a somewhat greater number of smaller ones. Metanotum and first three abdominal tergites each with a small tooth on either side of hind margin. Metathoracic epiphysis with one bristle on hind margin; anterior to this a row containing one large and two smaller ones; still anterior to this row occur two small bristles. Abdominal tergites each with two rows of bristles, the posterior row of about fourteen larger ones, the anterior of fewer and smaller ones. Middle sternites each with four bristles on either side. Antepygidial spines three on each side, the middle one of each group extending to the end of the pygidium, the inner and outer scarcely half the length of the middle one. Beneath the pygidium on either side occur two large bristles and one small one. The hind margin of eighth segment laterally is lined with about six large bristles.

Style stout, the length not twice the width at base, rapidly narrowing to the apex where there is a long bristle; proximad of the apical bristle there is another on the upper margin and also one on the lower margin. Substylar flap obtuse, with two stout bristles near the apex, and four or five short, stout ones on the lower surface.

Hind coxæ without minute teeth on inner surface. Hind femur with two small bristles on the side. Apical spines on second hind tarsal joint shorter than the third joint. The third joint of hind tarsi has three groups of spines on either side. First pair of spines on fifth joint of hind tarsi inserted on a line with the others, but bent inward. Lengths of hind tarsal joints in the proportion 25–15–10–5–10.5. Length, 3.25 mm. Color, clear brown.

Male: Head flattened above as usual, the front gently rounded. Antepygidial spines with the central one of each group as in the female, but the inner and outer aborted. On the sides the eighth segment is obtusely extended posteriorly, the upper margin of this portion with about five stout bristles, none on the lower margin, but a number on the disk. Lateral portion of ninth tergite with a slender thumb-shaped lobe, which is twice longer than wide, the two bristles over insertion of claspers standing very close together.

The upper claspers are large, subrectangular above the thick pedicel, the rectangular portion about twice longer than wide and twice the

length of the lobe of the ninth tergite. The upper posterior angle of claspers is rounded and with two slender bristles; below this angle stands a short, stout, dark-colored, downward-curved bristle, while another like it also occurs at the roundly, slightly extended lower angle. Length, 2.5 mm.

Type.—Cat. No. 6914, U.S.N.M.

CERATOPHYLLUS LUCIDUS, new species.

Plate XX, figs. 5–9.

While camped near Pagosa Peak, in southern Colorado, during 1899, at an elevation of about 9,000 feet, I found that the little spruce squirrels so abundant there were commonly infested with a flea which differs from any of the other squirrel fleas, though closely related to *vison*.

Female: Margin of head above strongly and evenly rounded from occiput to mouth. The frontal notch is inconspicuous. Of the bristles in the lower row on gena the middle one is smallest. The upper row consists of about five bristles, and extends from the antennal groove to the lower margin of the head. Gena below eye broadly subtruncate posteriorly. Above the strongly ovate eye are a few minute hairs. The antennal groove extends to two-thirds the depth of the head, and is somewhat narrowed below, the hind margin with a very few minute hairs above and below. First antennal joint with a few short hairs near the apex, the second joint having about five bristles, which are shorter than third joint. On the disk of the vertex back of the middle of the antennal groove occurs one stout bristle and two smaller ones. Hind margin of head with the usual bristles, and also with a small supernumerary bristle beneath the large one at each lower angle. Labial palpi equaling or a little exceeding the anterior trochanters.

Pronotum with a transverse row of about ten bristles on the posterior third, and on the hind margin a ctenidium of about sixteen stout spines. Meso- and metanotum posteriorly each with a row of about ten stronger bristles, anterior to which is a row of fewer smaller bristles. Metathoracic epiphysis with one large bristle on the hind margin, one large and two small bristles in front of this, and two still smaller in front of the latter. Metanotum and first three abdominal sternites each with a small tooth on either side of hind margin. Middle abdominal tergites each with a row of about twelve larger bristles, and anterior to this a row of fewer smaller bristles. Sternites each with a row of six to ten bristles. Antepygidial bristles three on each side, the central one in each group about twice longer than the others, but scarcely projecting beyond the pygidium. Below the pygidium on each side occur two bristles.

Style short and stout, not twice longer than wide at base, narrowing to the apex, where there is a long bristle; proximad of the apical bristle occurs one on upper and another on lower margin.

Hind coxa without minute teeth inside. Hind femur with one minute bristle on side. Spines on apex of second hind tarsal joint shorter than third joint. Third joint of hind tarsi with two groups of spines on either margin. First pair of spines on last joint of hind tarsi inserted on a line with the others, but somewhat bent inward. Length of hind tarsal joints in the proportions 20–13–8–5–9.

Length, 3 mm. Color, dark, almost blackish, brown.

Male: Head flattened above as usual. The genital organs are very similar in structure to those of *vison*. Length, 2.25 mm.

Type.—Cat. No. 6915, U.S.N.M.

CERATOPHYLLUS MONTANUS Baker.

Plate XXII, figs. 7–8, and Plate XXIII, figs. 1–5.

Originally taken from the gray squirrel in the northern Colorado mountains; this species has since been found in southern Colorado and in Arizona. In southern Colorado, at Arboles, I found it abundant on Rock Squirrel, and in Arizona, Hubbard collected a series on Rock Squirrel in the Santa Rita Mountains. In addition to the original description, further details are indicated in the accompanying figures and synopsis.

CERATOPHYLLUS ARCTOMYS, new species.

Plate XXII, figs. 1–6.

At Peterboro, New York, Mr. Gerrit S. Miller, jr., of the U. S. National Museum, has collected a large and distinct species, on *Arctomys monax*, which is related to *montanus*, possessing like it the greatly elongated mouthparts, but differing in the much greater size and various details.

Female: Head with a rather broadly evenly rounded outline above, the frontal notch distinct. The gena with two oblique rows of bristles—three in each. A few minute hairs occur above the small oval eye. Gena below eye truncate posteriorly. Bristles on second joint of antennæ exceeding third joint. Hind margin of antennal groove lined with a number of small hairs. On disk of vertex, back of middle of antennal groove, stands a single large stout bristle. Hind margin of head with two or three bristles above; somewhat above lower angle occurs a large, long bristle, beneath which stands one or two small supernumerary bristles. The labial palpi extend nearly to end of anterior femora.

Pronotum with a transverse row of about fourteen bristles on posterior third and on hind margin a ctenidium of eighteen or twenty stout spines. The anterior row of bristles on meso- and metanotum contains about ten small bristles; on mesonotum posteriorly there is a row of about twelve larger bristles, and on metanotum a row of sixteen. On the hind margin of the metathoracic epiphysis stands one large

bristle, anterior to this a second large one, and still anterior to the second two smaller ones. The hind margin of metanotum and first four abdominal tergites each with two small teeth on either side. The rows of larger bristles on abdominal tergites number about as follows: I—14, II—24, III—22, IV—16, V—18, VI—20, VII—18. Antepygidial bristles, three on each side, the central one in each group extending beyond pygidium; the outer in each group five-sixths as long as the central, the inner slightly more than a third as long. Posterior rows of bristles on abdominal sternites with from eight to sixteen bristles; an anterior row is represented by one or two median bristles. The end of the abdomen is very bristly. Beneath the pygidium on either side stand four stout bristles. The tenth tergite is unusually well covered with medium sized and small bristles.

The style is short and unusually stout, not twice longer than broad, thickest at middle, but little narrowed at the tip, where there is a long bristle; back of the apical are several shorter bristles. The substylar flap is almost hidden in long strong bristles, and the lateral portion of eighth segment bears many.

The hind coxæ are without minute teeth on the inside. The hind femur has a row of about twelve strong bristles on the side. A bristle on either side of apex of second joint of hind tarsi extends beyond third joint. The spines on fifth tarsal joint are arranged in the typical *Ceratophyllus* manner.

Length, 3.75–4 mm. Color, clear brown.

Male: Head flattened above in the usual manner. Antennal groove reaching upper margin of head. But one long bristle occurs in the antepygidial groups, the other two being aborted. Hind margin of eighth segment above with about eight stout spines, and in front of these are scattered a number others of equal size. Lateral portion of ninth segment with its lobe short, thick at base, and rapidly tapered above to an obtuse point. Apparently only one bristle occurs over the insertion of the claspers. Upper claspers with a stout pedicel, the limb rather large, somewhat reversed thumb-shaped, the rounded hind margin with about five small bristles. The ventral style is long and dilated toward the tip, where there are two long bristles, the lower margin bearing a row of several smaller bristles.

Length, 2.75 mm.

Type.—Cat. No. 6916, U.S.N.M.

CERATOPHYLLUS PROXIMUS, new species.

Plate XIX, figs. 1–5.

From southern California come only females of another spermophile flea, which differ in various characters from any spermophile flea previously examined. Mr. H. G. Hubbard collected it at Palm Springs.

Female: Head normally rounded from occiput to mouth, with a dis-

tinct frontal notch. Gena with the normal lower row of three bristles, the middle one of the row weakest, the upper row represented by one bristle near the margin. No minute hairs occur above the eye. Gena below eye obliquely truncated posteriorly. Hind margin of antennal groove with a very few small hairs. Hind margin of head with the usual bristles, and one on the disk of the vertex behind the middle of the antennal groove. Labial palpi reaching beyond the middle of the anterior femora.

Pronotum with a transverse row of about ten bristles and a ctenidium of sixteen stout spines. Meso- and metanotum with two rows of bristles each, the principal row, in both cases, composed of about twelve bristles. Hind margin of metanotum with four small dark-colored teeth. Abdominal tergites each with two rows of bristles, the principal row of fourteen to sixteen bristles. Antepygidial bristles three on each side, two larger of nearly equal length, and one smaller near the median line in each group. Hind margins of first and second abdominal tergites with a single small dark tooth on each side. Abdominal sternites each with six or seven bristles on either side, the seventh and eighth only with two rows. Just beneath the pygidium on either side are two stout bristles. Tenth tergite with scattering small bristles, which are larger toward the tip.

Style rather short, swollen toward the base and narrowed to the tip, where there is one long bristle, back of which are two small bristles, one above and one below. Substylar flaps thickly bristled, the longest bristles being apical.

Hind coxæ without minute teeth within. Hind femur with a row of four or five bristles on the side. One of the apical spines on joint ii of hind tarsi extends to one-half of fifth joint. The last tarsal joint has five spines on either margin, but the first pair are slightly bent inward. Lengths of hind tarsal joints in the proportion 24–10–7–5–9.

Length, 2.5 mm. Color, clear brown.

Type.—Cat. No. 6917, U.S.N.M.

CERATOPHYLLUS BRUNERI Baker.

Plate XXV, figs. 1–5.

This species was originally described from *Citellus 13-lineatus* and *C. franklini*. We have no new records to add, as some of the supposedly new records have turned out to refer to different species. Additional structural details may be made out from the figures and synopsis.

CERATOPHYLLUS IDAHOENSIS, new species.

Plate XVIII, figs. 1–6.

Four specimens which Professor Aldrich took on *Citellus columbianus* at Moscow, Idaho, represent two perfectly distinct species,

and fortunately a male and a female of each. The smaller (*tuberculatus*) has been described (p. 393); the other is a larger species, lacking the frontal tubercle and differing in various other details.

Female: Head broadly rounded from occiput to frontal notch, which is minute and inconspicuous. The lower row of genal bristles with three members, the middle a little higher than the others and much smaller. The upper row is represented by one rather small bristle on the margin. The gena, below the eye, is posteriorly broad and truncate. Antennal groove with a number of small rather stout hairs on the hind margin. The second joint of antenna with about ten bristles, which extend beyond third joint. The hind margin of the head has two or three bristles above and the usual stout one on either side below. One spine occurs on the disk of the vertex behind the middle of the antennal groove. The mandibles extend to one-third of the anterior femora.

The thoracic tergites each have a transverse row of about twelve stout bristles and one distinct row of smaller ones. The pronotum has the usual long spine on each lateral angle and on the hind margin a ctenidium of about twenty stout black spines. The bristles on the abdomen are all unusually long and stout. Most of the tergites have about eighteen bristles in the principal row, and sixteen to twenty in the smaller row. The metanotum and first two tergites each with two small teeth on either side of hind margin. Antepygidial bristles three on each side, the inner in each group shortest, the middle longest, though not exceeding pygidium. Most of the sternites have a principal row of about twelve stout bristles, and four or six bristles in a second row. Beneath the pygidium on either side there are four large bristles, the two outer shorter. The eighth segment on either side below with about three rows of four bristles each.

Style slightly swollen below and narrowed to the apex, where there is a long, stout bristle, below which is a shorter one; behind the apical bristle is a transverse row of still shorter ones. Substylar flap with several longer bristles at the tip and a dense brush of short bristles on the lower margin.

Hind coxæ without minute teeth inside. Hind femur with a longitudinal row of about nine minute bristles on the side. A spine on the apex of second joint of hind tarsi equals joint III and IV together. Spines on under side of fifth tarsal joint similarly placed in rows of five on either margin. Lengths of hind tarsal joints in the proportion 19–11–8–5–9. Length 3.5 mm.

Male: Head flattened and thickened above in the usual manner. Middle bristle in lower row on gena longer than in female. Two bristles occur in upper row, the first above the first of the lower row. The bristles on the hind margin of the antennal groove are larger and fewer than in female. Only one large antepygidial bristle occurs on either

side, and this extends to the apex of the abdomen; the other two bristles normally occurring in each group are here reduced to minute hairs. The eighth segment on either side bears about three rows of four or five stout bristles each. Lateral portion of ninth tergite with the apical lobe short, very much broadened at base, and with a few weak hairs at tip. The upper claspers resemble those of *tuberculatus*. The ventral style has several very long, rather stout bristles.

Length, 2.5 mm. Color, clear brown.

Type.—Cat. No. 6918, U.S.N.M.

CERATOPHYLLUS ARIZONENSIS Baker.

Plate XXIII, fig. 6, and Plate XXIV, figs. 8–12.

This species was based on a single male specimen taken by Mr. Hubbard from the nest of *Neotoma albigula* at Tucson, Arizona. Additional structural details are brought out in the figures and synopsis.

CERATOPHYLLUS PETIOLATUS, new species.

Plate XVIII, figs. 7–11.

This is one of several peculiar things which Professor Aldrich found on *Lynx canadensis* at Moscow, Idaho, though its occurrence on that host is undoubtedly wholly fortuitous. It but still more emphatically indicates the great need of a careful collection of the species normal to the many small rodents. This species is closely related to *Arizonensis*. It is represented in the collection by one male specimen. I at first took it to be the male of *tuberculatus*, but the far greater length of labial palpi and mandibles in the latter species, together with other minor differences not considered sexual, make such a reference impossible.

Head flattened above as usual. The frontal notch is prominent, somewhat as in *tuberculatus*. Gena with a normal lower row of three bristles, the upper row represented by one bristle on the lower margin of head and one near the antennal groove. Gena below the eye obtusely pointed posteriorly. Antennal groove nearly reaching the upper margin of the head, its hind margin with a scattering row of minute bristles slightly back from the edge. Second joint of antennæ with seven or eight bristles which are nearly as long as the third joint. On the disk of the vertex back of the middle of the antennal groove there is one stout bristle. On the hind margin of the head occur the usual bristles, with one long, stout one at each lower angle. The labial palpi extend to the end of the anterior coxæ.

The pronotum has a transverse row of about fourteen bristles on the posterior third and on the hind margin a ctenidium of about twenty stout spines. The meso- and metanotum each have two rows of bristles, the posterior row in each case of twelve or fourteen stouter

bristles. The metathoracic epiphysis has one bristle at the posterior angle and two others in front of this; still anterior to the latter and somewhat above occur three more. Hind margins of metanotum and first and second abdominal tergites each with two small teeth on either side; the third tergite has one on either side. The middle abdominal tergites each with about twenty larger bristles in the posterior row, fewer smaller ones in the anterior row. But one long antepygidial bristle occurs on either side, the others being aborted. Lateral portions of eighth segment with numerous bristles in two thick-set lots near the hind margin, the upper lot of about sixteen smaller bristles, the lower lot of about twenty larger, longer ones.

Lateral portion of ninth tergite very large, the lobe very large, scarcely narrowed toward tip, and extending as far dorsad as do the claspers. The two bristles over the insertion of the claspers are rather far up on the margin and somewhat separated. The upper claspers are long and narrow; inner margin nearly straight, the outer rounded and with four bristles. Above, the claspers are squarely truncate across the tip and obliquely so toward the hind margin.

Hind coxa without minute teeth inside. The hind femur has a longitudinal row of about ten small hairs on side. First tarsal joint with five groups of spines on either side. Spines on apex of second joint of hind tarsi longer than joints ii and iii together. Spines on fifth tarsal joint arranged after the normal Ceratophyllus manner. Lengths of joints of hind tarsi in the proportions 15–10.5–6–5–6.5.

Length, 2.5 mm. Color, pale brown, darker dorsally.

Type.—Cat. No. 6919, U.S.N.M.

CERATOPHYLLUS IGNOTUS Baker.

Plate XXI, figs. 1–6.

The American mole flea was originally described from specimens taken in Iowa, Colorado, and Idaho, on *Geomys bursarius* and *Thomomys talpoides*, under two names. The eyes are rudimentary. A certain portion of the material with eyes fairly distinct was placed in *Pulex ignotus*. Later, additional material, with the eyes almost entirely wanting pigment, was described as *Typhlopsylla americana*. The former name takes precedence. This but illustrates the impossibility of using the comparative development of the eye as a primary generic character.

CERATOPHYLLUS DIVISUS Baker.

Plate XXI, figs. 7–10.

This was originally described from specimens collected by Professor Bruner on Fremont's Chickaree, in Colorado, as *Pulex longispinus*, which name had, however, been previously used by Wagner.

CERATOPHYLLUS COLORADENSIS Baker.

Plate XXV, figs. 6–9.

This was originally collected with *dirisus*. It is, however, far larger and differs in many characters which can scarcely be secondary sexual characters, judging from experience with many other species. Further collections of both species are great desiderata. A careful comparison of synopsis and drawings will show the conspicuous differences.

CERATOPHYLLUS EREMICUS, new species.

There have been in the collection for some time two female specimens collected from a nest of *Peromyscus eremicus* in the foothills of the Santa Rita Mountains, Arizona, by Mr. H. G. Hubbard. By reason of the greatly elongate first joint of hind tarsi this species is closely related to *coloradensis*, but it possesses a number of very distinctive features.

Upper margin of head a broad, sloping curve from occiput to frontal notch, which is distinct though minute. Lower row of three bristles on gena with the middle bristle scarcely half the length of the others, the upper even with, though somewhat removed from, the small somewhat oblong eye. Superior row also of three bristles, the upper one not near the edge of the antennal groove, the middle one very minute, and the lower much smaller than the upper. Gena below the eye obtusely pointed posteriorly. Antennal groove reaching scarcely two-thirds the depth of the head; the hind margins with a number of minute, irregularly placed hairs. Bristles on second joint of antennæ very small and short, not half the length of the third joint. Disk of vertex back of middle of antennal groove with one large bristle. Hind margin of head with the usual bristles, one large one at each lower angle.

Pronotum with a row of about twelve bristles on the posterior third and on the hind margin a ctenidium of about eighteen stout spines. Meso- and metanotum each with a row of about ten larger bristles, anterior to which are several illy defined rows of very minute bristles. Metathoracic epiphysis with one larger bristle on the posterior border, two in front of this, and three in front of and above the latter. Metanotum and first and third abdominal tergites each with one small tooth on either side, the second tergite having two on either side. The middle abdominal tergites have each a row of about twelve larger bristles, and anterior to this a row of about the same number of smaller ones. Antepygidial bristles, three on each side, the middle in each group longest, the inner shortest. Abdominal sternites each with one row of six bristles, though the sixth and seventh show two or four

minute bristles in the position of the second row. The end of the abdomen is provided with comparatively very few bristles. Beneath the pygidium on either side occurs one long and one short bristle.

The style is very broad at base and rapidly narrowed to the apex, where there is a single bristle, proximad of which on the lower margin stands a smaller bristle. Substylar flap rather long, obtusely pointed, with two long bristles near the tip and about four short, stout bristles on the lower margin. Lateral portion of eighth segment near hind margin with scattering small bristles.

Hind coxæ without minute teeth inside. Hind femur with one small bristle on the side dorsally. First joint of hind tarsi with five groups of spines on the anterior border and six on the posterior. Apical spines on second joint of hind tarsi not exceeding the third joint. First pair of spines on fifth tarsal joint slightly dislocated toward median line and directed straight distad. Lengths of hind tarsal joints in the proportions 28–11–6.5–5–10.

Length, 2.75 mm. Color, pale brown.

Type.—Cat. No. 6920, U.S.N.M.

CERATOPHYLLUS STYLOSUS, new species.

Plate XIV, figs. 1–7, and Plate XV, figs. 1–2.

This species is the largest of the order in America, and of most anomalous structure. It was collected at Astoria, Oregon, on *Aplodontia rufa*, by Dr. A. K. Fisher, of the U. S. Biological Survey. There is no doubt but that in the still further division of this genus which must come this will form a separate genus by itself. Viewed in the broad sense in which these genera are here treated, it may be placed in *Ceratophyllus* temporarily, though in most of its characters it is absolutely unique and stands alone. It has some affinities with *Hystrichopsylla*.

Female: Head evenly, rather strongly rounded from the occiput to the deeply cut frontal notch. Save for a slight thickening in the chitin at the edge of the antennal groove, the eye is totally wanting. The lower row of genal bristles consists of five stout bristles distributed between the margin of the antennal groove and the lower margin of the head. Above this the second oblique row consists of about six much smaller bristles. The lower margin of gena is strongly sinuate, and the posterior prolongation is narrowly rounded or very obtusely pointed. The antennal groove extends to two-thirds the depth of the head, the anterior margin greatly thickened, the posterior margin not sharply defined and covered by a large number of minute hairs. The first antennal joint has three transverse rows of short bristles on outside; the second joint bears about ten bristles which do not extend to half the length of the third. The disk of the vertex back of the middle of the antennal groove with an oblique row of bristles, consisting of one large bristle near the antennal groove and about six

smaller ones, the row extending upward and backward. Hind margin of head with about eighteen bristles, one at each lower angle, and one above this within the lower angle, large and long. Mouth parts large and long, the labial palpi slightly exceeding anterior trochanters.

Pronotum with a transverse row of about twenty small bristles near hind margin, and on hind margin a ctenidium of about thirty stout spines. Meso- and metanotum each with a row of about eighteen larger bristles posteriorly, and anterior to this three more or less clearly defined rows of minute bristles. Metathoracic epiphysis with two bristles on the posterior margin, in front of which is a row of about six, and still in front of the latter a row of about three bristles. First abdominal tergite with two short teeth on either side, second with three, and third with two on either side. Abdominal tergites each with a transverse row of about twenty stronger bristles and an anterior row of fewer and far smaller bristles. Antepygidial bristles four on each side, the two middle of each group longest, but not surpassing the pygidium. Sometimes an extra bristle may occur in one or both groups. Between the two groups of antepygidial bristles, the seventh segment is slightly, medially, angularly produced caudad. Abdominal sternites each with one row of stout bristles (of about twenty-four bristles on each middle sternite), which curves cephalad laterally, and in front of this two very irregular rows of smaller and far fewer bristles.

The end of the abdomen is clothed with rather numerous small bristles, two stouter ones occurring on either side beneath the pygidium. The style is small, twice longer than broad, almost perfectly cylindrical, and with two bristles at the tip. Substylar flap small, with several long bristles at tip and a number of shorter stouter ones on lower margin. Tenth tergite with numerous weak bristles, and hind margin of eighth segment below with numerous bristles.

Hind coxa without minute teeth inside. Hind femur with about two irregular rows of many small bristles on the side. The tibial spines are similar to those of others of the genus, but there are a greater number of bristles on the side of the tibia than occurs in other species. The tarsal joints are not more slender than usual. The first hind tarsal joint with six groups of spines on either margin. The spines on the apex of the second hind tarsal joint shorter than the third joint. First pair of spines on the last tarsal joint somewhat dislocated inward and incurved, though not projecting straight distad. Lengths of hind tarsal joints in the proportions 25–13.5–8.5–5–9.5.

Length, 5.75 mm. Color, clear brown.

Male: Head flattened above in the usual manner. The antennal groove reaches the upper margin of the head. The first abdominal tergite has three teeth on either side of hind margin, the outer on each side quite long; the second tergite has four or five of about equal length on either side; the third has three on either side and the fourth

one or two. Antepygidial bristles three on each side, the middle in each group longest and far exceeding pygidium, the inner shortest. Between the two groups of antepygidial bristles there projects caudad over one-third of pygidium a narrowly triangular median prolongation of the seventh tergite, in which character this species differs from any other known species of the order. The eighth segment is large laterally and subrectangular posteriorly; the hind margin above has numerous medium-sized bristles and below is provided with a brush of numerous long, fine, and soft hairs.

The lateral portion of the ninth tergite bears three bristles over insertion of upper clasper and is extended dorsally into a slightly recurved, rather sharp triangular lobe. Upper claspers very large, obtriangular, the upper margin with a thick-set row of rather numerous, quite uniform bristles.

Length, 5.5 mm.

Type.—Cat. No. 6921, U.S.N.M.

Genus CTENOPHTHALMUS Kolenati.

1857. *Ctenophthalmus* Kolenati, Die Parasiten der Chiropteren, p. 33.
1863. *Ctenophthalmus* Kolenati, Horæ Ent. Soc. Ross., II, p. 35.

This genus differs from *Ceratophyllus* in very much the same way that *Ctenocephalus* does from *Pulex*—by the possession of ctenidia on the genæ. As has been noted under *Ceratophyllus*, the characters indicated by Wagner can not be used for the division of the American species. As known at present, the genus is not well represented in America, though any generalizations of this sort are premature, owing to the very desultory character of the collecting which has been done. Doubtless many other species will be found infesting our moles and shrews.

SYNOPSIS OF AMERICAN SPECIES.

a. Head ctenidia of one tooth on either side; size large ..... *gigas* (p. 421).
aa. Head ctenidia of three to five teeth on either side; size small.
  b. Spines of head ctenidia in longitudinal rows on lower margins of genæ, three on each side; the last joint of the hind tarsi with only three well-developed spines on either margin ..... *pseudagyrtes* (p. 421).
  bb. Spines of head ctenidia in vertical rows on hind margins of genæ, four or five on each side; the last joint of hind tarsi with four well-developed spines on either side, at least in *fraternus* and *genalis*.
    c. Spines of head ctenidia very similar in shape; pronotal ctenidium of twenty to twenty-two spines.
      d. Head ctenidia each of four spines; head evenly rounded in front; antennal grooves connected by a furrow over top of head (male); front with a marginal row of six bristles on each side ..... *intermedius* (p. 423).
      dd. Head ctenidia each of five spines; head angulate in front; antennal grooves not connected by a furrow over top of head (male); front without marginal bristles ..... *fraternus* (p. 423).
    cc. Spines of head ctenidia very dissimilar in shape; pronotal ctenidium of about twenty-eight spines ..... *genalis* (p. 424).

CTENOPHTHALMUS GIGAS (Kirby).

The attempt to employ this name, based as it was on an unrecognizable description, was perhaps unwise. At the time it was done some Canadian and Northern United States fleas were in the collection, and this was the only one which at all fitted the original description as to size. It was collected by myself at Agricultural College, Michigan, on *Lepus*. Later, two northern species of *Hystrichopsylla* came to hand, either of which might have been referred to under this name with equal propriety, so far as the description is concerned. Only an examination of the type can settle the matter, and this may still be in existence in the British Museum. In the meantime the matter will be allowed to stand just as it is in order to avoid any additional confusion. In addition to the characters given in the first description, the following may be noted:

Female: The upper and lower rows of genal bristles are continued obliquely on to the vertex in the manner so characteristic of this genus—on the vertex about six bristles occurring above and about eight below. A pigmented eye is wholly wanting. Hind margin of antennal groove with a single row of small hairs.

The pronotum has two rows of bristles, and the meso- and metanotum three or four each. The first and second abdominal tergites each have two small teeth on either side, and the third one on either side. End of abdomen very heavily bristled. Antepygidial bristles three on each side and very large, the middle one in each set longest.

Style long and slender, about three times as long as wide at base, nearly cylindrical, with a long bristle at apex, and just back of this two minute ones. The fourth pair of spines on last joint of hind tarsi are aborted, so that there are only four pairs of well-developed spines, as in *Pulex*.

CTENOPHTHALMUS PSEUDAGYRTES, new species.

Plate XI, figs. 7–12.

Although in the Preliminary Studies this species was referred to a varietal form of *assimilis*, yet later it became a very doubtful reference. The appearance of Rothschild's study of the European *agyrtes* confirmed the suspicions as to its distinctness. It differs from *agyrtes* more especially in the armature of the first joint of the hind tarsi and in the genitalia. Specimens are now in the collection from *Geomys bursarius* at Agricultural College, Michigan (Baker), from *Scalops argentatus* at Ames, Iowa (Osborn), from nest of field mouse at Ithaca, New York (MacGillivray), and from *Megascops asio* at Wellesley, Massachusetts (Morse). The last-mentioned occurrence is to be considered as wholly accidental. The Michigan specimens are taken as types.

Female: Head broadly evenly rounded from occiput to mouth. The frontal notch is distinct by reason of a thickening of the chitinous crust at this point. Gena with an upper row of about five bristles (uppermost largest), a middle row of three larger ones, and a row of three heavy dark-colored ctenidial teeth on lower margin. The eye is represented by a scarcely pigmented thickening of the chitin on the margin of the antennal groove. The antennal groove extends to three-fourths the depth of the head and is connected with that on opposite side, across the top of the head, by a fine groove flanked with chitinous thickenings. The lower row of bristles on the vertex is represented by one large bristle back of the middle of the antennal groove; the upper row consists of four strong bristles standing in a slightly oblique line. Antennal groove strongly narrowed below, its hind margin near the lower edge of the head covered by a patch of numerous minute bristles. Labial palpi reaching to three-fourths of anterior coxæ.

Pronotum with a row of about fourteen bristles on posterior third, and on hind margin a ctenidium of about fourteen long stout spines. Meso- and metanotum each with three rows of bristles, the posterior of about twelve large bristles, the next of fewer and smaller bristles. Metathoracic scale with two vertical rows of three bristles each. First, second, and third abdominal tergites each with a small tooth on either side of hind margin. Abdominal tergites each with two distinct rows of bristles, and anteriorly a third row represented by a few bristles; there are about twelve larger bristles in the posterior row on middle tergites, varying to four in this row on the eighth tergite. Antepygidial bristles three on each side, the middle in each group longest, the inner shortest. Middle abdominal sternites each with about ten bristles in the principal row, in front of which are scattered remnants of two other rows, one to three bristles each.

The end of the abdomen is only moderately bristled. No stout bristles occur on either side just below pygidium. The tenth tergite dorsally bears numerous small bristles. The style is two and a half times as long as broad at base, and narrowed to the slender tip, where there is a long bristle. The substylar flap has two long bristles near the apex and a few short stout ones on the lower margin. The eighth segment possesses a number of bristles below.

Hind coxa without minute teeth on inside. Hind femur without minute hairs on side. The first joint of hind tarsi has six sets of spines on anterior margin and five sets on posterior margin. One spine on apex of joint II of hind tarsi somewhat exceeding joint III. First pair of spines on fifth tarsal joint strongly dislocated toward median line and directed straight distad; the fourth pair are aborted, occurring as fine hairs only. Length of hind tarsal joints in the proportions 18.5–13.5–8.5–5–8.5.

Length, 3 mm. Color, pale brown.

Male: Head flattened above or even a little depressed. Upper row of bristles on vertex dislocated at middle, two bristles being lower than the other two. The inner and outer spines in each group of antepygidial bristles are considerably smaller than the middle one, though not reduced to hairs.

Lateral portion of ninth tergite two-lobed, the upper lobe very short and bluntly rounded and with three long bristles on the posterior margin; lower lobe as in *agyrtes*, with one bristle over the insertion of the claspers. Upper claspers rather long, parallel sided, the outer upper angle obtusely pointed, the upper inner angle broadly obliquely rounded and here margined with a number of small hairs; on the hind margin are several minute hairs near the upper end, and several small bristles below.

Length, 1.75 mm.

Type.—Cat. No. 6922, U.S.N.M.

CTENOPHTHALMUS INTERMEDIUS (Wagner).

This species—described as a *Typhlopsylla* by Dr. Wagner—was collected on *Metachirus opossum* in Paraguay and Ecuador. It is an interesting addition to the American fauna, very distinct from anything previously described. The structure of the head strongly suggests *Ctenopsyllus*, but the tibial spines and other characters are those of *Ctenophthalmus*.

CTENOPHTHALMUS FRATERNUS Baker.

This species is known only from the type, a single female taken at Brookings, South Dakota, by Professor Aldrich. He did not give the host, though it is quite likely to prove to be one of the moles. As the original characterization was somewhat meager, the following descriptive notes are added:

The head is broadly rounded from the occiput to the prominent frontal notch, and thence slopes downward and backward to the mouth, giving the head an angulated appearance. A row of six bristles occurs high upon the gena; below this a row of two large and one small bristle, and on lower posterior portion of gena a ctenidium parallel to the upper rows of bristles and composed of five large, stout, dark-colored spines, the middle three longest. The antennal groove reaches to three-fourths the depth of the head, is not connected with the opposite antennal groove by a furrow passing over the top, and is without minute hairs or bristles scattered along the posterior margin. On the disk of the vertex occur extensions of the two rows of bristles on gena—about seven bristles above and eight below. Hind margin of head with the usual bristles. Labial palpi equaling three-fourths of anterior coxæ, the apex of the last joint having the usual minute hairs except that posteriorly on each palpus one is much enlarged and hooked.

Pronotum with a row of about twelve bristles on the posterior third, and on the hind margin a ctenidium of about twenty stout spines. Meso- and metanotum each with a row of ten or twelve larger bristles and a second row of more numerous smaller ones. Metathoracic epiphysis with a single bristle on the hind margin, and anterior to this two rows of three bristles each. The middle abdominal tergites each have a transverse row of fourteen larger bristles, and a second row of more numerous smaller ones. First abdominal tergite with three small teeth on either side of hind margin, second, third, and fourth each with two on either side, and fifth and sixth each with one. Antepygidial bristles badly broken in this specimen, but there are apparently only two on either side. The abdominal sternites each have a single row of from four to six large bristles.

The end of the abdomen is rather heavily clothed with bristles. The style is about three times as long as wide at base, nearly cylindrical, and with a long bristle at apex. The substylar flap has a thick brush of hairs on the lower margin.

The hind coxæ have a group of numerous small, short, somewhat thickened bristles on the inside, which resemble the grouped teeth occurring here in some *Pulex* and *Ceratophyllus*. Hind femur with a single small bristle on side near base. The spines on hind legs are unusually long. The first joint of the hind tarsi has five groups of spines on either margin; the last joint with but eight heavy spines, four on either margin. Hind tarsi mutilated in this specimen, but lengths of middle tarsal joints in the proportion 12–11–7–5–12.

Length, 2.25 mm. Color, pale brown.

CTENOPHTHALMUS GENALIS, new species.

A species collected on *Geomys bursarius* at the Agricultural College of Michigan, and formerly supposed to be a variety of *fraterna*, is now considered wholly distinct and described herewith from a single male.

Head somewhat flattened above. Rows of genal bristles pushed high up on head. The insertions of the five irregular ctenidial spines occupy half the surface of the genæ. These ctenidial spines are very dissimilar, the middle three longer, the upper distinctly spatulate, and the next one slightly so. The bristles on the second antennal joint are far shorter than the third joint. The antennal groove reaches the upper margin of the head, and its hind margin is without minute bristles or hairs. The upper row on either side of vertex has about four bristles, the second row about six. The hind margin of the head has the usual bristles. The labial palpi are slender and equal three-fourths of anterior coxæ. The maxillary palpi are unusually short and thick.

Pronotum with a row of about twelve bristles on posterior third, and on hind margin a ctenidium of about twenty-eight slender spines.

Mesonotum with a single row of about twelve bristles. Metanotum with a row of about twelve larger bristles, and behind this, on either side, three smaller ones. Metathoracic epiphysis with one large bristle posteriorly, two anterior to this, and one small, short one in front of the latter. First abdominal tergite with a single small tooth on either side, second with three on either side, third with two, and fourth with one on either side. Abdominal tergites each with a transverse row of ten bristles, and on the first two or three segments a second row of one to three bristles on a side. One stout antepygidial bristle mounted on a tubercle on each side. Middle abdominal sternites each with a single row of six bristles.

Lateral portion of ninth tergite greatly enlarged and triangular, long-pointed backward. Upper claspers rather small, not extending beyond tip of prolonged portion of ninth tergite, somewhat spatulate, the inner upper angle acute, the outer upper angle broadly rounded, the hind margin with six to eight bristles; on the inside at base there is separated a short, broad, acute piece like a large tooth.

Hind coxæ with a group of short stout bristles on inside, resembling the similarly grouped teeth in *Pulex*. Hind femur with a single bristle on inside. The first joint of the hind tarsi has four groups of spines on either margin; the apical spines on the second joint are shorter than the third joint. The fifth tarsal joint on first and second tarsi have five spines on either margin as in typical *Ceratophyllus*, while on the fifth joint of hind tarsi there are but four on either margin as in *Pulex*. Lengths of hind tarsal joint in the proportions 23–15–10–5–12.

Length, 2.25 mm. Color, pale brown.

Type.—Cat. No. 6923, U.S.N.M.

Genus ANOMIOPSYLLUS, new genus.

This genus is founded on an insect which I described in 1898 as *Typhlopsylla nudata*. It then dropped into that convenient "catch-all" *Typhlopsylla*, on account of its lack of eyes, though it was remarked at that time that it represented a distinct genus. One of the most conspicuous characters is the great length of the maxillary palpi, which exceed the fore coxæ. The eyes are wholly wanting. On the dorsal line the pronotum and mesonotum are of equal length, while the metanotum is shorter. There is a remarkable and wholly unique reduction in the vestiture, the body, excepting the posterior extremity, being almost wholly nude, and the number of spines on the legs greatly reduced, there being but four pairs of spines on the posterior margin of the tibiæ. One of the most important characters is found in the rounded emargination formed distally on the hind margin of fore and middle coxæ at the juncture of the coxa and its epiphysis. In most fleas this is shallow or wanting, with the outer subtending

limb obtuse. In this case it is very deep, deeper than broad, and the outer subtending limb is narrowly acute. On the fifth tarsal joints are combined the characters of two of the Wagnerian genera; on the fore and middle last tarsal joints the first pair of spines is dislocated toward the median line and directed straight distad. On the hind last tarsal joint there are but four spines on either side.

While I am somewhat loath to separate any new genera at this time when the inflow of strange and aberrant forms has just begun, still, in this case there is hardly any other course open to me, for otherwise *nudata* might be placed with equal propriety in any one of two or three genera.

ANOMIOPSYLLUS NUDATUS Baker.

This species, the smallest known American flea, was originally described from two females collected at Tucson, Arizona, in a nest of *Neotoma albigula* by the late Mr. Hubbard, who was one of the most thorough collectors America has yet seen. In addition to the characterization originally given, the following additional details may be noted:

The lower row of genal bristles is represented by one very weak and slender bristle on margin of antennal groove and a similar one on the lower margin of the head. There are no other bristles on the head excepting one or two at each lower angle of hind margin, and a very few short ones on second antennal joint. The thorax is without bristles excepting one on either side of pronotum at each lateral angle.

The abdominal tergites each have a single row of about six very weak and slender bristles. One small and slender antepygidial bristle occurs on either side. The hairs on pygidium are very fine, but longer than usual.

Style about three times longer than wide at base, and slightly narrowed to the tip, where there is a long bristle. The substylar flap is long and acute and has numerous bristles on the lower margin. Below the substylar flap a number of short, stout bristles occur near the margin.

The first joint of the hind tarsi has four groups of spines on the anterior margin and two groups on the posterior margin. One of the spines on apex of second joint of hind tarsi posteriorly is very long and slender, extending nearly to the end of the last joint. Lengths of hind tarsal joints in the proportions 18–10–6–5–10.

Length, 2 mm. Color, pale brown.

Genus CTENOPSYLLUS Kolenati.

1863. *Ctenopsyllus* KOLENATI, Horæ Soc. Ent. Ross., II, p. 37.
1893. *Ctenopsyllus* WAGNER, Horæ Soc. Ent. Ross., XXVII, p. 350.

This is preeminently the genus of mouse and rat fleas. Elsewhere has been noted the extreme paucity of knowledge on the American

forms, and also the great probability of some of the European species having been introduced. If these are found anywhere it will be in or near our great ports, and from these localities we have no specimens collected on house mice or rats.

SYNOPSIS OF AMERICAN SPECIES.

a. Head without ctenidial spines ..... *alpinus* (p. 427).
aa. Head with ctenidia.
b. Head ctenidia of two spines each ..... *hesperomys* (p. 428).
bb. Head ctenidia of four spines each ..... *mexicanus* (p. 430).

CTENOPSYLLUS ALPINUS Baker.

This species is still known only from the types—a male and female collected by Professor Bruner at Georgetown, Colorado, on *Neotoma*. It is congeneric with *musculi*, showing the same peculiar type of head, but it has no genal ctenidia. The following descriptive notes are added:

Female: Head gently rounded or nearly flat above from occiput to frontal noteh (which is very high on the front), thence sloping downward and backward to the mouth. The bristles on the head are developed into short, stout, dark-colored spines, all of which project downward and backward. The antennal groove extends to about two-thirds the depth of the head, and above is connected by a chitinous thickening and furrow across the top of the head with the antennal groove on opposite side. Near the margin of the front on either side, extending from mouth to antennal groove, is a row of ten short, stout spines. There are only two spines in the normal lower row on gena. The upper row has six spines, but instead of stopping above at the antennal groove this row curves around cephalad nearly to the margin of the front. Disk of vertex on each side with three oblique rows of spines, an upper one of two spines, a middle of three, and a lower one of five spines. The antennal groove is somewhat contracted below, and is without minute hairs or bristles on the posterior margin. The labial palpi extend to one-third of the anterior femora.

Pronotum with a row of about twelve stout bristles on the posterior third, and on the hind margin a ctenidium of about eighteen or twenty spines. The usual soft and minute articulatory hairs on anterior margin of mesonotum are here small teeth. Meso- and metanotum each with a transverse row of about eight bristles. Metathoracic epiphysis with about ten irregularly placed bristles.

First abdominal tergite with three or four small teeth on either side of hind margin. The abdominal tergites each has a transverse row of about ten bristles. Antepygidial bristles three on each side, the middle one in each group slightly longer. Abdominal sternites each with a row of about ten rather strong and close-set bristles. The eighth segment, near the middle of hind margin on either side, with a

group of several long, and several short, stout bristles. One stout bristle occurs beneath the pygidium on either side.

The style is very long, about five times as long as broad at base, nearly cylindrical, except at the tip, where there is a weak bristle, back of which are about six bristles irregularly placed. Substylar flap with numerous short, stout bristles above and three very heavy ones on the lower margin.

The hind coxal epiphysis slopes gradually into the coxa distally, thus not forming any emargination. The hind femur is without minute bristles on side. Hind margin of hind tibia with about six distant longer inner spines and about twelve shorter close-set inner ones.

First joint of hind tarsi without paired spines on hind margin, but with a double row of numerous spines. Bristles on apex of second hind tarsal joint shorter than third joint. The first pair of spines on fifth tarsal joint is dislocated toward median line and directed straight caudad.

Length, 2.5 mm.

Male: Head nearly as in the female, but the antennal groove extends to its upper margin. The two outer in each group of antepygidial bristles somewhat reduced. The last five abdominal sternites only, have rows of six bristles each.

The lateral portion of ninth tergite is without a lobe on the upper margin. The upper claspers are long, narrow, subrectangular, curved backward a little, and with two black teeth at the upper posterior angle. Lower claspers with a short, stout, black, recurved spine on hind margin.

Length, 1.5 mm.

CTENOPSYLLUS HESPEROMYS, new species.

There is in the collection a *Ctenopsyllus* taken at Franconia, New Hampshire, on *Peromyscus*, by Mrs. A. T. Slosson, which represents a very distinct species in that it possesses a ctenidium of two spines on either side of the head.

The upper margin of the head is very gradually rounded from the occiput to the frontal notch, thence curved downward and backward to the mouth. The antennal groove is margined by chitinous thickenings above and is narrowed to the upper margin of the head, where it joins the groove of the other side. The marginal row of bristles usual to this genus occurs on either side of the head; from the frontal notch to the mouth these bristles are short and heavy and spine-like; from the frontal notch to the occiput they are much longer and bristle-like. The upper row of genal bristles is represented by two placed high up; below this is a row of three bristles, two of which are very strong—one over eye, the other considerably above lower margin of head. Beneath the eye on either side, standing in a vertical row, are two

short, heavy ctenidial spines directed downward and backward. On either side of disk of vertex are three oblique rows of small bristles, the upper with five bristles, the middle of six, and the lower of three. The usual bristles occur on the hind margin of the head, the larger one at each lower angle being unusually short and stout. The few bristles on the second antennal joint are shorter than the third joint. There are six or eight minute bristles along the hind margin of the antennal groove. In the position of the eye occurs a dark thickening of the chitin. The mouth parts are unusually short, the labial palpi extending little more than one-half of anterior coxæ. The maxillæ are not more than twice as long as broad.

The mesonotum is twice as long on the dorsal line as either pronotum or metanotum. On the posterior third of the pronotum occurs a transverse row of about twelve bristles, and on the hind margin a ctenidium of about thirty slender spines, the row curving downward and backward laterally. Meso- and metanotum each with a larger row of about ten bristles and anterior to this about three rows of numerous very irregularly placed smaller bristles. Metathoracic epiphysis with one bristle on hind border, and anterior to this two rows of five bristles each.

Hind margins of dorsal segments with small teeth as follows: Six on metanotum, six on first abdominal tergite, six on second, two on third, two on fourth, and two on fifth. The abdominal tergites each have a row of about fourteen larger bristles and a second row of fewer smaller ones. Antepygidial bristles all unusually long and stout, the longest in each set of three nearly equaling the pygidium. The abdominal sternites each have one transverse row of six bristles. The extremity of abdomen is moderately bristled. One stout bristle occurs beneath the pygidium on either side.

The style is short and stout, not twice as long as wide at the base, with one long bristle at the apex and several short ones proximad of it on lower margin. The substylar flap is obtusely but symmetrically pointed and clothed with eight or ten bristles of varying sizes about the apical margin. The eighth segment laterally near the lower portion of the hind margin bears a number of long and a number of shorter bristles.

The hind coxæ are without bristles or teeth on the inside. Hind femur with but a single bristle on the side. Hind tibiæ with three long spines on hind margin and a close-set row of twelve shorter ones. The spines on apex of joint II of hind tarsi are shorter than joint III. First pair of spines on fifth tarsal joint dislocated toward median line and directed straight caudad. Length of hind tarsal joints in the proportions 25–10.5–8.5–5–7.

Length, 2.5 mm. Color, pale brown.

Type.—Cat. No. 6924, U.S.N.M.

CTENOPSYLLUS MEXICANUS Baker.

It was expected that the flea found on *Mus rattus* at Guanajuato, Mexico, by Dr. Dugès, would turn out to be some European species. It proved, however, to differ materially from anything described. Later, Dr. Dugès sent further material from *Mus norvegicus* taken at the same place. The following notes may be added to the original description:

Female: Dorsal segments with small teeth on hind margins as follows: Six on metanotum, six on first abdominal tergite, four on second, four on third, and two on the fourth. Antepygidial bristles four in each set, the first inner one and third shortest, second longest and largest, fourth nearly as long as second. One stout bristle occurs on either side below pygidium.

The style is rather long and narrow, the length twice the width at base, narrowing gradually to the apex, where there is a long bristle; another bristle nearly as large occurs on the lower margin. The substylar flap has a number of bristles near the apex, mostly on lower margin.

The hind margin of posterior tibæ bears three long spines and a close-set straight row of about fifteen short spines. The apical spines on second joint of hind tarsi are shorter than the third joint. The first pair of spines on last joint of hind tarsi dislocated toward median line and directed straight caudad.

Length, 2.5 mm. Color, pale brown.

Male: Antepygidial bristles, three on either side; the middle one of each group longest. The eighth segment on either side below bears but five bristles.

The lateral portion of the ninth tergite is strongly constricted below the pygidium, then expanded into a symmetrically rounded limb which in outline is shaped like a pestle. There is but a single bristle over the insertion of the claspers. The upper claspers are small but stout, thumb-shaped, with the ball of the thumb turned caudad, not extending above the lateral portion of the ninth tergite, and with four or five bristles on the hind margin.

Length, 2 mm.

Genus STEPHANOCIRCUS Skuse.

1890. *Stephanocircus* Skuse, Records of Austral. Mus., II, p. 77, pl. xvii.
1895. *Stephanocircus* Baker, Canad. Ent., XXVII, p. 63.
1896. *Stephanocircus* Skuse, Records of Austral. Mus., II, p. 7.

The original description of this remarkable genus came to me just as the Preliminary Studies were being published. I copied the description and remarked that it presented such an anomalous structure and such a remarkable case of sexual dimorphism that I would not attempt to place it in Taschenberg's system, which I was then com-

pelled to follow. The male and female, even though properly associated, would fall in different genera, perhaps, according to all that Taschenberg had given us in the characterization of genera.

Mr. Skuse took deep umbrage at my wholly innocent remarks and the next year presented a "rejoinder," in which he reasserts the specific identity of the male and female. Beyond this one statement, his paper was principally taken up with personal criticisms. There was not the faintest intention on my part to attempt passing *Stephanocircus* "under the heel"—the organism will still continue to exist in its original status, no matter what either of us may write about it. In copying the description at all there was no other motive than a desire for more knowledge concerning it. I was unfortunate in not having had access to the plates. The simple fact concerning Mr. Skuse's description is that out of it all he presents in the generic characterization but a single diagnostic generic character—that of the pectinated "cap-like patella" on the head—the other characters being common to other genera, either separately or in combination. I was not able at that time to interpret even this clearly from the description alone, as some species of *Ctenopsyllus* presented a similar general appearance. Indeed, the male of *Stephanocircus* is apparently a *Ctenopsyllus*, as that genus is commonly known. The matter of four-jointed antennæ must certainly be reexamined. If such a character is presented, then this species must be made the type of a new family differing from all other known fleas. But in the description of the apparently congeneric *Stephanocircus mars*, Rothschild says nothing about four-jointed antennæ, and his drawing does not show four joints. Some of the characters given by Mr. Skuse in the generic description are of specific value only, and the length of thorax given in the specific diagnosis is a character usually of generic value. Other than this, his specific description is not at all diagnostic.

Mr. Skuse, in this connection, criticises me also for not being able to place the flea *Echidnophaga ambulans*. But I could not do anything with it until a fuller and more exact morphological study was made and a real generic diagnosis presented.

The genus *Stephanocircus* now possesses far greater interest for American students on account of the recent publication of

STEPHANOCIRCUS MARS Rothschild.

This species was collected on a "*Hesperomys*" in Argentina by Dr. Berg, and is known from a single female in the Rothschild collection. It is greatly to be regretted that the male could not have also passed under Mr. Rothschild's critical eye. The occurrence of this genus also in South America is a matter of great interest. It is of interest to note that a greater number of striking cases of sexual dimorphism occur in South American fleas than in those of any other country.

Genus HYSTRICHOPSYLLA Taschenberg.

1880. *Hystrichopsylla* TASCHENBERG, Die Flöhe, p. 83.
1895. *Hystrichopsylla* BAKER, Canad. Ent., XXVII, p. 186.

Taschenberg based this genus on the remarkable flea originally named *Pulex talpæ* by Curtis, which is the *obtusiceps* of Ritsema (but not the *talpæ* of Bouché, which is *bisoctodentatus* Kolenati). The species seems to have been unknown to Kolenati, or he would certainly have given it a separate generic designation. The genus remained monotypic until the description of

HYSTRICHOPSYLLA AMERICANA Baker.

This species is represented in the collection by a single female collected on an *Evotomys* at Orono, Maine, by the late Prof. F. L. Harvey. Although evidently congeneric with the European species, it shows very wide specific differences. The head lacks the flattened, calloused front as illustrated by Taschenberg, and the pronotum is by far the longest thoracic segment. However, the specimen, figured in "Die Flöhe," is a male, while our unique type is a female. A complete study of both sexes of this species is much to be desired.

Dr. Fletcher has sent to me from Nepigon, Canada, a dried and badly mutilated specimen of a large, totally new flea, apparently of this genus, which presents a still wider divergence. It was taken, I understand, on a sandy lake shore, near which its host probably lives. I hesitate to describe it from this material, and yet am loath to leave unrecorded such an interesting addition to our fauna.

Genus CERATOPSYLLUS Curtis.

1832. *Ceratopsyllus* CURTIS, Brit. Entomolog., X.
1833. *Ceratopsyllus* WESTWOOD (Ischnopsyllus) Ent. Mo. Mag., I, p. 359.
1863. *Ceratopsyllus* KOLENATI, Horæ Soc. Ent. Ross., II, p. 39.
1893. *Ceratopsyllus* WAGNER, Horæ Soc. Ent. Ross., XXVII, p. 350.
1898. *Ceratopsyllus* WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 580.
1898. *Ceratopsyllus* ROTHSCHILD, Novitates Zoologicæ, V, p. 542.

The species of this genus—the most distinctly marked genus in the *Pulicidæ*—are confined to bats. Unquestionably, species belonging here will be found in North and South America. I regret not to be able to record a single one.

LIST OF SIPHONAPTERA OF THE WORLD, WITH BIBLIOGRAPHY, HOSTS,[a] AND HABITATS.

To January 1, 1903.

Family SARCOPSYLLIDÆ Taschenberg.

Genus SARCOPSYLLA Westwood.

SARCOPSYLLA PENETRANS (Linnaeus) Westwood.

1743. CATESBEY, Nat. Hist. of Carolina, Florida, and Bahama Islands, III, app., p. 10, fig. 3. (*Pulex minimus cutem penetrans.*)
1743. BARRÈRE, Nouv. Relation de la France equinoxiale, p. 63. (*Pulex minutissimus nigricans.*)
1756. PATRICK BROWN, Nat. Hist. of Jamaica, II, p. 418. (*Acarus fuscus sub cutem nidulans proboscide acutiore.*)
1758. LINNAEUS, Syst. Nat., 10th ed., p. 614. (*Pulex penetrans.*)
1788. SWARTZ, Kongl. vetensk. Acad. Nya. Handl., IX, p. 40. (*Pulex penetrans.*)
1815. OKEN, Naturgesch. f. alle Stände, III, p. 402. (*Rhynchoprion penetrans.*)
1821. POHL, Reisen in Brasilien, I, p. 106. (*Pulex penetrans.*)
1823. DUMÉRIL, Considerations gener. sur la classe des Insectes, pl. LIV, figs. 4–5. (*Pulex penetrans.*)
1826. DUMÉRIL, Dict. scienc. nat., XLIV, p. 82. Atlas, pl. LIII, figs. 4–5. (*Pulex penetrans.*)
1829. GUERIN, Iconograph. d. règne animal Insectes. Text. expl., p. 12, pl. II. (*Dermatophilus penetrans.*)
1832. POHL and KOLLAR, Brasiliens vorzüglich lästige Insecten, p. 8. (*Pulex penetrans.*)
1836. SHUCKARD, Ann. Mag. Nat. Hist., p. 129, pl. VII. (*Pulex penetrans.*)
1837–40. WESTWOOD, Trans. Ent. Soc., II, p. 199, pl. XX. (*Sarcopsylla penetrans.*)
1844. GERVAIS, Hist. nat. d. Ins. Aptères, III, p. 368, pl. XLIX, fig. 11. (*Pulex penetrans.*)
1863. KOLENATI, Horæ Soc. Ent. Ross., II, p. 28. (*Sarcopsylla penetrans.*)
1864. KARSTEN, Beitr. z. Kennt. d. Rhynchoprion penetrans.
1867. BONNET, Mémoire sur la Puce penetrante au Chique. (*Pulex penetrans.*)
1874. RITSEMA, Regensb. Corresp., XXVIII, p. 76. (*Pulex penetrans.*)
1880. RITSEMA, Zeitschr. f. ges. Naturwiss., p. 181. (*Pulex penetrans.*)
1880. TASCHENBERG, Die Flöhe, p. 44. (*Sarcopsylla penetrans.*)
1895. BAKER, Canad. Ent., XXIII, p. 20. (*Sarcopsylla penetrans.*)
1896. OSBORN, Div. Ent. Dept. Agrcl. Bull. No. 5 (n. s.), p. 142, fig. LXII. (*Sarcopsylla penetrans.*)

Hosts: Man and the domesticated animals and some others.
Habitat: Tropical regions of both hemispheres.

[a] In the descriptive portion of the text the hosts are referred to under names used by Taschenberg, Wagner, Rothschild, and the various collectors who have sent in specimens. These names are necessarily in great confusion and represent many schools of nomenclature. In this list these same names are referred to again in the bibliography. Through the kindness of Mr. Gerrit S. Miller, jr., of the U. S. National Museum, the host names are also given according to the current nomenclature, thus reducing all the names to one system and in such a manner as to make the references plain in every case.

Genus XESTOPSYLLA Baker.

XESTOPSYLLA GALLINACEA (Westwood) Baker.

1874–75. Westwood, The Entom. Mo. Mag., XI, p. 246. (*Sarcopsylla gallinacea.*)
1880. Taschenberg, Die Flöhe, p. 55, pl. 1, fig. 5. (*Sarcopsylla gallinacea.*)
1890. Johnson, Proc. Ent. Soc. Wash., I, p. 203. (*Pulex pallulorum.*)
1895. Baker, Canad. Ent., XXVII, p. 20. (*Sarcopsylla gallinacea.*)
1896. Osborn, Div. Ent. Dept. Agrcl., Bull. No. 5 (n. s.), p. 144, figs. 76–77. (*Sarcopsylla gallinacea.*)

Hosts: Domesticated animals, especially chickens.
Habitat: Warmer portions of America and Africa.

Family HECTOPSYLLIDÆ Baker.

Genus HECTOPSYLLA Frauenfeld.

HECTOPSYLLA PSITTACI Frauenfeld.

1860. Frauenfeld, Sitzungsb. d. k. Acad. d. Wiss. Wien., XI, p. 462. (*Hectopsylla psittaci.*)
1880. Haller, Archiv. f. Naturgesch., Jahr. 46, p. 72, pl. IV. (*Rhynchopsylla pulex.*)
1880. Taschenberg, Die Flöhe, p. 5. (*Rhynchopsylla pulex.*) Hosts, "*Psittacus* and *Molossus.*"
1895. Baker, Canad. Ent., XXVII, p. 21. (*Rhynchopsylla pulex.*)

Hosts: Psittacus and *Nyctinomus.*
Habitat: Ceylon.

Family VERMIPSYLLIDÆ Wagner.

Genus VERMIPSYLLA Schimkewitsch.

VERMIPYSLLA ALACURT Schimkewitsch.

1885. Schimkewitsch, Zool. Anz., no. 187.
1889. Wagner, Horæ Soc. Ent. Ross., XXIII, nos. 1–2, p. 205.
1895. Baker, Canad. Ent., XXVII, p. 22.

Hosts: The ungulates.
Habitat: Western Asia.

Family MEGAPSYLLIDÆ Baker.

Genus MEGAPSYLLA Baker.

MEGAPSYLLA GROSSIVENTRIS (Weyenbergh) Baker.

1879. Weyenbergh, Bull. de la Acad. Nac. de Ciencias Republ. Argent., III, p. 188. (*Pulex grossiventris.*)
1880. Taschenberg, Die Flöhe, p. 101. (*Pulex grossiventris.*)
1895. Baker, Can. Ent., XXVII, p. 3. (*Sarcopsylla grossiventris.*)
1898. Baker, Journ. N. Y. Ent. Soc., VI, p. 53. (*Megapsylla grossiventris.*)

Host: Zaëdyus minutus.
Habitat: Argentine Republic.

Family PULICIDÆ.

Genus PULEX Linnaeus.

PULEX ANOMALUS Baker.

1903. Baker, see p. 381.

Host: *Citellus.*
Habitat: Southern Colorado.

PULEX AFFINIS Baker.

1903. Baker, see p. 382.

Host: *Lepus.*
Habitat: Arizona.

PULEX BOHLSII Wagner.

1900. Wagner, Horæ Soc. Ent. Ross., XXXV, p. 5.

Host: ———.
Habitat: Paraguay.

PULEX BRASILIENSIS Baker.

1903. Baker, see p. 379. Host, "*Mus rattus* and *Mus decumanus.*"

Host: *Mus rattus* and *Mus norvegicus.*
Habitat: Sao Paulo, Brazil.

PULEX CUSPIDATUS Kolenati.

1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 33.
1893. Wagner, Horæ Soc. Ent. Ross. XXVII, p. 9.

Host: *Erinaceus europæus.*
Habitat: Europe.

PULEX DUGESII Baker.

1899. Baker, Ent. News, Feb., p. 37. (*Pulex irritans* var. *dugesii.*) Host, "*Spermophilus macrourus.*"

Host: *Citellus macrourus.*
Habitat: Mexico.

PULEX ECHIDNÆ Denny.

1840. Westwood, Mod. Classif. Insects, II, p. 493.
1843. Denny, Ann. and Mag. Nat. Hist., XII, p. 315, pl. xxvii, fig. 6. Host, "*Echidna hystrix.*"
1844. Gervais, Hist. nat. d. Ins. Aptères, III, p. 374.
1874. Ritsema, Regensb. Correspondenzblatt, XXVIII, p. 79.
1880. Ritsema, Zeitsch. f. ges. Naturwiss., LIII, p. 185.
1880. Taschenberg, Die Flöhe, p. 98.
1895. Baker, Canad. Ent., XXVII, p. 130.

Host: *Tachyglossus aculeatus.*
Habitat: Van Diemans Land.

PULEX GLACIALIS Taschenberg.

1880. Taschenberg, Die Flöhe, p. 76, pl. III, fig. 17.
1895. Baker, Canad. Ent., XXVII, p. 111 (ex. Amer. spec.).

Host: *Lepus "glacialis."*
Habitat: "Nord Pole."

PULEX HYÆNÆ Kolenati.

1846. Kolenati, Meletemata Entomologica, Pt. 5, p. 26, pl. XIX, fig. 1.
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 30. (*Pulex striatus.*)
1874. Ritsema, Regensb. Correspondenzblatt, XXVIII, p. 77.
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 184.
1880. Taschenberg, Die Flöhe, p. 100.

Host: *Hyæna striata.*
Habitat: Transcaucasia, Persia.

PULEX IRRITANS Linnæus.

1746. Linnæus, Fauna suecica, 2d ed., No. 1695.
1746. Linnæus, Fauna suecica, 1st ed., No. 1471. (*Pulex ater.*)
1762. Geoffroy, Hist. abrégée d. Ins., II, p. 614, pl, XX, fig. 4.
1778. Degeer, Mem. p. servir. a l'hist. d. Ins., VII, p. 1, pl. 1, figs. 1–4. (*Pulex vulgaris.*)
1832. Dugès, Ann. d. science nat., XXVII, p. 147, pl. IV, fig. 1.
1832. Dugès, Ann. d. science nat., p. 163. (*Pulex hominis.*)
1832. Bouché, Nov. Act. Acad. Leop. Carol., XVII, p. 503.
1844. Gervais, Hist. nat. d. Ins. Apt., III, p. 365.
1855. Küchenmeister, Parasiten, I, p. 452.
1856. Walker, Dipt. Brit., III, p. 2.
1858. Maitland, Herklots Bouwstoff., p. 310.
1859. Kolenati, Fauna d. Altvaters, p. 65.
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 31, fig. 2.
1873. Ritsema, Tijds. v. Entomol., 2d ser., VIII, p. lxxxiv.
1874. Ritsema, Regensb. Corresp., XXVII, p. 76.
1880. Ritsema, Zeitschr. f. ges. Naturwiss., p. 181.
1880. Taschenberg, Die Flöhe, p. 64.
1895. Baker, Canad. Ent., XXVII, p. 66. (*Pulex irritans* and *P. simulans.*)
1896. Osborn, Div. Ent., Dept. Agr., Bull. No. 5 (n. s.), p. 147, fig. 80. (*Pulex irritans* and *P. simulans.*)

Hosts: *Homo, Vulpes, Didelphis, Canis, Felis,* etc.
Habitat: Temperate and tropical regions of the world.

PULEX JACULANS Motschulsky.

1840. Motschulsky, Bull. Soc. Imp. des Nat. de Moscou, p. 170. Host, "*Dipus jaculus.*"
1880. Taschenberg, Die Flöhe, p. 105.

Host: *Alactaga jaculus.*
Habitat: Siberia.

PULEX KERGUELENSIS Taschenberg.

1880. Taschenberg, Die Flöhe, p. 67, pl. II, fig. 12.
1895. Baker, Canad. Ent., XXVII, p. 65.

Host: "*Pelecanoides urinatrix*," fide Taschenberg.
Habitat: Kerguelen Island.

PULEX LAMELLIFER Wagner.

1895. Wagner, Horæ Soc. Ent. Ross., XXIX, p. 1, fig. 1.
1895. Baker, Journ. N. Y. Ent. Soc., VI, p. 54.

Host: Some rodent.
Habitat: Transcaspia.

PULEX LEMMUS Motschulsky.

1840. Motschulsky, Bull. Soc. Imp. des Nat. de Moscou, p. 170. Host, "*Myodes lemmus*."
1880. Taschenberg, Die Flöhe, p. 105.

Host: *Lemmus* sp.
Habitat: ? Siberia.

PULEX LONGISPINUS Wagner.

1893. Wagner, Horæ Soc. Ent. Ross., XXVII, p. 9, pl. IV, fig. 1. Host, "*Erinaceus europæus*."
1895. Baker, Journ. N. Y. Ent. Soc., VI, p. 54.

Host: *Erinaceus* sp.
Habitat: West Turkestan.

PULEX LUTZII Baker.

1903. Baker, see p. 380. Host, "*Galictis vittatus*."

Host: *Grison vittatus.*
Habitat: Sao Paulo, Brazil.

PULEX LYNX Baker.

1903. Baker, see p. 383.

Host: *Lynx canadensis.*
Habitat: Moscow, Idaho.

PULEX MADAGASCARIENSIS Rothschild.

1900. Rothschild, The Ent. Record and Journ. of Variation, XII, no. 2, fig. 3. Host, "*Centetes ecaudatus*."

Host: *Tenrec ecaudatus.*
Habitat: Madagascar.

PULEX PALLIDUS Taschenberg.

1880. Taschenberg, Die Flöhe, p. 65, pl. I, fig. 9.
1895. Baker, Canad. Ent., XXVII, p. 66.

Hosts: *Herpestes ichneumon* and *Mus albipes.*
Habitat: Egypt and Island of Socotra.

PULEX TUBERCULATICEPS Bezzi.

1890. Bezzi, Bull. della Soc. Entom. Ital., XXII.
1895. Baker, Canad. Ent., XXVII, p. 64.

Host: *Ursus arctos.*
Habitat: Europe.

PULEX VULPES Motschulsky.

1840. Motschulsky, Bull. Soc. imp. de Moscou, p. 170.
1874. Ritsema, Regensb. Corresp., XXVIII, p. 79.
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 183.
1880. Taschenberg, Die Flöhe, p. 66, pl. II, figs. 10–11. (*Pulex globiceps.*) Hosts, "*Canis vulpes* and *Meles taxus.*"
1895. Baker, Canad. Ent., XXVII, p. 66. (*Pulex globiceps.*)

Hosts: *Vulpes vulpes* and *Meles meles.*
Habitat: Europe.

Genus CTENOCEPHALUS Kolenati.

CTENOCEPHALUS CANIS (Curtis) Baker.

1749. Roesel, Insektenbelustigungen, II, Muscarum atque culicum, pls. II–IV. (Der so bekannte als beschwerliche Flöh.)
1826. Curtis, Brit. Entom., III, no. 111, fig. 8. (*Pulex canis.*)
1832. Dugès, Ann. d. scienc. nat., XXVII, p. 154, pl. IV, figs. 2, 5–9. (*Pulex canis.*)
1835. Bouché, Nov. Act. Acad. Leop. Carol., XVII, Pt. 1, p. 505. (*Pulex felis.*)
1844. Gervais, Hist. nat. des Insectes, Apt., III, pp. 371–372, pl. XLVIII, fig. 8. (*Pulex canis, P. felis,* and *P. serraticeps.*)
1856. Walker, Dipt. Brit., III, pp. 2–3. (*Pulex canis* and *P. felis.*)
1858. Maitland, Herklots Bonwstoff., II, p. 310. (*Pulex canis* and *P. felis.*)
1859. Kolenati, Fauna d. Altvaters, p. 66. (*Ctenocephalus norvemdentatus* and *C. enneodus.*)
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 45, figs. 14–15. (*Ctenocephalus norvemdentatus* and *C. enneodus.*)
1867. Landois, Nov. Act. Acad. Leop.-Carol., XXXIII, p. 19, pls. I–VII. (*Pulex canis.*)
1873. Ritsema, Tijdsch. v. Entomol., 2d ser., VIII, p. lxxxv. (*Ctenocephalus norvemdentatus* and *C. enneodus.*)
1874. Ritsema, Regensb. Corresp., XXVII, pp. 77–78. (*Pulex canis* and *P. felis.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, pp. 182–183. (*Pulex canis* and *P. felis.*)
1880. Taschenberg, Die Flöhe, p. 77, pl. III, fig. 16. (*Pulex serraticeps.*)
1888. Simmons, Amer. Mo. Micr. Journ., Dec. (*Pulex canis.*)
1895. Baker, Canad. Ent., XXVII, p. 164. (*Pulex serraticeps.*)
1896. Osborn, Div. Ent., Dept. Agrcl., Bull. No. 5 (n. s.), p. 150, fig. 83. (*Pulex serraticeps.*)
1896. Howard and Marlatt, Div. Ent., Dept. Agrcl., Bull. No. 4 (n. s.), p. 24, fig. 5. (*Pulex serraticeps.*)
1901. Rothschild, The Ent. Record and Journ. of Variation, XIII, No. 4, p. 126, pl. III. (*Pulex canis* and *P. felis.*)

Hosts: *Canis familiaris, Urocyon cinereoargenteus, Felis domestica,* etc.
Habitat: Cosmopolitan.

CTENOCEPHALUS ERINACEI (Leach) Baker.

1832. Leach, in Curtis Brit. Ent., IX, no. 417. (*Ceratophyllus erinacei.*)
1835. Bouché, Nov. Act. Acad. Leop.-Carol., XVII, Pt. 1, p. 507. (*Pulex erinacei.*)
1844. Gervais, Hist. nat. d. Ins., Apt., III, p. 373. (*Pulex erinacei.*)
1856. Walker, Insecta Brit., Diptera, III, p. 3. (*Pulex erinacei.*)
1874. Ritsema, Regensb. Corresp., XXVIII, p. 78. (*Pulex erinacei.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 183. (*Pulex erinacei.*)
1880. Taschenberg, Die Flöhe, p. 81. (*Pulex erinacei.*)
1893. Wagner, Horæ Soc. Ent. Ross., XXVII, p. 9. (*Pulex erinacei.*)
1895. Baker, Canad. Ent., XXVII, p. 164. (*Pulex erinacei.*)

Host: *Erinaceus europæus.*
Habitat: Europe.

CTENOCEPHALUS INÆQUALIS Baker.

1895. Baker, Canad. Ent., XXVII, p. 164. (*Pulex inæqualis.*)
1896. Osborn, Div. Ent., Dept. Agrcl., Bull. No. 5 (n. s.), p. 153, fig. 84. (*Pulex inæqualis.*)

Host: *Lepus.*
Habitat: Arizona.

CTENOCEPHALUS LEPORIS (Leach) Baker.

1832. Leach, in Curtis Brit. Ent., IX, no. 417. (*Ceratophyllus leporis.*)
1874. Ritsema, Regensb. Corresp., XXVIII, p. 76. (*Pulex leporis.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 182. (*Pulex leporis.*)
1880. Taschenberg, Die Flöhe, p. 82. (*Pulex goniocephalus.*)
1895. Baker, Canad. Ent., XXVII, p. 165. (*Pulex goniocephalus.*)
1896. Osborn, Div. Ent., Dept. Agrcl., Bull. V, (n. s.), p. 153. (*Pulex goniocephalus.*)

Host: *Lepus* spp.
Habitat: Europe.

CTENOCEPHALUS SIMPLEX Baker.

1895. Baker, Canad. Ent., XXVII, p. 164. (*Pulex inæqualis* var. *simplex.*) Host, "*Lepus sylvaticus.*"
1896. Osborn, Div. Ent., Dept. Agrcl., Bull. V, (n. s.), p. 153. (*Pulex inæqualis* var. *simplex.*)

Host: *Lepus floridanus* subsp.
Habitat: Michigan and Iowa.

Genus ECHIDNOPHAGA Olliff.

ECHIDNOPHAGA AMBULANS Olliff.

1886. Olliff, Proc. Linn. Soc. N. S. Wales (2), I, p. 172. Host, "*Echidna hystrix.*"

Host: *Tachyglossus aculeatus.*
Habitat: New South Wales.

Genus CERATOPHYLLUS Curtis.

CERATOPHYLLUS ALASKENSIS Baker.

1903. Baker, see p. 394.

Host: *Citellus barrowensis.*
Habitat: Point Barrow, Alaska.

CERATOPHYLLUS ARCTOMYS Baker.

1903. Baker, see p. 411.

Host: *Arctomys monax.*
Habitat: Peterboro, New York.

CERATOPHYLLUS ARIZONENSIS Baker.

1898. Baker, Journ. N. Y. Ent. Soc., VI, p. 55. (*Pulex Arizonensis.*) Host, "*Silvery mouse.*"

Host: *Neotoma albigula.*
Habitat: Tucson, Arizona.

CERATOPHYLLUS ARMATUS Wagner.

1900. Wagner, Horæ Soc. Ent. Ross., XXXV, p. 17. Host, "*Pteromys volans.*"

Host: *Sciuropterus russicus.*
Habitat: Siberia.

CERATOPHYLLUS ASIO Baker.

1903. Baker, see p. 406.

Host: *Megascops asio.*
Habitat: Wellesley, Massachusetts.

CERATOPHYLLUS BRUNERI (Baker) Wagner.

1895. Baker, Canad. Ent., XXVII, p. 132. (*Pulex bruneri.*) Host, "*Spermophilus 13-lineatus.*"
1896. Osborn, Div. Ent. Dept. Agrcl., Bull. V (n. s.), p. 149, fig. 82. (*Pulex bruneri.*)
1898. Baker, Journ. N. Y. Ent. Soc., VI, p. 55. (*Pulex bruneri.*)

Hosts: *Citellus 13-lineatus*, *C. franklinii*, and *C. columbianus.*
Habitat: Nebraska and Idaho.

CERATOPHYLLUS CALIFORNICUS Baker.

1903. Baker, see p. 395.

Host: *Microtus californicus.*
Habitat Mountain View, California.

CERATOPHYLLUS CANADENSIS Baker.

1903. Baker, see p. 407.

Host: (?)
Habitat: Ottawa, Canada.

CERATOPHYLLUS CHARLOTTENSIS Baker.

1898. Baker, Journ. N. Y. Ent. Soc., VI, p. 56. (*Pulex charlottensis.*)

Host: "A mouse."
Habitat: Queen Charlotte Islands.

CERATOPHYLLUS CILIATUS Baker.

1903. Baker, see p. 397.

Host: Eutamias.
Habitat: Mountain View, California.

CERATOPHYLLUS COLORADENSIS (Baker) Wagner.

1895. Baker, Canad. Ent., XXVII, p. 111. (*Pulex coloradensis.*)

Host: Sciurus fremonti.
Habitat: Colorado.

CERATOPHYLLUS COLUMBÆ (Walckener and Gervais) Rothschild.

1832. Stephens, in Curtis' Brit. Ent., IX, no. 417. (*Nomen nudum.*)
1844. Walckener and Gervais, Hist. Nat. Ins. Aptères., III, p. 375, pl. XLVIII, fig. 7. (*Pulex columbæ.*)
1856. Walker, Diptera Brit., III, p. 5. (*Pulex columbæ.*)
1858. Maitland, Herklots Bouwstoffen, p. 311. (*Pulex columbæ.*)
1874. Ritsema, Regens. Corresp., XXVIII, p. 79. (*Pulex columbæ.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 183. (*Pulex columbæ.*)
1892. Theobald, An Account of British Flies, I, p. 540. (*Pulex columbæ.*)
1900. Rothschild, Novitates Zoologicæ, VII, p. 542.

Host: Columba livia.
Habitat: Europe.

CERATOPHYLLUS CONSIMILIS Wagner.

1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 562, pl. VIII, fig. 11. Host, "*Arvicola.*"

Host: Microtus.
Habitat: Gouv. Charkow, Russia.

CERATOPHYLLUS DENTATUS Baker.

1903. Baker, see p. 390.

Host: Lynx canadensis.
Habitat: Moscow, Idaho.

CERATOPHYLLUS DIVISUS Baker.

1895. Baker, Canad. Ent., XXVII, p. 132. (*Pulex longispinus.*)
1898. Baker, Journ. N. Y. Ent. Soc., VI, p. 54. (*Pulex divisus.*)

Host: Sciurus fremonti.
Habitat: Colorado.

CERATOPHYLLUS DRYAS (Wagner) Baker.

1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 568, pl. VIII, fig. 4. (*Ceratophyllus sciurorum* var. *dryas.*) Host, "*Myoxus dryas.*"

Host: *Glis nitedula.*
Habitat: Gouv. Waronesch, Russia.

CERATOPHYLLUS EREMICUS Baker.

1903. Baker, see p. 417.

Host: *Peromyscus eremicus.*
Habitat: Santa Rita Mts., Arizona.

CERATOPHYLLUS FASCIATUS (Bosc.) Curtis.

1801. Bosc d'Antic, Bull. Sci. Soc. Phil., III, p. 156, no. 44. (*Pulex fasciatus.*)
1802. Bosc d'Antic, Wiedemann's Archiv., p. 211. (*Pulex fasciatus.*)
1805. Latreille, Hist. Nat. d. Ins., XIV, p. 42. (*Pulex fasciatus.*)
1844. Gervais, Hist. Nat. d. Ins. Aptères, III, p. 373. (*Pulex fasciatus.*)
1832. Curtis, Brit. Ent., IX, no. 417. (*Ceratophyllus fasciatus.*)
1858. Maitland, Herklots Bouwstoffen, p. 310. (*Pulex fasciatus.*)
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 34, fig. 5. (*Ctenopsyllus fasciatus.*)
1874. Ritsema, Regensb. Corresp., XXVIII, p. 76. (*Pulex fasciatus.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 182. (*Pulex fasciatus.*)
1880. Taschenberg, Die Flöhe, p. 69. (*Pulex fasciatus.*) Hosts, "*Myoxus nitela, Talpa europæa, Mus musculus* and *Mus decumanus.*"
1895. Baker, Canad. Ent., XXVII, p. 111. (*Pulex fasciatus*, as to European specimens only.)
1896. Osborn, Div. Ent. Dept. Agric., Bull. V (n. s.), p. 148. (*Pulex fasciatus.*)
1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 560, pl. VIII, fig. 10.

Hosts: *Eliomys quercinus*, *Talpa europæa*, *Mus musculus*, and *Mus norvegicus.*
Habitat: Europe.

CERATOPHYLLUS FRINGILLÆ (Walker) Baker.

1856. Walker, Dipt. Brit., III, p. 4. (*Pulex fringillæ.*)
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 34. (*Trichopsylla fringillæ.*)
1873. Ritsema, Tijds. v. Entom., XVI, p. 84. (*Trichopsylla fringillæ.*)
1874. Ritsema, Regensb. Corresp., XXVIII, p. 79. (*Pulex fringillæ.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 184. (*Pulex fringillæ.*)
1892. Theobald, An Account of British Flies, 1, p. 32. (*Pulex fringillæ.*)

Hosts: *Passer domesticus* and *Chloris chloris.*
Habitat: Europe.

CERATOPHYLLUS GALLINÆ (Schrank) Wagner.

1804. Schrank, Fauna boica, III, p. 195. (*Pulex gallinæ.*)
1827. Gravenhorst, Uebers. d. Arb. u. veränd. d. Schles. Gesellsch. f. vaterl. Kultur., p. 67. (*Pulex rufus.*)
1835. Bouché, Nov. Act. Acad. Leop. Carol., XVII, Pt. 1, p. 504. (*Pulex gallinæ.*)
1844. Gervais, Hist. Nat. d. Ins. Aptères, III, p. 375. (*Pulex gallinæ.*)
1856. Walker, Dipt. Brit., III, p. 2. (*Pulex gallinæ.*)

1858. Maitland, Herklots Bouwstoffen, p. 11. (*Pulex gallinæ.*)
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 34. (*Trichopsylla gallinæ.*)
1873. Ritsema, Tijdschr. v. Entom., XVI, p. lxxxiv. (*Trichopsylla gallinæ.*)
1874. Ritsema, Regensb. Corresp., XXVIII, p. 78. (*Pulex gallinæ.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 182. (*Pulex gallinæ.*)
1880. Taschenberg, Die Flöhe, p. 70. (*Pulex avium.*) Hosts, "*Gallus domesticus, Turdus merula, Erithacus rubicula, Acredula rosea, Columba anas, Mus sylvaticus,* and *Scotophilus noctula.*"
1892. Theobald, An Account of British Flies, I, p. 31. (*Pulex gallinæ.*)
1895. Baker, Canad. Ent., XXVII, p. 110. (*Pulex avium.*)
1896. Osborn, Div. Ent. Dept. Agrcl., Bull. (n. s.), p. 147. (*Pulex avium.*)
1900. Rothschild, Novitates Zoologicæ, VII, p. 540.

Hosts: Gallus domesticus, Merula merula, Erithacus rubecula, Egithalos rosea, Columba anas, Mus sylvaticus, and *Pterygistes noctula.*
Habitat: Europe.

CERATOPHYLLUS HIRSUTUS (Baker) Wagner.

1895. Baker, Canad. Ent., XXVII, p. 132. (*Pulex hirsutus.*)
1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 560.

Host: Cynomys ludovicianus.
Habitat: Colorado.

CERATOPHYLLUS HIRUNDINIS Curtis.

1831. Köhler, Uebers. d. Arb. u. Veränd. d. Schles. Gesellsch. f. vaterl. Kultur. p. 73. (*Pulex hirundinis.*) Host, "*Chilidon urbica.*"
1832. Curtis, Brit. Entom., IX, no. 417, fig.
1835. Guérin and Percheron, Genera des Ins., 5th livr. No. 7.
1844. Gervais, Hist. nat. d. Ins. Aptères, III, p. 374. (*Pulex hirundinis.*)
1856. Walker, Dipt. Brit., III, p. 5. (*Pulex hirundinis.*)
1858. Maitland, Herklots Bouwstoffen, p. 311. (*Pulex hirundinis.*)
1859. Bouillon, Ann. d. Soc. Ent. Belge. (*Pulex hirundinis.*)
1874. Ritsema, Regensb. Corresp., XXVII, p. 78.
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 187.
1892. Theobald, An Account of British Flies, I, p. 31. (*Pulex hirundinis.*)
1900. Rothschild, Novitates Zoologicæ, VII, p. 542.

Host: Hirundo urbica.
Habitat: Europe.

CERATOPHYLLUS IDAHOENSIS Baker.

1903. Baker, see p. 413.

Host: Citellus columbianus.
Habitat: Moscow, Idaho.

CERATOPHYLLUS IGNOTUS (Baker) Wagner.

1895. Baker, Canad. Ent., XXVII, pp. 111 and 191. (*Pulex ignotus* and *Typhlopsylla americana.*)
1896. Osborn, Div. Ent. Dept. Agrcl., Bull. V (n. s.), p. 154, figs. 86, 87. (*Typhlopsylla americana.*)
1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 560.

Hosts: Geomys bursarius and *Thomomys talpoides.*
Habitat: Iowa, Colorado, and Idaho.

CERATOPHYLLUS KEENI Baker.

1896. Baker, Canad. Ent., p. 234. (*Pulex keeni.*) Host, "*Sitomys keeni.*"

Host: *Peromyscus keeni.*
Habitat: Queen Charlotte Islands.

CERATOPHYLLUS LABIATUS Baker.

1903. Baker, see p. 402.

Host: *Lynx canadensis.*
Habitat: Moscow, Idaho.

CERATOPHYLLUS LAGOMYS Wagner.

1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 567, pl. VIII, fig. 1. Host, "*Lagomys rutilus.*"

Host: *Ochotona rutilus.*
Habitat: Transcaspia.

CERATOPHYLLUS LEUCOPUS Baker.

1903. Baker, see p. 401.

Host: *Peromyscus leucopus.*
Habitat: Peterboro, New York.

CERATOPHYLLUS LUCIDUS Baker.

1903. Baker, see p. 410.

Host: *Sciurus fremonti.*
Habitat: Southern Colorado.

CERATOPHYLLUS MELIS Curtis.

1832. Curtis, Brit. Ent., IX, no. 417. Host, "*Meles taxus.*"
1844. Gervais, Hist. nat. d. Ins. Aptères, III, p. 371. (*Pulex melis.*)
1856. Walker, Insecta Brit., Diptera, III, p. 5. (*Pulex melis.*)
1857. Gurlt, Archiv. f. Naturgesch., XXIII, p. 280. (*Pulex melis.*)
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 33. (*Trichopsylla melis.*)
1874. Ritsema, Regensb. Correspond., XXVIII, p. 79. (*Pulex melis.*)
1875. Ritsema, Tijdschr. voor Entomol., XVI, p. lxxiv. (*Trichopsylla melis.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 184. (*Pulex melis.*)
1880. Taschenberg, Die Flöhe, p. 73, pl. II, fig. 15 and pl. III, fig. 16. (*Pulex melis.*)
1895. Baker, Canad. Ent., XXVII, p. 132. (*Pulex melis.*)

Host: *Meles meles.*
Habitat: Europe.

CERATOPHYLLUS METALLESCENS (Kolenati) Baker.

1856. Kolenati, Parasiten d. Chiropteren, p. 33. (*Pulex metallescens.*) Host, "*Pteropus ægyptiaca.*"
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 30, pl. I, fig. 1. (*Pulex metallescens.*)

1874. RITSEMA, Regensb. Corresp., XXVIII, p. 77. (*Pulex metallescens.*)
1880. RITSEMA, Zeitschr. f. ges. Naturwiss., LIII, p. 184. (*Pulex metallescens.*)
1880. TASCHENBERG, Die Flöhe, p. 101. (*Pulex metallescens.*)

Host: Rousettus aegyptiacus.
Habitat: Egypt.

CERATOPHYLLUS MONTANUS (Baker) Wagner.

1895. BAKER, Canad. Ent., XXVII, p. 132. (*Pulex montanus.*)
1898. WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 560.

Host: Sciurus aberti.
Habitat: Colorado.

CERATOPHYLLUS MULTISPINOSUS Baker.

1898. BAKER, Journ. N. Y. Ent. Soc., VI, p. 54. (*Pulex multispinosus.*) Host, "*Lepus sylvaticus.*"

Host: Lepus floridanus mallurus.
Habitat: North Carolina.

CERATOPHYLLUS MUSTELÆ Wagner.

1898. WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 565, pl. VIII, fig. 2. Host, "*Putorius vulgaris.*"

Host: Putorius nivalis.
Habitat: Gouv. Lublin, Russia.

CERATOPHYLLUS OCULATUS Baker.

1903. BAKER, see p. 396.

Host: Putorius vison.
Habitat: Washington City.

CERATOPHYLLUS PENCILLIGER (Grube) Wagner.

1852. GRUBE, Middendorfs Sibirische Reise, II, Pt. 1, p. 500. (*Pulex pencilliger*, as to male only.)
1863. KOLENATI, Horæ Soc. Ent. Ross., II, p. 32, pl. 1, fig. 3. (*Trichopsylla pencilliger.*)
1874. RITSEMA, Regensb. Corresp., XXVIII, p. 79. (*Pulex pencilliger.*)
1880. RITSEMA, Zeitschr. f. ges. Naturwiss., LIII, p. 183. (*Pulex pencilliger.*)
1880. TASCHENBERG, Die Flöhe, p. 99. (*Pulex pencilliger.*)
1898. WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 15, pl. VIII, fig. 6 (as to male only).

Host: Putorius sibirica.
Habitat: Siberia.

CERATOPHYLLUS PERPINNATUS Baker.

1903. BAKER, see p. 391.

Host: (?)
Habitat: Queen Charlotte Islands.

CERATOPHYLLUS PETIOLATUS Baker.

1903. Baker, see p. 415.

Host: *Lynx canadensis.*
Habitat: Moscow, Idaho.

CERATOPHYLLUS PINNATUS Wagner.

1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 573, pl. VIII, fig. 5.

Host: *Mus* sp.
Habitat: New Alexandria, Russia.

CERATOPHYLLUS PROXIMUS Baker.

1903. Baker, see p. 412.

Host: *Citellus* sp.
Habitat: Palm Springs, Arizona.

CERATOPHYLLUS PSEUDARCTOMYS Baker.

1903. Baker, see p. 399.

Host: *Arctomys monax.*
Habitat: Newport, Herkimer County, New York.

CERATOPHYLLUS SCIURORUM (Schrank) Curtis.

1804. Schrank, Fauna boica, III, p. 195. (*Pulex sciurorum.*)
1832. Curtis, Brit. Ent., IX, no. 407.
1835. Bouché, Nov. Act. Acad. Leop. Carol., XVII, p. 506. (*Pulex sciurorum.*)
1844. Gervais, Hist. nat. d. Ins. Aptères, III, p. 373. (*Pulex sciurorum.*)
1856. Walker, Insect. Brit., III, p. 3. (*Pulex sciurorum.*)
1858. Maitland, Herklots Bouwstoffen, p. 310. (*Pulex sciurorum.*)
1874. Ritsema, Regensb. Corresp., XXVIII, p. 78. (*Pulex sciurorum.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 183. (*Pulex sciurorum.*)
1880. Taschenberg, Die Flöhe, p. 75. (*Pulex sciurorum.*)
1895. Baker, Canad. Ent., XXVII, p. 132. (*Pulex sciurorum.*)
1896. Osborn, Div. Ent. Dept. Agrcl., Bull. V (n. s.), p. 48. (*Pulex sciurorum.*)

Host: *Sciuris vulgaris.*
Habitat: Europe.

CERATOPHYLLUS SEXDENTATUS Baker.

1903. Baker, see p. 403.

Host: *Neotoma* sp.
Habitat: Boulder Creek, California.

CERATOPHYLLUS SILANTIEWII Wagner.

1898. Wagner, Horæ Soc. Ent. Ross., XXVII, p. 574, pl. VIII, fig. 12.

Host: *Arctomys bobac.*
Habitat: Russia.

CERATOPHYLLUS STURNI (Gervais) Baker.

1844. Gervais, Hist. nat. des Ins. Aptères, III, p. 375. (*Pulex sturni.*)
1856. Walker, Dipt. Brit., III, p. 7. (*Pulex sturni.*)
1858. Maitland, Herklots Bouwstoffen, p. 311. (*Pulex sturni.*)
1892. Theobald, An Account of British Flies, p. 32. (*Pulex sturni.*)

Host: *Sturnus vulgaris.*
Habitat: Europe.

CERATOPHYLLUS STYLOSUS Baker.

1903. Baker, see p. 418. Host, "*Haplodon rufa.*"

Host: *Aplodontia rufa.*
Habitat: Astoria, Oregon.

CERATOPHYLLUS STYX Rothschild.

1832. Curtis, Brit. Entom., IX, No. 417. (*Ceratophyllus bifasciatus.*)
1844. Gervais, Hist. nat. d. Ins. Aptères., III, p. 575. (*Ceratophyllus bifasciatus.*)
1874. Ritsema, Regensb. Corresp., XXVIII, p. 76. (*Ceratophyllus bifasciatus.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 182. (*Ceratophyllus bifasciatus.*)
1900. Rothschild, Novitates Zoologicæ, VII, p. 543, pl. IX, figs. 5, 7, 8, 16. (*Ceratophyllus styx.*)

Host: *Riparia riparia.*
Habitat: Europe.

CERATOPHYLLUS SUBARMATUS Wagner.

1900. Wagner, Horæ Soc. Ent. Ross., XXXV, p. 18. Host, "*Lagomys* sp."

Host: *Ochotona* sp.
Habitat: Alpine region of Altai Mountains, Russia.

CERATOPHYLLUS TESQUORUM Wagner.

1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 564, pl. VIII, fig. 9. Hosts, "*Spermophilus musicus* and *S. guttatus.*"

Hosts: *Citellus musicus* and *C. guttatus.*
Habitat: Russia and Siberia.

CERATOPHYLLUS TOLLII Wagner.

1900. Wagner, Horæ Soc. Ent. Ross., XXXV, p. 19, pl. I, fig. 8. Host, "*Pteromys volans.*"

Host: *Sciuropterus russicus.*
Habitat: Siberia.

CERATOPHYLLUS TUBERCULATUS Baker.

1903. Baker, see p. 393.

Host: *Citellus columbianus.*
Habitat: Moscow, Idaho.

CERATOPHYLLUS URALENSIS Wagner.

1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 571, pl. VIII, fig. 3.

Host: (?).

Habitat: Ural Mountains, Russia.

CERATOPHYLLUS VISON Baker.

1903. See p. 408.

Host: Putorius vison.

Habitat: Peterboro, New York.

CERATOPHYLLUS WAGNERI Baker.

1903. See p. 405.

Host: Peromyscus sp.

Habitat: Moscow, Idaho.

CERATOPHYLLUS WICKHAMI (Baker) Wagner.

1895. Baker, Canad. Ent., XXVII, p. 111. (*Pulex wickhami*, Host, "*Sciuropterus volans*," *P. gillettei*, Host, "*Sciurus canadensis*," and *P. howardii*, Hosts, "Red squirrel, Gray or Fox squirrel, and Field mouse.")

1896. Osborn, Div. Ent. Dept. Agrcl., Bull. V, p. 140, fig. 81. (*Pulex wickhami*, *P. gillettei*, and *P. howardii*.)

1898. Baker, Journ. N. Y. Ent. Soc., VI, 54. (*Pulex gillettei* and *P. howardii*.)

1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 560.

Hosts: Sciuropterus volans, *Sciurus hudsonicus*, *Sciurus carolinensis*, *Arctomys monax*, and field mouse.

Habitat: New York, Michigan, Iowa, Nebraska, Georgia, Arizona.

Genus CTENOPHTHALMUS Kolenati.

CTENOPHTHALMUS AGYRTES (Heller) Baker.

1891. Saunders, Ent. Mo. Mag., II (2), p. 170. (*Typhlopsylla assimilis*, not of Taschenberg.)

1896. Heller, Entom. Nachrichten, XXII, p. 97. (*Typhlopsylla agyrtes.*)

1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 35, pl. IX, figs. 23–24. (*Typhlopsylla agyrtes.*)

1898. Rothschild, Novitates Zoologicæ, V, p. 533, pl. XV, figs. 1–2; pl. XVII, figs. 12, 14, and 17–25. (*Typhlopsylla agyrtes.*) Hosts, "*Hypudæus glareolus*, *Mus sylvaticus*, *Arvicola amphibius*, *Sorex vulgaris*, *Crossopus ciliatus*, *T. alpa europæa*."

Hosts: Erotomys hercynicus, *Mus sylvaticus*, *Microtus amphibius*, *Sorex araneus*, *Neomys fodiens*, and *Talpa europæa*.

Habitat: Europe.

CTENOPHTHALMUS ALTAICA (Wagner) Baker.

1900. Wagner, Horæ Soc. Ent. Ross., XXXV, p. 11, pl. I, fig. 5. (*Typhlopsylla altaica.*) Host, "*Lagomys* sp."

Host: Ochotona sp.

Habitat: Altai Mountains.

CTENOPHTHALMUS ASSIMILIS (Taschenberg) Baker.

1880. Taschenberg, Die Flöhe, p. 95, pl. IV, fig. 27. (*Typhlopsylla assimilis.*) Hosts, *Sorex vulgaris*, *Talpa europæa*, *Mus sylvaticus*, and *Arvicola arvalis.*
1895. Baker, Canad. Ent., XXVII, p. 190. (*Typhlopsylla assimilis*, excluding American forms.)
1896. Osborn, Div. Ent. Dept. Agrel., Bull. V (n. s.), p. 153. (*Typhlopsylla assimilis*, as to European forms.)
1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 34, pl. IX, fig. 25. (*Typhlopsylla assimilis.*)
1900. Wagner, Horæ Soc. Ent. Ross., XXXV, p. 9. (*Typhlopsylla assimilis.*)

Hosts: Sorex araneus, *Talpa europæa*, *Mus sylvaticus*, and *Microtus arvalis.*
Habitat: Europe.

CTENOPHTHALMUS BIDENTATIFORMIS (Wagner) Baker.

1889. Wagner, Horæ Soc. Ent. Ross., XXIII, p. 351, pl. VI, figs. 4, 5. (*Typhlopsylla bidentatiformis.*) Host, "*Mus decumanus.*"
1898. Baker, Journ. N. Y. Ent. Soc., VI, p. 55. (*Typhlopsylla bidentatiformis.*)

Host: Mus norvegicus.
Habitat: Siberia.

CTENOPHTHALMUS BISOCTODENTATUS Kolenati.

1835. Bouché, Nov. Act. Acad. Leop. Carol., XVII, p. 507. *Pulex talpæ*, not Curtis.)
1857. Kolenati, Paras. d. Chirop., p. 33. (*Ctenophthalmus talpæ.*)
1858. Maitland, Herklots Bouwstoffen, II, p. 310. (*Pulex talpæ*, not Curtis.)
1859. Kolenati, Fauna des Altvaters, p. 65. (*Ctenophthalmus bisbidentatus*, syn. fide Kolenati.)
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 35. (*Ctenophthalmus bisoctodentatus.*)
1873. Ritsema, Tijds. v. Entomol., 2d ser., p. lxxxiv. (*Ctenophthalmus bisoctodentatus.*)
1874. Ritsema, Regensb. Correspondenzblatt, XXVIII, p. 77. (*Ctenophthalmus bisoctodentatus.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 184. (*Ctenophthalmus bisoctodentatus.*)
1900. Wagner, Horæ Soc. Ent. Ross., XXXV, p. 8, pl. I, fig. 2. (*Typhlopsylla bisoctodentata.*)

Host: Talpa europæa.
Habitat: Europe.

CTENOPHTHALMUS DASYCNEMUS (Rothschild) Baker.

1897. Rothschild, The Ent. Record and Journ. of Variation, IX, No. 7, pl. (*Tryphlopsylla dasycnemus.*) Hosts, "*Sorex vulgaris* and *Talpa europæa.*"
1898. Rothschild, Novitates Zool., V, p. 540, pl. XV, figs. 4, 5. (*Typhlopsylla dasycnemus.*)

Hosts: Sorex araneus and *Talpa europæa.*
Habitat: England.

CTENOPHTHALMUS FRATERNUS Baker.

1895. Baker, Canad. Ent., XXVII, p. 190. (*Typhlopsylla fraterna.*)

Host: (?)
Habitat: South Dakota.

CTENOPHTHALMUS GENALIS Baker.

1903. See p. 424.

Host: *Scalops* sp.
Habitat: Michigan.

CTENOPHTHALMUS GIGAS (Kirby) Baker.

1837. Kirby, in Richardson's Fauna Boreali-Amer., IV, p. 318, pl. VI, fig. 9. (*Pulex gigas.*)
1840. Westwood, Introd. to Mod. Classif. of Ins., II, p. 493. (*Pulex gigas.*)
1843. Denny, Ann. and Mag. Nat. Hist., XII, p. 316. (*Pulex gigas.*)
1844. Gervais, Hist. Nat. d'Ins. Aptères., III, p. 374. (*Pulex gigas.*)
1874. Ritsema, Regensb. Correspondenzblatt, XXVIII, p. 78. (*Pulex gigas.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 180. (*Pulex gigas.*)
1880. Taschenberg, Die Flöhe, p. 98. (*Pulex gigas.*)
1895. Baker, Canad. Ent., XXVII, p. 164. (*Pulex gigas.*) Host, "*Lepus sylvaticus.*"
1896. Osborn, Div. Ent. Dept. Agricl., Bull. V (n. s.), p. 152. (*Pulex gigas.*)

Host: *Lepus floridanus* subsp.
Habitat: Canada and Michigan.

CTENOPHTHALMUS INGENS (Rothschild) Baker.

1900. Rothschild, The Entom. Record. and Journ. of Variation, XII, No. 2. (*Typhlopsylla ingens.*)

Host: *Bathyergus maritimus.*
Habitat: Cape Colony.

CTENOPHTHALMUS INTERMEDIUS (Wagner) Baker.

1900. Wagner, Horae Soc. Ent. Ross., XXXV, p. 8, pl. I, fig. 9. (*Typhlopsylla intermedia.*)

Host: *Metachirus opossum.*
Habitat: Paraguay and Ecuador.

CTENOPHTHALMUS ORIENTALIS (Wagner) Baker.

1898. Wagner, Horae Soc. Ent. Ross., XXXI, p. 37, pl. X, fig. 30. (*Typhlopsylla orientalis.*) Host, "*Spermophilus* sp."

Host: *Citellus* sp.
Habitat: Gouv. Charkow, Russia.

CTENOPHTHALMUS PENTACANTHUS (Rothschild) Baker.

1897. Rothschild, The Ent. Record and Journ. of Variation, IX, No. 3. (*Typhlopsylla pentacanthus.*

1898. ROTHSCHILD, Novitates Zoologicæ, V, p. 541, pl. xv, fig. 3. (*Typhlopsylla pentacanthus.*)

Host: *Mus sylvaticus*, *Talpa europæa.*
Habitat: England.

CTENOPHTHALMUS PSEUDAGYRTES Baker.

1895. BAKER, Canad. Ent., XXVII, p. 190 (*Typhlopsylla assimilis*)—not of Taschberg. Host, *Scalops* "*argentatus.*"
1898. BAKER, Journ. N. Y. Ent. Soc., (*Typhlopsylla assimilis* var.?)
1903. BAKER, see p. 421.

Hosts: *Scalops argentatus.*
Habitat: Iowa and Michigan.

CTENOPHTHALMUS SETOSA (Wagner) Baker.

1898. WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 37, pl. x, fig. 78. (*Typhlopsylla setosa.*) Host, "*Spermophilus* sp."

Host: *Citellus* sp.
Habitat: Southeastern Russia.

CTENOPHTHALMUS SIBIRICA (Wagner) Baker.

1900. WAGNER, Horæ Soc. Ent. Ross., XXXV, p. 10. (*Typhlopsylla sibirica.*)

Host: *Spalax* sp.?
Habitat: Transbaikalia.

CTENOPHTHALMUS TRISTIS (Rothschild) Baker.

1900. ROTHSCHILD, The Entom. Record and Journ. of Variation, XII, no. 2, fig. 1. (*Typhlopsylla tristis.*)

Host: *Petaurus australis.*
Habitat: Victoria, Australia.

CTENOPHTHALMUS TYPHLUS (Motschulsky) Baker.

1840. MOTSCHULSKY, Bull. Soc. imp. Moscow, p. 169, fig. (*Pulex typhlus.*)
1874. RITSEMA, Regensb. Corresp., XXVIII, p. 79. (*Pulex typhlus.*)
1880. RITSEMA, Zeitschr. f. ges Naturwiss., LIII, p. 183. (*Pulex typhlus.*)
1880. TASCHENBERG, Die Flöhe, p. 94. (*Typhlopsylla caucasica.*)
1895. BAKER, Canad. Ent., XXVII, p. 190. (*Typhlopsylla caucasica.*)
1898. WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 35. (*Typhlopsylla caucasica.*)

Host: *Spalax* sp.
Habitat: Caucasian steppes.

CTENOPHTHALMUS UNCINATA (Wagner) Baker.

1898. WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 590, pl. x, fig. 29. (*Typhlopsylla uncinata.*) Host, "*Putorius vulgaris.*"

Host: *Putorius nivalis.*
Habitat: Gouv. Lublin, Russia.

Genus ANOMIOPSYLLUS Baker.

ANOMIOPSYLLUS NUDATUS Baker.

1898. Baker, Journ. N. Y. Ent. Soc., VI, p. 56. (*Typhlopsylla nudata.*)

Host: *Neotoma albigula.*
Habitat: Arizona.

Genus CTENOPSYLLUS Kolenati.

CTENOPSYLLUS ALPINUS (Baker) Wagner.

1895. Baker, Canad. Ent., XXVII, p. 100. (*Typhlopsylla alpina.*)
1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 577.

Host: *Neotoma* sp.
Habitat: Colorado.

CTENOPSYLLUS BIDENTATUS (Kolenati) Wagner.

1860. Kolenati, Monog. der Europ. Chirop., p. 147. (*Ctenophthalmus bidentatus.*)
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 38.
1893. Wagner, Horæ Soc. Ent. Ross., XXVII, p. 351.

Host: (?)
Habitat: Europe.

CTENOPSYLLUS GRACILIS (Taschenberg) Baker.

1880. Taschenberg, Die Flöhe, p. 96. (*Typhlopsylla gracilis*, exc. syn.) Hosts, "*Talpa europæa* and *Sorex vulgaris.*"
1895. Baker, Canad. Ent., XXVII, p. 190. (*Typhlopsylla gracilis.*)

Hosts: *Talpa europæa* and *Sorex araneus.*
Habitat: Europe.

CTENOPSYLLUS HESPEROMYS Baker.

1903. Baker. See p. 428.

Host: *Peromyscus* sp.
Habitat: Franconia, New Hampshire.

CTENOPSYLLUS MEXICANUS Baker.

1896. Baker, Canad. Ent., XXVIII, p. 85. (*Typhlopsylla mexicana.*)

Host: *Mus rattus.*
Habitat: Mexico.

CTENOPSYLLUS MUSCULI (Duges) Wagner.

1832. Duges, Ann. d. Sci. Nat., XXVIII, p. 163. (*Pulex musculi.*)
1835. Bouché, Nov. Act. Acad. Leop. Carol., XVII, p. 208. (*Pulex musculi.*)
1844. Gervais, Hist. Nat. d. Ins. Aptères, III, p. 374. (*Pulex musculi.*)
1856. Walker, Insect. Brit., Diptera, III, p. 4. (*Pulex musculi.*)
1856. Kolenati, Parasiten d. Chirop., p. 33. (*Ctenophthalmus musculi.*)
1859. Kolenati, Fauna d. Alvaters, p. 65. (*Ctenophthalmus quadridentatus.*)
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 37. (*Ctenopsyllus quadridentatus.*)

1873. Kolenati, Tijds. v. Entomol., LXXXV. (*Ctenopsyllus quadridentatus.*)
1874. Ritsema, Regensb. Corresp., XXVIII, p. 78. (*Pulex musculi.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 182. (*Pulex musculi.*)
1880. Taschenberg, Die Flöhe, p. 92, pl. IV, fig. 25. (*Typhlopsylla musculi.*) Hosts, "*Mus musculus, M. agrarius, M. decumanus,* and *M. rattus.*"
1895. Baker, Canad. Ent., XXVII, p. 190. (*Typhlopsylla musculi.*)
1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 577.

Host: *Mus musculus, M. agrarius, M. norvegicus,* and *M. rattus.*
Habitat: Europe.

CTENOPSYLLUS PECTINICEPS Wagner.

1893. Wagner, Horæ Soc. Ent. Ross., XXVII, p. 347, pl. VI, figs. 2–3. (*Typhlopsylla pectiniceps*). Host, "*Arvicola œconomus.*"
1898. Baker, Journ. N. Y. Ent. Soc., VI, p. 55. (*Typhlopsylla pectiniceps.*)

Host: *Microtus œconomus.*
Habitat: Transbaikalia.

CTENOPSYLLUS SIBIRICUS Wagner.

1852. Grube, Middendorf's Sibirische Reise, II, Pt. 1, p. 500. (*Pulex penicilliger* as to female only.)
1898. Wagner, Horæ Soc. Ent. Ross, XXXI, p. 24, pl. VIII, figs. 13–14. Hosts, "*Putorius sibiricus* and *P. vulgaris.*"

Hosts: *Putorius sibiricus* and *P. nivalis.*

CTENOPSYLLUS SILVATICUS (Meinert) Baker.

1896. Meinert, Entom. Meddels. 5 Bd. (*Typhlopsylla silvatica.*)

Host: (?)
Habitat: Europe.

CTENOPSYLLUS SPECTABILIS (Rothschild) Baker.

1898. Rothschild, The Entom. Record and Journ. of Variation, X, no. 10, fig. (*Typhlopsylla spectabilis.*) Host, "*Hypudæus glareolus.*"

Host: *Evotomys hercynicus brittanicus.*
Habitat: England.

CTENOPSYLLUS TASCHENBERGI Wagner.

1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 577.

Host: *Mus musculus.*
Habitat: Russia.

Genus STEPHANOCIRCUS Skuse.

STEPHANOCIRCUS DASYURI Skuse.

1890. Skuse, Records of Australian Museum, II, p. 77, Sydney, Sept.
1895. Baker, Canad. Ent., XXVII, p. 63.

Host: *Dasyurus maculatus.*
Habitat: New South Wales.

STEPHANOCIRCUS MARS Rothschild.

1898. Rothschild, Novitates Zoologicæ, V, p. 544, pl. xvi, fig. 11.

Host: "*Hesperomys*" sp.
Habitat: Argentina.

Genus HYSTRICHOPSYLLA Taschenberg.

HYSTRICHOPSYLLA AMERICANA Baker.

1899. Baker, Ent. News, Feb., p. 37. Host, "*Evotomys* sp."

Host: Evotomys gapperi.
Habitat: Maine.

HYSTRICHOPSYLLA TALPÆ (Curtis) Rothschild.

1826. Curtis, Brit. Ent., III, no. 114, fig. (*Pulex talpæ.*)
1844. Gervais, Hist. Nat. d. Ins. Aptères, III, p. 373. (*Pulex talpæ.*)
1856. Walker, Ins. Brit., Diptera, III, p. 4. (*Pulex talpæ.*)
1858. Bouillon, Ann. d. la Soc. Ent. Belge., II, p. 187. (*Pulex talpæ.*)
1868. Ritsema, Tijdschrift voor Entomol., 2 ser., III, p. 173. (*Pulex talpæ.*)
1873. Ritsema, Tijds. voor Entomol., p. lxxxiv. (*Pulex talpæ.*)
1874. Ritsema, Regenst. Corresp., XXVII, p. 76. (*Pulex talpæ.*)
1878. Ritsema, Tijds. voor Entomol., XVII, p. lxxiii. (*Pulex talpæ.*)
1880. Ritsema, Zeitschr. f. ges Naturwiss., LIII, p. 182. (*Pulex talpæ.*)
1880. Taschenberg, Die Flöhe, p. 83, pl. iii, fig. 21. (*Hystrichopsylla obtusiceps.*)
1895. Baker, Canad. Ent., XXVII, p. 186. (*Hystrichopsylla obtusiceps.*)
1900. Rothschild, The Entom. Record and Journ. of Variation, XII, no. 11, p. 257, pl. x. Hosts, "*Talpa europæa, Sorex vulgaris, Crossopus ciliatus, Mus sylvaticus, Hypudæus glareolus, Mustela vulgaris, Mustela erminea.*"

Hosts: Talpa europæa, Sorex araneus, Neomys fodiens, Mus sylvaticus, Evotomys hercynicus, Putorius nivalis, and *Putorius erminea.*
Habitat: Europe.

Genus CERATOPSYLLUS Kolenati.

CERATOPSYLLUS DICTENUS Kolenati.

1856. Kolenati, Paras. d. Chiropt., p. 32.
1857. Kolenati, Wiener Ent. Monats., p. 66.
1860. Kolenati, Monogr. d. europ. Chiropt., p. 58.
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 43, fig. 13. Host, "*Vesperugo discolor.*"
1874. Ritsema, Regensb. Corresp., XXVIII, p. 79.
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 184.
1880. Taschenberg, Die Flöhe, p. 91. (*Typhlopsylla dictenus.*)
1895. Baker, Canad. Ent., XXVII, p. 190. (*Typhlopsylla dictenus.*)

Host: Vespertilio murinus.
Habitat: Russia.

CERATOPSYLLUS ELONGATUS (Curtis) Rothschild.

1829. Curtis, Guide Gen., p. 36. (*Ceratophyllus elongatus.*) Host, "*Vesperugo noctula.*"
1844. Gervais, Hist. Nat. d. Ins. Aptères., III, p. 372. (*Pulex elongatus.*)
1832. Curtis, Brit. Entom., IX, No. 417, fig. (*Ceratophyllus elongatus.*)

1874. RITSEMA, Regensb. Corresp., XXVIII, p. 78. (*Ceratophyllus elongatus.*)
1880. RITSEMA, Zeitschr. f. ges. Naturwiss., LIII, p. 182. (*Ceratophyllus elongatus.*)
1898. WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 32, pl. IX, fig. 5. (*Ceratopsylla subobscura.*)
1898. ROTHSCHILD, Novitates Zool., V, p. 542, pl. XVI, figs. 6, 8, 10.

Host: Pterygistes noctula.
Habitat: Europe.

CERATOPSYLLUS HEXACTENUS Kolenati.

1856. KOLENATI, Paras. d. Chiropt., p. 51.
1857. KOLENATI, Wiener Ent. Monats., I, p. 66.
1860. KOLENATI, Monog. d. europ. Chiropt., pp. 122, 131, 138, and 142.
1863. KOLENATI, Horæ Soc. Ent. Ross., II, p. 41, fig. 11. Hosts, "*Plecotus auritus, Vesperugo discolor, Rhinolophus hipposideros, Synotus barbastellus, Vespertilio murinus, Vespertilio capacinii.*"
1873. RITSEMA, Tijds. v. Entomol., p. lxxxv.
1874. RITSEMA, Regensb. Corresp., XXVIII, p. 79.
1880. RITSEMA, Zeitschr. f. ges. Naturwiss., LIII, p. 184.
1880. TASCHENBERG, Die Flöhe, p. 89. (*Typhlopsylla hexactena.*)
1895. BAKER, Canad. Ent., XXVII, p. 189. (*Typhlopsylla hexactenus.*)
1898. WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 31, pl. IX, fig. 19.

Hosts: Plecotus auritus, Vespertilio murinus, Rhinolophus hipposideros, Barbastella barbastellus, Myotis myotis, and *Myotis capacinii.*
Habitat: Europe.

CERATOPSYLLUS INCERTUS Rothschild.

1900. ROTHSCHILD, The Entom. Record and Journ. of Variation, XII. No. 2.

Hosts: Nyctinomus jugularis and *N. brachypterus.*
Habitat: Madagascar and Sierra Leone.

CERATOPSYLLUS INTERMEDIUS Rothschild.

1898. ROTHSCHILD, Novitates Zoologicæ, V, p. 543, pl. XVII, fig. 15. Host, "*Vesperugo serotinus.*"

Host: Vespertilio serotinus.
Habitat: England.

CERATOPSYLLUS JUBATUS Wagner.

1898. WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 30, pl. IX, figs. 20 and 22. Host, "*Vesperugo pipistrellus.*"
1898. ROTHSCHILD, Novitates Zoologicæ, V, p. 544.

Host: Pipistrellus pipistrellus.
Habitat: Europe.

CERATOPSYLLUS OBSCURUS Wagner.

1898. WAGNER, Horæ Soc. Ent. Ross., XXXI, p. 30. Host, "*Vesperugo discolor.*"

Host: Vespertilio murinus.
Habitat: Russia.

CERATOPSYLLUS OCTACTENUS Kolenati.

1856. Kolenati, Paras. d. Chiropt., p. 31, pl. III, fig. 31.
1857. Kolenati, Wiener Ent. Monats., I, p. 66.
1858. Kolenati, Fauna d. Altvaters, p. 65.
1860. Kolenati, Monogr. d. europ. Chiropt., pp. 51, 55, 58, 66, 77, 86, 91, 95, 115, 122, 131, and 148.
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 42, fig. 12. Hosts, "*Synotus barbastellus, Plecotus auritus, Rhinolophus hipposideros, Amblyotus atratus, Vesperugo pipistrellus, Vesperugo serotinus, Vesperugo noctula, Vesperugo discolor, Vesperugo nilssonii, Vespertilio nattereri, Vespertilio murinus, Vespertilio ciliatus,* and *Vespertilio mystacinus.*"
1873. Ritsema, Tijds. v. Entomol., p. lxxxv.
1874. Ritsema, Regensb. Corresp., XXVIII, p. 79.
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 184.
1880. Taschenberg, Die Flöhe, p. 87, pl. IV, fig. 22. (*Typhlopsylla octactenus.*)
1895. Baker, Canad. Ent., XXVII, p. 189. (*Typhlopsylla octactenus.*)
1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 26, pl. IX, fig. 16.
1898. Rothschild, Novitates Zoologicæ, V, p. 543, pl. XVI, figs. 7 and 9.

Hosts: Barbastella barbastellus, Plecotus auritus, Rhinolophus hipposideros, Amblyotus atratus, Pipistrellus pipistrellus, Vespertilio serotinus, Pterygistes noctula, Vespertilio murinus, Vespertilio nilssonii, Myotis nattereri, Myotis myotis, Myotis ciliatus, and *Myotis mystacinus.*
Habitat: Europe.

CERATOPSYLLUS PENTACTENUS Kolenati.

1856. Kolenati, Paras. d. Chiropt., p. 32. (*Ceratopsyllus pentactenus* and *C. tetractenus.*)
1857. Kolenati, Wiener Ent. Monats., I, p. 66. (*Ceratopsyllus tetractenus.*)
1860. Kolenati, Monogr. d. europ. Chiropt., pp. 58, 86, 122, 131, and 138. (*Ceratopsyllus tetractenus.*)
1863. Kolenati, Horæ Soc. Ent. Ross., II, p. 39. (*Ceratopsyllus tetractenus.*) Hosts, *Plecotus auritus, Synotus barbastellus, Vesperugo pipistrellus, Vesperugo noctula, Vesperugo discolor,* and *Vespertilio murinus.*
1873. Ritsema, Tijds. v. Entom., p. lxxxv. (*Ceratopsyllus tetractenus.*)
1874. Ritsema, Regensb. Corresp., p. 80. (*Ceratopsyllus tetractenus.*)
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 185. (*Ceratopsyllus tetractenus.*)
1880. Taschenberg, Die Flöhe, p. 90, pl. IV, fig. 24. (*Typhlopsylla pentactenus.*)
1892. Saunders, Ent. Mo. Mag., (2), III, p. 66.
1895. Baker, Canad. Ent., XXVII, p. 189. (*Typhlopsylla pentactenus.*)
1895. Rothschild, Novitates Zool., II, p. 66.

Hosts: Plecotus auritus, Barbastella barbastellus, Pipistrellus pipistrellus, Pterygistes noctula, Vespertilio murinus, and *Myotis myotis.*
Habitat: Europe.

CERATOPSYLLUS PETROPOLITANUS (Wagner) Baker.

1898. Wagner, Horae Soc. Ent. Ross., XXXI, pl. IX, fig. 18. (*Ceratopsylla hexactena* var. *petropolitana.*)

Host: A bat.
Habitat: Russia.

CERATOPSYLLUS UNIPECTINATUS (Taschenberg) Wagner.

1880. Taschenberg, Die Flöhe, p. 91. (*Typhlopsylla unipectinata.*)
1895. Baker, Canad. Ent., XXVII, p. 189. (*Typhlopsylla unipectinata.*)
1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 580.

Host: *Rhinolophus hipposideros.*
Habitat: Europe.

CERATOPSYLLUS VARIABILIS Wagner.

1898. Wagner, Horæ Soc. Ent. Ross., XXXI, p. 28, pl. IX, fig. 16. Host, "*Vesperugo nathusii.*"

Host: *Pipistrellus abramus.*
Habitat: Russia.

HOST INDEX.

Class AVES.

Aegithalos roseus ..... *Ceratophyllus gallinæ* (Schrank) Wagner.
Chloris chloris ..... *Ceratophyllus fringillæ* (Walker) Baker.
Columba livia ..... *Ceratophyllus columbæ* (Walckener and Gervais) Rothschild.
Columba oenas ..... *Ceratophyllus gallinæ* (Schrank) Wagner.
Erithacus rubecula ..... *Ceratophyllus gallinæ* (Schrank) Wagner.
Gallus domesticus ..... *Ceratophyllus gallinæ* (Schrank) Wagner.
Nestopsylla gallinacea (Westwood) Baker.
Hirundo urbica ..... *Ceratophyllus hirundinis* Curtis.
Megascops asio ..... *Ceratophyllus asio* Baker.
Meleagris gallipavo ..... *Ceratophyllus gallinæ* (Schrank) Wagner.
Nestopsylla gallinacea (Westwood) Baker.
Merula merula ..... *Ceratophyllus gallinæ* (Schrank) Wagner.
Passer domesticus ..... *Ceratophyllus fringillæ* (Walker) Baker.
Pelecanoides urinatrix ..... *Pulex kerguelensis* Taschenberg.
Psittacus sp ..... *Hectopsylla psittaci* Frauenfeld.
Riparia riparia ..... *Ceratophyllus styx* Rothschild.
Sturnus vulgaris ..... *Ceratophyllus sturni* (Gervais) Baker.

Class MAMMALIA.

Order MONOTREMATA.

Tachyglossus aculeatus ..... *Echidnophaga ambulans* Olliff.
Pulex echidnæ Denny.

Order MARSUPALIA.

Dasyurus maculatus ..... *Stephanocircus dasyuri* Skuse.
Didelphis virginiana ..... *Pulex irritans* Linnæus, var. *simulans* Baker.
Metachirus opossum ..... *Ctenophthalmus intermedius* (Wagner) Baker.
Petaurus australis ..... *Ctenophthalmus tristis* (Rothschild) Baker.

Order EDENTATA.

Zaëdyus minutus ..... *Megapsylla grossiventris* (Weyenberg) Baker.

Order GLIRES.

Family LEPORIDÆ.

Lepus cuniculus	*Pulex leporis* (Leach) Baker.
Lepus floridanus sub sp.	*Ceratophyllus multispinosus* Baker.
	Pulex inaequalis Baker.
	Pulex simplex Baker.
Lepus "glacialis"	*Pulex glacialis* Taschenberg.
Lepus timidus	*Ctenocephalus canis* (Curtis) Baker.
	Pulex leporis (Leach) Baker.
Lepus sp	*Pulex affinis* Baker.

Family OCHOTONIDÆ (Lagomyidæ).

Ochotona rutilus	*Ceratophyllus lagomys* Wagner.
Ochotona sp.?	*Ceratophyllus subarmatus* Wagner.
	Ctenophthalmus altaica (Wagner) Baker.

Family DIPODIDÆ.

Alactaga jaculus	*Pulex jaculans* Motschulsky.

Family GEOMYIDÆ.

Geomys bursarius	*Ceratophyllus ignotus* (Baker) Wagner.
Thomomys talpoides	*Ceratophyllus ignotus* (Baker) Wagner.

Family SPALACIDÆ.

Bathyergus maritimus	*Ctenophthalmus ingens* (Rothschild) Baker.
Spalax sp	*Ctenophthalmus sibirica* (Wagner) Baker.
Spalax sp	*Ctenophthalmus typhlus* (Motschulsky) Baker.

Family MURIDÆ.

Cricetus cricetus	*Ceratophyllus fasciatus* (Bosc) Curtis.
Evotomys gapperi	*Hystrichopsylla americana* Baker.
Evotomys hercynicus	*Ctenophthalmus agyrtes* (Heller) Baker.
	Ctenopsyllus spectabilis (Rothschild) Baker.
	Hystrichopsylla talpæ (Curtis) Rothschild.
"Hesperomys" sp.	*Stephanocircus mars* Rothschild.
Lemmus sp.	*Pulex lemmus* Motschulsky.
Microtus amphibius	*Ctenophthalmus agyrtes* (Heller) Baker.
Microtus arvalis	*Ctenophthalmus assimilis* (Taschenberg) Baker.
	Hystrichopsylla talpæ (Curtis) Rothschild.
Microtus californicus	*Ceratophyllus californicus* Baker.
Microtus oeconomus	*Ctenopsyllus pectiniceps* Wagner.
Microtus sp	*Ceratophyllus consimilis* Wagner.
Mus agrarius	*Ctenopsyllus musculi* (Duges) Wagner.
Mus albipes	*Pulex pallidus* Taschenberg.
Mus musculus	*Ceratophyllus fasciatus* (Bosc) Curtis.
	Ctenopsyllus musculi (Duges) Wagner.
	Ctenopsyllus taschenbergi Wagner.
Mus norvegicus	*Ceratophyllus fasciatus* (Bosc) Curtis.
	Ctenophthalmus bidentatiformis (Wagner) Baker.
	Ctenopsyllus musculi (Duges) Wagner.
	Pulex brasiliensis Baker.

Mus rattus	*Ctenopsyllus mexicanus* Baker.
	Ctenopsyllus musculi (Duges) Wagner.
	Pulex brasiliensis Baker.
Mus sylvaticus	*Ceratophyllus gallinæ* (Schrank) Wagner.
	Ctenophthalmus agyrtes (Heller) Baker.
	Ctenophthalmus assimilis (Taschenberg) Baker.
	Ctenophthalmus pentacanthus (Rothschild) Baker.
	Ctenopsyllus musculi (Duges) Wagner.
	Hystrichopsylla talpæ (Curtis) Rothschild.
Neotoma albigula	*Inomiopsyllus nudatus* Baker.
Neotoma spp	*Ceratophyllus sexdentatus* Baker.
	Ctenopsyllus alpinus (Baker) Wagner.
Peromyscus eremicus	*Ceratophyllus eremicus* Baker.
Peromyscus leucopus	*Ceratophyllus leucopus* Baker.
Peromyscus keeni	*Ceratophyllus keeni* Baker.
Peromyscus sp	*Ceratophyllus wagneri* Baker.
Peromyscus sp	*Ctenopsyllus hesperomys* Baker.

Family MYOXIDÆ.

Eliomys quercinus	*Ceratophyllus fasciatus* (Bosc) Curtis.
Glis nitedula	*Ceratophyllus dryas* (Wagner) Baker.

Family APLODONTIIDÆ.

Aplodontia rufa	*Ceratophyllus stylosus* Baker.

Family SCIURIDÆ.

Arctomys bobac	*Ceratophyllus silantiewii* Wagner.
Arctomys monax	*Ceratophyllus arctomys* Baker.
	Ceratophyllus pseudarctomys Baker.
	Ceratophyllus wickhami (Baker) Wagner.
Citellus columbianus	*Ceratophyllus braueri* (Baker) Wagner.
	Ceratophyllus idahoensis Baker.
	Ceratophyllus tuberculatus Baker.
Citellus empetra	*Ceratophyllus alaskensis* Baker.
Citellus franklinii	*Ceratophyllus braueri* (Baker) Wagner.
Citellus guttatus	*Ceratophyllus tesquorum* Wagner.
Citellus macrourus	*Pulex dugesii* Baker.
Citellus musicus	*Ceratophyllus tesquorum* Wagner.
Citellus 13-lineatus	*Ceratophyllus braueri* (Baker) Wagner.
Citellus spp	*Ceratophyllus proximus* Baker.
	Ctenophthalmus orientalis (Wagner) Baker.
	Ctenophthalmus setosa (Wagner) Baker.
	Pulex anomalus Baker.
Cynomys ludovicianus	*Ceratophyllus hirsutus* (Baker) Wagner.
Eutamias sp	*Ceratophyllus ciliatus* Baker.
Sciuropterus russicus	*Ceratophyllus armatus* Wagner.
	Ceratophyllus tollii Wagner.
Sciuropterus volans	*Ceratophyllus wickhami* (Baker) Wagner.
Sciurus aberti	*Ceratophyllus montanus* (Baker) Wagner.
Sciurus carolinensis	*Ceratophyllus wickhami* (Baker) Wagner.

Sciurus fremonti	*Ceratophyllus coloradensis* (Baker) Wagner.
	Ceratophyllus divisus Baker.
	Ceratophyllus lucidus Baker.
Sciurus hudsonicus	*Ceratophyllus wickhami* (Baker) Wagner.
Sciurus vulgaris	*Ceratophyllus sciurorum* (Schrank) Curtis.

Order INSECTIVORA.

Family TENRECIDÆ.

Tenrec ecaudatus	*Pulex madagascariensis* Rothschild.

Family SORICIDÆ.

Crocidura aranea	*Ctenophthalmus assimilis* (Taschenberg) Baker.
	Ctenopsyllus gracilis (Taschenberg) Baker.
Neomys fodiens	*Ctenophthalmus agyrtes* (Heller) Baker.
	Hystrichopsylla talpæ (Curtis) Rothschild.
Sorex alpinus	*Ctenophthalmus assimilis* (Taschenberg) Baker.
	Ctenopsyllus gracilis (Taschenberg) Wagner.
Sorex araneus	*Ctenophthalmus agyrtes* (Heller) Baker.
	Ctenophthalmus assimilis (Taschenberg) Baker.
	Ctenophthalmus dasycnemus (Rothschild) Baker.
	Ctenopsyllus gracilis (Taschenberg) Wagner.
	Hystrichopsylla talpæ (Curtis) Rothschild.

Family TALPIDÆ.

Scalops argentatus	*Ctenophthalmus genalis* Baker.
	Ctenophthalmus pseudagyrtes Baker.
Talpa europæa	*Ctenophthalmus agyrtes* (Heller) Baker.
	Ctenophthalmus assimilis (Taschenberg) Baker.
	Ctenophthalmus bisoctodentatus Kolenati.
	Ctenophthalmus dasycnemus (Rothschild) Baker.
	Ctenophthalmus pentacanthus (Rothschild) Baker.
	Ctenopsyllus gracilis (Taschenberg) Baker.
	Ceratophyllus fasciatus (Bosc) Curtis.
	Hystrichopsylla talpæ (Curtis) Rothschild.

Family ERINACEIDÆ.

Erinaceus europæus	*Ctenocephalus erinacei* (Leach) Baker.
	Pulex cuspidatus Kolenati.
	Pulex longispinus Wagner.

Order CHIROPTERA.

Amblyotus atratus	*Ceratopsyllus octactenus* Kolenati.
Barbastella barbastellus	*Ceratopsyllus hexactenus* Kolenati.
	Ceratopsyllus octactenus Kolenati.
	Ceratopsyllus pentactenus Kolenati.
Myotis capacinii	*Ceratopsyllus hexactenus* Kolenati.
Myotis ciliatus	*Ceratopsyllus octactenus* Kolenati.
Myotis myotis	*Ceratopsyllus hexactenus* Kolenati.
	Ceratopsyllus octactenus Kolenati.
	Ceratopsyllus pentactenus Kolenati.
Myotis mystacinus	*Ceratopsyllus octactenus* Kolenati.
Myotis nattereri	*Ceratopsyllus octactenus* Kolenati.

Nyctinomus sp	*Hectopsylla psittaci* Frauenfeld.
Nyctinomus brachypterus	*Ceratopsyllus incertus* Rothschild.
Nyctinomus jugularis	*Ceratopsyllus incertus* Rothschild.
Pipistrellus abramus	*Ceratopsyllus variabilis* Wagner.
Pipistrellus pipistrellus	*Ceratopsyllus jubatus* Wagner.
	Ceratopsyllus octactenus Kolenati.
	Ceratopsyllus pentactenus Kolenati.
Plecotus auritus	*Ceratopsyllus hexactenus* Kolenati.
	Ceratopsyllus octactenus Kolenati.
	Ceratopsyllus pentactenus Kolenati.
Pterygistes noctula	*Ceratopsyllus elongatus* (Curtis) Rothschild.
	Ceratopsyllus octactenus Kolenati.
	Ceratopsyllus pentactenus Kolenati.
	Ceratopsyllus gallinæ (Schrank) Wagner.
Rhinolophus hipposideros	*Ceratopsyllus hexactenus* Kolenati.
	Ceratopsyllus octactenus Kolenati.
	Ceratopsyllus unipectinata Taschenberg.
Rousettus ægyptiacus	*Ceratophyllus metallescens* (Kolenati) Baker.
Vespertilio murinus	*Ceratopsyllus dictenus* Kolenati.
	Ceratopsyllus hexactenus Kolenati.
	Ceratopsyllus obscurus Wagner.
	Ceratopsyllus octactenus Kolenati.
	Ceratopsyllus pentactenus Kolenati.
Vespertilio nilssonii	*Ceratopsyllus octactenus* Kolenati.
Vespertilio serotinus	*Ceratopsyllus intermedius* Rothschild.
	Ceratopsyllus octactenus Kolenati.

Order UNGULATA.

Family SUIDÆ.

Sus scrofa	*Sarcopsylla penetrans* (Linnaeus) Westwood.

Family BOVIDÆ.

Bos taurus	*Sarcopsylla penetrans* (Linnaeus) Westwood.
	Vermipsylla alacurt Schrank.
	Xestopsylla gallinacea (Westwood) Baker.
Capra hircus	*Sarcopsylla penetrans* (Linnaeus) Westwood.
	Vermipsylla alacurt Schrank.
Ovis aries	*Sarcopsylla penetrans* (Linnaeus) Westwood.
	Vermipsylla alacurt Schrank.

Family EQUIDÆ.

Equus spp	*Sarcopsylla penetrans* (Linnæus) Westwood.
	Vermipsylla alacurt Schrank.
	Xestopsylla gallinacea (Linnæus) Baker.

Order FERÆ.

Family PROCYONIDÆ.

Procyon lotor	*Ctenocephalus canis* (Curtis) Baker.

Family URSIDÆ.

Ursus arctos	*Pulex tuberculaticeps* Bezzi.

Family MUSTELIDÆ.

Grison vittata	*Pulex lutzii* Baker.
Meles meles	*Ceratophyllus melis* Curtis.
	Pulex vulpes Motschulsky.
Putorius erminea	*Hystrichopsylla talpæ* (Curtis) Rothschild.
Putorius nivalis	*Ceratophyllus mustelæ* Wagner.
	Ctenophthalmus uncinata (Wagner) Baker.
	Ctenopsyllus sibiricus Wagner.
	Hystrichopsylla talpæ (Curtis) Rothschild.
Putorius sibirica	*Ceratophyllus pencilliger* (Grube) Wagner.
	Ctenopsyllus sibiricus Wagner.
Putorius vison	*Ceratophyllus oculatus* Baker.
	Ceratophyllus vison Baker.

Family VIVERRIDÆ.

Herpestes ichneumon	*Ctenocephalus canis* (Curtis) Baker.
	Pulex pallidus Taschenberg.

Family HYÆNIDÆ.

Hyæna striata	*Ctenocephalus canis* (Curtis) Baker.
	Pulex hyænæ Kolenati.

Family CANIDÆ.

Canis familiaris	*Ctenocephalus canis* (Curtis) Baker.
	Pulex irritans Linnæus.
	Sarcopsylla penetrans (Linnæus) Westwood.
	Xestopsylla gallinacea (Westwood) Baker.
Fennecus brucei	*Ctenocephalus canis* (Curtis) Baker.
Urocyon cinereoargenteus	*Ctenocephalus canis* (Curtis) Baker.
Vulpes lagopus	*Ctenocephalus canis* (Curtis) Baker.
Vulpes vulpes	*Ctenocephalus canis* (Curtis) Baker.
	Pulex vulpes Motschulsky.
Vulpes sp.	*Pulex irritans* Linnæus.

Family FELIDÆ.

Felis domestica	*Ctenocephalus canis* (Curtis) Baker.
	Pulex irritans Linnæus.
	Sarcopsylla penetrans (Linnæus) Westwood.
	Xestopsylla gallinacea (Westwood) Baker.
Felis leo	*Sarcopsylla penetrans* (Linnæus) Westwood.
Felis macroscelis	*Ctenocephalus canis* (Curtis) Baker.
Felis tigris	*Ctenocephalus canis* (Curtis) Baker.
Felis yaguaroundi	*Ctenocephalus canis* (Curtis) Baker.
Lynx canadensis	*Ceratophyllus dentatus* Baker.
	Ceratophyllus labiatus Baker.
	Ceratophyllus petiolatus Baker.
	Pulex lynx Baker.

Order PRIMATES.

Gorilla gorilla	*Sarcopsylla penetrans* (Linnæus) Westwood.
Homo sapiens	*Ctenocephalus canis* (Curtis) Baker.
	Pulex irritans Linnæus.
	Sarcopsylla penetrans (Linnæus) Westwood.
	Xestopsylla gallinacea (Westwood) Baker.

GEOGRAPHICAL DISTRIBUTION.

With our very incomplete knowledge of the group, any broad generalizations as to distribution must be considered as merely tentative. At this stage, however, the following observations may be of interest:

I. The Palæarctic and Nearctic regions each possess a genus not known to the other, the other genera being common to the two regions.

II. The order is very homogeneous north of the equator, very heterogeneous near to and south of it, South America furnishing the greatest number of isolated types.

III. Species peculiar to those regions have not yet been described from Central America, Polynesia, Japan, China, India, and South Africa. Unquestionably all of these regions will furnish many peculiar forms.

IV. One species has been described from Arctic regions and one from Antarctic regions.

V. The genus *Stephanocircus* is represented by two species—one Australian (on *Dasyurus*) and one South American (on "*Hesperomys*").

VI. The genus *Hystrichopsylla* contains two species—one from Europe, the other from northeast America.

VII. In America no species have been reported from the larger proportion of our native mammals, including bats, raccoon, badger, beaver, puma, muskrat, etc., though they all probably harbor fleas.

VIII. The following genera are distinctly local in distribution: *Vermipsylla*, *Echidnophaga*, *Stephanocircus*, *Megapsylla*, *Hectopsylla*, and *Anomiopsyllus*.

IX. In tropical regions four species are nearly cosmopolitan: *Pulex irritans*, *Ctenocephalus canis*, *Sarcopsylla penetrans*, and *Xestopsylla gallinacea*. The two former are also nearly cosmopolitan in temperate regions.

Statistics of families, genera, and species.

Described from—	Families.	Genera.	Species.
Europe and North Asia	2	8	65
Africa and South Asia	2	8	10
Eastern North America	2	7	17
Middle North America	2	7	25
Pacific North America	1	4	10
South America	3	8	10
Mexico	2	4	7
Australasia	1	3	6
Kerguelen Island	1	1	1
Listed by Taschenberg in 1880	2	3	33
Listed in present paper (1902)	1	14	135

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SPECIES INCERTÆ SEDIS.

CERATOPHYLLUS MURIS Curtis.

1832. CURTIS, British Entomology, IX, No. 417.
1874. RITSEMA, Regensb. Correspondenzblatt, XXVIII, p. 76.
1880. RITSEMA, Zeitschr. f. ges. Naturwiss., LIII, p. 182.

Questionably referred to *musculi* Duges by Taschenberg.

CTENOPHTHALMUS BISSEPTEMDENTATUS Kolenati.

1859. KOLENATI, Fauna d. Altvaters, p. C5 (*C. unidentatus*).
1863. KOLENATI, Horæ Soc. Ent. Ross., II, p. 36.
1873. RITSEMA, Tijdsch. v. Entomol., p. lxxxiv.
1874. RITSEMA, Regensb. Correspondenzblatt, XXVIII, p. 77.
1880. RITSEMA, Zeitschr. f. ges. Naturwiss., LIII, p. 185.

Considered by Taschenberg as questionably equivalent to his *assimilis*.

PULEX AURITUS Fabricius.

1783. FABRICIUS, Nye Samling af der Kong. Danske Vet. Sels. Skrifter., p. 309, fig.
1874. RITSEMA, Regensb. Correspondenzblatt, XXVIII, p. 77.
1880. RITSEMA, Zeitschr. f. ges. Naturwiss., LIII, p. 181.

Described from *Picus viridis* in Sweden. Evidently one of the *avium* group.

PULEX BOLETI Guerin.

1836. GUERIN, Iconogr. du règne animal. Texte explicatif. Insectes, p. 14.

Presumably an insect of some other order.

PULEX MURIS Gervais.

1844. GERVAIS, Hist. nat. d. Ins. Aptères, III, 374.

Taschenberg questions the identity of this with *musculi* of Dugès.

PULEX SEGNIS Schönherr.

1816. SCHÖNHERR, Kon. Vet. Nya Handl., XXXII, p. 98, fig.
1874. RITSEMA, Regensb. Correspondenzblatt, XXVIII, p. 76.
1880. RITSEMA, Zeitschr. f. ges. Naturwiss., LIII, p. 182.

Taschenberg also thinks that this and *musculi* Duges may possibly be the same.

PULEX TERRESTRIS Macquart.

1831. Macquart, Ann. d. Scienc. Nat., XXII, p. 465.
1844. Gervais, Hist. Nat. d. Ins. Aptères, III, p. 375.
1874. Ritsema, Regensb. Correspondenzblatt, XXVIII, p. 76.
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 182.

Listed by Taschenberg as a possible synonym of *Hystrichopsylla talpæ*.

PULEX VAGABUNDA Boheman.

1865. Boheman, Ofvers. of K. Vet. Akad. Förh., p. 576, fig.
1874. Ritsema, Regensb. Correspondenzblatt, XXVIII, p. 80.
1880. Ritsema, Zeitschr. f. ges. Naturwiss., LIII, p. 185.

Taschenberg considers this as questionably *fasciatus*.

PULEX VESPERTILIONIS Dugès.

1832. Dugès, Ann. d. Scienc. Nat., XXVII, p. 161, fig.

Considered by Taschenberg as questionably *octactenus* Kolenati.

PULEX VESPERTILIONIS Bouché.

1835. Bouché, Nov. Act. Acad. Leop. Carol., XVII, Pt. 1, p. 508.

Apparently not the same as last, and Taschenberg lists it as a possible synonym of *hexactenus* Kolenati.

APPENDIX.

Just as the foregoing paper is going to the printers I have, through the kindness of Mr. Rothschild, been enabled to examine his last two papers published during this year.

In the one entitled New British Fleas he describes *Ceratophyllus garei* from the water hen (*Gallinula chloropus*) and *Ceratophyllus walkeri* from *Putorius ermineu*, *P. nivalis*, *Sorex araneus*, *Evotomys hercynicus*, and *Microtus amphibius*.

The other paper, Some New Nearctic Fleas, is of more direct interest to us, in that three new American fleas are described.

Pulex ursi, from *Ursus horribilis*, in Alberta, Canada, is very interesting, in that it appears to be more closely related to *bohlsii* and *lutzii* than to any other North American species.

Typhlopsylla grandis, from *Tamias striatus*, in Ontario, is apparently a Ctenophthalmus, and closely related to *C. gigas*, from which it differs, among other things, in having two unequal genal spines.

Hystrichopsylla dippiei, from *Putorius longicaudus*, in Alberta, Canada, is apparently near the species already noted by me as being new. It differs from *H. americana* in having but six genal spines and thirty-six teeth in the pronotal ctenidium.

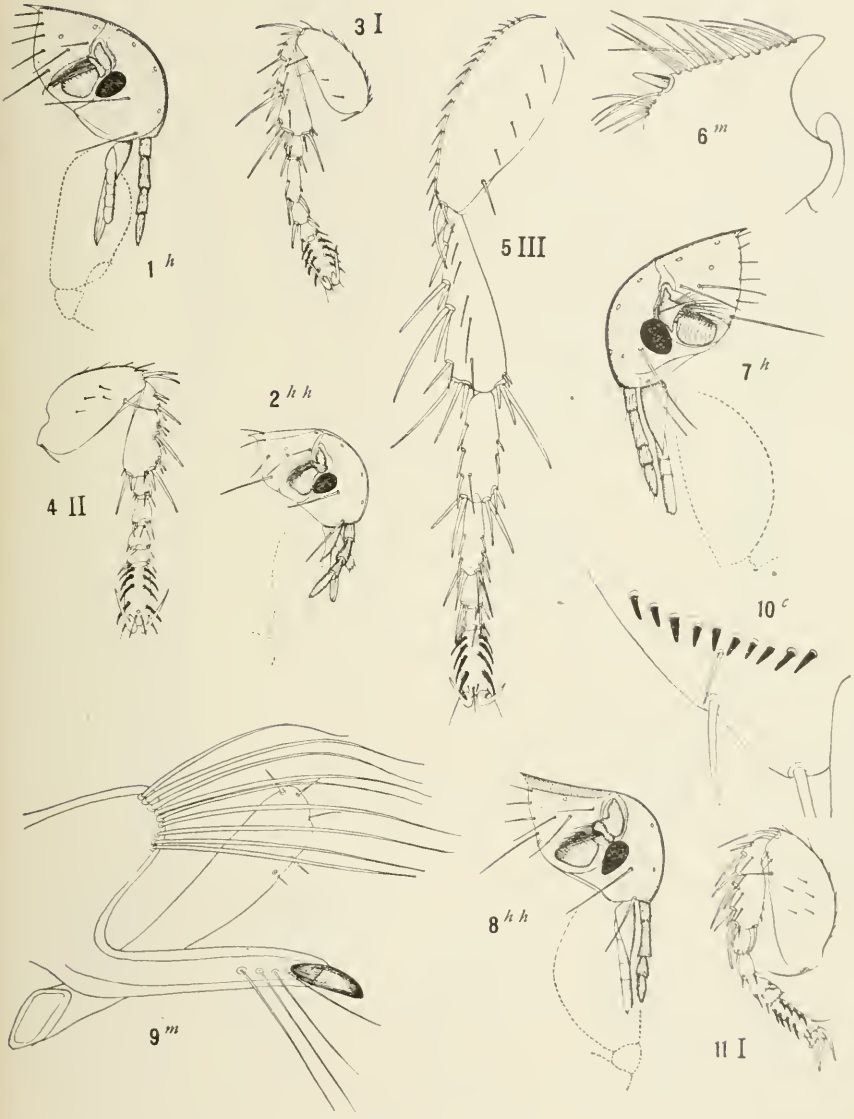
I regret not having been able to examine Mr. Enderlein's late paper, though I have made repeated endeavors to do so.

Stanford University, California, March 1, 1900.

EXPLANATION OF LETTERING ON PLATES.

h=head of female.
hh=head of male.
I=fore leg.
II=middle leg.
III=hind leg.
m=genital apparatus of male.
f=genital apparatus of female.
c=inner distal portion of hind coxa.
c=hind coxa.
t=hind tarsus.
d=dorsum of female.
dd=dorsum of male.

With but few exceptions all the figures were drawn to the same scale, and these exceptions will be apparent. For exact measurements refer to descriptions.



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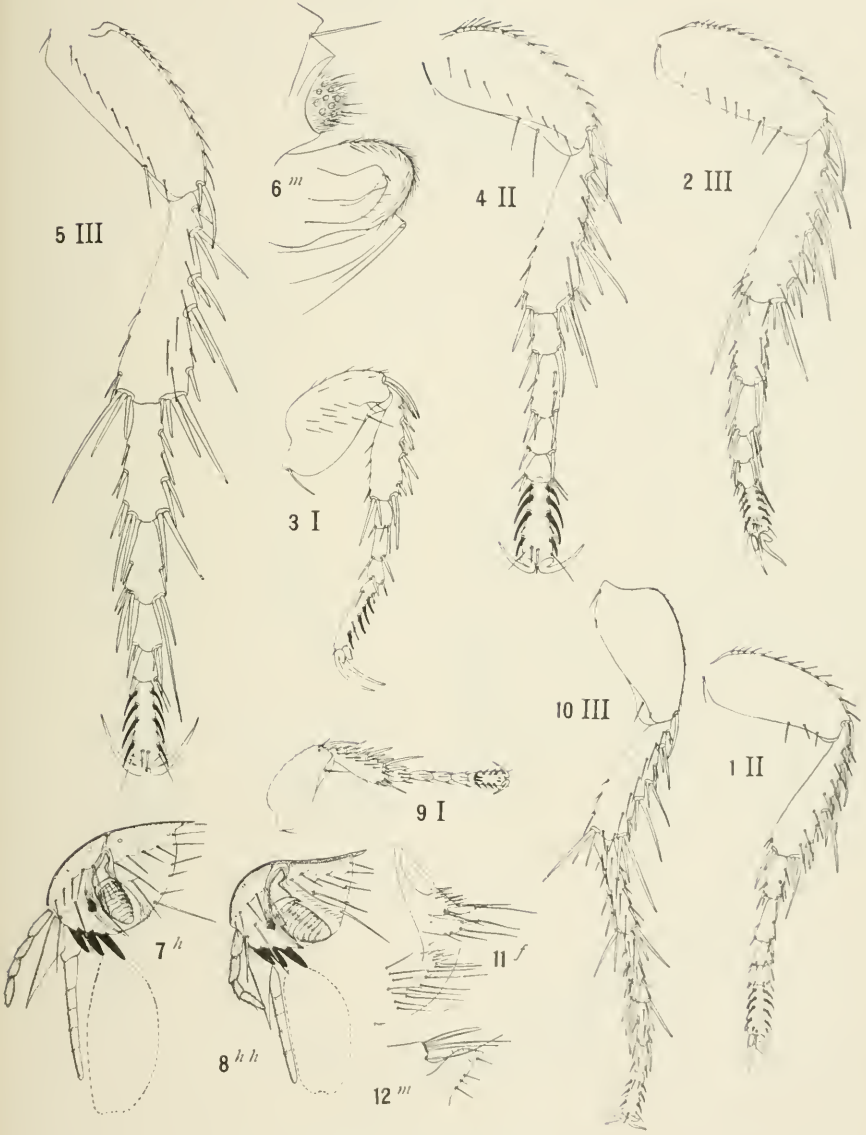

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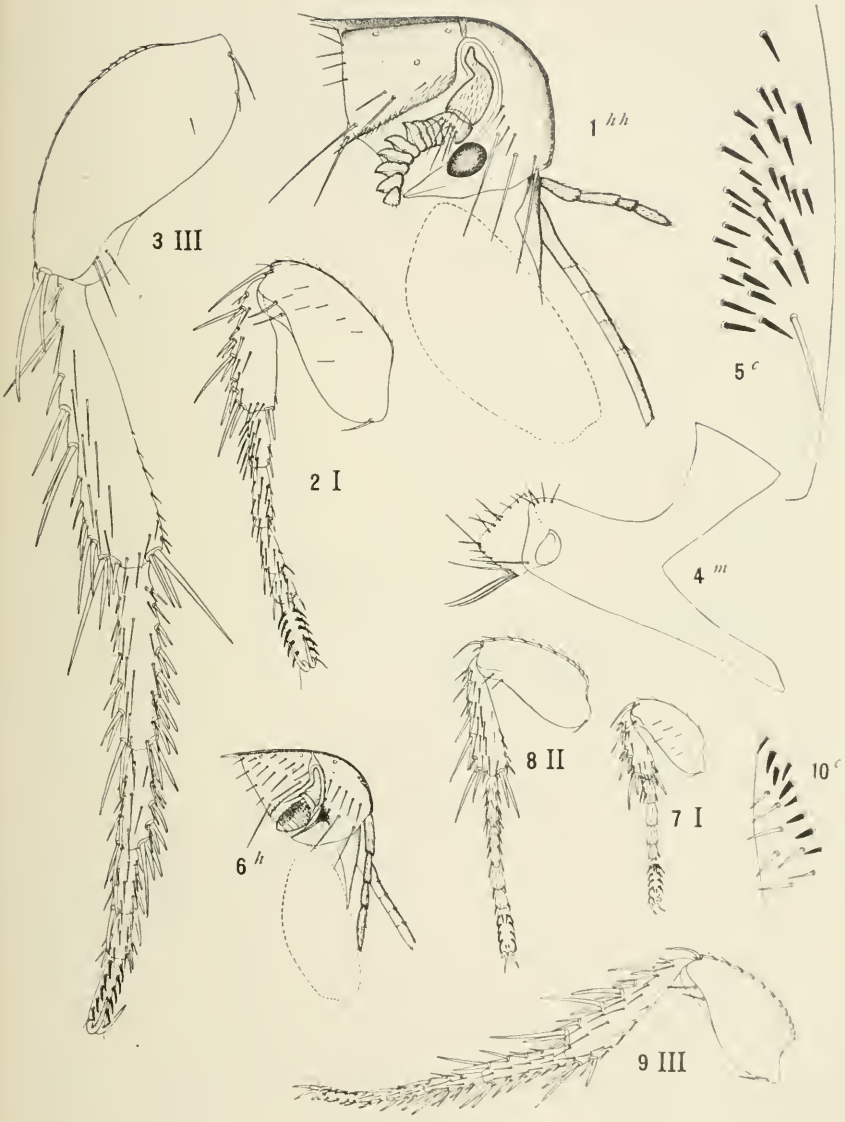

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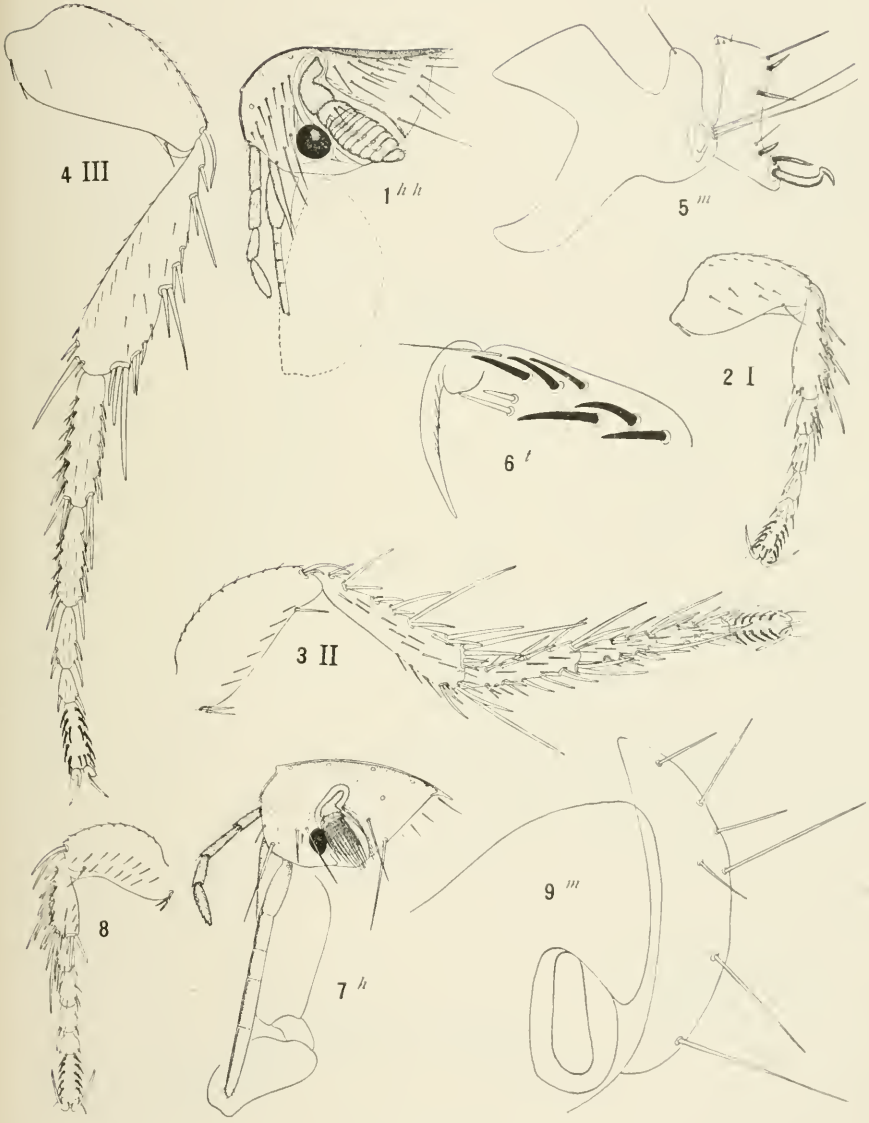

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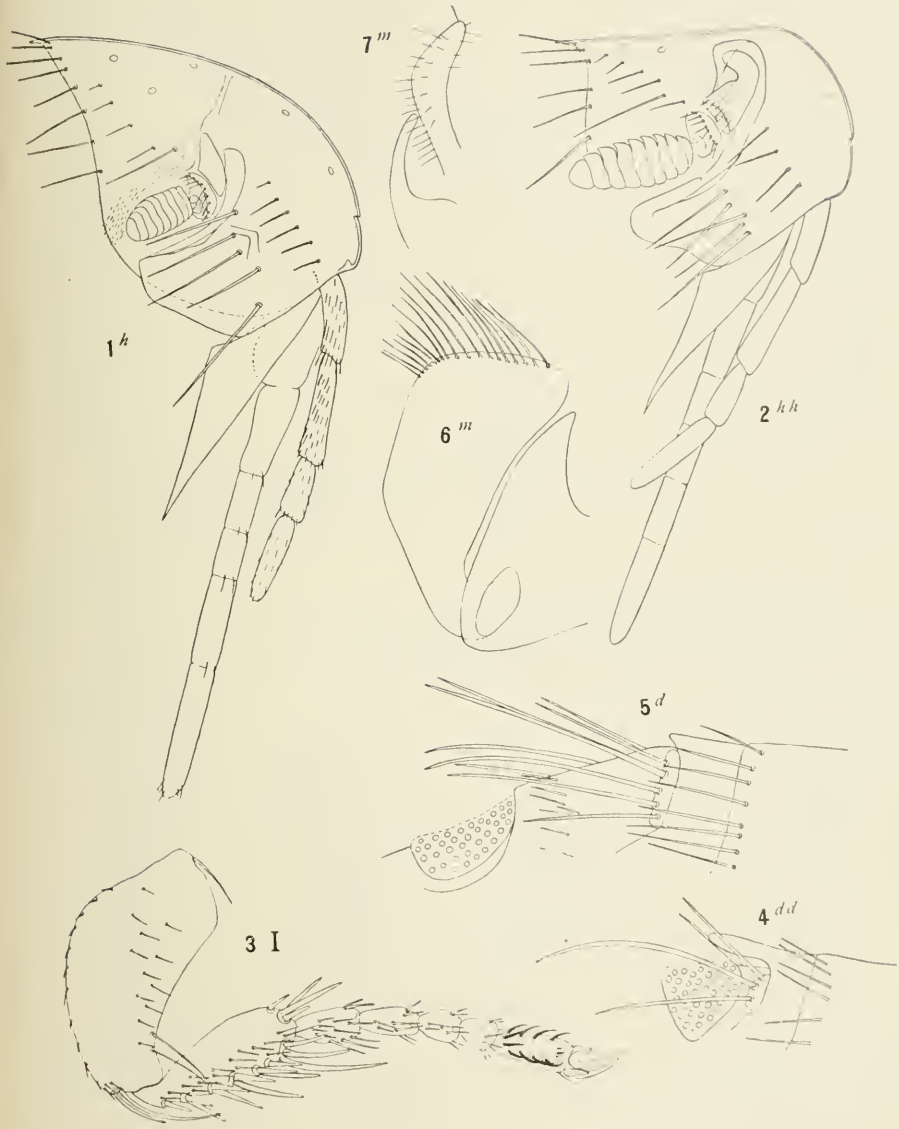

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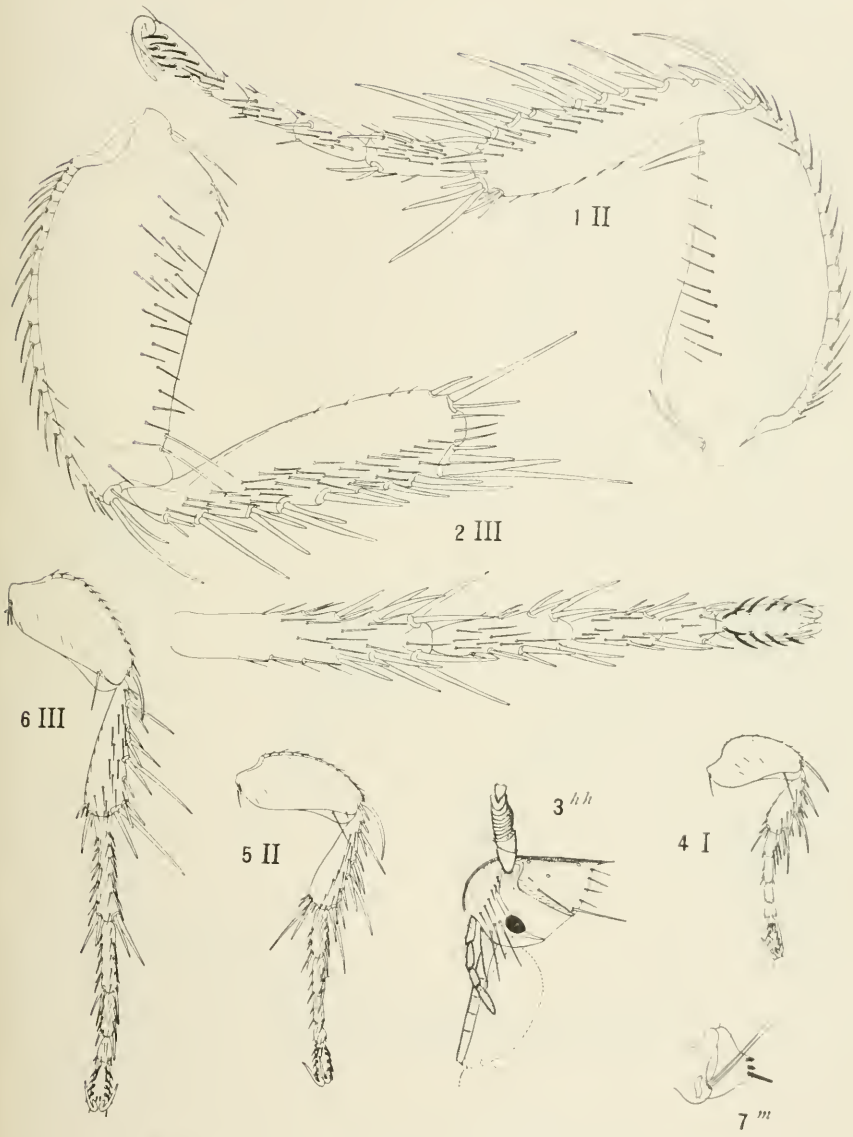

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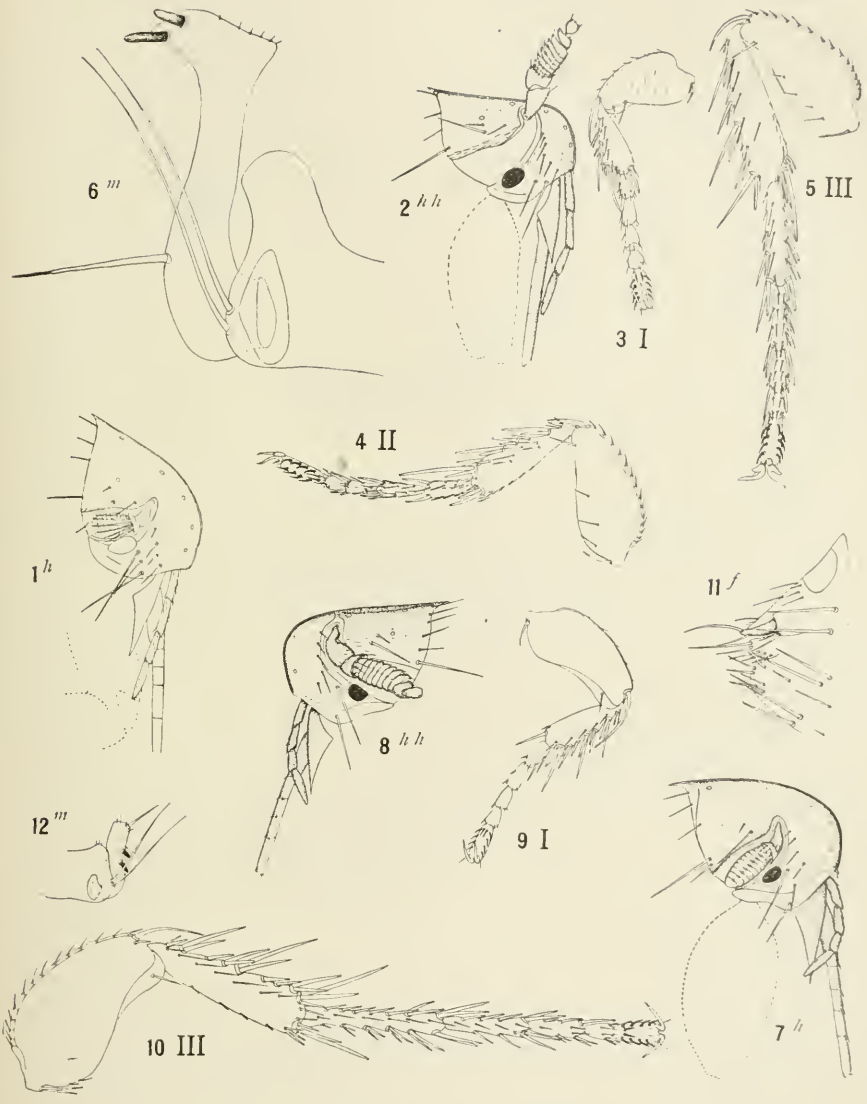

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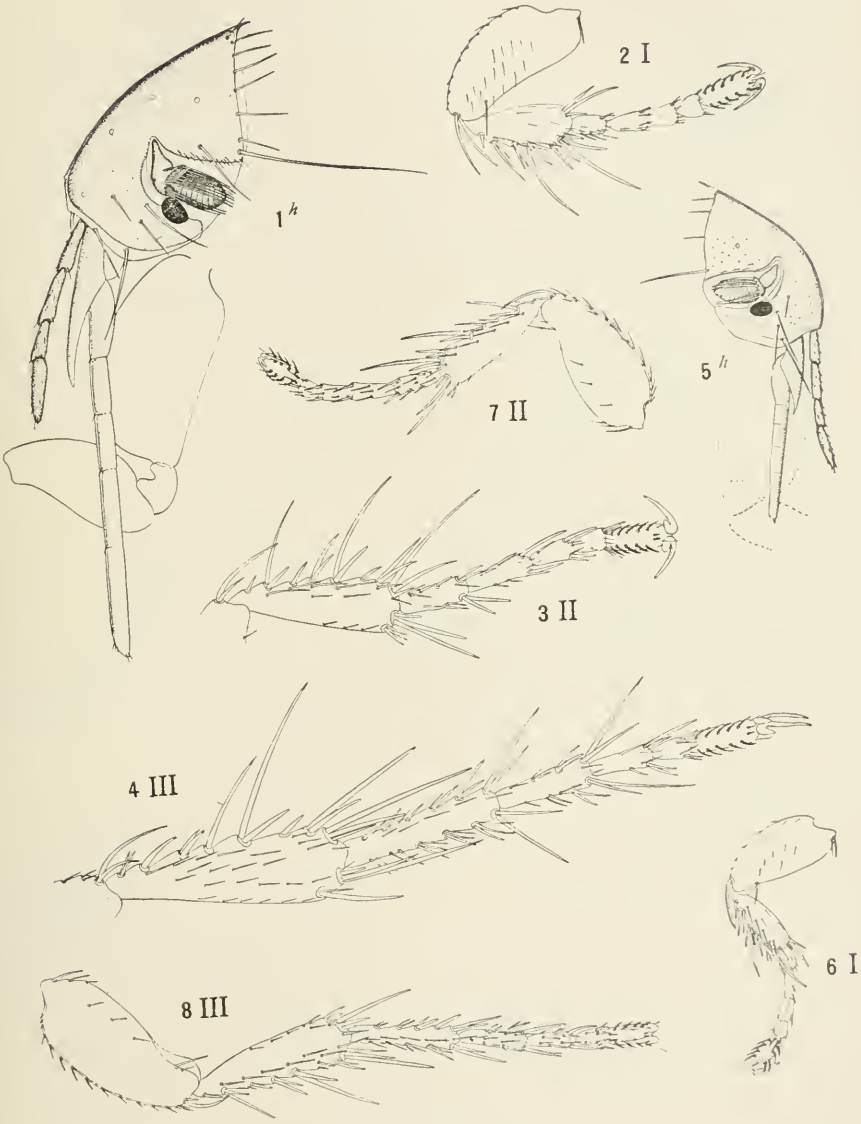

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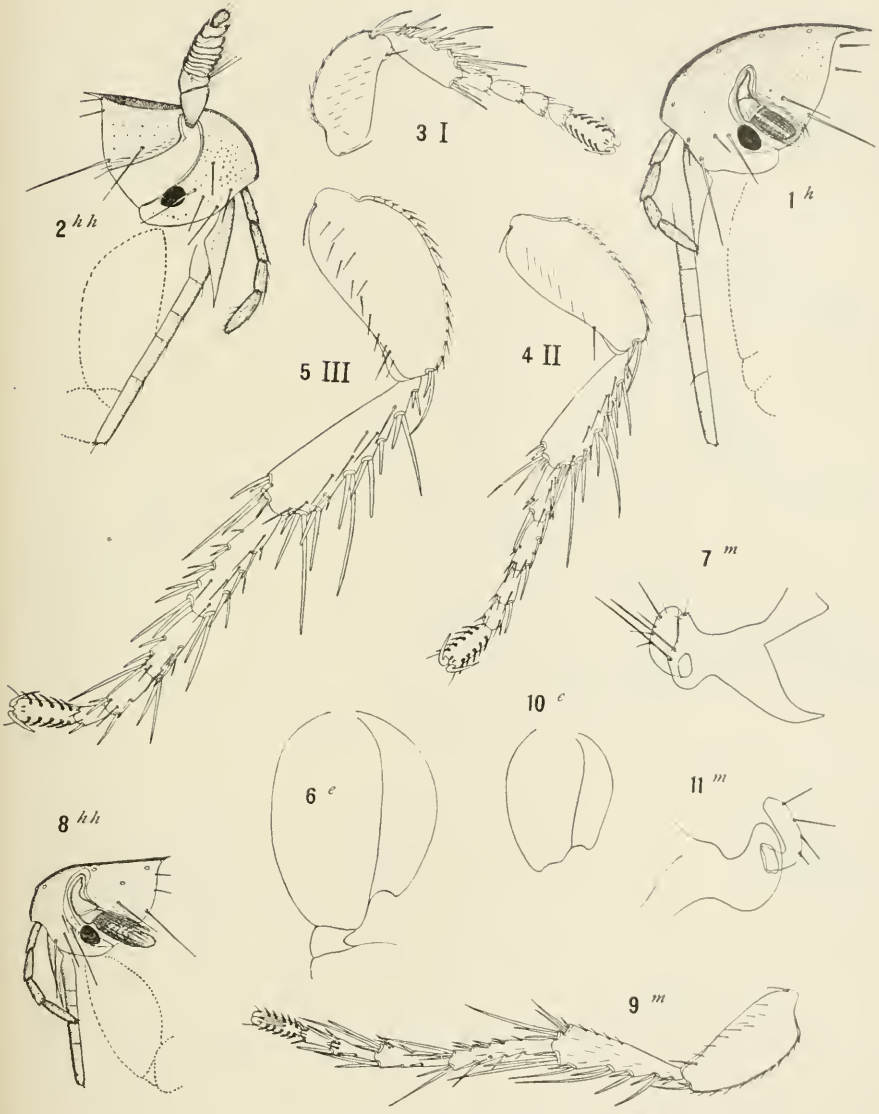

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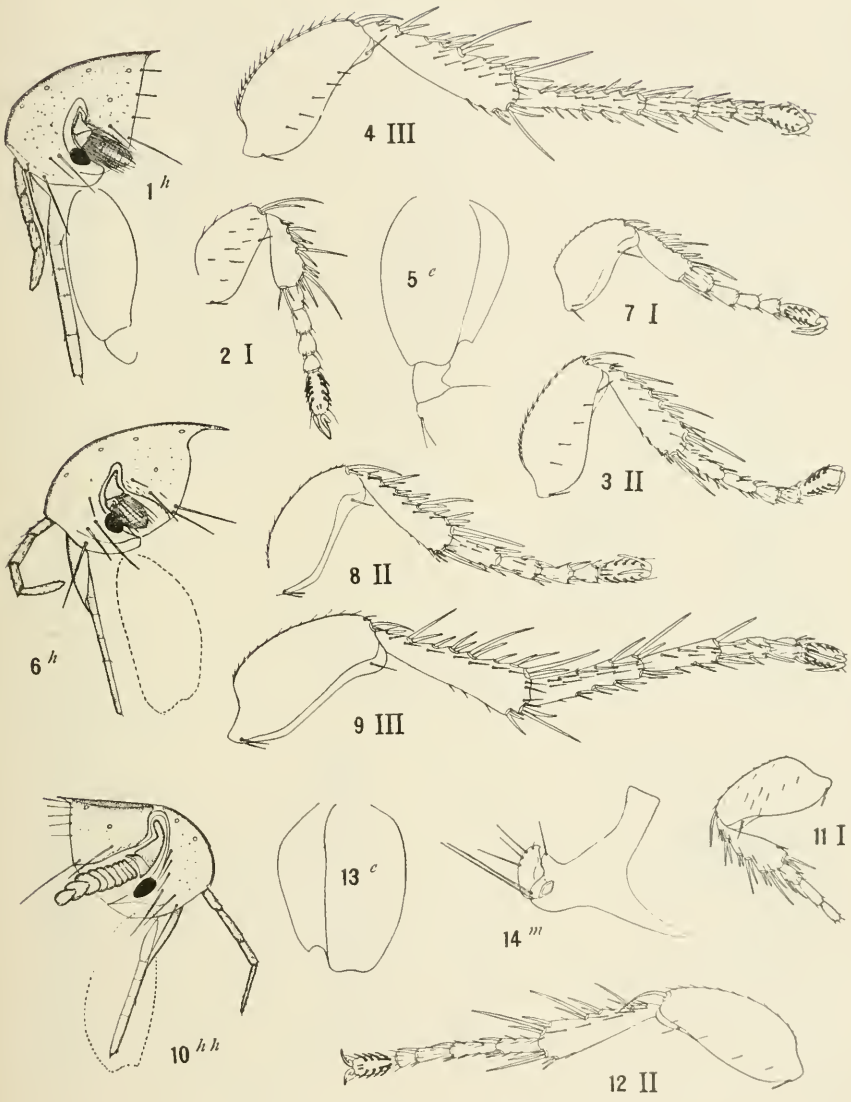

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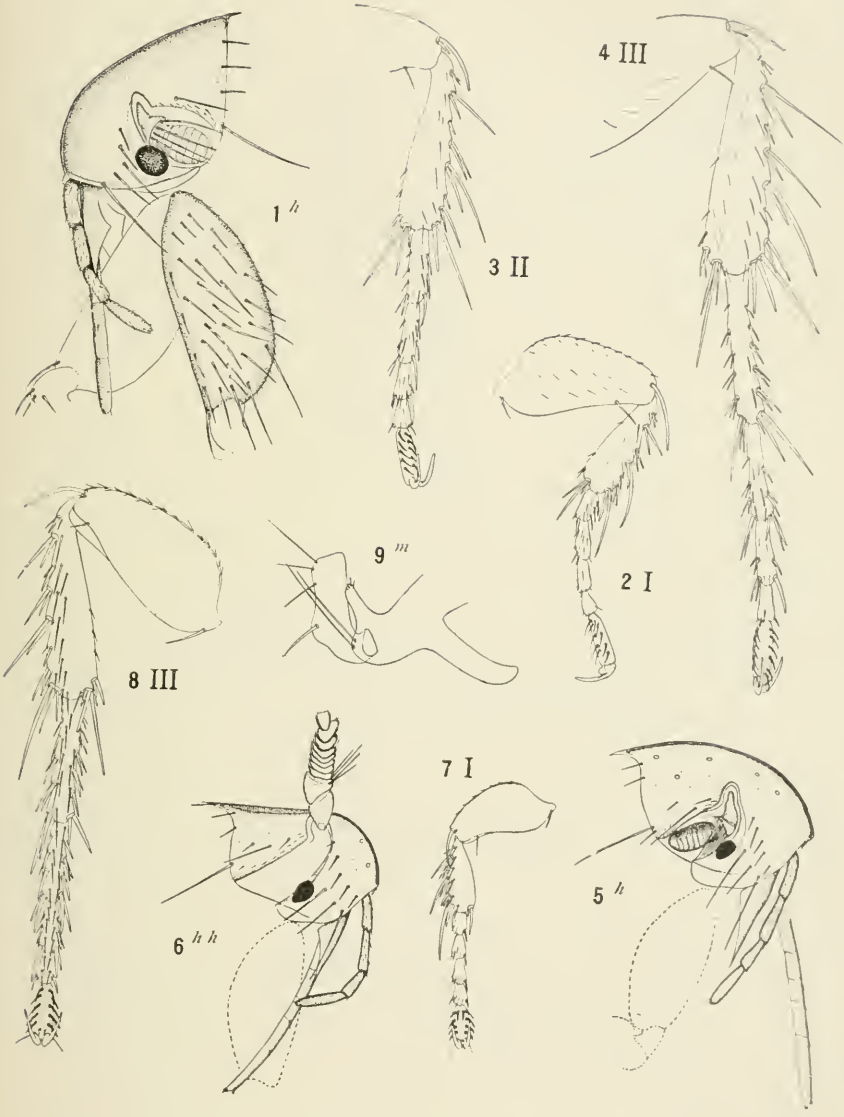

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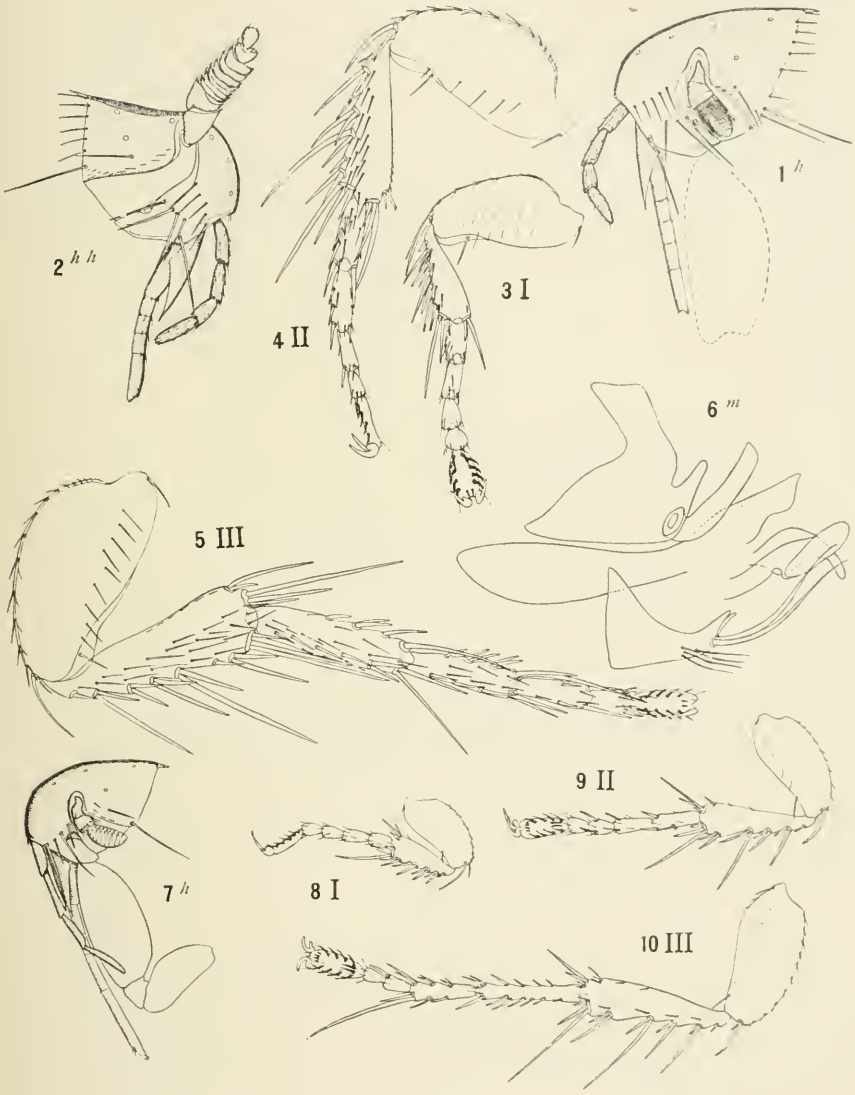

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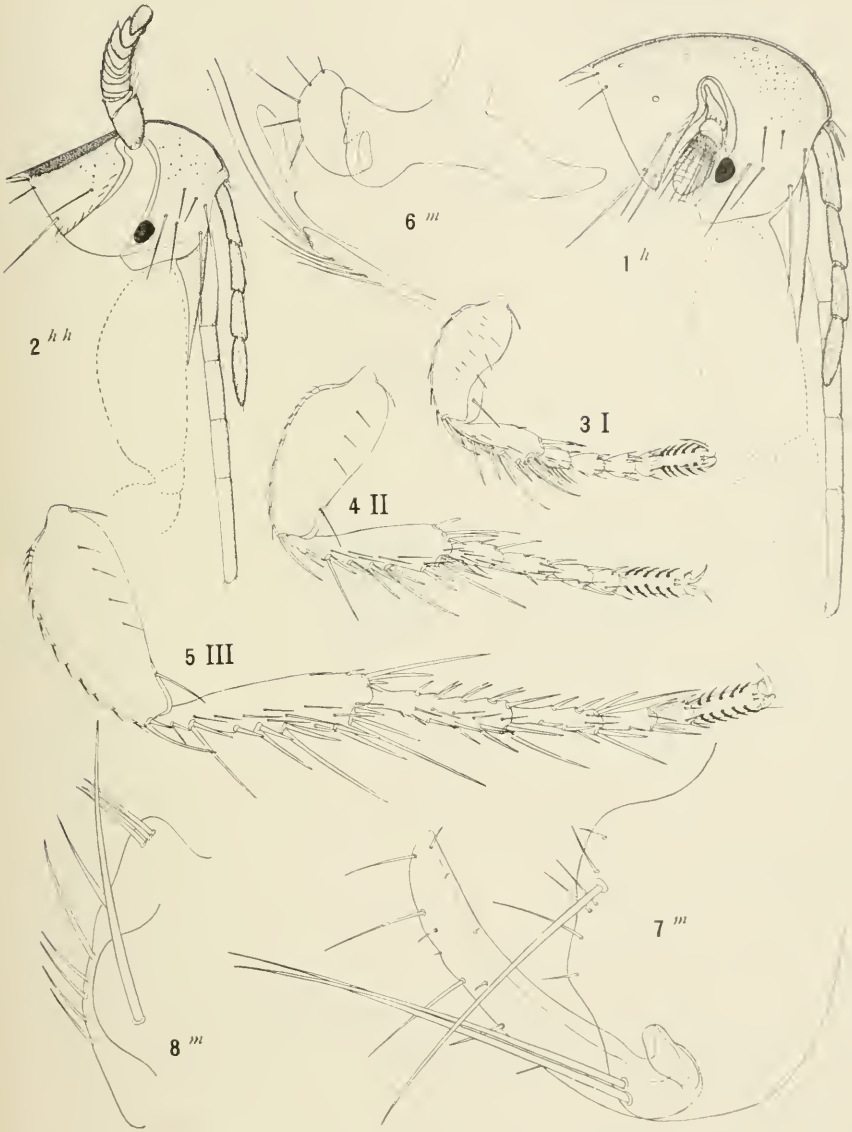

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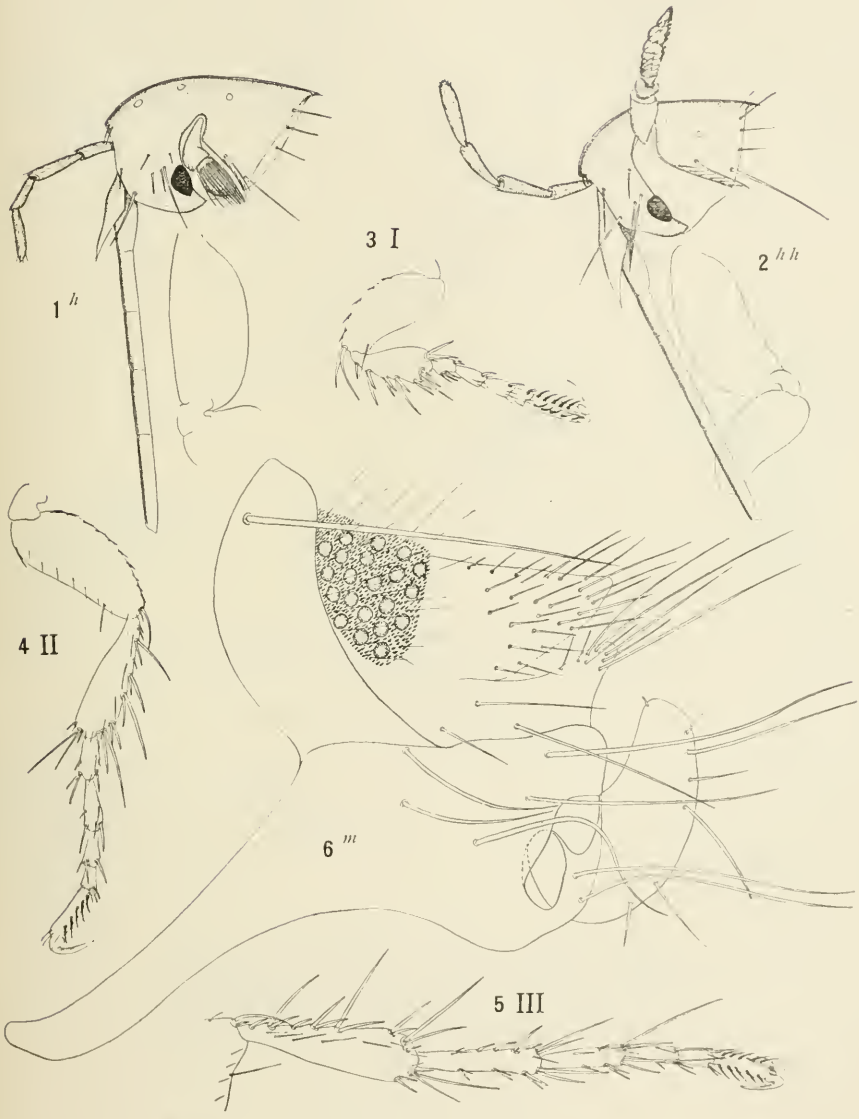

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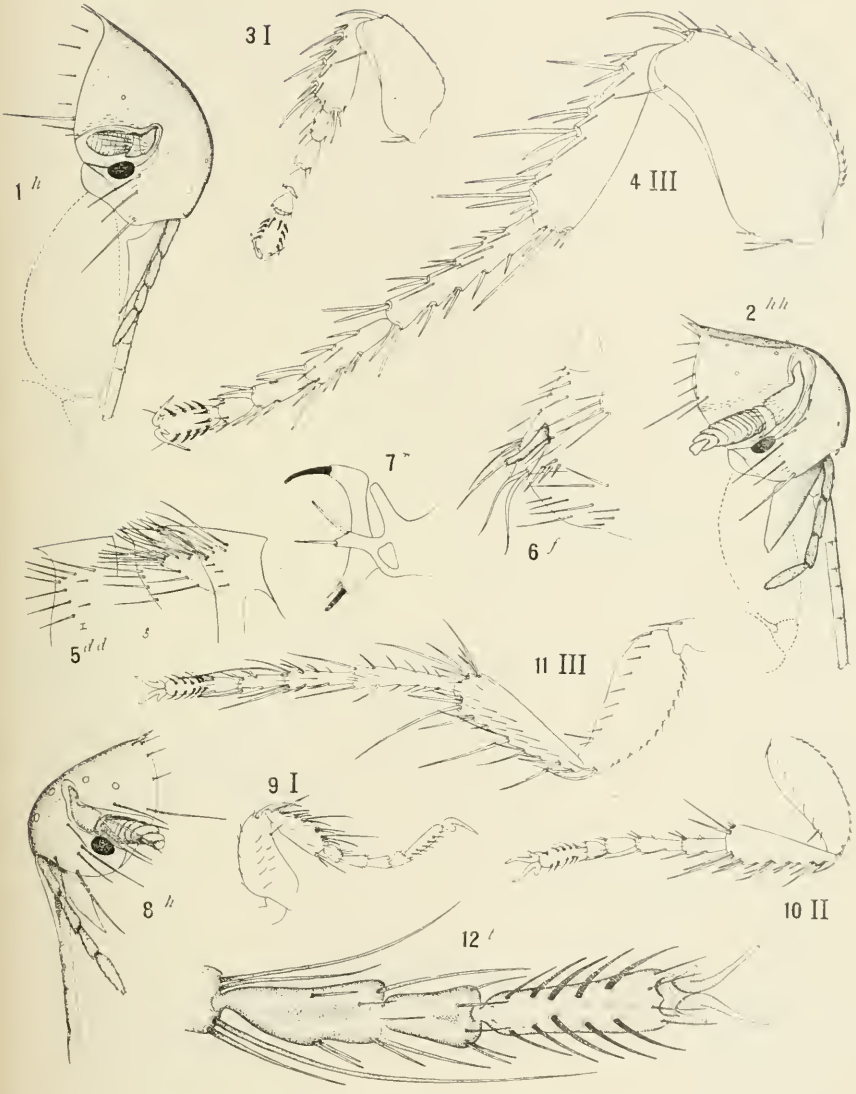

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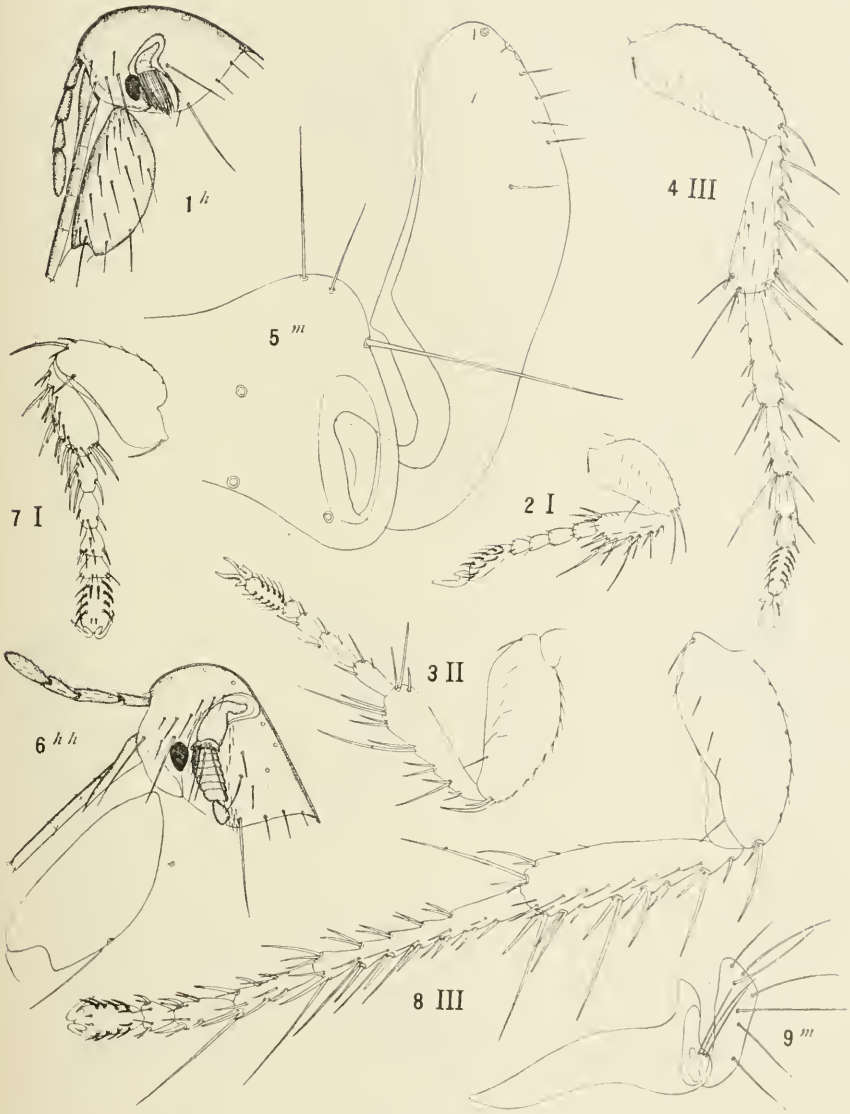

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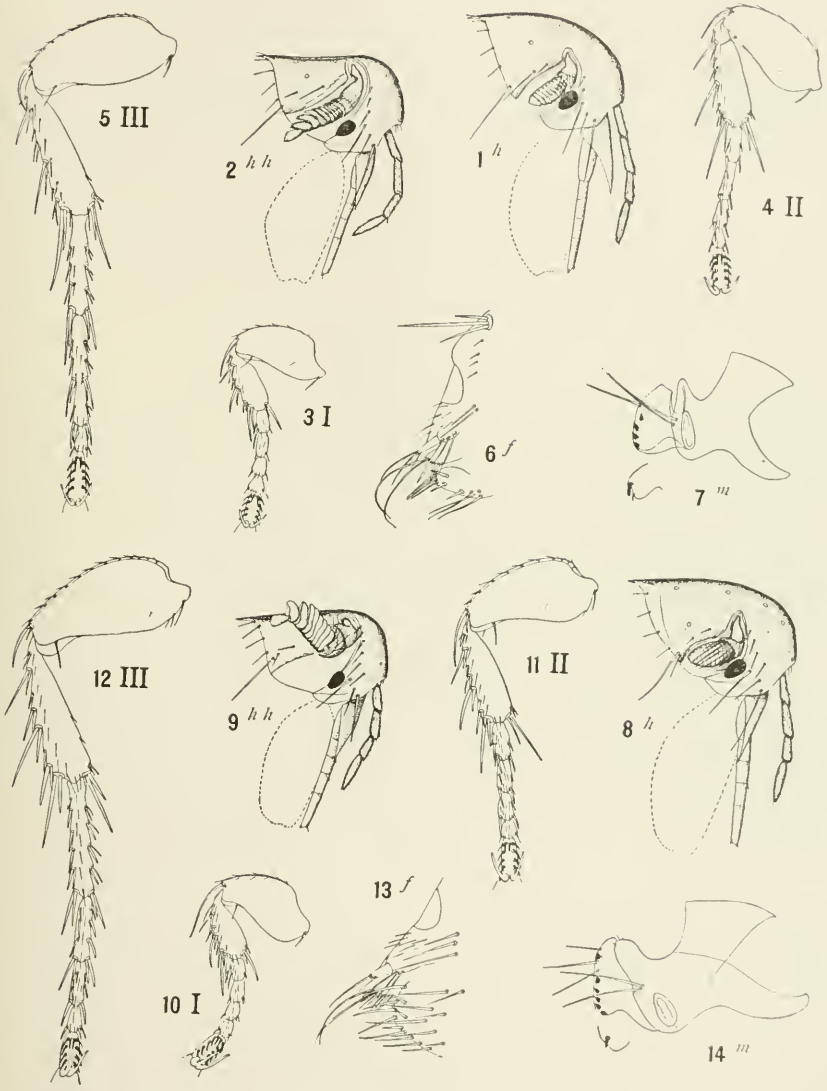


AMERICAN SIPHONAPTERA.

FOR EXPLANATION OF PLATE SEE PAGE 403.

THE ALEYRODIDS, OR MEALY-WINGED FLIES, OF CALIFORNIA, WITH REFERENCES TO OTHER AMERICAN SPECIES.

By Florence E. Bemis,
Of Stanford University, California.

INTRODUCTION.

This paper includes the descriptions, usually with account of egg and larval stage, of nineteen new species of North American Aleyrodidæ, or mealy-winged flies, all found in California; a catalogue with references, food-plants, and distribution of all the other American species so far described, and an analytical key of all the American species now known. This key is practically that of Quaintance (1900), expanded and modified to include the author's nineteen new species. The addition of these new forms brings the total number of species of American Aleyrodes, so far known, to sixty-six.

In beginning the study of the Californian Aleyrodidæ, it was found that but four species in this little known family of insects had been recorded from this State. The accounts of these species consist solely of the technical specific descriptions, and are mostly included in the papers of Maskell[a] and Quaintance.[b] Quaintance's Monograph enables one to become acquainted readily with our knowledge of American Aleyrodidæ up to 1900.

The insects themselves have been found to be very plentiful, the author having collected them from 30 native plants (see p. 474) and from various cultivated plants in gardens and conservatories. They are so plentiful in some cases as to vie with their near relatives, the Coccids, in economic importance; the author has found the leaves of the native live oak (*Quercus agrifolia*), the madroño (*Arbutus menziesii*), and the sow thistle (*Sonchus oleraceus*), curled, abnormally small, and incrusted on the under side with the immature stages; a cultivated fern kept in the laboratory and left to its own resources

[a] Maskell, Trans. New Zeal. Inst., 1895, p. 415.

[b] Quaintance, Contributions toward a Monograph of the American Aleurodidæ (U. S. Agri. Dept., Division of Entomology. Technical Ser., No. 8, 1900).

was almost killed by the multiplication of a few members of one species within a year. Already these insects are being fought as a pest in the conservatories. On the other hand, the author has frequently found colonies of Aleyrodes parasitized to an extent which indicates that nature herself will check the threatened danger. The chief reason why these insects might become troublesome economically is that many of them are omnivorous in food habit, and, not being capable of strong flight, would, under stress, readily become habituated to the nearest food plants.

But it is not from the point of view of the economic entomologist that the author has begun the study of the Aleyrodidæ. It is rather with the hope of throwing some light on their somewhat ambiguous zoological position through a detailed study of their structure and life history that the work has been undertaken. The curious metamorphosis of the Aleyrodids is not definitely understood; whether it should be called "complete" or "incomplete" is certainly still a mooted question. In the present paper the author uses the terminology which is already in vogue in the literature of this group, though the terms "pupa" and "pupa-case" are arbitrarily employed when applied to a family in which the metamorphosis may be incomplete.

With this structural and developmental study as an ultimate aim the author has made a beginning in the study of the Aleyrodidæ. An acquaintance with species has necessarily been the first step in the work, and this paper is therefore primarily systematic in character.

The geographical range covered in collecting the species herein described will be but briefly indicated here, as the exact localities are given in the text for each species described. It may here be said, however, that all the collecting has been confined to California, specimens having been taken in the Santa Clara Valley (Santa Clara County), on the slopes of the Santa Cruz and Sierra Morena ranges (Santa Clara and San Mateo counties), in Golden Gate Park, San Francisco, in the San Ramon Valley (Alameda County), at the base of Mount Diablo (Contra Costa County), and to a small extent in Alameda, Napa, and Mendocino counties, in southern California, and in the Yosemite Valley. King's Mountain, often referred to as a collecting ground, is in San Mateo County and Black Mountain in Santa Clara County.

The immature stages may be looked for upon either surface of the leaves, appearing upon plants as dissimilar in habit as the plantain and the oak. Most of the species are omnivorous, while a few seem to be confined to a single host. It would appear from material collected at points scattered from the base of the coast range to its summit that in the distribution of the Aleyrodidæ in this range there are no zones defined by altitude, the author having found the greater number of species collected, characteristic of the entire region from valley to summit.

The adults may readily be found resting on the under sides of the leaves. In collecting, if the adults take to flight, it is only necessary to remain quietly in wait, for they usually return from this upward flight, alighting in almost the same places from which they arose; the author has frequently thus disturbed a female in the act of egg-laying, and has seen her return to the same leaf when the disturbance ceased. The sure method of securing adults is, of course, to breed them from pupæ which have been carefully isolated.

All the species described have been placed in the genus Aleyrodes. Where the author has described species from immature forms only (a usage adopted by systematic students of this family from the beginning), there was no means of definite generic identification, as the generic characters lie in the wing venation of the adult. But as all the adults found belonged to Aleyrodes it was deemed best to place all forms examined provisionally under the one genus.

The author has had to depend on the pupa-cases for the identification of species, there being very little specific difference in the adults. True, some have such distinct characters as immaculate wings and yellow body, but there are others with similarly unmarked wings in which the abdomen is yellow and the head and thorax brownish, while still others have wings bearing dusky spots and the bodies with regular dark-brown markings. But as apparently identical adults issue from widely different pupa-cases, even the constant adult characters have no systematic value unless correlated with the pupal characters.

In the determination of the adults here described the specimens in question have in every case been bred by the author from their pupæ in the laboratory, or taken out of doors in the act of issuing from the pupa-case. In the determination of larval stages the following precautions have been taken for securing accuracy: In determining the beginning of the first stage the author has used only specimens obtained by capturing the larvæ immediately upon their issuance from the eggs. In determining later stages advantage has been taken of the insects' habit of preserving the larval moults, which may be found on the dorsum in regular succession from the first to the latest, which rests immediately upon the dorsum of the pupa-case. These moults have been removed, mounted in glycerin jelly or in Canada balsam, their characters studied and their dimensions taken from comparison with identical stages found on the same leaf.

The following new species included in this paper, all from California, are described under the following names: *Aleyrodes madroni*, *A. splendens*, *A. quaintancei*, *A. stanfordi*, *A. errans*, *A. interrogationis*, *A. maskelli*, *A. diasemus*, *A. extraneus*, *A. merlini*, *A. wellmanæ*, *A. amnicola*, *A. pruinosus*, *A. nigrans*, *A. irideseens*, *A. tentaculatus*, *A. kelloggi*, *A. hutchingsi*, and *A. glacialis*.

The Aleyrodidæ taken in California have been found on the follow-

ing native food plants: *Rhamnus californica*, *Rhamnus crocea*, *Umbellularia californica*, *Heteromeles arbutifolia*, *Quercus agrifolia*, *Quercus densiflora*, *Clematis ligusticifolia*, *Opulaster capitatus*, *Lonicera involucrata*, *Rhus diversiloba*, *Prunus ilicifolia*, *Arbutus menziesii*, *Salix lævigata*, *Washingtonia nuda*, *Symphoricarpos racemosus*, *Ribes glutinosum*, *Ceanothus californicus*, *Rubus vitifolius*, *Troximon* sp., *Sonchus oleraceus*, *Convolvulus sepium*, *Convolvulus arvensis*, *Aesculus californica*, *Plantago major*, *Solanum douglasii*, *Arctostaphylos manzanita*, *Arctostaphylos* sp. (unnamed species from the Yosemite), *Quercus chrysolepis*, and *Eriodictyon californicum*.

The author's thanks are due to Prof. V. L. Kellogg, under whose direction the work has been done in the entomological laboratory of Stanford University; also to Superintendent MacLaren, of Golden Gate Park of San Francisco, and to Mr. Adolph Holme, in charge of the conservatory of the park; also to Mr. Edward M. Ehrhorn, horticultural officer of Santa Clara County, and to Mr. George A. Coleman for specimens; also to Prof. T. D. A. Cockerell for material, helpful suggestion, and valuable criticism, and to Prof. A. L. Quaintance, the well-known special student of Aleyrodidæ, who has most kindly examined the entire manuscript of this paper. The author desires to make an especial acknowledgment to Miss Mary H. Wellman, of Stanford University, who has made all the drawings from nature.

The cotypes of all the species described in this paper are deposited in the collections of the U. S. National Museum.

LIFE HISTORY AND HABITS.

In a number of species there have been six stages verified, namely: Egg, three larval, a pupal, and an adult. In all the species which have been under observation, the eggs are laid in a circle or an arc of one, one or more rows deep, and three to twenty-eight eggs have been counted in a place; occasionally they are found in an irregular group, but always close together. Each is laid singly, the female standing with her wings somewhat outstretched and her head at the center of the future circle, her body forming the radius. As the eggs leave the abdomen, she raises the tip of her body above the usual level; after each is deposited, she swings the posterior part of her body laterally for a short distance and lays another. This is kept up until oviposition is completed or she is disturbed. Often several females will be seen standing near each other upon a leaf where there are no eggs; they keep moving in a restless manner, and gradually the leaf becomes coated with minute, white granules of wax similar to that which is upon their bodies and wings; where there is but one insect at work the wax is regularly circular in shape, but where there are more it is irregular. Usually the eggs are found upon these places, and are

more or less covered with wax; they are elliptical in shape and curved to a greater or less degree. At first they are white or pale yellow, but as the embryo develops the color becomes darker; the young hatch in about ten to thirteen days, the egg opening along the inner curve from the apex toward the base. The pedicel, which is such a noticeable feature of the eggs of the Aleyrodidæ, is a prolongation of the chorion, and can be seen within the body of the gravid female, frequently attracting attention by its dark brown color.

The embryo lies with its head toward the apex of the shell, and about the sixth day after being laid the reddish eyespots and orange-colored visceral mass begin to show plainly. In the eggs under observation there elapsed from forty-two minutes to three hours and eight minutes from the time that the shell began to open till the larva was free. The egg that took the greater time was upon dry material and was dark brown in color, the shell when empty keeping its upright position and shape, so that the slow hatching was probably due to the toughness of the chorion. As soon as hatched the young larva moved freely about on the leaf, but never went more than an inch from its shell and to this habit it is doubtless due that the empty shell is so often found close to the pupa-case. Specimens were seen active for eight or more hours. One lived for fifty-three hours and died without attaching itself. This may have been because the leaf was withering, although when removed to another it did not affix itself.

At first the larvæ are very convex and entirely free from secretion of any kind, but within an hour after emerging from the egg the beginning of the marginal band of wax is seen. When the food was allowed to dry somewhat so that it wilted, the young larvæ secreted a coating of wax, which was not present under other circumstances.

The author has not been able to determine the time which elapsed before the first molt or between the successive molts. From the fact that the larval exuviæ are always on the dorsum of the succeeding stage, and that they are folded back with the cephalic portion of the ventral surface uppermost, it is almost certain that the skin breaks on the ventral surface or along lateral margins. This is the reverse of the mode in the pupal stage, where the imago issues through a rent made along the longi-dorso-medial and thoraco-abdominal sutures, the flaps being folded back. When a parasite emerges from a pupa-case there is left an irregular round hole in the dorsum of the thorax and cephalic region; this characteristic opening makes it possible to determine the extent of parasitization among the empty cases. The number of larval stages has been determined from the molts, which are uniformly found upon the dorsum of the pupa-cases.

In the first stage the larvæ are always semitransparent, with functional legs and antennæ, and in the majority of species have from seven to nine latero-marginal hairs. After the first molt the cuticle may begin to grow darker in color and thicker in texture, until the culmi-

nation is reached in the thick black pupa-case, or the color and texture may remain approximately the same as in the first stage; when the latter obtains, some of the structural stages can be followed by superficial examination. The degeneration, or loss of legs and antennæ, and the permanent disappearance of the latero-marginal hairs take place with the molt of the first skin; in the second stage there is no external trace of either legs or antennæ, but in the third and beginning of the fourth stage, the reduced legs and occasionally the minute antennæ may be made out; in the fourth stage the wings are present and the legs and antennæ are more like those of the adult, but are still unsegmented; in the later part of this stage they are approximately as in the adult, and sex can be readily distinguished. The mouthparts seem to be smaller in the second and third stages; often in the latter they can not be made out, but in the late pupal stage they occupy relatively the same space as in the first larval.

All of the pupæ secrete "honeydew," sometimes in such quantities that the leaf around the case and the dorsum of the pupa is covered with it; in some species there are seen minute, blunt tubes on the apex of the lingula, through which the fluid may be excreted (fig. 47, Plate XXXIII). When the "honeydew" is emitted the operculum is lifted, the lingula is protruded, dorsally recurved, and the drop thrown with considerable force (fig. 46, Plate XXXIII). The liquid is sweet, and when exposed to the air it becomes thick and finally hardens. The frequent appearance of fungus in and about the cases is probably induced by the presence of this medium, as it is in the Coccidæ. On *Chamædorea* sp., an introduced plant from Mexico which was kept in the Golden Gate Park Conservatory, San Francisco, the author saw many large, black ants busily engaged in gathering "honeydew," acting as ants do with Aphids.

Leaving the pupa-case is a slow and toilsome process; the imago often struggles for hours before it is free and ready for flight. After leaving the case, it usually remains quiet for a few minutes. At this time it is paler in color than it will be later, and its wings are damp and crumpled; soon it begins to walk very slowly, and after going a short distance crouches upon the leaf as if exhausted; gradually its wings unfold and straighten into definite shape, the color becomes vivid and the granular secretion of wax from which the family has derived its name, begins to appear.

The adults have a peculiar manner of flight; when disturbed they rise in an almost vertical direction, and, if not further molested, alight nearly where they were in the first place. This habit may account for the females returning to the same leaf where they were laying eggs when disturbed, for on several occasions they have been observed to resume egg laying within a short distance from the place where their other eggs had been deposited.

Although the adults possess mouthparts and an alimentary canal,

close observation on the part of the author has failed to reveal them feeding; Prof. A. L. Quaintance, however, in a letter, writes that he has frequently observed adults of *A. abutilonea* Haldeman feeding. Experiments for determining the average duration of adult life were not satisfactory, as the specimens had to be confined in an artificial environment that would not give results identical with natural conditions. From data gathered, it is probable that there are at least two broods each year, the adults in this vicinity emerging from the pupa-cases and laying in April and May, and again in September, October, and November of the same year.

Family ALEYRODIDÆ.

Small to minute insects infesting plants; oviparous; metamorphosis incomplete (?); immature stages quiescent, attached by sucking mouth parts to the leaves; adults free and active, covered with granules of white wax.

Adults of both sexes with four wings, which are held horizontally and extend beyond the abdomen when the insect is at rest. Wings rounded, pure white or with dusky spots, margins golden-yellow and serrulate or "beaded" all around, each serrulation with three to five minute, delicate hairs; color and serrulations of the costal margin more pronounced; forewings with a single, median vein; costal margin bearing nine spines at base. Color of body yellow; head and thorax usually darker; the entire body occasionally with conspicuous brown markings. Head small, convex above, rounded anteriorly. Eyes two; red, brown, or black; either more or less constricted near the middle, reniform, or divided into two lobes, the lesser of which is anterior, brighter in color, and with smaller facets. Anterior to each eye is a single small ocellus. When mounted the divided eyes appear single, and only a careful inspection under a high power of microscope will show the difference in structure. Antennæ of seven segments, the first of which is shortest and the third longest; the first two segments are simple and stout; segment one, cup-shaped; segment two, subpyriform; segments three to seven, inclusive, cylindrical and closely ringed with minute hairs. Legs long and slender, feet with dimerous tarsi, terminating in three claws, of which the middle one is smaller than the other two, and bears a number of spines. Rostrum projecting from the under side of head, composed of a single segment, at the apex of which are the setæ that form the suctorial tube; from the base arises the long, 3-segmented mentum, subcylindrical in shape, free for its entire length, and inclosing the rostral setæ. Thorax with about equal distinct segments. Abdomen roundly tapering, terminating in the genitalia; the first segment constitutes a very slender peduncle; on the dorsal surface of the last segment is the vasiform orifice (fig. 41, Plate XXXIII). In the adults this characteristic organ is but little differentiated in general appearance and of no specific tax-

onomic value. Orifice subcircular; operculum more than one-half the length of orifice, deeply emarginate on the distal end; lingula longer than orifice, subcylindrical, either somewhat pointed or else enlarged at the tip, usually protruded and dorsally recurved; both operculum and lingula setose. Genitalia of female conical, in three parts, the middle one of which is the ovipositor. (Fig. 44, Plate XXXIII.) Genitalia of male forcipate, also in three parts, the outer two of which are the valves or claspers, and inclose the penis. (Fig. 57, Plate XXXV.)

Pupæ inclosed in more or less transparent, chitinous cases, usually elliptical in shape. Rudimentary legs and antennæ inclosed, but when the case is sufficiently transparent they are often visible. Pupa-case naked, or bearing hairs or spines; dorsum free from secretion, or it may have a more or less copious white wax covering, which is frequently arranged in definite patterns, and often of great beauty; margins made up of adjacent lateral wax tubes, from the ends of which may be produced a fringe of transparent wax rods, or asbestiform threads of wax, more or less covered with flocculent wax. On the dorsum, in the last segment of the abdomen, is found the vasiform orifice which is the most distinctive character in this family, and in the immature stages forms the basis of classification. It is an opening variously modified in shape, with a lid, the operculum, which is hinged to the cephalic margin; this lid ranges in size from minute to large; lying within the orifice beneath the operculum is the lingula, a strap-shaped organ, also attached to the cephalic margin; in general shape, cylindrical at base and more or less enlarged at the distal end; in some specimens it is entirely obscured by the operculum, while in others it is conspicuously long, even projecting beyond the orifice; the distal portion is frequently protruded and dorsally recurved. The operculum and the distal part of the lingula are usually setose, and the latter, as a rule, bears two long apical hairs (fig. 30, Plate XXXI). On the ventral surface of the case are four pairs of spiracles, a pair on each of the thoracic segments, and a pair on the abdomen, lateral of the vasiform orifice. In freshly mounted specimens the tracheæ are often filled with air, and consequently may be easily traced (figs. 55, 56, Plate XXXV).

Larvæ thin and usually flat; elliptical in shape; early stages semitransparent and ranging in color from white to yellow; dorsum naked, or with hairs or spines; with or without lateral fringe and dorsal secretion. Vasiform orifice as in pupæ. In the beginning of the first stage the larvæ are free and active, legs and antennæ functional; after the first moult these organs are not usually recognizable until a somewhat later stage (fig. 58, Plate XXXV).

Eggs yellow and ellipsoidal, with or without polygonal markings of shell; attached by a peduncle to leaf, usually laid in circular groups.[a]

[a] For a more detailed account of the characters of Aleyrodidæ, see Maskell, Trans. New Zealand Inst., 1895, p. 415.

Genus ALEYRODES Latreille.

"With the characters of the family. Adults, with but a single basal branch to vein of forewings; hindwings, with but a single vein."

The author has not attempted to separate the genus into subgenera as proposed by Cockerell;[a] this work can be done more satisfactorily when students have become better acquainted with more species.

TABLE OF ALL AMERICAN SPECIES.[b]

I. Pupa-case usually but little hidden by secretion; with lateral fringe—that is, any secretion from marginal wax tubes.
II. Pupa-case usually hidden by a mass of hairy, waxy, or flocculent secretion.
III. Pupa-case evident and without lateral fringe.

I. Pupa-case usually but little hidden by secretion; with lateral fringe—that is, any secretion from marginal wax tubes.
Pupa-case uniformly brown or black.
With dorsal secretion of wax. Dorsal secretion cottony or mealy in appearance.
Pupa-case dark brown to black, elliptical, slightly convex, about 0.85 mm. long. Dorsum covered with white meal, frequently becoming quite solid. Lateral fringe, all around, agglomerated almost into a solid plate, of unequal length, giving a star shape of about 8 rays. Operculum subcircular, covering about one-half of orifice; lingula obsolete.....*stellatus* (37).
Pupa-case black, elliptical, convex, 1.8 mm. long. Margin thick with conspicuous groove on dorsal surface, and short fringe of wax on ventral surface. Around vasiform orifice, a large, nearly transparent, hemispherical area, but dusted with white secretion. Around lateral margin, a row of about 32 sharp sword-like hairs. Adult with basal half and portions of rest of wing smoky.....*fumipennis* (18).
Pupa-case shiny black; size, about 0.92 by 0.61 mm.; subelliptical, moderately convex; lateral fringe rather short, truncate; dorsal secretion of 3 longitudinal stripes of cottony or mealy wax .....*acaciæ* (47).
Pupa-case shining black, elliptical, 0.9 by 0.7 mm. Lateral fringe of transparent rods as wide as the case; dorsal secretion a narrow elliptical band mesad of the lateral wax tubes, and also a longitudinal stripe of mealy white wax..*madroni* (25).
Pupa-case shiny black, oval, convex, 0.9 by 0.6 mm. Lateral wax tubes deflexed to form the marginal rim, which is sharply demarked from dorsum by a ridge. Lateral fringe copious, at least as wide as case; dorsal secretion forming a second fringe, which rises perpendicularly above the dorsum and then curves downward and outward.....*splendens* (2).

[a] Proc. Acad. Nat. Sci. Phila., 1902, p. 282.

[b] *A. phalænoides* (No. 30) is not included in this table, as it was not included in Quaintance's key, and the writer has not had access to the original description. In Quaintance's list it is not described, simply listed with a reference to the original description.

Pupa-case dull black, subelliptical, 0.81 by 0.52 mm; the copious lateral fringe about twice the width of case in length. A slight mealy secretion may occur on dorsum; with tube-like longitudinal medio-dorsal elevation, cephalad, arrow-shaped; along abdominal segments, suggesting a trachea, with a glottis caudad ..... *tracheifer* (48).

Pupa-case shiny black, flat, subovate, 0.95 by 0.81 mm.; cephalo-lateral margins on each side with an indenture and thickening. Lateral fringe semitransparent; a very light mealy secretion of wax may occur along body segments. Dorsum with small black dots ..... *quercus-aquaticæ* (49).

Without dorsal secretion of wax.

Lateral fringe gelatinous looking (translucent).

Pupa-case pitch black, oval, hardly 1 mm. long. The gelatinous fringe extending out from case, and raising it up somewhat. From cephalo-lateral margin on each side and from caudal end a pencil of white wax resting on gelatinous rim. *gelatinosus* (19).

quercus-aquaticæ. See above.

Lateral fringe a series of distinct radiating waxy ribbons.

Pupa-case intense black, oval, hardly over a millimeter long. The lateral fringe of 12 broad ribbon-like rays of glassy wax, yellow basally, about as long as length of case .. *vinsonioides* (41).

Lateral fringe a narrow, continuous rim of white waxen filaments.

Pupa-case dense black, broadly elliptical, 1.2 mm. long. Moderately convex, with rounded median ridge .... *cockerelli* (9).

Lateral fringe of very narrow, radiating, waxy ribbons, about 0.1 mm. long.

Pupa-case extremely dense and black, oval, 1.25 mm. long. *perilencus* (36).

Lateral fringe regular; of white, waxy ribbons, curved over so as to be strongly convex above.

Pupa-case dense black, broad-oval, about 1.5 mm. long. *melanops* (62).

Lateral fringe a continuous rim of transparent rods about width of case.

Pupa-case shiny black, oval, 0.83 by 0.6 mm. Dorsal disk larger than ventral, lateral wax tubes deflexed, making an oblique rim ..... *quaintancei* (42).

Lateral fringe a more or less copious, cottony secretion.

Pupa-case shiny black, elliptical, about 0.7 by 0.55 mm. A copious, white cottony fringe all around, continuous basally, but ragged distally. Case moderately convex, with evident rounded median ridge. Forewings of adults marked with red and brownish black ..... *mori* (24).

Pupa-case as in *A. mori*, but the margin more deeply crenulated. Adults with wing-markings black ..... *mori arizonensis* (65).

"Larva (Pupa-case?) flavous, the disk of the larger individuals dark brown; the margin is ciliate and white." Wings of adults immaculate ..... *corni* (10).

Pupa-case shining black, subelliptical 0.7 by 0.55 mm. Dorsal disk larger than ventral, and the marginal rim of wax tubes

bent downward and inward. The scant cottony secretion from marginal wax tubes appearing as a vertical fringe.
abnormis (50).

tracheifer. See above.

Pupa-case shining black, broadly elliptical, average size, 1.37 by 1.07 mm. Lateral fringe usually about one-half width of case. Dorsum with conspicuous, deflexed marginal rim, and a tube-like, longi-medial keel, arrow-shaped cephalad, along abdominal segments, suggesting a trachea with a glottis caudad ..... *stanfordi* (28).

Pupa-case shining black, elliptical, 0.9 by 0.8 mm.; with a copious, white, cottony, lateral fringe. Dorsum convex with evident median keel, arrow-shaped at the cephalic end and a reflexed marginal rim narrowed at both ends of case; body segments conspicuous ..... *errans* (16).

Pupa-case yellowish or greenish.

Dorsal secretion simply a submarginal series of brittle curved waxen rods from distal pores or papillæ.

Pupa-case pale yellow, elliptical, about 0.56 mm. long, flattish. Margin minutely crenulated, the wax tubes bearing a short fringe of straight white tubes. Within the submarginal series of papillæ on dorsum, are 8 large circular orifices: 2 on cephalic, 4 on thoracic, and 2 on abdominal region.
erigerontis (12).

Dorsal secretion a submarginal series of curved waxen rods from distinct pores or pustules, and a more central secretion of thin, brittle, yellow wax, usually fragmentary.

Pupa-case yellow, the median region at length darkening, elliptical, about 0.75 mm. long. With two lateral depressions on each side, similar to those in a *Lecanium*. Lateral fringe short, fragmentary. Within submarginal series of pustules on dorsum are 12 other pustules; 2 large on cephalic region, 2 large on thoracic region, 4 large on abdominal region, 2 large on caudal region, and 2 small at vasiform orifice ..... *nicotianæ* (26).

Pupa-case yellow, brown on central area.

Dorsal secretion in tufts, or pencils.

Lateral fringe gelatinous looking (translucent).

Pupa-case with gelatinous fringe wider than case, extending beyond and raising it from leaf. Dorsum with nine tufts, or pencils of white wax; a pair on the cephalic and on the thoracic regions near median line, a pair at the vasiform orifice, a pair caudad of vasiform orifice, and at caudal end of case, a long pencil resting on gelatinous fringe.. *interrogationis* (29).

Without dorsal secretion.

The lateral fringe a delicate, white, band-like secretion.

Pupa-case pale greenish, oval, with margins anteriorly very sinuous; 0.5 mm. long. Within margin all around a parallel line, the intervening space crossed by equidistant straight lines; a second parallel line, often faint, within the first, the space thus formed also crossed by lines closer and shorter than in first zone. On ventral surface, near middle line, are five pairs of strong setaceous hairs, all very long, and pro-

jecting mostly beyond the margin. Wings of adults immaculate; eyes large, black, bean-shaped ..... *filicium* (13).

The lateral fringe consisting of but three curling, white waxen filaments, from long, thickened tubular pores, opening one on each side in cephalolateral region and one at caudal end of case.

Pupa-case pale greenish yellow to yellowish, broadly oval, but little convex, applied close to leaf, and inconspicuous; 1.4 by 0.8 to 1 mm.; margin minutely crenulated and with radiating lines extending mesad. Vasiform orifice small, subcircular, operculum short, concave distally. Adults with immaculate wings ..... *citri* (8).

The lateral fringe transparent, white rods of variable length; when short, so deflexed as to appear vertical.

Pupa-case pale yellow, elliptical, caudal, and truncate; 0.9 by 0.65 mm.; marginal rim wide, demarked from dorsum by a thick line. Vertical fringe common to this type of Aleurodes, absent ..... *maskelli* (44).

The lateral fringe of separate, glassy rods, or of glassy, agglomerate rods covered more or less with flocculent wax.

Pupa-case yellow, elliptical, 1.4 by 0.8 mm., raised on a vertical fringe; dorsum with 12 pairs of conspicuous spines. *diasemus* (38).

The lateral fringe very narrow, of white agglomerate rods, ragged distally.

Pupa-case yellow, when empty, a white, transparent film; elliptical, 0.9 by 0.8 mm.; dorsum with 5 pairs of spines. Lateral secretion may be fragmentary, or so short and deflexed that it similates a vertical fringe ..... *extranicus* (46).

II. Pupa-case usually hidden by a mass of hairy, waxy, or flocculent secretion.

The secretion white, felt-like, or hairy.

Pupa-case black, oval, 0.94 mm. long. Flat, but dorsum with median ridge, and several transverse furrows. Margin with double crenulation. Vasiform orifice and operculum hemispherical; operculum small, not filling orifice. Wings of adults immaculate ..... *parvus* (27).

Larva yellowish green, somewhat roundish, 0.5 mm. long. Margin with double crenulations which are pointed distally. Ventral surface with five pairs of bristles along middle line, about as long as one-third width of body. Pupa-case with 10 to 12 long radiating wax threads, star-like ..... *goyabæ* (20).

Larva similar to *goyabæ*, but only the caudal pair of bristles readily discernable. Pupa-case scantly covered with the unequal curling waxen threads. A submarginal series of equally placed short bristles ..... *aepim* (4).

Pupa-case covered with a mass of wool-like wax often more than twice its length. Case yellow, elliptical, 1 by 0.6 mm., raised on a short, vertical fringe; dorsum convex, covered with conspicuous papillæ ..... *merlini* (31).

The secretion yellowish, long, hair-like.

Pupa-case light yellow, elliptical, 1 mm. long, flat. Denuded of the yellowish hair-like secretion, a longitudinal median, and submarginal secretion on each side of white wax is evident. Vasiform orifice subelliptical. Operculum hemispherical, n rly fitting orifice, the caudal end notched. Adult with wings immaculate, eyes black ..... *horridus* (22).

The secretion white, flocculent.

Pupa-case dull yellow, elliptical, 0.56 to 0.84 mm. long, slightly convex. Margin conspicuously crenulated, the wax tubes bearing besides the flocculent matter a moderately long fringe of straight, white wax tubes. Dorsum with six long slender cylindrical spines, the caudal pair frequently bearing a pencil of white wax. Vasiform orifice twice as broad as long; operculum short, broad; lingula obsolete. *floccosus* (15).

The secretion of very long, curling bundles of snowy white wax in the form of a rosette.

Pupa-case yellowish, elliptical 0.78 by 0.5 mm.; the curling bundles of white wax from submarginal area, and a more or less columnar central secretion. A submarginal series of glassy curved, waxen rods, from distant papillæ; case raised on vertical fringe ..... *pergandei* (51).

The secretion a submarginal series of broad waxy ribbons with a more central secretion, more or less columnar in appearance.

Pupa-case shiny black, sub-elliptical; 0.72 by 0.46 mm. The copious secretion, as a whole, rosette-like, the ribbons of wax rather long, curving outward and downward. Lateral fringe semi-transparent and agglomerated ..... *plumosus* (52).

The secretion a submarginal series of appressed wax rods rising almost vertically for some distance above case, then bending downward and outward to leaf, central dorsum with secretion either plate-like or granular.

Pupa-case dark to yellow-brown; elliptical; 1.3 by 0.6 mm.; the central dorsal secretion when granular, lying thicker along medio-dorsal line and mesad of submarginal fringe. *hutchingsi* (61).

111. Pupa-case evident, and without lateral fringe.

Pupa-case more or less marked with brown or black, but not uniformly.

With dorsal secretion of wax from distinct pores or papillæ.

The secretion, a submarginal series of brittle more or less curving waxen rods.

Pupa-case yellowish to whitish, with broad, longitudinal medio-dorsal band of dark brown; elliptical, 0.7 by 0.43 mm.; raised on vertical fringe ..... *fitchi* (53).

Pupa-case greenish white, but with a row on each side of more or less brownish spots; elliptical, 0.83 by 0.57 mm. The glassy rods, from very closely set submarginal papillæ, and frequently as long as case is wide ..... *floridensis* (54).

Pupa-case with a longitudinal medio-dorsal stripe, and a submarginal area of varying width, whitish, otherwise brown, deepest laterad of central stripe; elliptical, 0.75 by 0.52 mm. The submarginal series of waxen rods rather short. No vertical fringe ..... *rittatus* (55).

Pupa-case brown with marginal rim, sutures, and vasiform orifice transparent, yellow, elliptical, 0.93 by 0.6 mm.; dorsum flat, punctate; marginal rim with a series of large papillæ ..... *wellmani* (45).

The secretion in part a submarginal series of sheathed bundles of small, curling, white waxen rods, from distinct groups of rather small pores.

Pupa-case with marginal, somewhat wedge-shaped, dashes of brown; two broad, longitudinal, interrupted, sub-dorsal bands of brown; subovate; 1.79 by 1.26 mm. A central and two lateral longitudinal matted exudations of wax. A very high vertical fringe ..... *altissimus* (56).

The secretion a submarginal series of glassy, curved, waxen rods from papillæ or pores, and similar rods more or less promiscuous on dorsum from circular pores.

Pupa-case yellowish to whitish, but with frequently a brownish coloration along dorsi-meson; elliptical; 0.72 by 0.45 mm. On the thorax the pores are promiscuous, but along abdomen are inclined to occur in longitudinal rows. Adults with wings marked with smoky black ..... *rolfsii* (34).

Dorsal secretion when present in form of a whitish, mealy exudation, or in extreme cases a matted plate of wax covering entire dorsum.

Pupa-case brown to brownish black, with 3 more or less evident transverse stripes of whitish: one at cephalic end, one at middle, and one at caudal end, crossing vasiform orifice. Ovate, to broadly elliptical, about 1.5 mm. long. Case raised quite high on vertical fringe of wax, about as high as one-half width of case ..... *forbesii* (17).

Without dorsal secretion of wax.

Pupa-case yellowish brown, and with more or less interrupted stripes of dark brown along dorsi-meson; oblong to elliptical; 1 by 0.46 mm. On each side of median rounded keel, along abdomen, are large, irregular, toothed impressions, usually a pair to each segment. In adult male wings immaculate; eyes divided; antenna with a long terminal process. *graminicola* (21).

"Larva (pupa-case?) plane above and beneath; elevation about one-third the length, periphery vertical; pale flavous; the larger individuals with a conspicuous dorsal vitta." *abutiloneus* (60).

Pupa-case wholly black, or with a yellow triangular patch near the anterior margin and a small spot of the same color near the posterior margin ..... *struthanthi* (63).

Pupa-case dorsally black, but with a very broad lemon-yellow or whitish marginal area; oval somewhat over a millimeter long. Adult, with eyes completely divided; wings with suffused dusky spot at end of vein, more evident on cephalic pair ..... *aureocinctus* (6).

Pupa-case white, central region brown, color extending cephalad in two conspicuous prongs; each segment with a great number of black dots. Case broadly elliptical, cephalic margin truncate, 1.4 by 1.03 mm., with a short, vertical fringe ..... *amnicola* (33).

Pupa-case yellow to smoky brown, darker in central region, broadly elliptical, 1.33 by 1 mm. Dorsum with minute black spots and a longitudinal row of depressions on each side of dorsi-meson, usually a pair to each segment. Adults, wings with dusky spots ..... *pruinosus* (3).

Pupa-case uniformly black.

The dorsal secretion a submarginal series of glassy, curling, waxen rods from distinct pores or papillæ.

Pupa-case ovate, about 0.8 mm. long. The glassy, waxen rods in some cases almost if not quite as long as case is wide. Case with conspicuous vertical fringe. Adults with immaculate wings, eyes not completely divided ..... *ruborum* (35).

The dorsal secretion a submarginal series of short, truncate, white, waxy ribbons, with a more central secretion of columnar appearance.

Pupa-case shiny black, subelliptical, 0.92 by 0.66 mm. The submarginal ribbons extending out at an angle of about 45°, giving appearance of an elliptical crown ..... *coronatus* (11).

Without dorsal secretion.

Pupa-case dull black, subelliptical, narrowed at both ends, and prolonged caudad into a pointed lobe; 0.9 by 0.6 mm. Dorsal disk larger than ventral, and the marginal rim of wax tubes bent downward and inward ..... *nigrans* (43).

Pupa-case iridescent-black.

The dorsal secretion a submarginal series of glassy, waxen rods from distinct pores or papillæ, with a more mesal secretion of small, stellate whorls of white, waxen ribbons in four longitudinal lines.

Pupa-case elliptical, 1.2 by 0.7 mm.; the submarginal fringe about one-half width of case. Adults with immaculate wings, eyes divided ..... *iridescens* (1).

Pupa-case uniformly yellowish or whitish.

Without waxy secretion of any kind.

Pupa-case pale straw yellow, somewhat darker toward center, elliptical, 1.25 by 1 mm. Margin finely and densely wrinkled all around, the wrinkles extending radially inward to about one-half the length to the middle line, on the sides. Vasiform orifice darker than surrounding area, unequally triangular ..... *pyrolæ* (32).

Pupa-case (empty) colorless, oval, 0.75 mm. long. Margin radiately striate. Vasiform orifice an elongated triangle, the two sides nearly straight, and nearly twice as long as base. Lingula elongate sub-spatulate. No conspicuous submarginal orifices. Adult with immaculate wings; head and entire body deep orange-yellow; legs pale lemon yellow. Eyes jet black, each one completely divided .. *berbericola* (7).

Pupa-case whitish, elliptical, 1 by 0.61 mm. Flat, marginal wax tubes evident. Vasiform orifice sub-cordate without corrugations; lingula terminating in sub-circular lobe. *nephrolepidis* (66).

Pupa-case yellow to lighter, ovate, narrowed caudad; 0.81 by 0.55 mm. Somewhat convex, marginal wax tubes obscure. Vasiform orifice subtriangular, inner lateral margins corrugated; lingula arrow-shaped distally ..... *inconspicuus* (23).

Pupa-case light yellow. Fore-wings of adults with a dark spot at distal end of vein ..... *youngi* (64).

Secretion present.

Dorsal secretion a submarginal series of glassy, curved, waxen rods from distinct pores of papillæ, and a more dorsal secretion of very long, tapering, curved, waxen rods, in pairs, from large circular pores.

Pupa-case yellowish, oval to elliptical; about 0.76 by 0.48 mm. The submarginal wax tubes rather short and blunt. The very long rods from dorsum occurring; a pair very close to cephalic margin, a pair on cephalic region, a pair on thoracic region; two pairs on abdominal region; a pair at caudal end; and a pair just within margin, from caudo-lateral region. In adults rostrum reaching nearly to abdomen. Wings immaculate ..... *vaporariorum* (39).

Dorsal secretion a thin, white wax pellicle, to which is attached a submarginal series of long, glassy, curved, waxen rods from distinct papillæ, and a more mesal secretion of shorter, similar rods from large circular pores.

Pupa-case yellow, elliptical, 0.85 by 0.6 mm., raised on vertical fringe of white wax. Vasiform orifice with rounded indenture and finger-like process caudad; lingula with three lateral lobes and a distal lobe. In adults, wings immaculate. *glacialis* (40).

With a rather copious, white, dorsal secretion.

Pupa-case yellowish, elliptical, 0.86 by 0.53 mm., with a short, downward curving, pearly white submarginal secretion of wax, hiding margin of case, and three prominent, more central, inward-curving columns set in a triangle. Operculum considerably broader than long; lingula spatulate, with two pairs of setæ near distal end ..... *perseæ* (57).

pergandei. See above.

Pupa-case yellow, elliptical, 1.25 by 1 mm., raised on a very short, vertical fringe of white wax, with a submarginal series of broad, downward curving, pearly white, waxen ribbons, and a more mesal secretion forming a plate over the dorsum; the secretion, as a whole, covering case. *kelloggi* (14).

Dorsal secretion a variable submarginal series of glassy, curved rods from distinct pores or papillæ.

Pupa-case yellowish, elliptical, 0.65 by 0.36 mm., raised on vertical fringe of white wax. Vasiform orifice with rounded indenture caudad; lingula four-fifths length of orifice, with three pairs of lateral lobes and a distal lobe. In adults, wings immaculate ..... *variabilis* (58).

rolfsii. See above.

Dorsal secretion a thin, white wax pellicle, to which is attached a single, submarginal series of broad, short, glassy, waxen rods closely appressed to margin; or longer, more slender and tapering, waxen rods with a variable number of very long rods among them; each from a distinct papillæ.

Pupa-case yellow, elliptical, 0.96 by 6 mm., raised on vertical fringe of white wax. Vasiform orifice with rounded indenture and finger-like process caudad; lingula with three lateral lobes and a distal lobe. In adults, wings immaculate ..... *tentaculatus* (5).

Without dorsal secretion.

Pupa-case yellow, broadly elliptical, convex, 1.15 by 0.83 mm. A short, more or less slanting, fringe all around of white wax, doubtless homologous with vertical fringe. Vasiform orifice broadly ovate, lingula spatulate. Dorsum void of pores and papillæ. In adults, wings with a distal dusky spot. *spiræoides* (59).

1. ALEYRODES IRIDESCENS, new species.

Plate XXVII, figs. 1–2a.

Egg.—Yellowish brown, slightly curved, unmarked; pedicel short at one side of base on the convex curve.

Larva.—(Stage 1.) Size, about 0.25 by 0.11 mm.; elliptical; pale yellow. Dorsum with a narrow, thickened, uncrenulated marginal rim which bears a series of nine pairs of short, delicate hairs set in conical base; three of these seven pairs are lateral and extend from the latero-cephalic margin about one-half the length of larva; the remaining two pairs are the usual caudal and latero-caudal hairs; besides these there are five pairs of long, tapering, hollow, dorsal spines, a pair on cephalic segment, a pair on the meso-thorax, a pair on the meta-thorax, a pair just within the caudal margin, and a pair of delicate tubercled hairs caudad of the cephalic margin. Vasiform orifice, subcircular, minute; operculum the same shape and filling the orifice; lingula minute, barely visible through the operculum. Mouth parts large, setæ more than one-half the length of the insect. Eye-spots red, divided, the posterior lobe round and the larger of the two. Legs and antennæ functional.

Larva.—(Stage 2.) Abdominal segments distinct along dorsi-meson; two crescent-shaped thickenings in tergum, cephalad of the vasiform orifice. Lateral hairs, dorsal spines, eyespots, legs and antennæ have disappeared. In other respects as in Stage 1.

Larva.—(Stage 3.) The more cephalic of the flattened filaments of each stellate whorl of the dorsal exudation much longer than the others. Smaller than the pupa-case, in other respects the same.

Pupa-case.—Length, 1.2 mm.; width, 0.7 mm.; elliptical, somewhat narrow caudad. Color, on leaf, under hand lens, shining black; under microscope, by reflected light, it shows a most exquisite iridescence. The case is flat upon the leaf and has neither lateral nor ventral secretion, but there is a long, downward-curving fringe from a series of porēs near the mesal border within the marginal rim, made up of separate, tapering, transparent rods which are more than one-half the width of the case. In dry specimens the rods are often joined together at the base, thus making a continuous fringe. The most striking characteristic of this species is the arrangement of the dorsal exudation in stellate whorls of filaments or flat rays, which form a beautiful, flower-like pattern repeated many times in four longitudinal, subparallel lines, the outer pair of which correspond to the shape of case and contain twenty-four whorls, much larger than those of the inner lines; the inner lines have about twenty whorls each; along the abdominal keel the latter are so close together that the whorls are massed, forming a single line. Dorsum flat, with a longi-medial keel, which is rounded on the abdomen and sharply ridged from there

cephalad to its arrow-shaped anterior end; between the keel and the marginal rim there is a depressed, flat space. Upon the dorsum there are rows of tubercles, or cylindrical papillæ, which correspond in position with the stellate whorls of wax. In the outer rows there are thirteen pairs; on the abdominal keel there are six pairs, very close together; caudo-laterad of these is another pair; laterad of the first pair of tubercles on the anterior abdominal segment is a pair; on the metathorax is a pair; on the prothorax near the median line is a pair, and more laterad, near the cephalic suture is another pair; on the cephalic region there are two pairs, the caudal pair more mesad; between the vasiform orifice and the caudal margin of case there is a pair, the inner borders of which form the lateral margins of the furrow. Lateral wax tubes, deflexed to meet the ventral disc, form a plainly demarked marginal rim; a second, and superimposed, row of large wax tubes seem to show in specimens which are partially cleared in Labarraque; the dorsal, submarginal fringe comes from a row of pores mesad of the latter tubes. Crenulations of the marginal rim, regular, minute, and round, with acute reentrant angles; from these thickenings extend mesad, producing a rather irregularly marked margin. At the caudal end of case and on each side between meso- and meta-thorax there are some crenulations larger than usual and altered in shape; from these points on the margin there is a furrow leading within the case; here it widens into an air-chamber from which the second and third pairs of spiracles open. Dorsum between rim and outer row of tubercles, striate, the lines formed of minute depressions, mid-dorsal area of case more or less marked with reticulated lines; abdominal segments distinct along central area.

Thorax and cephalic region with many transverse ridges; these include segmental divisions and outlines of legs; laterad of the anterior pair of tubercles is a pair of small pores, and another pair at the vasiform orifice. The usual caudal, latero-caudal, and cephalo-marginal hairs are not present. Vasiform orifice broadly ovate, cephalic margin straight, caudal end broadly rounded, emarginate at the median line; laterally there is a conspicuous, double, marginal rim, and the space not covered by the operculum is overlaid with semicircular, heavily chitinized folds; operculum about four-fifths length of orifice, subovate, distal end somewhat pointed, cephalic margin not coincident with that of orifice; lingula shorter than the operculum, cylindrical at base, broadly spatulate at distal portion, which bears three lateral lobes.

Adult female.—Length of body, about 1.4 mm.; fore wing, 1.4 by 0.5 mm.; hind wing, 1.13 by 0.5 mm.; hind tibia, 0.43 mm.; hind tarsus, 0.23; proximal segment, 0.15 mm; abdomen, pale yellow; head and thorax, deep yellow; legs, antennæ, and mentum dusky; eyes, dark red, divided. Wings, immaculate, costal margin bright yellow; main

veins about seven-eighths length of wing; in the front wing, distad of flexure, the main vein gradually becomes less distinct; the basal vein-let arises at very base of wing and is short; vein of hind wing, straight. Antennæ with segment 1, cup-shaped, as broad as long; segment 2, pyriform, slender, bearing a number of delicate hairs set in conspicuous conical bases; segments 3 to 6, inclusive, cylindrical and closely ringed with minute hairs. Genitalia usual.

Male.—Length, 1.5 mm.; fore wing, 1.6 by 0.75 mm.; hind wing, 1.33 by 0.56 mm.; hind tibia, 0.5 mm.; hind tarsus, 0.25 mm.; proximal segment, 0.16 mm. Genitalia usual. In other respects, as in the female. This is the only instance where the author has found the male uniformly larger than the female.

Cotypes.—No. 7084, U.S.N.M.

Collected on *Rhamnus californica*, *Umbellularia californica*, and *Heteromeles arbutifolia*, from the Santa Clara Valley and the slopes of the Santa Cruz Mountains; also on *Rhamnus crocea*, *Arctostaphylos manzanita* from King's Mountain, and on Arctostaphylos from the Yosemite Valley. All the immature stages are on the under sides of the leaves, while the pupa-cases are found frequently on the upper sides. In view of the fact that the larvæ are able to move about in their first stage only, it is puzzling to find a supposedly fixed stage isolated in this manner.

Eggs were collected in April and May, 1901, and again in September and October of the same year; the other stages within a week later. Verified adults not common, but a few were bred out the last week in April, 1902.

2. ALEYRODES SPLENDENS, new species.

Plate XXXVI, fig. 68, and Plate XXXVII, fig. 69.

Egg.—Size, about 0.18 by 0.98; dark yellow, unmarked, pedicel long, at one side of the base on the convex curve.

Larva.—(Stage 1.) Size, about 0.26 by 0.15 mm.; oval, pale transparent yellow; a narrow, solid band of white wax around the margin. There is an uncrenulated, thickened, marginal rim bearing nine pairs of hairs set in conical bases; of these, seven pairs are lateral and reach from the cephalic margin about one-half the distance toward the caudal end; the remaining pairs are the usual caudal and latero-caudal hairs. Dorsum free from secretion, convex, and with five pairs of spines; a pair on the cephalic region, two pairs on the thorax, and a pair on the abdomen, about midway between the first segment and the vasiform orifice. Abdominal segments barely visible. Vasiform orifice and operculum as in pupa-case; lingula minute, spatulate, hidden by operculum. Eyespots single, red. Legs and antennæ, functional.

Larva.—(Stage 2.) Size, about 0.4 by 0.27 mm.; elliptical; shining, pale golden brown; lateral fringe of white, waxen threads, ragged dis-

tally. Dorsum free from secretion, convex; no marginal rim, but the lateral wax tubes are distinct, crenulations broad and round, reentrant angles acute. There are four pairs of dorsal spines; a pair that are short and stout on the cephalic region; two pairs of long, curved ones on the thorax; and a pair that are short and slender at the vasiform orifice; caudal and latero-caudal hairs, and vasiform orifice as in pupa-case. Legs, antennæ, and eyespots not visible.

Larva.—(Stage 3.) Size, about 0.6 by 0.45 mm.; elliptical; under hand lens, shining brown-black; under microscope by transmitted light, smoky-brown with darker spots on outer part, the abdominal segments outlined with dark brown and each with many minute, transparent dots. Central dorsum very convex, no marginal rim, but the flutings of the lateral wax tubes are very prominent nearly to the body sutures, the margin is crenulated, incisions deep and acute, the ends of the tubes rounded distally. Spines as in stage 2, but short. Lateral fringe of wax rods somewhat overlaid with flocculent wax. Caudal and latero-caudal hairs, and vasiform orifice as in pupa-case. Legs, antennæ, and eyespots not evident.

Pupa-case.—Size, about 0.9 by 0.6 mm.; oval. Color, under hand lens, shining black; under microscope, deep brown, lighted by a narrow, submarginal, oval stripe of semitransparent yellow; there are also two wedge-shaped, semitransparent places on the cephalic region, through which the red coloring of the eyespots show, and a pair of small, circular spaces on the third and fourth segments of the abdomen. The copious, asbestiform, lateral fringe of white wax may extend out on leaf to more than the width of case; basally it is continuous, distally ragged, and of unequal lengths. The similar dorsal secretion forms a second fringe which rises perpendicularly to a considerable height above the dorsum and then curves outward and downward—sometimes the ends curl under, making a roll; central dorsum free from secretion. Dorsum very convex, body sutures prominent; lateral wax tubes well developed, deflexed to ventral disk, making a vertical, rather high, marginal rim, which is narrowed at the caudal end of case; crenulations rounded distally, incisions deep, reentrant angles acute; mesad of the ends of the wax tubes is a row of small openings, one on the convex side of each tube. Dorsum with a longimedial keel, crossed by a deep, transverse furrow on the thorax, on which are two pairs of small pores. The cephalo-marginal, latero-caudal, and caudal hairs are present, the latter longer than usual. Vasiform orifice small, subcircular, with cephalic margin almost straight; operculum relatively the same shape and size, filling the orifice; lingula obscured. On the ventral surface the reduced legs are evident; no trace of antennæ.

Adults.—Unknown.

Cotypes.—No. 7085, U.S.N.M.

This species is not common where collecting has been done by the author. It was found in April and May, 1902, on campus of Leland Stanford Junior University, on the under sides of leaves from *Rhamnus californica*, together with *A. iridescens* and *A. irelliana*. In July, 1902, the author collected a number of pupa-cases on an unnamed manzanita in the Yosemite Valley; in the latter place the species was much more numerous.

3. ALEYRODES PRUINOSUS, new species.

Plates XXXIII–XXXIV, figs. 40–55.

Egg.—Yellow-brown in color; subpyriform, pointed at base, which is prolonged into a long stalk; chorion firm.

Late embryo.—(Within the eggshell.) Color yellow, eyespots red, divided, the smaller of each pair round, more lateral and anterior; the larger lobe not so definite in shape. Near the basal part of egg there is a broad, irregular, orange-colored mass which extends almost the width of the shell; anteriorly it is divided into two rounded lobes; this mass corresponds to the visceral glands seen in the larvæ. Lingula distinct, agrees with older specimens. The anterior pair of legs readily made out.

Larva.—(Stage 1.) Size, 0.4 by 0.23 mm.; subelliptical, slightly pointed caudad; color, whitish yellow; lateral fringe about one-third the width of larva, continuous at base but distally divided into irregular plates. Dorsum free from wax, very convex, marginal crenulations shallow and regularly rounded; lateral margins with seven pairs of long, delicate, equally spaced hairs, which begin at cephalic margin and extend about two-thirds of the distance toward the caudal end; the caudal and latero-caudal hairs are very long, and between them is a third pair of short hairs. Vasiform orifice broadly ovate, nearly as wide as long, lateral margins straight, apex truncate at latero-cephalic margin; operculum similar in shape, not quite one-half as long as orifice, with a pair of spines on the free, distal end; lingula spatulate, nearly or quite as long as the orifice, usually protruded and dorsally recurved; dorsum convex and densely covered with minute, blunt spines, or tubes, and with a series of hairs which are much longer than usual on the lateral and caudal margins; near the apex and attached to the ventral surface is a pair of conspicuously broad and long spines; these are usually sickle-shaped and curved toward each other; on the lateral margins is a pair of spines similar to the subapical ones, while on the apex is a pair of blunt tubes and a pair of long hairs (Plate XXXIII, figs. 46–47). The abdominal sutures are distinct along the dorsi-meson, the posterior ones reflexed caudad. Eyespots large and bright red. Legs and antennæ functional.

Larva.—Size, 0.53 by 0.35 mm.; color a pale dusky brown; abdominal segments distinct along the central dorsum. Lateral hairs, legs,

and antennæ have disappeared from view, and the mouthparts are much smaller. In other respects as in stage 1.

Pupa-case.—Size, 1.33 by 1 mm.; broadly elliptical, very convex, slightly narrower at the cephalic region; caudal end truncate, emarginate, and bent abruptly to the leaf. Color smoky brown, sometimes yellow, darker over the developing pupa or parasite; leg outlines conspicuous. The entire dorsum is rugose, and marked with more or less radially arranged thickenings or reticulations, which show as minute, blackish dots; on each segment from the vasiform orifice to the mouthparts there are two parallel rows of depressions of irregular outline, bounded cephalad by the margin of the preceding segment. Case very convex and with a medio-dorsal keel; there is neither dorsal nor lateral secretion, and the vertical fringe is very short. The marginal rim is lacking, and the wax tubes are not evident except at extreme margin, crenulations shallow and irregular; abdominal sutures conspicuous, the posterior ones reflexed caudad. The cephalomarginal hairs are minute, the caudal and latero-caudal hairs are present, but their relative lengths are reversed, the latero-caudal being much the longer. Just within the caudal margin is a pair of short, delicate hairs, and a similar pair is found at vasiform orifice. Scattered over the dorsum are a number of small pores. Vasiform orifice outlined by a dark rim; subovate almost as broad as long, the distal end bluntly rounded, lateral margins with corrugations, or folds, extending downward and inward; operculum one-half length of orifice, sub-semielliptical, cephalic margin straight, caudal end usually truncate but occasionally rounded and somewhat pointed; color brown; dorsal surface covered with closely set, minute hairs; lingula nearly the length of orifice, cylindrical, the distal two-fifths somewhat enlarged and arrow-shaped, thickly setose, and terminating in two straight setæ, which reach beyond the caudal end of orifice; a pair of setæ is also found on the lateral margins. Cephalad of the orifice is a thickened prolongation of the outline of the lingula, which reaches nearly to the two crescent-shaped thickenings in tergum, and caudad a narrow furrow extends from orifice to margin of case. Rudimentary legs distinct on the ventral surface. Eyespots divided, the anterior lobe smaller, color bright red.

Adult female.—Length of body, 1.8 mm.; fore-wing, 1.7 by 0.8 mm.; hind wing, 1.6 by 0.6 mm.; hind tarsus, 0.25; color, yellow with strongly chitinized places which make brown markings; segment 1 of abdomen has three longitudinal stripes; between segments 1 and 2, on line of suture, there is a transverse stripe; segment 2 has two lateral longitudinal curved bands the length of segment, between these are two sub-crescent-shaped, lighter colored patches, not as long as the lateral bands, with concave side of the crescents toward the median line; segments 3 and 4 have each two broad, transverse bands

nearly their width, these are not continuous on median line; segments 5 and 7 have transverse bands as wide as the segments; from segments 3 to 7, inclusive, the transverse bands become gradually longer; from segment 7 to genitalia, and surrounding the vasiform orifice, is a subcircular, broad band which is narrow cephalad of the orifice and much wider caudad of it; on the venter or latero-venter, there is a longitudinal stripe on segments 4 and 5, which are here curved conspicuously both cephalad and caudad, making the lateral ends of the segments very much wider than in central dorsum. On venter there is a broad subcircular band which surrounds the latero-ventral parts of base of genitalia; at the caudal end cephalad of this are two transverse dashes of brown. Thorax with transverse bands on each segment. Head also strongly marked. Legs, antennæ, and mentum dusky and marked. Operculum and lingula brown, densely setose. The eyes are red and divided, the lobes subrectangular and separated by a wedge-shaped space, which in the live insects is covered with white granules of wax; ocelli conspicuous. Fore-wing with two dusky spots; one, a narrow band on the anal side at flexure, the other larger at and including the apex of vein which is here curved toward the anal margin; basal veinlet arises near the base of main vein and is short; there is a long, oblique anal fold which reaches nearly to the margin; hindwing with but one dusky patch, this at and including the apex of vein. Antennæ about 0.5 mm. long; segment 1, cup-shaped; segment 2, pyriform; segments 3 to 7, inclusive, subcylindrical, closely ringed with minute hairs; segment 7, with finger-like process and hair at tip. Mentum with apex dark brown, median segment the shortest. Genitalia ordinary.

Male.—Length of body, 1.7 mm.; fore-wing, 1.7 by 0.7 mm.; hind wing, 1.6 by 0.6 mm.; the latero-ventral, longitudinal stripe of brown extends from the middle of the second segment partly through the seventh segment, from it toward venter the segments are outlined by dark stripes. Genitalia ordinary. In other respects as in the female.

Cotypes.—No. 7086, U.S.N.M.

Collected on *Heteromeles arbutifolia* by Mr. Edward Ehrhorn, at Avalon, Catalina Islands, Southern California; and by the auther on campus, Leland Stanford Junior University. The specimens were found on the under side of the leaves massed in large numbers, and together with the leaves were very thickly coated with granules of white wax, which readily dissolved in alcohol. The pupa-cases were conspicuously purplish in color when *in situ*. From April 16 to May 16, 1902, the adults were seen emerging from the pupa-cases in great numbers and depositing their eggs. Many of the leaves were incrusted with the immature forms and as a consequence were bent and dry.

4. ALEYRODES AEPIM Goldi.

Aleyrodes aepim GOLDI, Mittheil. Schweitz. entom. Gesellsch., VII, 1886, p. 250.

On *Manihot palmata* ("Aepim," "Mandioca doce") Rio de Janeiro.

5. ALEYRODES TENTACULATUS, new species.

Plate XXXI, fig. 26–30a.

Larva.—(Described from moult). Size, 0.3 by 0.16 mm.; thin, transparent and white; elliptical; the dorsum free from pores and papillæ; there is a pair of long, curved setæ on the caudal margin and a pair of shorter ones on the latero-cephalic margin of the operculum. Lingula as long as orifice, spatulate and enlarged distally; the lateral margins show faint traces of the three lateral lobes and the terminal lobe characteristic of the pupal stage.

Larva.—Size, 0.4 by 0.23 mm.; elliptical, whitish yellow, thin and semi-transparent; the dorsum has neither pores nor papillæ and is void of all secretion; caudal margin bears a pair of long, curved spines set in conspicuous, tubercled bases; antennæ minute, slender, and with a notch near the tip. In other respects as in pupa-case.

Pupa-case.—Size varies from 0.83 by 0.56 mm. to 0.96 by 0.7 mm.; elliptical, narrowed at thoracic region and tapering somewhat to the cephalic margin; caudad the case narrows more abruptly, and the caudal end is somewhat emarginate to meet the furrow which extends from it to the vasiform orifice; color yellow, sometimes brown from the presence of fungus or a parasite; the empty case is a white, semi-transparent film. There is no lateral fringe, but the case rests upon a rather high, vertical, ventral fringe of coalesced, white wax rods; the dorsal secretion is a submarginal series of separate, glassy, white wax rods, which are short, tapering, and flattened somewhat, as they are closely appressed to the margin of case, or it is composed of a series of longer and more slender rods, interspersed with very much longer and stouter similar wax rods; this latter type is not appressed to the margin of case, but bends downward slightly toward the leaf. The dorsum is convex and marked with more or less radially arranged thickenings, or reticulations; sutures distinct nearly, or quite, to the marginal rim, thoraco-abdominal one sinuate, posterior ones of abdomen strongly reflexed caudad. There is a well-defined marginal rim, within which is a single, usually regular, row of about one hundred closely set, large, conical papillæ, which have a diameter of nearly the width of the rim. Scattered among the papillæ, and mesad of them, are three rather definitely arranged rows of small pores; besides these there is a longitudinal row on each side of the dorsi-meson from the vasiform orifice cephalad, with a pair to each segment on the abdomen; this same order seems to obtain also on the thorax, but the segments are not well enough defined to verify it; many small pores are also

scattered over the entire dorsum. The marginal crenulations are rounded and have acute reentrant angles; at the caudal margin, on a line with the furrow, the crenulations are pointed and closely crowded together. There is a pair of short, tapering hairs cephalo-laterad of the vasiform orifice, the usual latero-caudal hairs are short, delicate, and set in tubercled bases, but the conspicuous caudal spines, usually found in Aleyrodids of this type, were not present in any of the numerous specimens examined. Within the abdomen are two large, orange-colored visceral glands. Vasiform orifice broadly conical, bounded dorsally by a dark raised rim, its inner lateral and caudal margins with conspicuous corrugations or folds, extending downward and inward; caudal end emarginate and with a median lobe or process; operculum subovate, more than one-half length of orifice; dorsum convex and covered with minute hairs; lingula well developed, spatulate, about two-thirds as long as the orifice, distal portion with three pairs of lateral lobes and a terminal emarginate lobe; on each side, in the angle between the distal lateral and the apical lobe, there is a long seta which projects caudad beyond the orifice, the entire organ densely setose; cephalad the outline is prolonged to the two pairs of crescent-shaped thickenings in the tegument of dorsum, which are more strongly chitinized and darker colored than usual. On the ventral surface the rudimentary legs are evident, but no trace of the antennæ can be seen. Eyespots dark red, divided into two round lobes.

Late pupa. (Male dissected from pupa-case). Abdomen pale yellow; head and thorax pale dusky-brown; legs and antennæ white; wings immaculate; eyes black and constricted, very broad; antennæ four-segmented; segment one, cup-shaped, broader than long; segment two, pyriform, densely setose, with stout hairs scattered over it; segment three, subcylindrical, very long and narrow, insertion with segment two very slender; central part somewhat constricted; near the distal end there is a stout rather blunt spine; segment four, closely ringed with minute hairs. Mentum very long, dusky-brown; apex darker. Wings too crumpled to describe in detail. Abdomen with two, large, orange-colored glands. Genitalia ordinary.

Adult female.—Body too distorted to measure accurately; forewing, 1.3 by 0.6 mm.; hind wing, 0.9 by 0.5 mm. Forewing with one rather large dusky spot at and including end of main vein; basal veinlet arising at some distance from the base of the wing; main vein with but a single flexure and not curved at apex; hindwing with dusky spot as in forewing, vein straight; abdomen pale yellow, head and throax darker; eyes large, reniform, by transmitted light, brown-black; antennæ usual, segment seven without notch and with an apical hair. Genitalia ordinary.

The dusky spot on wings which is present in the adult, but not seen in the late pupa, may need the action of the air to render it visible.

Cotypes.—No. 7087, U.S.N.M.

Specimens have been found on the leaves of *Quercus densiflora* and *Quercus agrifolia* together with *A. coronatus* and *A. gelatinosus;* also on *Clematis ligusticifolia*, *Opulaster capitatus*, *Lonicera involucrata*, and *Rhus diversiloba;* the latter shrub was examined in Alameda during the last week in August, 1901, many adults were flying around and resting upon it, but as there were other species of pupa-cases upon the adjacent food plants, it was deemed best not to assume that the adults were *A. tentaculu*. From the pupa-cases which were isolated, only the one female from which description was made, was bred out; also there was but one pupa-case found upon which there was a moult, although pupa-cases have been found at all seasons during a year. This species is rather common but not plentiful, seldom more than two being found upon a leaf.

6. ALEYRODES AUREOCINCTUS (Cockerell).

Aleyrodes aureocincta COCKERELL, Jn. N. Y. Ent. Soc., 1897, p. 42.

On *Aquilegia*, Organ Mountains, New Mexico.

7. ALEYRODES BERBERICOLA Cockerell.

Aleyrodes berbericola COCKERELL, Jn. N. Y. Ent. Soc., 1896, p. 207.

On a shrubby *Berberis*, Mescalero Reservation, Tularosa Creek, New Mexico.

8. ALEYRODES CITRI Riley and Howard.

Aleyrodes citri RILEY and HOWARD, Insect Life, V (1893), pp. 219–226.

Food plants: Orange, *Melia azederach*, *Viburnum nudum*, Cape Jassamine, and occasionally on *Quercus aquatica*. Florida, Louisiana, and greenhouses generally.

9. ALEYRODES COCKERELLI von Ihering.

Aleyrodes cockerelli VON IHERING, "Os Piolhos Vegetaes do Brazil." Revista do Museu Paulisto, N. H., 1897, p. 393.

On *Baccharis pauciflosculosa*, São Paulo, Brazil.

10. ALEYRODES CORNI Haldeman.

Aleyrodes corni HALDEMAN, Am. Jn. of Sci. and Arts, IX (1850), p. 109.—SIGNORET, Ann. de la Soc. Entom. de France, Dec., 1867, p. 398.

"Size and general appearance of *A. abutiloneu;* body pale flavous; eyes black; wings pure white, without bands. Pennsylvania in September and October; the larva and imago on the inferior surface of the leaves of *Cornus amomum*.

"Larva flavous, the disk of the larger individuals dark brown; the margin is ciliate with white. A great many are destroyed in the larva state by *Amitus corni* Hald."

11. ALEYRODES CORONATUS (Quaintance.)

Plate XXVIII, fig. 9.

For further description see reference. Only those stages not included by Quaintance, in his paper already referred to, or variations from his description, will be given here.

Larva.—(Just from egg, April 19, 1901.) Size, 0.38 by 0.15 mm.; elliptical; semitransparent white; neither dorsal nor lateral secretion; dorsum convex and with a distinct noncrenulated, marginal rim, bearing from seven to nine pairs of delicate, lateral hairs, which extend from the latero-cephalic margin about one-half the distance to the caudal end; the usual caudal and latero-caudal hairs are present and are relatively long, and there is a pair of shorter ones at the vasiform orifice. Abdominal sutures distinct to the marginal rim. Vasiform orifice prominent, subcircular; operculum short, lingula obscured by it. Eye-spots large, single, bright red. Legs and antennæ functional, the former with digitule-like hairs on tarsi.

As the larvæ grow older they become flatter, except along the dorsi-meson. There is much variation in the lateral secretion, which is as great among larvæ of the same stage as in different stages; this fringe may be entirely wanting, some specimens have only a narrow band of solid wax closely appressed to the margin, others a narrow fringe of separate, glassy rods set far apart, while still others have a fringe one-half the width of dorsum, made up of separate rods of transparent, white wax, which taper to a point and are twisted, or even coiled upon themselves, in various directions.

Pupa-case.—Size variable, 0.9 by 0.67 mm. to 1.1 by 0.9 mm.; with a few exceptions these cases are surrounded by a broad sloping ring of gelatinous substance; this secretion melts when heated, but rehardens as soon as it begins to cool and is difficult to remove; xylol, or absolute alcohol, does not entirely dissolve it unless the cases are covered for some time; the dorsal wax can be brushed off, and is quickly melted in hot water or weak alcohol. There are three pencils of opaque, white wax lying upon the gelatinous mass and extending to its distal margin. One of these is from the median line of the caudal margin, the other two are from the meso-thorax and extend almost at right angles from the case; these pencils are very conspicuous, and have been found on every perfect specimen examined. On the dorsum of specimens which have been partially cleared in caustic potash there are many pores which vary in size with the amount of clearing. Around the case is a single, equally spaced submarginal row; mesad of this row there are scattered, single, larger ones; on the cephalic region there is a transverse row of eight pores; caudad of these is a pair, one pore on each side of the dorsi-meson; on the meta-thorax

there are two transverse lines, each containing six pores, and latero-cephalad of these are two pairs; on the abdomen, each side of the dorsal keel, are two longitudinal rows of pores, the inner row of six and the outer with five; on the second abdominal segment there is an additional pore on each side, thus making a transverse row of six pores instead of the usual number.

Adult female.—(Bred from pupa-case.) Length of body, 1.1 mm.; fore wing, 1.05 by 0.65 mm.; hind tibia, 0.4 mm.; hind tarsus, 0.2 mm. Abdomen whitish yellow, head and thorax darker, legs and antennæ white; wings immaculate, main veins to apex; in the fore wing the flexure is very slight and the veinlet arises near the base of the wing; between the veinlet and the anal margin there is a conspicuous, oblique fold; in the hind wing the vein is straight. Antennæ, length formula, 3–7–5–6–4; segment one, short, about as long as broad, cup-shaped; segment two, pyriform, densely setose and with a number of short spines set in tubercled bases. Genitalia usual.

Aleyrodes coronatus has been found in varying numbers upon every live oak examined and is widely distributed in California, specimens having been received from San Diego to Mendocino counties. It seems to be more liable to the attack of fungus than any other species which has been under observation; material from widely separated localities and from different hosts, suffering equally. Frequently the leaves are so thickly covered with the immature forms that a solid crust is made upon the underside; such leaves are abnormally small, paler in color, and curled; sometimes only individual leaves on a tree are in this condition, and again all are infested, and the tree is stunted.

Collected on the live oak (*Quercus agrifolia*) by Mr. Edward M. Ehrhorn at San Jacinto and the Santa Catalina Islands, southern California; by Mr. James McMurphy at Albion Ridge, Mendocino County; and by the author in San Ramon Valley, Santa Clara Valley, Golden Gate Park, and in Alameda County in various places. Also collected by Mr. G. H. Coleman on the tan-bark oak (*Quercus densiflora*), at the head of the Big River Canyon, Mendocino County, June 6, 1901; and by the author on the same host plant, from the slopes and ridges of the Santa Cruz and Sierra Morena Ranges. This same species has also been found on *Heteromeles arbutifolia* and *Arbutus menziesii* on Kings Mountain, and in the Santa Clara Valley. The madrones along the roads leading from the San Ramon Valley to Haywards, Contra Costa County, were carefully examined in 1901, but this species was not found upon them; also collected by the author on the leaves of *Quercus chrysolepis* in the Yosemite Valley, in July, 1902.

12. ALEYRODES ERIGERONTIS Maskell.

Aleyrodes erigerontis Maskell, Trans. N. Z. Inst., 1895, p. 429; Entom. News, VII, p. 247.

On an *Erigeron*, Escalon, Mexico.

13. ALEYRODES FILICIUM Goldi.

Aleyrodes filicium Goldi, Mittheil, Schweitz. Entom. Gesellsch., VII (1886), p. 247; Ent. Mo. Mag., 1891, p. 44.

On *Asplenium cuneatum* and other Brazilian ferns, in the botanic garden at Rio de Janeiro; also on *Oleandra articulata* and *Pteris quadriaurita* in the fern house, Kew Gardens.

14. ALEYRODES KELLOGGI, new species.

Plate XXIX, figs. 13–16.

Egg.—Size, 0.2 by 0.09 mm.; yellowish, unmarked, pedicel short, at one side of base. The empty shells are dark brown and much crumpled.

Larva.—(Stage 1.) Size, 0.3 by 0.1 mm.; elliptical; margin with a narrow band of white wax; color, semitransparent white. Dorsum free from secretion, convex, lateral margins with pairs of short hairs set in conical bases; besides these, there are the usual caudal and latero-caudal hairs, which are conspicuously long. Abdominal segments distinct. Vasiform orifice as in pupa-case. Antennæ and legs functional, the latter with long, digitule-like hairs.

Larva.—(Stage 2.) Size, 0.4 by 0.25 mm.; elliptical; the dorsal secretion a submarginal, flat fringe, continuous at base but distally separated into irregular plates. Abdominal segments distinct, rounded along the dorsi-meson into a keel, crenulations of margin broad and shallow. Vasiform orifice subcordate; operculum short, subsemi-elliptical; dorsum setose; anterior margin straight, distal end with two conspicuous hairs on the lateral angles; lingula short, projecting beyond the operculum, strap-shaped, distal part covered with hairs. Reduced legs and antennæ evident. Eye-spots small and dark red.

Pupa-case.—Size, 1.3 by 0.87 mm.; broadly elliptical, narrowed cephalad; color, pale yellow; the central region darker. There is no lateral fringe; the case is raised some distance from the leaf upon a vertical, ventral fringe of coalesced, white wax rods and covered by the dorsal secretion with the exception of the vasiform orifice; this secretion consists of a central shell of thick, porous, pearly white wax, and a submarginal series of broad, opaque, white ribbons, which are irregular in width and raised into a high-arching, curved fringe, which entirely covers the margin of the case and, in many specimens, is curled under itself, making a roll. The ribbons are made up of from two to four thin sheets of wax closely appressed to each other; the different layers in each ribbon may come from separate sets of wax-secreting tubes; this seems extremely probable, as the yellow color of the case shows at the base between the sheets. The wax around the vasiform orifice is raised above the dorsal shell and forms a concave rim which meets the caudal ribbon and incloses the orifice. In nearly all the specimens

the wax plate is divided transversely along the thoraco-abdominal suture.

The dorsum is covered with minute pores, underlying which are relatively large, irregular, intersecting canals.[a] It has a wide, conspicuous, irregularly striate, marginal rim, which bears a row of minute, tubercled hairs. The crenulations of this rim are sharply pointed, incisions shallow and reentrant angles acute; mesad of the rim are three or four rather regular rows of small pores. The abdomen is rounded into a slight keel on the dorsi-meson, along which the sutures are distinct and the outlines of the legs are conspicuous. Vasiform orifice subcircular; its margin is a dark raised rim or fold which bounds the orifice on its lateral sides, but does not quite come together cephalad; on each inner, lateral edge of its cephalic margin, there is a short hair which projects into the open space within the orifice; the lining is laid in conspicuous, transverse folds. Operculum almost obsolete, subrectangular; cephalic margin, straight. Lingula very short, projecting slightly beyond the operculum; it is cylindrical at base and widened at the apex, which is densely setose. There is a pair of short spines latero-cephalad of the vasiform orifice; the latero-caudal hairs are present, so delicate that they are nearly invisible, but the usual caudal hairs are absent.

Adults.—Unknown.

Cotypes.—No. 7088, U.S.N.M.

Collected on the under sides of the leaves of the *Quercus agrifolia* and *Prunus ilicifolia* in the Santa Clara County, and on the slopes of the Sierra Morena Range. On the former food plant only an occasional pupa-case has been found, but the leaves of the cherry are frequently incrusted with the immature forms. Verified adults have never been secured, although many pupa-cases were isolated.

15. ALEYRODES FLOCCOSUS (Maskell).

Aleyrodes floccosa Maskell, Trans. N. Z., Inst., 1895, p. 432.

From Jamaica, on *Lignum-vitæ*, in company with *A. stellata*.

16. ALEYRODES ERRANS, new species.

Plate XXX, figs. 20–21.

Egg.—Size, about 0.21 by 0.11 mm.; yellow, curved, shell unmarked. Pedicel short, slender, and on the convex curve at one side of truncate base.

Larva.—(Stage 1.) Size 0.3 by 0.16 mm.; subelliptical, pale, semitransparent yellow. Dorsum convex and bearing five pairs of spines—a pair of very long curved ones on the cephalic region; two pairs much shorter on the thorax; a pair on abdomen cephalad of the vasiform ori-

[a] These may be spaces which, in the living insect, are filled with wax; when freshly mounted specimens are examined the spaces are seen filled with air,

fice and a pair latero-cephalad of it. The usual caudal and latero-caudal hairs are present, much longer than in other species. There is a distinct thickened marginal rim, in which are two parallel rows of minute transparent spots; the lateral wax tubes seem to be wanting and there is no wax secretion of any kind; on the lateral margins of the rim are seven pairs of delicate hairs set in conical bases. These hairs are much longer than usual, and extend from the latero-cephalic margin, about one-half the distance to the caudal end. Vasiform orifice subcircular, bounded by a dark rim; operculum relatively the same shape and size as orifice; lingula the length of orifice, enlarged distally, strap-shaped. Legs and antennæ functional. Mouth parts large, setæ more than one-half the length of larva.

Larva.—(Stage 2.) Size, 0.45 by 0.3 mm.; broadly elliptical in shape and of a yellowish-brown color mottled with dark spots. Dorsum flat, with a narrow lateral fringe of transparent rods, which are continuous at base but ragged distally; no dorsal exudation. Spines as in stage 1, except that the cephalic pair are wanting and the second and third pairs are very long. Lateral wax tubes distinct; crenulations of margin shallow and rounded; marginal rim, latero-marginal hairs, legs, and antennæ have disappeared from view.

Larva.—(Stage 3.) Size, 0.5 by 0.45 mm. to 0.7 by 0.83 mm.; color, dark brown; by transmitted light, yellow or gray-brown. No marginal rim, but the lateral wax tubes are bent downward to some extent, and the crenulations are relatively deeper than in the pupa-case. Hairs and spines as in stage 2, except that there is a pair of minute hairs on the cephalic region. Abdominal segments distinct along the dorsimeson, bearing two rows of small pores on each side of the median line, a pair to each segment; in other respects as in pupa-case.

Pupa-case.—Size, from 0.75 by 0.5 mm. to 1.03 by 0.7 mm.; shape, broadly subelliptical, widest across the abdomen, narrow on thorax, and tapering to the caudal end; color, shining black. There is a profuse lateral exudation in the form of a fringe made up of thread-like, white, wax rods which have many minute projections, the whole interlaced into a mass which varies considerably in width. Dorsum keeled for entire length, body segments conspicuous; on the third and fourth abdominal segments are a pair of small pores; the thoraco-abdominal suture is very sinuate and extends to the marginal ridge. There is a distinct and wide marginal rim somewhat wider on the sides, which is demarked from the dorsum all around by a sharp ridge; the lateral wax tubes are quite prominent and extend mesad about one-half the width of the rim; the margin is crenulated, incisions irregular, and the ends of the tubes truncate and notched. On the cephalic region there are a pair of wedge-shaped or triangular transparent places, the acute angle toward the median line, the outer edge parallel with the marginal ridge; between the transparent places is a pair of small pores,

and near to the median line are several longitudinal dashes. Vasiform orifice small, tubercled, and subcircular; operculum heavily chitinized, approximately the same shape and size as the orifice; lingula obscured by the operculum. On the ventral side the reduced legs can be made out; antennæ not visible.

Adult female.—Body so distorted that accurate measurements could not be made; fore-wing, 1.4 by 0.65 mm.; hind tibia, 0.5 mm.; middle tibia, 0.35 mm.; fore tibia, 0.3 mm.; hind and middle tarsi, 0.25 mm.; proximal segments, 0.15 mm.; fore tarsus, 0.21 mm. Color, bright yellow, legs and antennæ white. Wings immaculate, thickly coated with white wax granules; costal margins golden yellow; main vein of both wings extending to apex; in fore-wing the flexure is at the middle of length, beyond it the vein becomes gradually less evident; the basal veinlet arises at base of wing and extends obliquely caudad to margin of wing. Mentum yellow, with proximal segment longest; this is slender and tapers to the middle segment, which is shorter than the others; distal segment gradually tapering to the apex, which is dark brown at extreme tip. Eyes divided into two lobes, of which the anterior lobe is smaller, more transparent, and glowing red; the facets are also much smaller and of a different shape from those of the posterior one, which is subrectangular in shape and of a dark, reddish-brown color. (See drawing of *A. pruinosus.*) Genitalia ordinary, brown in color and acute conical.

Adult male.—Fore-wing, 1.23 by 0.6 mm.; hind tibia, 0.6 mm.; middle tibia, 0.33 mm.; proximal tibia, 0.3 mm.; tarsi, proximal and middle, 0.21 mm., hind 0.26 mm., the proximal segment of latter 0.15 mm. Genitalia ordinary. The body very much smaller than that of the female, in other respects essentially the same.

Cotypes.—No. 7089, U.S.N.M.

Collected on *Umbellularia californica* on campus, Leland Stanford Junior University; in various places in the Santa Clara Valley; on the lower slopes of the Santa Cruz Mountains, and along the San Ramon Creek at the base of Mount Diablo, Contra Costa County. Also collected on *Arbutus menziesii* on King Mountain, on the Ceanothus, near Usal, Mendocino County, July 6, 1901, and on *Umbellularia californica* at Redwood Creek, Napa County, June 6, 1901, by Mr. George Coleman.

The pupa-cases are common all the year. The eggs and young larva were collected from the middle of March to May, and again found in October and November. April 28, 1902, the adults emerged from segregated cases. This species is common in the above localities. Often the leaves are incrusted with the pupa-cases, which are always on the under sides of the leaves. Frequently *A. inconspicuus*, *A. nigrans*, *A. quaintancei*, and *A. pruinosus* are collected from the same leaves with *A. errans.*

17. ALEYRODES FORBESII Ashmead.

Aleyrodes forbesii Ashmead, Fourteenth Rept. Ill. St. Ent. (1884), p. 110 (*aceris* Forbes).

This is the common, large, box-like species, on leaves of *Acer dasycarpum*, in many parts of the North—Ithaca, New York; Washington, District of Columbia; Urbana, Illinois.

18. ALEYRODES FUMIPENNIS Hempel.

Aleyrodes fumipennis Hempel, Psyche, VIII, No. 280, p. 394.

On undetermined grass growing on swampy ground, S. Paulo, Brazil.

19. ALEYRODES GELATINOSUS (Cockerell).[a]

Egg.—Size, 0.2 by 0.1 mm.; oval, yellow, curved, unmarked, pedicel short, at one side of center of base.

Larva.—(Stage 1). Size, 0.27 by 0.1 mm.; subelliptical; wax secretion a narrow, white band of coalesced rods closely appressed to the margin; color, pale-yellow to yellowish-brown; dorsum convex, abdominal sutures distinct along the dorsi-meson; vasiform orifice subcircular; operculum relatively the same shape and size, nearly filling the orifice; lingula not seen.

Larva.—(Stage 2). Size, 0.5 by 0.4 mm.; broadly elliptical; wax secretion a continuous dorso-submarginal fringe about width of larva, made up of crystalline rods coalesced nearly to distal end, where it is separated into irregular plates; cephalad of the vasiform orifice on each side of the dorsi-meson is a small knob-like portion of flocculent wax. Color, yellow-brown. In other respects as in stage 1.

Larva.—(Stage 3). Size, 0.6 by 0.43 mm.; there is a long caudal pencil of cottony white wax projecting from the median line for some distance; sometimes the caudal pencil is divided into two plume-like parts, the dorsal knobs found in previous stage present, but the fringe is wanting. Color, dark brown; dorsum finely punctate, bearing a pair of long, tapering, caudo-submarginal spines and a pair of stout, shorter spines, latero-cephalad of the vasiform orifice. Vasiform orifice tubercled. In other respects essentially as in previous stages.

Pupa-case.—Size, 0.9 by 0.7 mm.; broadly elliptical, caudal end truncate; secretion in form of a gelatinous ring upon which the case rests and which projects beyond it for a considerable distance. The secretion is a translucent, brownish mass of wax, which under the high power of the compound microscope shows its rod-like origin. This wax is difficult to remove; when heated it melts, but as soon as cooled it quickly re-forms. It can be dissolved by xylol or in absolute alcohol, if allowed to remain covered for some time. On some specimens

[a] Contributions toward a Monograph of the American Aleurodidæ (U. S. Agri. Dept., Division of Entomology, Technical Ser. 8, p. 27).

there is found a dorsal, submarginal fringe of very small crystalline, coalesced rods, which overlie the gelatinous wax. From the thoracic margins there issues a long, white pencil of cottony wax; these project almost at right angles from the case and rest upon the underlying ring of dark wax. From the median line of the caudal margin there projects a third pencil similar in structure and position; these pencils often are spiral in arrangement. Color of pupa-case, iridescent, or shining black. Dorsum finely punctate; sutures distinct, the longimedial and thoraco-abdominal ones conspicuous, the latter sinuate; abdominal keel distinct, ending caudad in the tubercled vasiform orifice. There is no marginal rim, but the lateral wax tubes are evident; crenulations rather deep, broad, and rounded, the reentrant angles acute, each crenulation minutely recrenulated. There are many small dorsal pores. Among the striations which extend mesad from the marginal crenulations are from two to four irregular rows, mesad of these on each side of case, extending caudad of thoraco-abdominal suture is a longitudinal row containing four pores; laterad of the anterior margin of the vasiform orifice is a pair; cephalad of the thoraco-abdominal suture there is a transverse row of four, two on each side of the dorsi-meson; cephalad of the meso- and the metathoracic sutures there are two, one each side of the dorsi-meson; near the latero-cephalic margin there is a pair on each side, and in line with them are four circular light spaces; scattered over the dorsum are many smaller pores. When the pupa-case is cleared in caustic potash many more pores become evident.

Late pupa.—(Female dissected from case.) Body too distorted to measure accurately. Abdomen deep yellow and containing two large, orange-yellow visceral glands. Head and thorax darker colored, legs white. Antennæ: Segments 1 and 2 dark brownish yellow; segments 3 to 7, inclusive, white. Legs, ordinary; claws, 3, the middle one more slender and longer than the other two. Segment 1, cup shaped, broader than long; segment 2, pyriform, densely setose; segment 3, long and slender, sub-cylindrical, enlarged near the basal end; at insertion with segment 2, very slender; segments 4 to 7, inclusive, subequal and slender; segment 7, sub-fusiform, notched on each side near apex; segments 3 to 7, inclusive, closely ringed with minute hairs. Eyes reniform, broad, and dark red. Genitalia ordinary.

The pupa-case of this species agrees in the main with the brief description given by Cockerell, but as the author has secured other stages it has been thought best to give a full description here.

Collected from *Quercus agrifolia*, together with *A. coronatus*. It is common wherever the author has found the accompanying species, and from a general similarity the author has been led to believe that the two species are nearly related, or that *A. gelatinosus* is a variety of *A. coronatus*.

20. ALEYRODES GOYABÆ Goldi.

Aleyrodes goyabæ Goldi, Mittheil. Schweitz. entom. Gesellsch., VII (1886), p. 248.

On *Psidium guajava* and *Persea gratissima*, Rio de Janeiro.

21. ALEYRODES GRAMINICOLA Quaintance.

Aleyrodes graminicola Quaintance, Can. Ent., XXXI, p. 89.

On an undetermined grass, Lake City, Florida.

22. ALEYRODES HORRIDUS Hempel.

Aleyrodes horridus Hempel, Psyche, VIII, No. 280, p. 394.

On *Psidium* sp., São Paulo, Brazil.

23. ALEYRODES INCONSPICUUS (Quaintance).[a]

Plate XXXII, figs. 34–37a.

Although there are a number of differences between the above and the specimens from which these descriptions were taken, they agree in essentials sufficiently to justify placing them together. Only those stages not previously described and the variations from Quintance will be included here.

Larva.—(Stage 1.) Size, 0.26 by 0.13 mm.; elliptical; pale yellow. Dorsum convex, with a distinct marginal rim, in which are two parallel rows of minute, transparent dots, and which bear fifteen pairs of short, tubercled setæ on its lateral margins; of these the third cephalic pair is much the longest; besides these setæ there are the usual caudal and latero-caudal pairs both of long spines; a pair of delicate, minute hairs on the cephalic margin; a pair of long spines at the vasiform orifice and cephalad of these, a shorter pair. Abdominal sutures distinct, the posterior ones reflexed caudad. The last segment is narrowed and prolonged into a small lobe; marginal crenulations very shallow. Vasiform orifice cordate, almost as wide as long, the caudal end broadly rounded, cephalic margin straight; operculum subrectangular, about one-third as long as it is broad, distal margin truncate and densely setose; lingula spatulate, as long as the orifice, setose, and with a pair of long, sub-terminal setæ. Legs functional, tarsi with digitules as in the Coccidæ; antennæ long and slender, only the first segment defined.

Larva.—(Stage 2.) Size, 0.3 by 0.2 mm.; the marginal hairs and rim and the antennæ are not visible. The dorsum bears three pairs of long spines: A pair on the meso-thorax; a pair on the meta-thorax, and a pair at the vasiform orifice; the usual caudal hairs are present. Vasiform orifice small and subcircular, caudal end truncate; operculum

[a] Contributions toward a monograph of the American Aleurodidæ (U. S. Agri. Dept., Division of Entomology, Technical Ser. 8, p. 22).

end lingula not distinct. Reduced legs seen on the ventral surface; eyespots single, color bright red. In other respects essentially as in stage 1.

Larva.—(Stage 3.) Size, 0.9 by 0.75 mm.; narrowed caudad. Essentially as in pupa-case.

Pupa-case.—Size, 1.16 by 0.8 mm.; shape broadly elliptical, slightly narrowed cephalad, with caudal margin truncate, and emarginate to meet the furrow. There is neither lateral nor dorsal secretion, but when case is removed from the leaf, there is left a narrow, vertical, ventral fringe. Color from pale to deep yellow. Dorsum convex with many small pores scattered over it and covered by faint polygonal markings, the outer third is also covered with minute markings, or, it may be, transparent papillæ. Mesad of these on the abdomen are three parallel rows, each with five large, nearly circular transparent places, in each of which are a number of irregular spots, folds, or wrinkles, a row along the dorsi-medial line and a row each side of it;[a] after the specimens have been mounted for some time in Canada balsam, these have a tendency to disappear; these "spaces" are probably the "pores" of Quaintance. Marginal rim varies in width and distinctness, crenulations wide and shallow. Abdominal and thoraco-abdominal sutures well defined along the dorsi-meson. The usual caudal, latero-caudal, and cephalo-marginal hairs are present. There is also a pair of hairs at the vasiform orifice and a pair cephalad of these. Vasiform orifice characteristic of this species, conspicuous both in shape and color; elongate-subtriangular, the posterior end merged into the furrow which leads from it to the caudal end of case; operculum a broad, short semi-ellipse with caudal, free end somewhat pointed and densely setose along the margins; color, dusky brown; lingula somewhat darker, dorsum convex, lateral margins with five pairs of long setæ and a row of short hairs. Eyespots reniform, large and reddish. On the ventral surface are seen the reduced legs, but there is no trace of antennæ.

Adult female.—Unknown.

Adult male.—Length of body, 1.13 mm.; head and thorax, pale dusky-brown; abdomen, legs, and antennæ, paler. Eyes large, reniform, and black; by transmitted light, they are the same color but the outer rows of facets are colorless. Antennæ: Segment 1, cup-shaped, diameter and length equal; segment 2, subpyriform, densely setose; segments 3 to 6, inclusive, cylindrical; segment 7, subfusiform, with an apical hair; segment 3 is the length of segments 4, 5, 6, and plus one-half the length of segment 7; segments 4 and 5 are equal in length; segment 7 is slightly longer than segments 4 or 5. Segments 2, 3, and 7 have each a number of hairs set in conical bases; segments 3 to 7, inclusive, closely ringed with minute hairs.

[a] On the thorax and cephalic region there are found similar spaces, which vary in number and position.

Collected on *Arbutus menziesii* near Haywards, Contra Costa County, March 6, 1901, and later near Los Gatos, through the adjacent valleys, and on the slopes of the Santa Cruz and Sierra Morena mountains. Also collected on leaves of *Umbellularia californica*, *Heteromeles arbutifolia*, *Rhamnus californica*, *Rhamnus crocea*, *Clematis ligusticifolia*, *Quercus agrifolia*, and *Quercus densiflora* in the same localities. The species are found together with *A. coronatus*, *A. gelatinosus*, *A. stanfordi*, *A. iridescens*, *A. nigrans*, *A. tentaculatus*, and *A. glacialis*. Pupa cases are found upon both sides of the leaves, the earlier stages only upon the under sides; usually there is but one or two on a leaf. Eggs were often seen, but as there were other species of pupa-cases upon the same leaf, it was impossible to determine if they belonged to *A. inconspicua*. The same difficulty obtained with reference to the adults, and only one male was bred in the laboratory.

24. ALEYRODES MORI Quaintance.

Plate XXXII, fig. 39.

Aleyrodes mori Quaintance, Can. Ent., XXXI, pp. 1–4.

On *Morus* sp. at Tampa, and at Lake City, Florida, on *Tilia americana*, *Callicarpa americana*, *Liquidambar styraciflua*, *Ilex opaca*, and less frequently on *Persea borbonia*.

25. ALEYRODES MADRONI, new species.

Plate XXVIII, figs. 7–8.

Pupa-case.—Size about 0.9 by 0.7 mm.; broadly elliptical; lateral fringe nearly as wide as the case; dorsum covered with thinly scattered, minute, semitransparent granules of white wax; between the margin of the case and the central region, the granules form a narrow ellipse in which the wax is thicker; the same wax is also distributed in transverse lines along the abdominal sutures. Dorsum of case shining black, with a slight longitudinal keel, between which, and the marginal rim the case is covered with minute depressions arranged in somewhat irregular, radiating lines, giving a striate appearance to the case; the dorso-medial and the thoraco-abdominal sutures are distinct, the latter reaching to the margins. There is no marginal rim, but the lateral wax tubes are slightly bent downward, the incisions shallow and acute, the ends of the tubes reflexed and rounded; mesad of the margin there is a row of highly chitinized, large, conical papillæ whose tips point outward; at base of, and inclosed by each of the tubercles, is a transparent space, or it may be, an opening; mesad of the tubercles is a row of minute pores and on each side of the median line are two parallel rows; there is also a pair of pores latero-cephalad of the vasiform orifice in place of the usual hairs. On each side of the abdomen within the body, there is a large, oblong, orange-colored

mass which is probably a visceral gland. The vasiform orifice is elongate-ovate, cephalic margin straight and not as wide as the broadest part of the orifice, caudal end broad and acute-emarginate on the median line; the orifice is bounded by a dark rim, the inner margin of which is strongly chitinized and in folds; deeper within the cavity, it is semitransparent; operculum subsemielliptical, more than half the length of the orifice and not quite as wide, free and somewhat pointed; entire organ densely setose; lingula about four-fifths as long as the orifice, convex dorsally, cylindrical at base but becoming broadly spatulate at the distal end, on which are three pairs of lateral lobes and a terminal lobe. Eye-spots small and undivided.

Adults.—Unknown.

Cotypes.—No. 7090, U.S.N.M.

This species is neither plentiful nor omnivorous, being restricted to the *Arbutus menziesii* in the districts where the author has found it; on this host it inhabits the under sides of the leaves in common with *A. errans*, and because of the presence of the latter it has not been possible to verify the larval stages, as all found were apparently of *A. errans*. Collected during June, 1901, on the slopes of King's Mountain.

26. ALEYRODES NICOTIANÆ Maskell.

Aleyrodes nicotianæ Maskell, Trans. New Zealand Inst., 1895, p. 436; Entom. News, VII, p. 247.

On *Nicotiana tabacum*, Guanajuato, Mexico.

27. ALEYRODES PARVUS Hempel.

Aleyrodes parvus Hempel, Psyche, VIII, No. 280, p. 395.

On *Maytenus* sp., São Paulo, Brazil.

28. ALEYRODES STANFORDI, new species.

Plate XXX, figs. 22–25.

Eggs.—Size, 0.23 by 0.1 mm.; length of pedicel, 0.04 mm.; oval; color yellow, shell marked with irregular polygons; this character often seems to be wanting, but when the shell is examined by transmitted light it has always been present. Pedicel on convex curve at one side of center of base. The chorion is so firm that empty shells retain their shape.

Larva.—Size, 0.35 by 0.2 mm.; oval; the margin has a narrow, lateral fringe of white wax rods somewhat covered with flocculent wax; color shining black, sometimes iridescent by transmitted light, yellowish brown. The dorsum is free from secretion, convex, and sculptured; it has a distinct, thickened, deflexed marginal rim, which is sharply demarked from the dorsum by a ridge; this rim is formed of closely set, adjacent, cylindrical tubes, the ends of which form deep

crenulations, and from which issues the lateral fringe; near the mesal border of this rim there is found a row of seven or more pairs of short hairs set in conspicuous, tubercled bases; these extend about two-thirds the distance from the cephalic margin toward the caudal end of case. On the dorsum there are five pairs of conspicuous spines: A pair on the cephalic region, a pair on the meso- and a pair on the meta-thorax, a pair cephalo-laterad of the vasiform orifice, and a pair caudad of it; besides these are the usual caudal and latero-caudal pairs of hairs. All sutures distinct, the abdominal ones reaching nearly to the marginal rim and strongly reflexed caudad. Vasiform orifice subcordate, broad, and cephalad; operculum relatively the same shape, nearly filling the orifice and obscuring the lingula, which is spatulate and setose distally. Cephalad of the vasiform orifice are four crescent-shaped thickenings in the tergum. The dorsal keel, which is so prominent in the pupa-case, is not well developed at this stage, but the arrow-shaped outline on the cephalic region is distinct; laterad of it are two pores or light spaces. Eye-spots divided, the smaller part anterior. Legs and antennæ functional.

Larva.—Size 0.5 by 0.4 mm.; broadly elliptical; the marginal rim conspicuous, width 0.07 mm.; the tubercled hairs seen on the rim of the younger larva have disappeared and their places are occupied by pores; at the caudal end of the rim, there are also two pores and around the rim is a row of minute ones set close together. The legs and antennæ are much reduced in size.

Pupa.—Size from 1.14 by 0.83 mm. to 1.6 by 1.3 mm.; broadly elliptical. The case is similar to the larval stages with the following exceptions: The dorsum has a characteristic keel extending from near the cephalic margin to the tubercled vasiform orifice, at the anterior end it is arrow-shaped and from there to the thoraco abdominal suture, sharply ridged, on the abdomen it is conspicuously rounded and broader, and the segments are markedly distinct. On the thorax there are deep, curved depressions which extend caudad to the third abdominal segment; these furrows correspond in position to the leg markings in more transparent and thinner pupa-cases. The dorso-submarginal pair of spines are not present, but on the ventral surface, just cephalad of the mouthparts, there are two transverse rows of four hairs each; laterad of the dorsi-meson on each side there is usually two parallel rows of minute hairs; these are frequently wanting, and in their stead are large pits or pores. The wax tubes of the marginal rim extend about two-thirds its width, the crenulations are distinct, rounded, about as broad as long and with the reentrant angles blunt. Around the margin of case, there is a lateral fringe of white wax rods more or less overlaid with flocculent wax, which varies in length from a narrow, flat band to a mass as high and as wide as the case; when wide it is usually ragged distally. On the ventral side, the somewhat reduced legs are distinctly seen, but the antennæ are not visible.

Adults.—Unknown.

In this species, the pupa-case can easily be distinguished by the unaided eye as a black object surrounded by a white ring. The immature forms are found on the under sides of the leaves of *Quercus agrifolia* and *Quercus densiflora;* as a rule, they are confined to a single tree in each neighborhood where the author has collected them and are not plentiful. The eggs are laid very closely together in irregular patches, each of which contains a greater number than is usual among other species. Apparently fresh eggs and very small larvæ were collected in the Arboretum, Leland Stanford Junior University, on January 23, 1901, but no adults were seen; eggs were again found, together with small larvæ, during the last week in May and in June. The writer has kept the pupa-cases in the laboratory for various times since the date of first collection, but has never succeeded in securing the adults, and it has been impossible to obtain verified adults in the field, as the oaks have so many species of Aleyrodes upon them.

Cotypes.—No. 7091, U.S.N.M.

Collected by Mr. G. H. Coleman near the head of Big River, Mendocino County, June 6, 1901, and by the author in the Santa Clara Valley and on the slopes of Black and King's mountains at various times during 1901 and 1902.

29. ALEYRODES INTERROGATIONIS, new species.

Plate XXVIII, figs. 10–12.

Egg.—0.15 by 0.07 mm.; oval; yellow; unmarked. Pedicel at one side of center of base.

Larva.—(Stage 1.) Elliptical; brownish yellow; margin with lateral hairs; dorsum convex.

Larva.—(Stage 2.) Color yellow; dorsum convex; marginal crenulations irregular, shallow, and rounded; abdominal segments distinct; vasiform orifice as in pupa-case, but the operculum is nearly circular. On the dorsum, the submarginal hairs, the bases of the caudo-lateral, and the cephalic pairs of spines are present.

Larva.—Size, 0.57 by 0.35 mm.; essentially as in pupa-case.

Pupa-case.—Size, 0.7 by 0.4 mm.; elliptical; the outer part of the case pale amber; over the body of the developing pupa the color is a deeper yellow, sometimes brownish. There is no lateral fringe, in the usual sense of the term, but around the case is a wide, sloping ring of white or yellowish, translucent, gelatinous substance upon which the case rests. In the mass, the substance seems structureless, but when it is mounted in Canada balsam and examined under the microscope while it is dissolving, the rod-like structure is plainly seen. In a few specimens there seemed to be a true fringe overlying the gelatinous wax; this was transparent and apparently of separate,

glassy rods, but every effort to detach it was unsuccessful; from this it was assumed that if it were a true lateral fringe, it had adhered to the underlying ring, or, if it were a constituent part of the mass, then the gelatinous rim was a lateral and not a ventral secretion.

The dorsal secretion is of white, flocculent wax, in tufts or pencils attached to and enwrapping stout spines. Upon the cephalic region, near the mouth parts, there are found two small tufts or knobs; on the meso-thorax are two similar tufts, both sets near the dorso-median line; at the vasiform orifice are two pairs of short pencils; between the more caudal pair is a long pencil, which is prolonged for some distance caudad of the base and rests upon the gelatinous wax. This pencil has no underlying spine nor any visible pore from which it might issue; there are a number of pointed folds lying close together around the place of issuance, but these are probably a part of the ventral furrow. There is considerable variation from the usual arrangement given above, any or all of the pairs of tufts may be more or less pencil-like, this seeming to depend upon the length of the spine to which any tuft is attached; at the vasiform orifice the two pairs of pencils are sometimes curved and rim-like in their arrangement.

The dorsum is covered with large polygonal markings and has a large number of small pores more or less regularly arranged; of the latter there is a row of closely set ones near the margin of case, three subparallel rows each side of dorsi-meson on the abdomen, and a number placed irregularly on the thorax and cephalic region. The abdomen has a well-rounded keel along which the sutures are distinct; the dorsi-medial and thoraco-abdominal sutures are conspicuous, the latter very sinuate and extending to the lateral margins. Margin all around crenulated with a double rim, the ends of the tubes of the dorsal rim sharply deflexed downward, and the crenulations irregular; in places they are rounded, with the incisions between the tubes about the width of the crenulations; in other places they are crowded and almost form serrations. From these incisions thickenings extend mesad some distance, producing an irregularly-marked margin. Vasiform orifice subcircular, bounded on the cephalic and lateral margins by a straight perpendicular rim, which becomes very sloping at caudal margin; here its inner margin is chitinized or thickened for some distance within the cavity and at the bottom of the orifice it is thickly covered with transparent dots; operculum short, seldom more than one-half as long as orifice, broadly ovate, with cephalic margin not coincident with margin of orifice; lingula reduced, only the incised basal portion present. Legs rather long and stout, nonsegmented, but with folds indicating future joints. Antennæ not evident. Eye-spots very large; by transmitted light, brown, with reddish margin.

Adult male.—Length of body, 0.97 mm.; hind tarsus, 0.15 mm.; hind tibia, 0.25 mm.; proximal tarsus, 0.15 mm.; hind tibia, 0.17 mm.;

wings too crumpled to measure accurately. Color of body, dusky white, frons slightly darker; legs and antennæ white; mentum white with brown tip; wings immaculate; the almost entire lack of color is unusual. Eyes, large, reniform in shape, apparently black, but by transmitted light, reddish on the edges. Antennæ with segments four to seven inclusive, shorter than usual; segment seven, sub-fusiform, with a hair at tip and a conspicuous spine at about mid-length.

Cotypes.—No. 7092, U.S.N.M.

Collected by the author on the leaves of *Ceanothus californicus* at Pacific Congress Springs, Santa Clara County, April 16, 1901, and during June, 1901, on King's and Black mountains. The specimens are not plentiful and there is seldom more than one on a leaf. It is sometimes found together with *A. glacialis*. Many pupa-cases have been isolated, but only two adult males have been secured.

30. ALEYRODES PHALÆNOIDES Blanchard.

Aleyrodes phalænoides Blanchard, Ins. Voy. du Chile, de Gay., 1840, p. 319; Ann. de la Soc. Ent. de France, Dec., 1867, p. 399.

31. ALEYRODES MERLINI, new species.

Plate XXIX, figs. 17–19.

Egg.—Size, 0.22 by 0.1 mm.; pale yellow; unmarked; pedicel at one side of base.

Larva.—(Stage 1.) Size, 0.33 by 0.183; elliptical; pale yellow; dorsum convex, void of pores, papillæ and secretion, but with a narrow marginal band of white wax. Margin with fifteen pairs of equally spaced hairs, which are extremely long. Eye-spots single, large and light red. Specimens so filled with fungus that further detail was impossible.

Larva.—Size, 0.63 by 0.43 mm.; elliptical; the dorsal secretion is usually separated into several irregular plates at the caudal margin, while it is continuous around the remainder of the margin. In some specimens the dorsal wax is disposed in a somewhat confused pattern in which two parallel rows near the lateral margin and a central, transverse row can be made out. Color, pale semi-transparent yellow; dorsum convex, and covered with pores of several sizes; those nearest the margin are largest and are arranged in rather definite lines; each of the abdominal segments has a transverse row; the smaller pores are scattered irregularly. There is no marginal rim nor crenulations, and the wax tubes are not evident; abdomen with distinct segments and two crescent-shaped thickenings in tegument of dorsum cephalad of the vasiform orifice; laterad of the anterior margin of the vasiform orifice is a pair of small hairs; the usual latero-caudal and caudal hairs are present, the latter short. Vasiform orifice broadly ovate, anterior margin as broad as orifice is long; operculum a little more than one-

half length of orifice and wider than long, with a pair of short spines on the latero-cephalic angles; lingula as long as the orifice, spatulate, the distal part with three pairs of lateral lobes and a terminal lobe; the entire organ densely setose and with two pairs of long hairs—a pair from the angles between the distal-lateral and the terminal lobes projecting caudad beyond the orifice, and a pair on the lateral margin. On the ventral surface the reduced legs are distinct, but only faint outlines of the antennæ can be made out.

Pupa-case.—Average size, 1 by 0.6 mm.; elliptical, narrowed cephalad, caudal end truncate; dorsal secretion usually a confused mass of white wax; under a lens it is seen to be made up of numerous long, delicate, asbestos-like wax filaments, which are from two to four times the width of case and matted together, forming the very characteristic covering of this species. This secretion can be easily brushed off and quickly dissolves in alcohol. When the case is removed from the leaf there is left a short, vertical fringe. Color of case a dull amber-yellow to dark brown. The latter color is probably due to parasitization; dorsum convex and covered with papillæ and pores of various sizes; near the margin they are more numerous and closer together. On the central region they are not so evident, but each segment has a transverse row; scattered among the papillæ are many small pores. On the abdomen, each side of the dorsi-meson, there is a longitudinal row of large, semitransparent spaces. The thoracic and abdominal segments are distinct, the posterior abdominal sutures strongly reflexed caudad, the thoraco-abdominal suture sinuate and extending to margin of case; the longitudinal cephalo-thoracic suture is also evident; cephalad of the vasiform orifice are two strongly chitinized thickenings in tergum which are darker and broader than usual, and within the abdomen are seen two large, orange-yellow visceral glands. There is a pair of short, delicate hairs on the cephalic margin of case, a pair of somewhat stouter ones laterad of the anterior margin of the vasiform orifice, and the usual caudal and latero-caudal setæ, the former reduced to minute hairs. Vasiform orifice subcordate, anterior margin straight. On the inner lateral and caudal margins there are corrugations or folds, which extend downward and inward; operculum not as broad as the orifice and more than half its length, rounded on the anterior-lateral angles. Near the lateral margins of the free, distal end is a long, stout spine, which projects beyond the margin of the orifice; lingula spatulate, as long as orifice, distal part enlarged and with three lateral and two terminal lobes, apex bearing a pair of long hairs. Eye-spots large, constricted, and dark red; legs reduced, unsegmented; antennæ short, stout, unsegmented and tapering to a slender point.

Adult female.—Bred from segregated pupa cases. Length of body, 1.6 mm.; wings, too crumpled to measure; hind tarsus, 0.23 mm. Color of abdomen, pale yellow; head and thorax darker, frons brown-

ish; legs and antennæ white. Within the abdomen are two large, yellow glands. Eyes large, slightly constricted; color, black, reddish at the edges. Attennæ, as in *A. prunosus*. Genitalia, ordinary.

The larvæ vary much in the amount and arrangement of the dorsal secretion; some are entirely covered with the matted wax, others have but a scant, fragmentary secretion, while still others are surrounded by a mass which rises almost perpendicularly above the dorsum, and then bends downward and outward, forming a continuous ring at margin of case, but distally separated into irregular plates.

Cotypes.—No. 7093, U.S.N.M.

Collected by the writer on King's Mountain, on *Arbutus menziesii* only, during May, June, and July, 1901.

32. ALEYRODES PYROLÆ Gillette and Baker.

Aleyrodes pyrolæ Gillette and Baker, Prelim. Rep. Hemip. Colo., p. 125. (Colo. Agri. Exp. Sta., Bul. 31, Tech. Ser.).

On *Pyrola rotundifolia*, Fourmile Hill, 8 miles south of Steamboat Springs, Colorado.

33. ALEYRODES AMNICOLA, new species.

Plate XXVII, figs. 4–4a.

Egg.—Size, 0.21 by 0.1 mm.; oval; yellow; unmarked; pedicel at center of base.

Larva (fig. 4).—Size, 0.3 by 0.1 mm.; elliptical; color glistening white to pale yellow; there is a lateral fringe which varies greatly, many specimens have none, while others have a long fringe continuous at base and separated distally into irregular plates; some have granules of wax upon the dorsum, but as the leaf is also coated with similar wax it may be extraneous matter. Dorsum convex, lateral margins with thirteen rather long, delicate hairs set in tubercled bases; the third cephalic pair are much longer than the others; the caudal and latero-caudal hairs are present, longer and stouter than the lateral ones and inserted in conspicuous, conical bases. Abdominal segments distinct to margin and reflexed caudad. Vasiform orifice as in pupa case, the lingula sometimes longer than orifice.

Larva (fig. 4a).—Size, 0.73 by 0.5 mm.; broadly elliptical; there is no lateral secretion, but the dorsum bears an irregular, interrupted series of long, tapering, glassy rods; dorsum very convex and with minute depressions forming somewhat irregular striations to the central region; abdominal sutures distinct along dorsi-meson; crenulations of margin regular, rounded, and shallow, the reentrant angles acute; caudal and lateral hairs as in smaller larva.

Pupa-case.—Size, 1.3 by 0.9 mm. to 1.4 by 1.03 mm.; broadly elliptical, cephalic margin truncate, the caudal margin slightly emarginate at furrow; neither lateral nor dorsal secretion, but when the case is

removed from leaf there is left a narrow, white, vertical fringe; the outer part of case is transparent white, central region brown, laterally shading to yellow; this contrast in coloration renders the case very conspicuous; on the cephalic region the color is projected cephalad in two prong-shaped markings; near the anterior end of the dark space there is a pair of small pores, one each side of the dorsi-meson; on each segment of the case there are a number of small pores, usually arranged in a group at each end, with a transverse row between the groups; all of these pores lie within the space covered by the dark color; there are also many small pores outside this color limit, but the case is so transparent that they are nearly invisible. The dorsum is convex and has no marginal rim, crenulations of the margin itself are irregular, broadly rounded, and shallow, reentrant angles acute; abdomen keeled on dorsi-meson, the segments distinct along the keel; the thoraco-abdominal suture and the dorso-medial suture, which meets it at right angles, are also evident; cephalad of the vasiform orifice are two conspicuously chitinized, crescent-shaped thickenings in the tergum. Vasiform orifice subovate, caudal end broadly rounded, bounded by a slightly raised rim, deeper yellow than surrounding dorsum, the inner lateral and caudal margins of the orifice much corrugated or folded; operculum not one-half the length of orifice, and in width not quite filling the open space, distal, free end truncate; dorsum setose; lingula well developed, nearly or quite as long as the orifice, spatulate, distal portion convex, enlarged, rather bulbous, apex with a pair of long and caudally projecting hairs at its lateral angles, the portion which projects beyond the operculum setose. Latero-cephalad of orifice is a pair of short, delicate setæ.

Adults.—As in *A. prunosus*.

Cotypes.—No. 7094, U.S.N.M.

This species is found only on the willow and is peculiar to it; a great number of specimens were collected on November 4, 1901, from *Salix lævigata* at Stevens Creek, Santa Clara Valley; the immature stages were on the under sides of the leaves, which were frequently encrusted with them. Adults were issuing from the pupa-cases, and many had settled upon the under sides of leaves of *Washingtonia nuda*, which was growing under the host plants. The coloration of the pupa-cases is rather characteristic of parasitized cases in general; but as adults were seen issuing in numbers from the cases which were darkest, the coloration must be normal.

34. ALEYRODES ROLFSII Quaintance.

Aleyrodes rolfsii Quaintance, Can. Ent., XXXI, p. 90.

From Upola, Florida, on cultivated geranium.

35. ALEYRODES RUBORUM Cockerell.

Aleyrodes ruborum Cockerell, Jn. N. Y. Ent. Soc., V., No. 11, p. 96; Ann. Rept. Fla. Agr. Expt. Sta., 1898, p. 66.

On cultivated *Rubus cuneifolius* at Lake City and San Mateo, Florida.

36. ALEYRODES PERILEUCUS (Cockerell).

Aleyrodes perileuca Cockerell, Proc. Acad. of Nat. Sci. Phila., May, 1902, p. 283, and in an as yet unpublished bulletin written for the Florida Exper. Station, by T. D. A. Cockerell, who kindly furnished the author the description.

Pupa-case.—Oval in shape; extremely dense in texture; color perfectly black. Lateral margins with a fringe of very narrow; regular, white waxen ribbons regularly and strongly beaded. Dorsum free from secretion; it has a sharp, submarginal keel and a distinct longitudinal keel, which is sharp on the thorax and broad and rounded on the abdomen, where it is crossed by six narrow, transverse longitudinally corrugated bands. Abdomen with transverse ridges marking the segments. Vasiform orifice shovel shaped; marginal area with very numerous radiating furrows, the areas between them minutely punctured. Margin of case very regularly crenulate. The conical, black, larval skin was found in one example on the back of the pupa, but ordinarily it is lost.

Adults.—Unknown.

It occurs at La Jolla, California (Cockerell), and Cuero, Texas (Townsend), on leaves of *Quercus*, solitary on the upper side.

37. ALEYRODES STELLATUS (Maskell).

Aleyrodes stellata Maskell, Trans. New Zealand Inst., 1895, p. 442.

On *Lignum-vitæ*, in company with *A. floccosa*, Jamaica.

38. ALEYRODES DIASEMUS, new species.

Larva.—Size, 0.3 by 0.2 mm.; elliptical; no dorsal secretion, lateral fringe approximately one-sixth the width of larva. It is made up of opaque wax rods coalesced at base, but distally divided into irregular plates, sometimes ragged at the ends. Color, transparent white, slightly yellow around the mouth parts and in the central abdominal region. Dorsum convex and with a longi-medial carina; lateral margins with 14 pairs of equally spaced hairs, with the exception of the difference between the ninth and tenth pairs, which is much greater. Each hair is set in a conical base, and from each there is a distinct oblique fold extending mesad; the usual caudal and latero-caudal hairs are present. Immediately caudad of the eye-spots there are a pair of large circular pores, which may be the anterior pair of spiracles; the case is so thin and transparent that it could not be determined whether

the pores were dorsal or ventral; abdominal segments distinct; crenulations of the margins minute; vasiform orifice as in pupa case; the antennæ are not visible; the legs are distinct, though reduced; this is not the usual condition of these organs at this stage or size; eye-spots single and red.

Pupa-case.—Size, 1.4 by 0.84 mm.; elliptical, case flat; there is considerable variation in the amount and kind of secretion; specimens may have both lateral and dorsal wax, or either alone, or none; when present the lateral fringe is of coalesced crystalline wax rods either free from or covered by flocculent wax; the dorsal secretion is in the form of a submarginal series of separate crystalline wax rods, rather long and curved downward; when the case is lifted there remains a short vertical fringe of coalesced, opaque white wax rods. Color, glistening yellow. Dorsum convex and bearing 12 pairs of extremely long, stout spines—a pair of caudo-submarginal, a pair of latero-caudo-submarginal, a pair mesad of the latter, a pair caudad of vasiform orifice, a pair laterad of these, and a pair laterad of the anterior margin; a pair of abdomino-submarginal, a pair of extremely long ones on first abdominal segment near median line; two pairs on thorax close to median line; a pair of cephalo-submarginal. On the cephalic region near the dorsi-meson and caudad of the first pair of spines is a pair of small pores; mesad of the first pair of thoracic spines is another pair; on the abdomen there are two parallel rows on each side of the dorsi-meson. Abdomen with a slight longi-medial keel, along which the sutures are distinct, the posterior ones reflexed caudad. Vasiform orifice a brighter yellow than the surrounding dorsum, broadly ovate, as wide as long, apex broadly rounded; operculum, subrectangular, about one-half length of orifice, distal margin truncate; lingula nearly as long as the orifice, spatulate, often dorsally recurved; setose for about four-fifths of its length, with two terminal lobes and a pair of long latero-apical hairs which project caudad beyond the orifice. Marginal crenulations vary from shallow to deep, but they are always broad, round, and with acute reentrant angles. On the ventral surface the reduced legs are seen, apparently with all the parts except the tarsi present; antennæ nonsegmented, base broad, apex abruptly narrowed into a slender, finger-like process; eye-spots large and red.

Adults.—Unknown.

Cotypes.—No. 7096, U.S.N.M.

Collected on campus, Leland Stanford Junior University, along San Francisquito Creek, September 18, 1901, and at various other dates, from the under sides of the leaves of *Symphoricarpos racemosus*. Also collected on leaves of *Ribes glutinosum*, near Menlo Park, September, 1901, and on the same host in Alameda, June, 1901, and on Kings Mountain, August, 1901.

39. ALEYRODES VAPORARIORUM Westwood.

Aleyrodes vaporariorum Westwood, Gard. Chron., 1856, p. 852.—Signoret, Ann. de la Soc. Ent. de France, Dec., 1867, p. 387.—W. E. Britton, Ninth Ann. Rept. Conn. Agr. Expt. Sta., 1895, Pt. 2, p. 203.

40. ALEYRODES GLACIALIS, new species.

Plate XXXI, figs. 31–33.

Larvæ.—The dorsum lacks the curved mesal wax filaments which are found on the pupa case; in other external respects as in the pupa case.

Pupa-case.—Size, 0.85 mm. by 0.6 mm.; elliptical; color, with inclosed pupa, yellow; when the case is empty, semitransparent white; occasionally the color may vary from yellowish-brown to a more or less mottled brown, or, in extreme cases, to an almost uniform brownish-black; this color variation is due to parasitization or to the presence of fungus. There is no lateral fringe, but just inside the dorso-lateral margin there is a continuous submarginal fringe, made up of an irregular series of tapering crystalline rods of about equal length and more than one-half the width of case. These issue from large conical papillæ, which are arranged around the case in a row of from one to three deep, except caudad and latero-caudad of the vasiform orifice, where there are an irregular number. Mesad of the submarginal fringe there are a variable number of shorter tapering rods of wax, which are curved or even coiled upon themselves; these are arranged with reference to the segments and issue from large circular pores, which constitute the most conspicuous dorsal character of this species and which may vary from one on each side of the segment to groups of from three to five. Besides these pores there are others, so scattered that no definite place can be assigned them, and also many small pores scattered among the papillæ and over the dorsum. Dorsum convex, finely punctate, and with a pair of long tapering caudo-marginal spines set in conspicuous conical bases, and a pair of very long spines laterad of the anterior margin of the vasiform orifice; the usual caudal pair are wanting; the latero-caudal pair are short and the cephalo-marginal pair are minute. Crenulations of margin of case broad and very shallow; where the caudal furrow meets the margin the crenulations are distinctly different, being deeper and more pointed in outline and closer together (Plate XXXI, fig. 33). Abdominal sutures faintly defined, the posterior ones strongly reflexed caudad; in the abdomen two large yellow visceral glands show through the body wall. Vasiform orifice broadly ovate, almost as broad as long; cephalic edge straight, caudal end with a fine acute emargination with a small finger-like process. Operculum subsemielliptical, much broader than long, and less than one-half the length of orifice. Lingula nearly the length of orifice, subspatualate, densely setose with minute hairs, and bearing three pairs of lateral lobes and a terminal lobe. Cephalad

of vasiform orifice are two crescent-shaped thickenings of tergum, and between it and the caudal margin of case there is a shallow furrow. On the ventral surface the unsegmented reduced legs are seen; the antennæ are short, stout, unsegmented, and with a spine at apex; eye-spots large, dark red.

There is considerable variation in amount of dorsal secretion and in the number of pores and papillæ.

Adult female.—Length, about 1.83 mm.; fore wing, 1.27 mm. by 0.5 mm.; hind wing, 1.03 by 0.43 mm.; hind tarsus, 0.25 mm.; proximal segment, 0.15 mm.; tibia, 0.45 mm.; main vein, seven-eighths length of wing; flexure, about midway between base and apex of wing; beyond the flexure the vein fades out. Color, abdomen, pale yellow, head and thorax darker yellow to pale dusky; legs, antennæ almost white; wings immaculate, folded so that basal veinlet is not seen; fore wing with a conspicuous anal fold. Eyes dark reddish brown; in live specimens each is separated into two parts by a wedge-shaped band of white wax granules; in the mounted specimen the wax is dissolved away and the eyes are apparently only constricted. Antennæ and mentum usual. Vasiform orifice obscured. Genitalia sharply conical, brownish in color, otherwise ordinary. Insect bred from pupa case on *Ceanothus californicus*.

Male.—(Bred from pupa case on *Rubus vitifolius*.) Length, 1.1 mm.; fore wing, 1.1 mm. by 0.44 mm.; hind wing, 0.9 mm. by 0.37 mm.; hind tarsus, 0.25 mm.; middle tarsus, 0.21 mm.; proximal tarsus, 0.23 mm.; hind tibia, 0.43 mm.; middle tibia, 0.3 mm.; proximal tibia, 0.03 mm.; proximal segment, 0.16 mm.[a] Color as in female. Mentum dusky, nearly black. Genitalia, usual. In other respects essentially as in female.

The pupa cases were first collected in March, larvæ on April 16. Adults were seen flying at this time, but the first to emerge from the segregated cases came out on May 29.

Cotypes.—No. 7095, U.S.N.M.

This species is found on the under sides of the leaves and has been collected in the following localities: On *Ceanothus californicus*, from the Santa Cruz and Santa Moreno ranges; on Yerba Santa, from King's Mountain; on *Rubus vitifolius*, from the Santa Clara Valley and Alameda; on *Rhamnus californica*, from the Santa Cruz and Santa Moreno ranges and Santa Clara Valley; on *Clematis ligusticifolia*, *Opulaster capitatus*, and *Symphoricarpos racemosus*, from the Santa Clara Valley, and from *Quercus densiflora*, from Kings Mountain. There are seldom more than two or three specimens on a leaf; they are usually found together with *A. coronatus* and *A. gelatinosus*.

[a] There is considerable variation in the number of large dorsal pores and papillæ.

41. ALEYRODES VINSONOIDES Cockerell.

Aleyrodes vinsonoides COCKERELL, Psyche, VIII, No. 266.

Frontera, Tabasco, Mexico. On undetermined tree.

42. ALEYRODES QUAINTANCEI, new species.

Plate XXXVII, figs. 70–73.

Eggs.—Type; unmarked, pedicel at one side of base.

Larva.—(Stage 1.) Size, 0.33 by 0.2 mm.; elliptical; wax secretion wanting; color, white; the abdominal segments distinct to margin; neither marginal rim nor lateral wax tubes evident, but short lateral hairs set in conical bases extend around the entire margin; the usual caudal and latero-caudal hairs are very long, the former set in conspicuously large conical bases. Vasiform orifices broadly ovate, truncate at caudal end, lateral margins straight; operculum less than one-half length of orifice, rectanguiar, squarely notched at the latero-cephalic angles and with a minute spine mesad of the notch; lingula about two-thirds length of orifice, spatulate covered with transparent dots, which are probably minute hairs; apex setose, the hairs much longer than usual. Within the body two large dark-yellow visceral glands are conspicuous. Eye-spots large, dark red.

Larva.—(Stage 2, studied from molt.) Size, 0.35 by 0.26 mm.; shape broadly elliptical; wax secretion wanting. Color, a semitransparent whitish yellow. There is no marginal rim and the lateral wax tubes are evident; crenulations large, rather pointed, reentrant angle acute; abdominal sutures barely visible. No lateral hairs, but the dorsum bears three pairs of long and tapering spines—a pair on the cephalic region, a pair on thorax, and a pair latero-cephaled of the vasiform orifice; the latter are shorter and more delicate than the others; the usual caudal and latero-caudal hairs are present. Vasiform orifice as in pupa case. No traces of legs, antennæ, or eye-spots.

Larva.—Stage 3 (studied from moults). Size, 0.44 by 0.2 mm., broadly elliptical, truncate at the caudal end; color, brown; by transmitted light, a pale smoky shade; there are transverse bands of darker color on each of the abdominal segments, which are also covered with transparent dashes. Body segments distinct. The marginal rim is wanting, but the lateral wax tubes are slightly bent downward. Crenulations of margin, vasiform orifice, and lateral fringe as in pupa-case. Dorsal spines as in younger stage, but much reduced.

Early pupa-case.—Size, about 0.56 by 0.15 mm., measured within marginal rim; shape subovoid, prolonged caudad, extreme caudal end lobe-like; on each side of this part of case there is a short blunt spine. Color black, case highly chitinized, crenulations of rim as in pupa-case.

Pupa-case.—Size, about 0.83 mm. by 0.6 mm.; measured within the marginal rim, the dorsum is 0.7 mm. by 0.46 mm.; the outside measurement are variable and not exact, as the angle at which the rim bends varies continually; shape of dorsum oval, prolonged caudad until it is lobe-like at end, dorsal and ventral secretion wanting; lateral fringe, flat upon the leaf, made up of transparent wax rods, coalesced nearly to the distal ends and about the width of case. Dorsum with a sharp keel extending its entire length; within the ridge formed by marginal rim there is a sunken line extending around case; abdominal segments conspicuously set off to this sunken space; cephalo-thoracic region deeply sculptured. Color, shining black by transmitted light, with golden brown colorations; of these there is a continuous line around dorsal ridge of marginal rim; three pairs of transverse portions of case on the thoraco-cephalic region, occupying almost the entire space; latero-cephalad of the most cephalic of these and adjacent to marginal rim is a large pair of conspicuous wedge-shaped places; near cephalic end of case, on each side of the dorso-median suture, there are two small circular places; caudad of these and nearer the suture there is a pair of short oblique lines on each side, caudad of these is a pair of small circular places, caudad of these is a broken oblique line on each side of the suture; on the abdomen, caudad of each suture, is a narrow space; cephalad of the vasiform orifice is a large crescent-shaped place the central portion of which is continued to the vasiform orifice, and the vasiform orifice is of the same color. This coloration is probably due to unequal chitinization of the case. Body segmentation distinct; median and thoraco-abdominal sutures conspicuous, the latter very sinuate and extending to the marginal ridge. The dorsal disk is slightly larger than the ventral, and they are connected by the marginal wax tubes, which are bent downward and inward, thus making an oblique rim. Crenulations of margin deep and round, as wide as long; mesad of the end of each wax tube is a large pore. The usual caudal hairs are long and delicate, the latero-caudal pair shorter. Vasiform orifice small, tubercled, subcircular; operculum relatively the same shape, filling the orifice; lingula minute, strap-shaped, obscured by the operculum. There are a pair of pores latero-cephalad of orifice, which are probably the follicles of the hairs usually present at this place. Eye-spots black, situated mesad of the wedge-shaped transparent spot on cephalo-dorsum.

Adults.—Unknown.

Cotypes.—No. 7097, U.S.N.M.

Collected at Stevens Creek, October, 1901; found upon the under sides of the leaves of *Rhamnus crocea* together with *Aleyrodes iridescens.*

43. ALEYRODES NIGRANS, new species.

Plate XXVII, fig. 3.

Egg.—Size, 0.23 by 0.11 mm.; dark yellow to a dusky-brown in color, empty shells uniformly brown; the chorion is firm, and the egg, in consequence, keeps its shape and position when empty. Egg elliptical in shape, more curved than usual, apex rather pointed; shell unmarked; pedicel short and at one side of base on the convex curve. Eggs always found in an upright position on the under side of the leaf.

Larva.—When first hatched about 0.3 mm. by 0.08 mm.; elongate, elliptical, with dorsum very convex, and having a narrow band of semitransparent wax closely appressed to the margins. Under the lens it is semitransparent and pale yellow in color. Dorsum void of pores, setæ, or exudation; marginal rim distinct, thickened, narrow, noncrenulated, and with two parallel rows of minute transparent spots which extend around it. Lateral margins with seven pairs of short, delicate hairs set in tubercled bases; these extend from the latero-cephalic margin about two-thirds the distance toward the caudal end; the usual caudal and latero-caudal hairs are present, very minute. No trace of segmentation except along dorsi-meson of abdomen. Vasiform orifice subcircular, bounded by a conspicuous raised rim; operculum the same shape, filling the orifice; lingula not seen. Antennæ and legs functional; eye-spots red, divided, circular and subequal in size.

Just after the first moult the larva is about 0.4 mm. by 0.27 mm.; broadly elliptical in shape. The insect is flatter and has a narrow lateral fringe of glassy rods, which are continuous at base, but are divided distally into irregular plates; all lateral hairs have disappeared, and there are faint, irregular crenulations around the margin; abdominal segments distinct along the dorsi-meson; the caudal hairs are much longer than in the first stage, and the beginning of the mediocaudal lobe, which is characteristic of the pupal stage, is evident; dorsum with 4 pairs of long, tapering spines. A pair on the cephalic region, a pair on the meso-thorax, a pair on the meta-thorax, and a pair on the abdomen, laterad of the cephalic margin of the vasiform orifice. Lingula short, strap-shaped, and densely setose. Eye-spots single, bright red in color. No trace of legs or antennæ. In other respects essentially as in the first stage.

In the third stage the larva is the same as in the preceding, with the exception that it is darker yellow in color and has a dorso-median keel.

Pupa-case.—Size, about 0.9 mm. by 0.6 mm.; shape, oval, prolonged caudad into a conspicuous pointed lobe, on the lateral margins of which are the caudal hairs. The dorsal disk is much larger than the ventral, and the marginal wax tubes are bent downward and

inward to the ventral surface of case, thus connecting the two disks by an oblique rim on which the flutings of the wax tubes are very distinct; they also extend for a short distance on the dorsal disk, and then fade out. Dorsum void of exudation of any kind and without setæ. There is also no lateral fringe, but an occasional specimen has a little fragmentary wax around the ventral border of the case upon the leaf. Case dull black in color, and so thick that it is cleared only after prolonged boiling in caustic potash, or immersion in labarraque. Abdominal segmentation distinct along the median portion of case; second thoracic segment distinct near the dorsi-meson; third thoracic segment distinct, extending nearly to the marginal rim; thoraco-abdominal suture sinuate; a rounded keel reaches from the vasiform orifice to the thorax, and from this point, extending nearly to the cephalic margin, there is a sharp ridge; in partially cleared specimens the usual dorso-medial suture shows instead of the cephalic portion of the keel. Crenulations of the marginal rim irregular and notched; the openings are mesad of the ends of the tubes, and form a regular row of minute round pores. When a portion of the reflexed marginal rim is partially cleared in caustic potash and examined by transmitted light, there are seen irregular transverse rows of groups of minute black spots along the wax tubes. Vasiform orifice tubercled, subcircular; operculum relatively the same shape and filling the orifice; lingula not seen; when examining the cases the operculum was often seen to be raised while a drop of "honey dew" was being emitted, after which it was again lowered into the orifice.

Adult female.—Length, 1.3 mm.; forewing, 1.3 by 0.53 mm.; hind wing, 1.08 by 0.4 mm.; color uniformly a deep golden yellow, legs and antennæ paler; mentum yellow, the tip dusky. Wings somewhat dusky at distal end; this is caused by a structural thickening; the costal margins are a conspicuous golden yellow; main veins distinct to apex; flexure of forewing not acute; basal vein long—it arises from the very base of the wing, apparently distinct from the main vein, and extends obliquely caudad to anal margin. Eyes dark red, constricted to dumb-bell shape. Antennæ usual. Genitalia acute conical, ordinary.

Male.—Length, 0.83 mm.; forewing, 1 mm. by 0.4 mm. Genitalia ordinary. Very much smaller than the female; in other respects essentially the same.

Cotypes.—No. 7098, U.S.M.M.

Collected on *Clematis ligusticifolia*, *Rhamnus californica*, *Arbutus menziesii*, *Arctostaphylos manzanita*, *Umbellularia californica*, *Heteromeles arbutifolia*, *Eriodictyon californicum*, *Ceanothus californicus*, *Symphoricarpos racemosus*, *Prunus ilicifolia*, and *Lonicera involucrata* in the San Ramon Valley at the base of Mount Diablo, in the Santa Clara Valley, on Black and on King's mountains, and on the slopes of the Santa

Cruz Range near Los Gatos, Pacific Congress Springs, and along Stevens Creek, and on the slopes of Sierra Morena Range. Eggs were found in April and May, the early larval stages in April, May, June, and September and the first week of October, while pupa cases have been plentiful every month of the year on all except the deciduous host plants. Adults emerged April 22, 1902, from segregated cases kept in the laboratory.

44. ALEYRODES MASKELLI, new species.

Plate XXXVII, fig. 74.

Egg.—Size, about 0.27 mm. by 0.13 mm., exclusive of the pedicel which is nearly one-half the length of the egg, and placed at one side of center of the base; the egg is more pointed at the apex and longer and narrower than usual. Color, deep yellow, entire shell covered with polygonal markings.

Larvæ.—All stages are in external appearance essentially the same as in pupa case except that the caudal setæ are much longer.

Pupa case.—Size about 0.9 mm. by 0.65 mm., but varying somewhat; elliptical in shape, slightly narrowed caudad and with posterior end of case truncate. Case closely applied to leaf, at first flat, but later becoming somewhat convex. The vertical fringe so common in aleyrodids of this type is absent in this species. Dorsum without secretion, but there is a lateral fringe which varies in length and position, in some specimens being long and flat upon the leaf, in others it is short and so deflexed that it looks like the usual vertical fringe; it is about one-sixth the width of case and made up of very small crystalline coalesced rods, which are distally divided into irregular plates. The case is pale yellow in color, the coloration deepening as the developing insect approaches maturity, empty pupa case colorless; on each side of abdomen, within the body, there is an irregular oblong spot of deep orange-yellow, evidently a visceral gland. A majority of the late pupa cases show a closely striate, wide, marginal rim plainly demarked from dorsum all around by a thick line; the lateral wax tubes are not evident, but the crenulations of the marginal rim are rounded points about as long as they are broad at base; the incisions are quite uniform and acute. There is the usual pair of long setæ on the caudo-lateral margin of case, and a pair of short, delicate ones on the cephalo-lateral margin. The dorsum has a number of minte hairs scattered over it; in the marginal rim they are arranged in a row extending around the base; besides these it bears a pair of short setæ arising within the caudal margin of case, and a pair of well-developed spines laterad of the anterior margin of the vasiform orfice. Abdominal segments distinct on middle one-half of case and somewhat keeled along the dorsi-meson.

Vasiform orifice small, with a heavy yellow rim that is darker than the surrounding dorsum; the inner lateral and caudal margins with conspicuous folds or corrugations, which extend into the cavity of the orifice; operculum less than one-third length of orifice, subtrapezoidal, cephalic margin straight, caudal truncate, setose on distal margin; lingula short, projecting beyond the operculum, distal end enlarged, dorsally convex and densely setose. Cephalad of the vasiform orifice there are two crescent-shaped thickenings in the tegument of case, and a shallow furrow extends caudad to margin of case. On the ventral surface the unsegmented reduced legs are distinctly seen; the antennæ are nonsegmented, broad, reduced, and end in a finger-like process. Eyespots of the younger pupa are a bright dark red in color and are not facetted; in the older specimens they are large, very dark in color, with the edges reddish, and are strongly constricted in the middle.

Adults.—(Male and female, bred from segregated pupa cases.) Abdomen, legs, and antennæ whitish-yellow in color, head and thorax darker yellow. Wings immaculate, but so crumpled that they can not be accurately described in detail. Eyes undivided, strongly constricted through the middle; color, by transmitted light, black with reddish edges.

Male.—Length, 0.95 mm.; hind femur, 0.25 mm.; hind tibia, 0.33 mm.; hind tarsus, 0.183 mm. Fourth antennal segment much shorter than usual, about four-fifths length of segment seven.

Female.—Length, 1.1 mm.; antennæ about 0.4 mm.; the fourth and seventh segments equal, each approximately 0.07 mm.

Cotypes.—No. 7099, U.S.N.M.

Collected on under sides of the leaves of *Quercus densiflora* at La Honda, April 13, 1901, and again on King's Mountain, May 16, 1902; only a few isolated specimens found.

45. ALEYRODES WELLMANÆ, new species.

Plate XXVII, figs. 5, 5a, and Plate XXXV, fig. 61.

Pupa case.—Size, 0.93 mm. by 0.6 mm.; shape subelliptical, slightly narrowed cephalad and frequently truncate on caudal margin; color, by reflected light, dark brown with yellowish margin, by transmitted light the marginal rim, vasiform orifice, the furrow to caudal margin, and the sutures are a semitransparent yellow. There is no lateral fringe; the vertical, ventral fringe is short and usually remains upon the leaf when the pupa case is removed.

The dorsal secretion consists of a submarginal series of small crystalline rods, usually more than half width of case, which may be separate or more or less coalesced. Case rather flat; dorsum punctate, the minute depressions in the outer portion taking the form of irregular somewhat radiating striations. Scattered over the entire dorsum

of some specimens, but more usually found upon the cephalic and thoracic regions, are a number of large yellow semitransparent spaces; besides these there are a variable number of small pores, arranged in nearly parallel longitudinal lines or groups. The number of these pores is considerably increased when the case is slightly cleared in caustic potash. The median thoraco-cephalic suture and the thoraco-abdominal suture are conspicuous because of their color and semitransparency; the latter of these sutures is sinuate and extends to the lateral margins of the case. There is a dorsi-median longitudinal keel extending length of abdomen; upon this the sutures are distinct; the last three are strongly reflexed caudad. Within the marginal rim is a row of large conical papillæ, from which issues the dorso-submarginal waxen rods; mesad of the papillæ are several irregular rows of minute blunt spines. The marginal crenulations are shallow and irregular and the wax tubes indefinite in outline.

Vasiform orifice subovate, about four-fifths as wide as long, the inner lateral and caudal margins much corrugated, giving the impression of being toothed, and the folds darker in color than the surrounding surface. Operculum broadly ovate, scarcely one-half length of orifice and not as wide, the cephalic margin straight, dorsum convex and covered with minute hairs. Lingula about three-fourths length of orifice, cylindrical to enlarged distal portion, which has three pairs of lateral lobes and a terminal lobe; arising from the apex laterad of the terminal lobe is a pair of long stout setæ which project caudad; the enlarged portion is densely and minutely setose. From the apex of the vasiform orifice to the caudal margin there extends a distinct furrow. The margin of the pupa case bears a pair of delicate latero-caudal hairs; the usual caudal pair are wanting.

This Aleyrodid is found on the under sides of the leaves of *Rhamnus californica*, together with *A. iridescens* and *A. splendens*. The species is not plentiful; usually not more than a single specimen is found on a leaf. Only the pupal stage has been verified.

Cotypes.—No. 7100, U.S.N.M.

Collected by the author in April and May, 1902, on the campus, Leland Stanford Junior University, and at Stevens Creek November 12, 1901.

46. ALEYRODES EXTRANIENS, new species.

Plate XXXVI, figs. 65–67.

Egg.—Size, 0.2 mm. by 0.08 mm. Unmarked, deep yellow; apex pointed, pedicel to one side of base. Shell thick and so firm that it retains its shape when empty.

Larva.—(Stage 1.) Size about 0.4 mm. by 0.25 mm.; shape, elliptical; color, pale yellow; dorsum, convex. There is neither dorsal nor lateral exudation of wax, but most of the specimens show a slight

ventral secretion which may form a narrow base upon which the larva rests. The latero-marginal hairs and the marginal rim, usually present at this stage, are wanting. Crenulations indistinct; segmentation of abdomen distinct on central region; on each side of abdomen, about midway between the lateral margins and median line, there is a row of pores which extend from vasiform orifice cephalad to the thoraco-abdominal suture, one pore to each segment; these pores are distinct in the majority of specimens.

The dorsum bears five pairs of conspicuous long tapering spines; the cephalic pair is the longest; it is about two-thirds as long as the larva is wide and arises mesad of the eyespots; the metathoracic pair is the shorter and more slender, the pair on first abdominal segment is similar to the second pair; the fourth pair is the shortest and is laterad of the cephalic margin of the vasiform orifice; the fifth pair is caudo-submarginal in position, is stout, and projects caudad beyond the margin. The margin bears one pair of latero-cephalic hairs and one pair of latero-caudal ones; both are short and delicate; the usual pair of caudo-marginal setæ are wanting.

Vasiform orifice subcircular and bordered by a narrow, raised rim of deeper yellow color than the remaining dorsum. Operculum relatively the same shape and nearly filling the orifice, the cephalic margin straight; dorsum apparently setose. Lingula about length of orifice, cylindrical at base, with enlarged distal portion, the entire organ densely setose. Eye-spots single, large, of irregular shape, and bright red in color. Legs functional; antennæ not seen.

The older larval stages differ from the foregoing only in greater size and in the color being a brighter yellow. The second and third pairs of dorsal spines equal the cephalic pair in length, the fourth pair are approximately longer. The marginal crenulations and wax tubes are more evident. The legs are reduced, only the large, upper part being present. In a larva whose size was 0.6 mm. by 0.4 mm. minute antennæ were seen.

Pupa-case.—Size, 0.9 by 0.56 mm.; shape, elliptical; color, with inclosed pupa, a bright yellow; when empty, translucent white; texture, film-like. The vertical, ventral secretion of wax is sometimes flattened out and assumes the appearance of a lateral fringe. General characters as in later larval forms; the dorsum bears three longitudinal parallel rows of pores, one on median line and the remaining two rows about midway between the median row and the lateral margins. Marginal crenulations broad and rounded; the reentrant angles acute; the lateral wax tubes distinct and bent downward. Cephalad of the vasiform orifice there are two crescent-shaped thickenings in dorsum.

The distal portion of the lingula is conspicuously rounded and setose, and the apex is divided into two minute pointed lobes, laterad of which are two blunt tubes. In living specimens the lingula is frequently protruded and dorsally retracted.

On the venter of case, laterad of the cephalic margin of vasiform orifice, there are a pair of tapering hairs.

Legs distinct, apparently unsegmented. Antennæ not visible. Eyes single, large, and dark red in color.

Adult female.—Length, usually about 1 mm., but sometimes varies to 0.83 mm. Fore wing, 1.07 mm. by 0.47 mm. to 1 mm. by 0.4 mm., hind wing on same insect, 0.9 by 0.33 mm.; front tibia, 0.17 mm.; front tarsus, 0.2 mm.; hind tibia, 0.3 mm.; hind tarsus 0.2 mm.; color of body, uniformly pale yellow, legs and antennæ white; entire insect thickly coated with white granules; wings immaculate, entire wing with a narrow sculptured border, which is wider on the costal margin, each of the minute divisions with from three to five delicate hairs; margin of very bright yellow; main vein about seven-eighths length of wing, well defined to, and somewhat beyond the flexure and then fading out. Flexure of main vein of front wing at about one-half its length; basal half of main vein nearer the costal margin, the apex of vein in middle line of wing. The veinlet arises at base and varies in length with different specimens; in some it is very short; in others it turns abruptly and is continued to the anal margin of wing. Eyes, large; by transmitted light, reddish black; by reflected light, dark red. Each is divided into two distinct regions by a wedge-shaped white mass of wax, which dissolves in Canada balsam; the more dorsal region is subpyriform in shape and much the smaller; the facets are minute, and the color is bright red; the ventral region is crescent shaped on dorsal side, and the facets are much larger than those of the dorsal portion; color, brownish red. When the insect is mounted in Canada balsam there is no perceptible division of the compound eyes, and the general shape is either reniform or oblong, constricted about the middle.

Antennæ with segment one cup-shaped, short, as broad as long; segment two about twice as long as segment one, pyriform, and bearing a clavate process, which is tipped with a hair; segment three subcylindrical, long, and tapering considerably at point of insertion with second segment; near the distal end there are two clavate processes; segment four very short and cylindrical; segment five longer than fourth segment, cylindrical to near the distal end, where there is a notch from which arises a clavate process; segment six, subequal with fifth segment, cylindrical; segment seven, subequal with fifth and sixth segments. At one-half length it abruptly narrows to a point and ends in a finger-like process, which is tipped with a hair; at the place where segment is narrowed is seen one or more minute, clavate processes; segments three to seven, inclusive, are closely ringed with short hairs. Genitalia acutely conical.

Male.—Unknown. Of the very many adults collected at various times all proved to be females.

Cotypes.—No. 7101, U.S.N.M.

This is an introduced species and is a common pest in the conservatories of San Francisco, California. The described specimens were reared on a fern, *Acrostichum capense*, which was given to the author by Superintendent McLaren, of Golden Gate Park, San Francisco. When the plant was removed to the laboratory it had only a very moderate number of the Aleyrodes upon it, but within a year the under surfaces of the fronds were incrusted. The plant had from 14 to 30 fronds, some of which were over 3 feet in height and divided into innumerable leaflets, altogether making considerable space to be covered.

Observation of this plant was kept from February 2, 1900, to May 28, 1901, and during that time all stages could be found. In December and January there were but few adults. At this time the pupal stages were most in evidence, while in March, April, September, and October the adults arose in clouds whenever the plant was disturbed. It was not possible to determine the number of broods as the leaflets were so minute and withered as soon as taken from the plant; when dry they rolled up tightly and could not be examined without breaking into bits.

Specimens were taken from various plants in the conservatories mentioned as well as from the laboratory plant.

Upon the *Acrostichum capense* kept in the laboratory there were also found at various times a few minute larvæ which were very different in appearance from those of *A. extraniens*. Although a careful watch was kept for other stages, none were found which differed from *A. extraniens*, though the young larvæ were in evidence during the entire time the plant remained under observation (fig. 67, Plate XXXVI).

Larva.—Length, about 0.25 mm.; width, about 0.15 mm. Shape, subelliptical, narrowed at both ends, broadest across the mouth parts. Color, an opaque, grayish green. Dorsum convex, and with a pair of tapering, sharply pointed spines nearly one-half as long as larva. These spines are inserted meso-cephalad of the antennæ, and in the living larvæ are borne in an almost upright position. There is a narrow marginal rim which bears seven pairs of rather long lateral setæ, one pair of longer latero-caudal setæ, and one pair of long, tapering, stout spines, all of which are inserted in conspicuous tubercled bases. The lateral setæ extend caudad about two-thirds the length of the larva, and with the exception of the first two pairs, which are closer together, they are evenly spaced. On the ventral surface opposite the point of insertion of the latero-cephalic spines, there arises a similar pair of setæ. Abdominal segmentation distinct, the sutures extending to margin, the more caudal ones strongly reflexed.

Vasiform orifice subcircular and with a straight cephalic margin caudally bounded by a dark, raised rim. Operculum relatively the

same shape and nearly filling the orifice. Lingula spatulate, about length of orifice, enlarged at distal end, which is densely setose. Latero-cephalad of the vasiform orifice are a pair of minute spines.

Eye-spots large, bright red. Legs functional. Antennæ as long as one-half width of larva; segment 1, short, about as broad as long; segment 2, about the same length and tapering slightly; the remaining portion is unsegmented, slender, closely ringed with minute hairs and ends distally in a finger-like process tipped with a hair.

47. ALEYRODES ACACIÆ Quaintance.[a]

Plate XXVII, fig. 6.

Collected by the author on *Rhamnus californica*, Campus, Leland Stanford Junior University, immature stages found on the under sides of the leaves, together with *A. iridescens*, *A. splendens*, and *A. errans* during April and May, 1902. Adults unknown.

48. ALEYRODES TRACHEIFER Quaintance.[b]

49. ALEYRODES QUERCUS-AQUATICÆ Quaintance.[c]

50. ALEYRODES ABNORMIS Quaintance.[d]

51. ALEYRODES PERGANDEI Quaintance.[e]

52. ALEYRODES PLUMOSUS (Quaintance).[f]

53. ALEYRODES FITCHI Quaintance.[g]

54. ALEYRODES FLORIDENSIS Quaintance.[h]

55. ALEYRODES VITTATUS (Quaintance).[i]

56. ALEYRODES ALTISSIMUS (Quaintance).[j]

57. ALEYRODES PERSEÆ Quaintance.[k]

58. ALEYRODES VARIABILIS Quaintance.[l]

59. ALEYRODES SPIRÆOIDES Quaintance.[m]

Plate XXXV, figs. 56–60.

Egg.—Size, 0.3 by 0.13 mm.; pedicel, 0.083 mm.; shell covered with polygonal markings; oval, base more pointed than usual; when first laid it is white, but as the embryo develops the color becomes gradu-

[a] Contributions toward a Monograph of the American Aleurodidæ (U. S. Agr. Dept., Division of Entomology. Technical Ser. 8, p. 19.)

[b] Idem p. 38. [f] Idem p. 35. [j] Idem p. 20.

[c] Idem p. 33. [g] Idem p. 24. [k] Idem p. 32.

[d] Idem p. 71. [h] Idem p. 26. [l] Idem p. 39.

[e] Idem p. 31. [i] Idem p. 42.

[m] Contributions toward a Monograph of the American Aleurodidæ. (U. S. Agr. Dept. Division of Entomology. Technical Ser. 8), p. 36.

ally more yellow; from the first there can be seen a large, roundish, yellow body within the shell. This is at first pale in color, but also grows darker until near time of hatching, when it is orange. The pedicel is at center of base of shell and is divided at distal end into two or more prongs. The shell is densely covered with the wax granules, which are found upon the leaf.

Adult female.—Length of body, 1.5 mm.; fore wing, 1.6 by 0.83 mm.; hind wing, 1.08 by 0.63 mm.; hind femur, 0.33 mm.; hind tibia, 0.53 mm.; hind tarsus, 0.3 mm.; proximal segment, 0.18 mm. Antennæ: Segment 1, cup-shaped, about one-half the length of segment 2; segment 2, subpyriform, one-half as long as third segment; segment 3, 0.166 mm. long; segments 4, 6, and 7 equal 0.066 mm.; segment 5, slightly longer than segment 4; segments 3 to 7, inclusive, closely ringed with minute hairs. Fore wings with two dusky spots, one at the flexure of main vein, which is here curved toward the anal margin; hind wings with only the more distal spot. Basal veinlet of fore wings arises independently of main vein and at some distance from base of wing; between the veinlet and anal margin there is a heavy oblique fold, which is about one-half the length of wing and which curves nearly to the anal margin; main veins of both wings about seven-eighths length of wing; mentum dusky brown, the apex dark brown, median segment brown; ocelli conspicuously large; eyes red-black, divided; vasiform orifice subcircular; operculum brown, very convex dorsally, and about one-half length of orifice; lingula brown, very long, subcylindrical, with distal part somewhat enlarged and bilobed, densely covered with minute hairs; genitalia acute, conical, ordinary.

Male.—Length of body, 1.5 mm.; fore wing, 1.63 by 0.7 mm.; hind femur, 0.3 mm.; hind tibia, 0.45 mm.; hind tarsus, 0.26 mm.; proximal segment, 0.17 mm. Antennæ: Segment 2, 0.07 mm.; segment 3, 0.186 mm.; segments 4, 5, and 7 equal, 0.07 mm.; segment 6, 0.04 mm. Genitalia usual. Brown line on venter of abdomen, 0.3 mm. long.

For detail of body coloration, etc., see drawing of adults of *A. pruinosus*, which agrees closely with the markings of this species.

This species is very plentiful in all parts of California where the author has collected or from which specimens have been received. There are some minor variations in external characters, but these do not differ more from Quaintance's species than they do from one another. It is omnivorous, the number of host plants being greater than that of any other Aleyrodes known to the author. The exact number of broods has not been ascertained, but females were seen laying on February 22, 1901, again during May, October, and November of the same year on the campus of Leland Stanford Junior University; in 1902 the spring was cold and wet, and the first egg laying observed in the same locality was on March 29; the females are still

laying on May 27. Pupa-cases have been found at all seasons of the year during the time the leaves remained upon the host plants, the greater number of which are deciduous herbs.

The females are gregarious when egg laying, frequently seven to ten being on one leaf within a small radius. The habit of making a circular disk of granular wax upon which to deposit the eggs is noticeably marked in this species, and the leaves, even when large, are often covered with these disks which may overlap each other, thus confusing the different sets of eggs.

Collected by Mr. Kuwana at Wright's, in the Santa Cruz Range, on *Troximon sp.;* by Mr. Edward M. Ehrhorn, in the foothills near Mountain View, Santa Clara County, on the same plant and also on *Sonchus oleraceus;* by Miss Isabella McCracken, in Oakland, on *Convolvulus sepium;* by Mr. W. S. Atkinson, on horse chestnut (*Aesculus californica*), San Francisquito Creek, campus, Leland Stanford Junior University, and by the author on cultivated fuschia in Golden Gate Park, San Francisco, and on the campus, Leland Stanford Junior University; also found on *Plantago major*, *Sonchus oleraceus*, *Solanum douglasii*, *Nicotiana glauca*, and cultivated iris in the same locality; on cultivated dahlia, iris, and Cherokee rose, in Alameda; on *Opulaster capitatus*, *Sonchus oleraceus*, *Lonicera involucrata*, and *Solanum douglasii* along the banks of Stevens Creek, from the valley to the lagoon at its head in the Santa Cruz Range (or Sierra Morena Range), and along the banks of San Francisquito Creek on the same food plants.

The leaves of the plantain and *Sonchus oleraceus* (sow thistle) are more thickly covered than are those of the other hosts; frequently they are solidly incrusted with the immature forms; the leaves in such cases are usually paler and thinner.

The author has carefully observed this species on its many food plants with a view of ascertaining if there was constant variation in gross external structure caused by a great range of food plants, but this experiment has shown only trivial differences, such as are common among nearly all species. The test may have more result if made seasonal.

60. ALEYRODES ABUTILONEUS (Haldeman).

Aleyrodes abutilonea Haldeman, Am. Jn. of Sci. and Arts, IX (1850), p. 108.—Signoret, Am. de la Soc. Entom. de France, Dec., 1867, p. 397.

61. ALEYRODES HUTCHINGSI, new species.

Plate XXXVI, figs. 62–64.

Pupa-case.—Size about 1.3 by 0.6 mm.; elliptical; without lens, the case is brownish in color, but when mounted in Canada balsam and viewed by reflected light it ranges from a dense brown-black to semitransparent, pale, yellow-brown. The former color when found in semitransparent, yellowish species is usually the result of parasitization.

The dorsum bears a conspicuously long submarginal fringe, which rises almost perpendicularly from the case to a considerable distance; it is then curved outward and downward until the distal portion rests upon the leaf. This fringe is made up of appressed, slender, crystalline rods which form a solid ring above the case, but is broken into irregular plates after curving downward. The arrangement and length of this fringe is characteristic of *A. hutchingsi*, and makes it one of the most unique and beautiful of the Californian Aleyrodidæ.

Within the circle of submarginal fringe the dorsum is sometimes covered with a thin, pellucid coat of wax; this coating frequently extends over the lateral and ventral portions as well, thus completely inclosing the case. This wax covering is probably protective, as the author found it on a number of species collected in Yosemite Valley, which in lower altitudes and a warmer climate were without it. This dorsal wax is filled with minute dots, which doubtless is but an impression of the underlying wax-secreting tubes.

On the majority of the specimens the dorsal wax coat was granular; usually this granular wax was thicker in a strip along the dorso-medial line and in a ring inclosed by the submarginal fringe.

The dorsum has a narrow marginal rim, within which the lateral wax tubes are evident; the outer margin of the case is but slightly and irregularly crenulated; inside of the marginal rim, and extending around the case, there are about three irregular rows of closely set papillæ from which issues the submarginal dorsal fringe; scattered among the papillæ are a large number of small pores. Between the dorso-submarginal papillæ and the central dorsum the case is covered with minute papillæ. The abdomen has a slight keel, along which the segmentation is distinct. On each of the abdominal segments there are two small pores; these are arranged in two parallel lines, one each side of the dorsi-meson. Lateral of these pores there are occasionally seen irregular groups of from two to three pores; on the meta-thorax there is a transverse row of small pores. Caudad of each abdominal suture there is a pair of subcircular spaces which are somewhat more highly chitinized than the surrounding dorsum; these spaces are also usually slightly wrinkled in appearance. The thoraco-abdominal suture is distinct and extends to the submarginal papillæ.

The vasiform orifice is distinctly outlined by a dark rim, shape, subovate, the inner lateral and caudal margins much corrugated, the caudal end broadly rounded, or, in some specimens, indented and with a finger-like process projecting caudad from center. Operculum, subsemielliptical, about one-half length of orifice. Lingula, about four-fifths the length of orifice, subspatulate, the distal portion with three pairs of lateral lobes and a terminal lobe. Just cephalad of the vasiform orifice there are two crescent-shaped thickenings of the tergum of dorsum. Latero-cephalad of the orifice on each side is a small pore.

Cotypes.—No. 7102, U.S.N.M.

Collected by the author on an unnamed species of *Arctostaphylos* in Yosemite Valley, July, 1902; only a few pupa-cases found.

62. ALEYRODES MELANOPS Cockerell.

Aleyrodes melanops Cockerell, Proc. Acad. Nat. Sci. Phila., May, 1902, p. 283, and in an unpublished bulletin written for the Florida Exper. Station, by T. D. A. Cockerell.

Pupa-case.—Length about 1.5 mm., broad-oval, black, similar in structure to *A. perileucus*, but larger and with the fringe much longer and curled over, so as to be strongly convex above.

Adults unknown.

A. melanops is possibly only a variety of *A. perileucus*.

Found by T. D. A. Cockerell at Alpine Tavern, Mount Lowe, California, on upper sides of leaves of Quercus.

63. ALEYRODES STRUTHANTHI Hempel.

Aleyrodes struthanthi Hempel, Annals & Mag. Nat. Hist., sec. 7, VIII, pp. 385–387. (1901.)

On *Struthanthus flexicaulis*, Mart., orange, *Tichilia flava*, and an unidentified forest tree.

Habitat.—Paruahyba and São Paulo, Brazil.

64. ALEYRODES YOUNGI Hempel.

Aleyrodus Youngi Hempel, Annals & Mag. Nat. Hist., sec. 7, VIII, pp. 385. (1901.)

On cabbage and collards, Ignape and Campinas, State of São Paulo, Brazil.

65. ALEYRODES MORI ARIZONENSIS Cockerell.

Plate XXXII, figs. 38–38a.

Aleyrodes mori arizonensis Cockerell, Science Gossip, 1900, p. 366.

Pupa case.—Size about 0.7 by 0.55 mm.; elliptical, shiny black. Margin with a copious white, cottony fringe all around; continuous basally but ragged distally. Case moderately convex, with evident, rounded median ridge. The pupa is like that of *A. mori* Quaintance, but the lateral margins of case are more deeply crenulated. The adult has the wings white, with black markings, which show considerable variation in arrangement (Plate XXXII, fig. 38). This species occurs on orange trees in the Southwest. Collected at Mesa, Arizona, by T. D. A. Cockerell, and at Zapotlan, Mexico, by Prof. C. H. T. Townsend.[a]

[a] The above description is from a letter by Mr. Cockerell, the writer not being able to get access to references.

66. ALEYRODES NEPHROLEPIDIS Quaintance.

Aleyrodes nephrolepidis Quaintance, Bull. 8. Tech. Ser., Div. Ent., U. S. Dept. Agric., 1900, p. 29.

On *Nephrolepis*. Pennsylvania.

EXPLANATION OF PLATES.

[These plates were drawn by Mary H. Wellman.]

Plate XXVII.

Fig. 1. *Aleyrodes iridescens*, pupa-case.
2. *Aleyrodes iridescens*, same with wax removed, showing arrangement of wax-secreting pores.
2a. *Aleyrodes iridescens*, pore of same, enlarged.
3. *Aleyrodes nigrans*, pupa-case, cleared and mounted to show vertical, oblique rim.
4. *Aleyrodes amnicola*, pupa-case.
4a. *Aleyrodes amnicola*, vasiform orifice of same; *a*, operculum; *b*, lingula.
5. *Aleyrodes wellmanæ*, pupa-case with dorso-submarginal wax removed.
5a. *Aleyrodes wellmanæ*, vasiform orifice; *a*, operculum; *b*, lingula.
6. *Aleyrodes acaciæ*, pupa-case.

Plate XXVIII.

Fig. 7. *Aleyrodes madroni*, pupa-case.
8. *Aleyrodes madroni*, same showing a common variation in arrangement of dorsal and lateral wax.
9. *Aleyrodes coronatus*, pupa-case.
10. *Aleyrodes interrogationis*, pupa-case.
11. *Aleyrodes interrogationis*, caudal end of pupa, spines in detail and vasiform orifice with marginal rim; *a*, operculum; *b*, base of lingula; *c*, corrugated inner parts.
12. *Aleyrodes interrogationis*, pupa-case, showing dorsal spines, pores, and lateral wax tubes.

Plate XXIX.

Fig. 13. *Aleyrodes kelloggi*, pupa-case cleared of wax.
13a. *Aleyrodes kelloggi*, detail of minute dorsal wax-pores.
14. *Aleyrodes kelloggi*, pupa-case.
15. *Aleyrodes kelloggi*, young larva.
16. *Aleyrodes kelloggi*, vasiform orifice; *a*, operculum; *b*, lingula; *c*, marginal rim.
17. *Aleyrodes merlini*, pupa-case.
18. *Aleyrodes merlini*, same, cleared of wax, showing dorsal papillæ.
19. *Aleyrodes merlini*, vasiform orifice; *a*, operculum; *b*, lingula.

Plate XXX.

Fig. 20. *Aleyrodes errans*, pupa-case, with molt on dorsum.
21. *Aleyrodes errans*, pupa-case with molt removed.
22. *Aleyrodes stanfordi*, pupa-case.
23. *Aleyrodes stanfordi*, late larva or early pupa.
24. *Aleyrodes stanfordi*, detail of marginal rim of fig. 23.
25. *Aleyrodes stanfordi*, egg showing marking.

PLATE XXXI.

FIG. 26. *Aleyrodes tentaculatus*, pupa-case, dorsal view.
27. *Aleyrodes tentaculatus*, pupa-case from side to show vertical wax base, and variation from fig. 26.
28. *Aleyrodes tentaculatus*, pupa-case cleared of wax, showing marginal rim with papillæ.
29. *Aleyrodes tentaculatus*, portion of marginal in detail.
30. *Aleyrodes tentaculatus*, vasiform orifice of pupa-case with surrounding marginal rim; *a*, operculum; *b*, lingula.
30a. *Aleyrodes tentaculatus*, same showing crescent-shaped thickenings of dorsum cephalad of vasiform orifice.
31. *Aleyrodes glacialis*, pupa-case.
32. *Aleyrodes glacialis*, same with wax removed, showing dorsal pores and papillæ.
33. *Aleyrodes glacialis*, detail of caudal end of pupa-case, dorso-caudal furrow.

PLATE XXXII.

FIG. 34. *Aleyrodes inconspicuus*, pupa-case.
35. *Aleyrodes inconspicuus*, detail of dorsum of same.
36. *Aleyrodes inconspicuus*, vasiform orifice with surrounding rim; *a*, operculum; *b*, lingula of pupa-case.
37. *Aleyrodes inconspicuus*, parasite, dissected from pupa-case.
37a. *Aleyrodes inconspicuus*, last abdominal segment of male, showing genitalia.
38. *Aleyrodes mori arizonensis*, diagram showing variation in wing marking.
38a. *Aleyrodes mori arizonensis*, diagram showing crenulation of pupa-case.
39. *Aleyrodes mori*, diagram showing crenulation of pupa-case.

PLATE XXXIII.

FIG. 40. *Aleyrodes pruinosus*, adult, showing position of wings when at rest.
41. *Aleyrodes pruinosus*, male, cleared of wax, showing markings.
42. *Aleyrodes pruinosus*, abdomen of female, showing the variation from male in latero-ventral markings and width of segments 4 and 5.
43. *Aleyrodes pruinosus*, dorso-abdominal markings of female.
44. *Aleyrodes pruinosus*, last abdominal segments of female with vasiform orifice; *a*, operculum; *b*, lingula; and *c*, genitalia.
45. *Aleyrodes pruinosus*, detail of wing marking and main vein.
46. *Aleyrodes pruinosus*, caudal end of larva, showing spines, lateral view of vasiform orifice; *a*, operculum; *b*, lingula.
47. *Aleyrodes pruinosus*, dorsal view of larval vasiform orifice; *a*, operculum; *b*, lingula; *c*, minute, blunt tubes at apex of lingula.

PLATE XXXIV.

FIG. 48. *Aleyrodes pruinosus*, fore wing.
49. *Aleyrodes pruinosus*, hind wing.
50. *Aleyrodes pruinosus*, border of wing.
50a. *Aleyrodes pruinosus*, same, showing hairs, highly magnified.
51. *Aleyrodes pruinosus*, head of adult; *a*, compound divided eye; *b*, ocellus; *c*, mentum; *d*, rostral setæ; *e*, antennæ.
52. *Aleyrodes pruinosus*, mentum of same showing suctorial tube.
53. *Aleyrodes pruinosus*, antennæ of same, highly magnified.
54. *Aleyrodes pruinosus*, tarsi of same, front and side view.
55. *Aleyrodes pruinosus*, diagram showing typical alimentary tract and mouth parts of Aleyrodes.

PLATE XXXV.

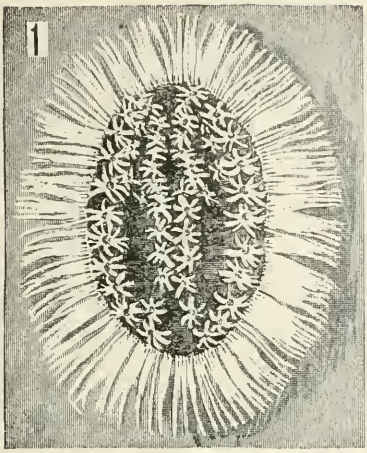
FIG. 56. *Aleyrodes spiraoides*, pupa case, ventral surface showing tracheal system and position of spiracles.
57. *Aleyrodes spiraoides*, same, showing transverse tracheal trunks.
58. *Aleyrodes spiraoides*, male, genitalia, vasiform orifice; *a*, operculum; *b*, lingula.
59. *Aleyrodes spiraoides*, vasiform orifice of pupa-case with surrounding marginal rim; *a*, operculum; *b*, lingula; *t. l.*, terminal lobes of lingula.
60. *Aleyrodes spiraeoides*, detail of marginal rim of pupa-case
61. *Aleyrodes wellmanæ*, pupa-case.

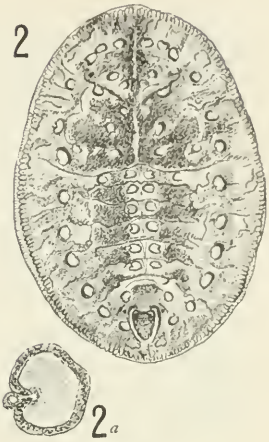
PLATE XXXVI.

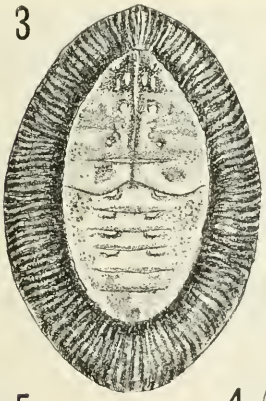
FIG. 62. *Aleyrodes hutchingsi*, pupa-case.
63. *Aleyrodes hutchingsi*, same, with wax removed, showing dorsal pores and papillæ.
64. *Aleyrodes hutchingsi*, detail of margin of case, submarginal papillæ and pores, and minute dorsal papillæ.
65. *Aleyrodes extraniens*, female, with granular wax removed.
66. *Aleyrodes extraniens*, egg.
67. *Aleyrodes extraniens*, young larva.
68. *Aleyrodes splendens*, young larva.

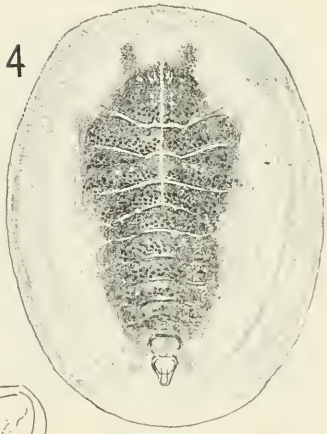
PLATE XXXVII.

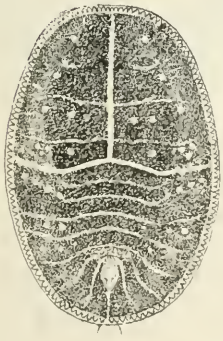
FIG. 69. *Aleyrodes splendens*, pupa-case.
70. *Aleyrodes quaintancei*, pupa-case mounted to show marginal rim and coloration of dorsum.
71. *Aleyrodes quaintancei*, early pupa-case, outline to show shape.
72. *Aleyrodes quaintancei*, young larva.
73. *Aleyrodes quaintancei*, vasiform orifice of pupa-case and portion of case directly cephalad.
74. *Aleyrodes maskelli*, vasiform orifice of pupa-case with marginal rim.

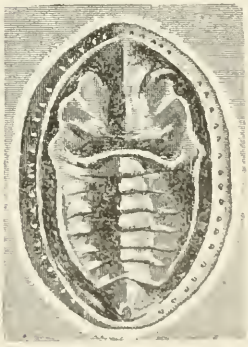












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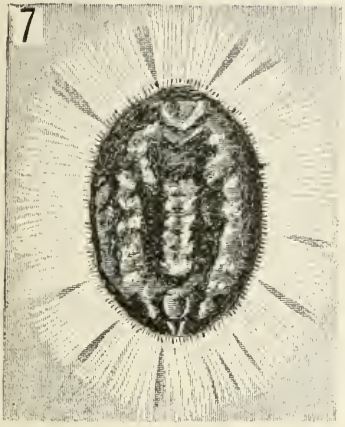

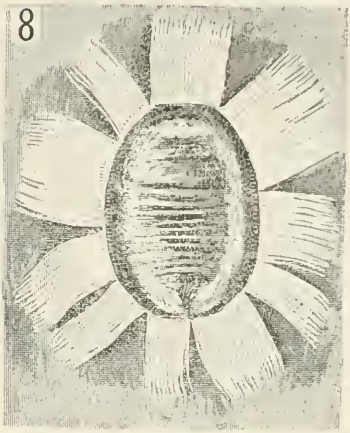

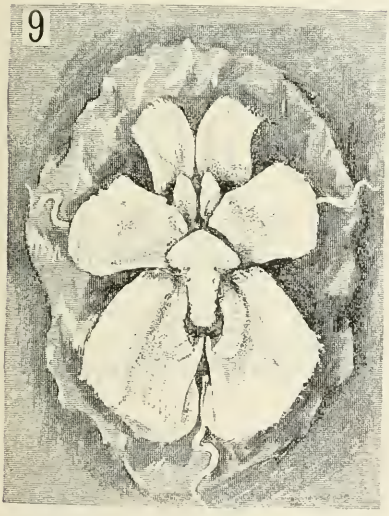

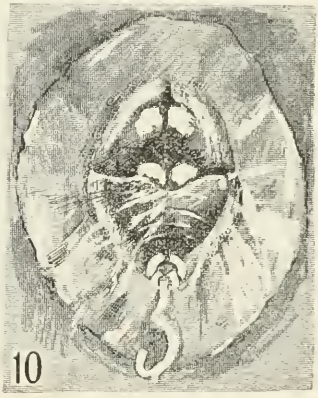

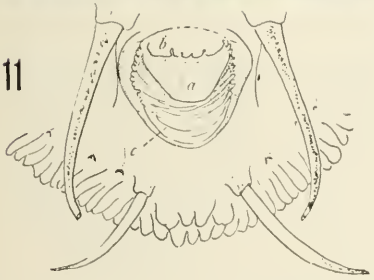

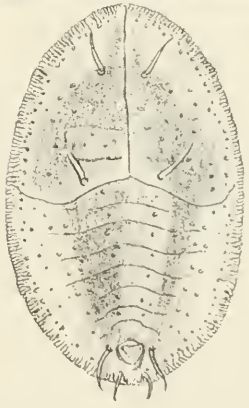

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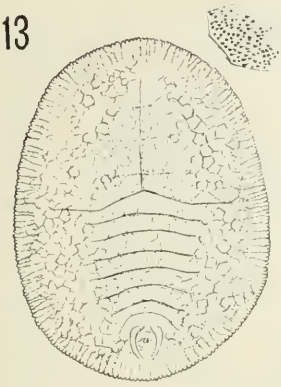

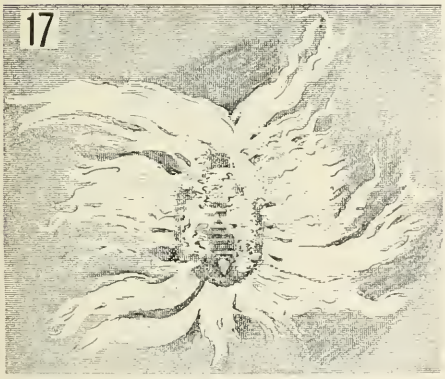

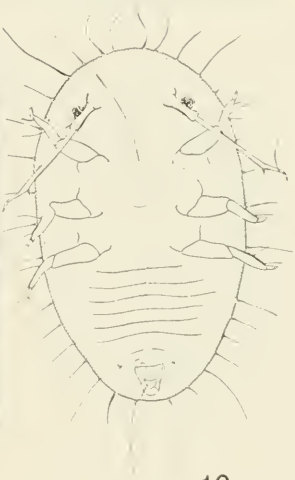

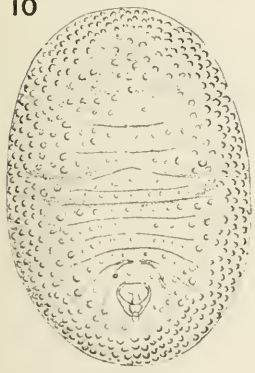

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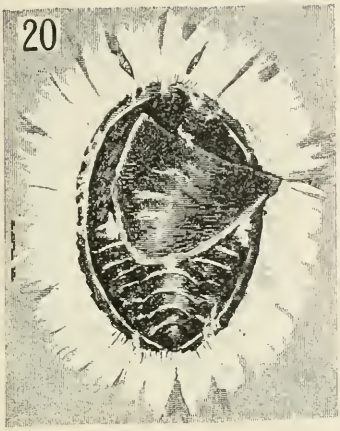

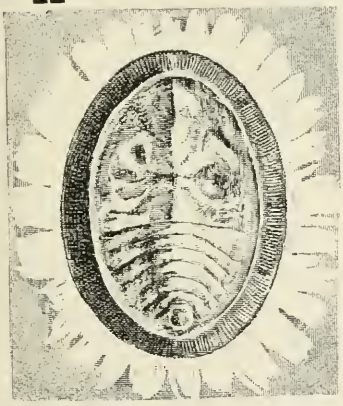

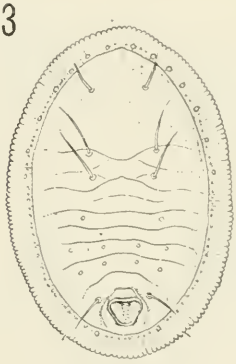

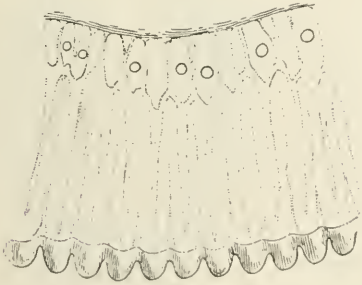

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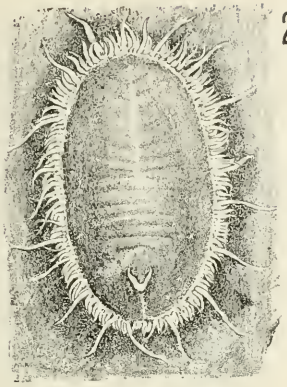

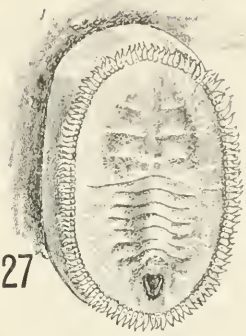

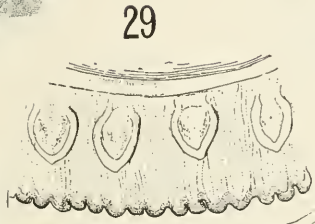

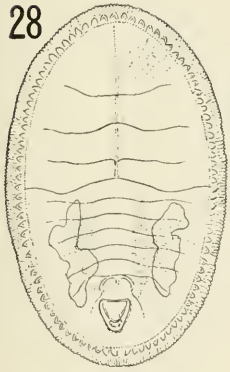

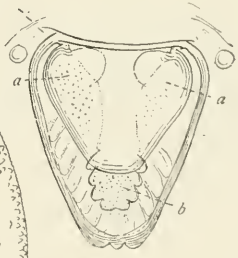

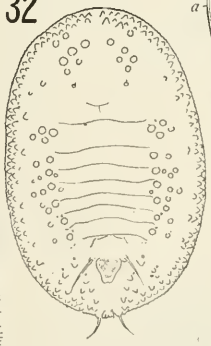

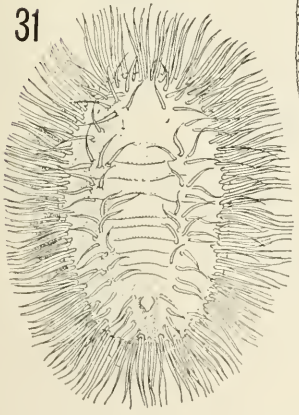

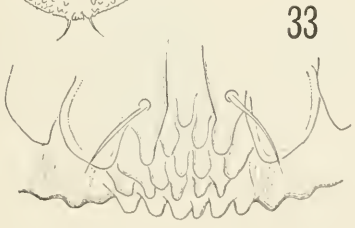

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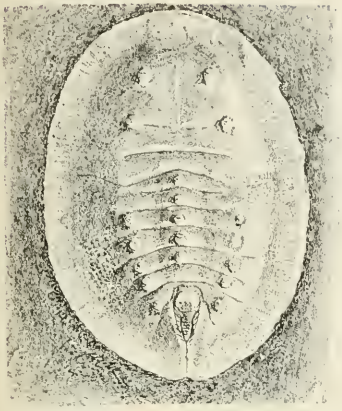

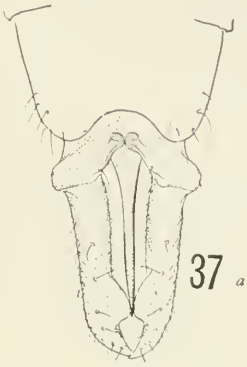

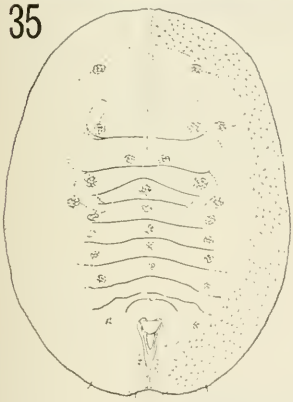

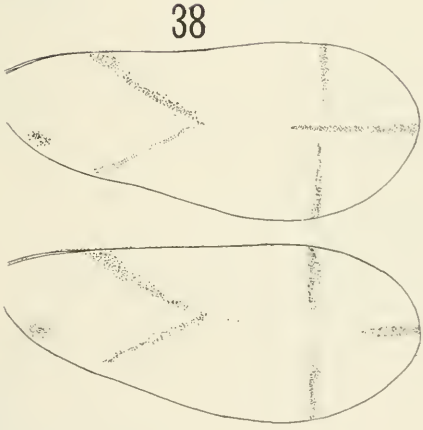

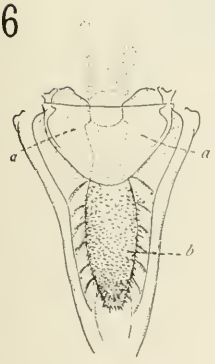

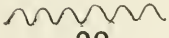

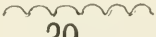

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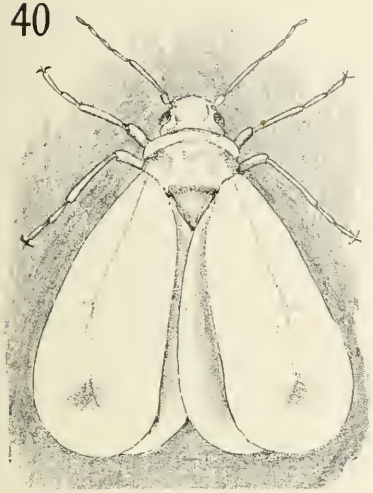

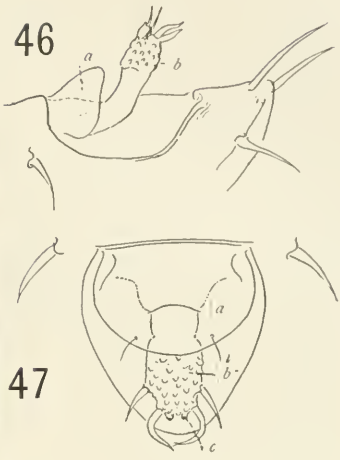

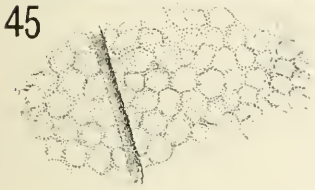

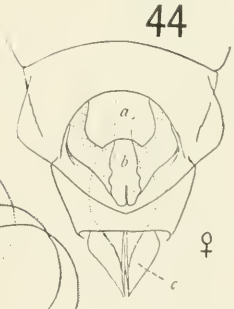

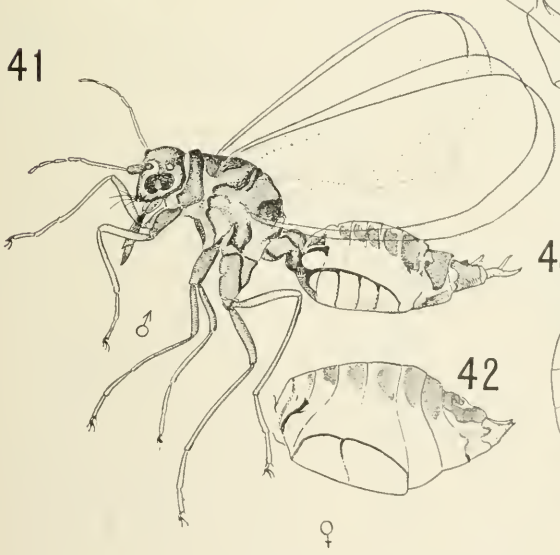

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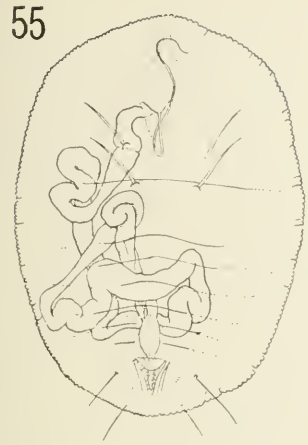

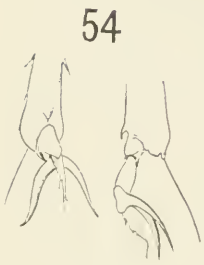

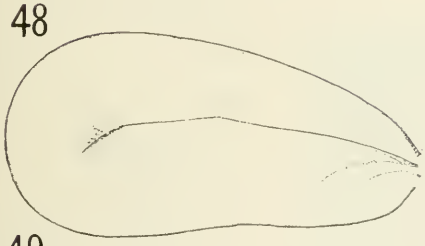

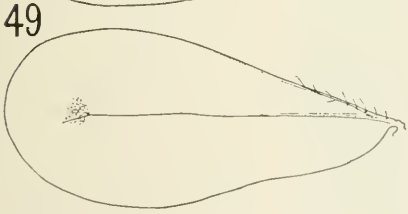

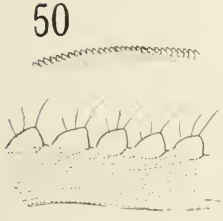

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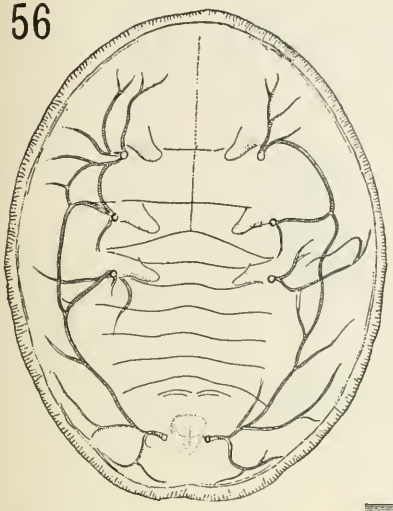

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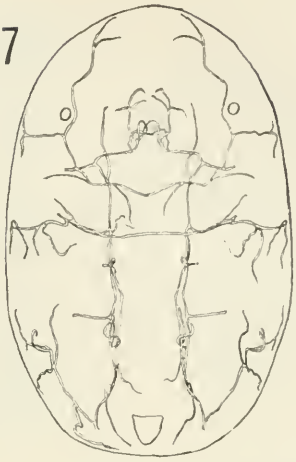

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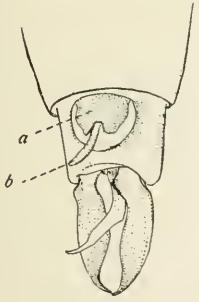

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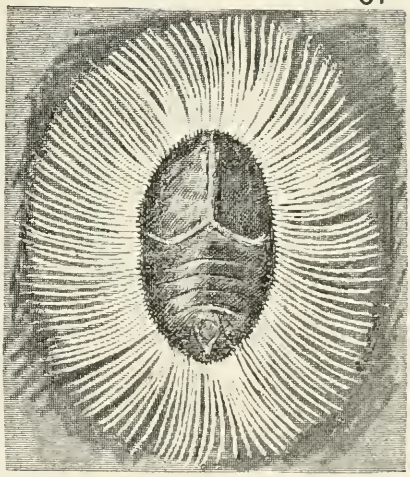

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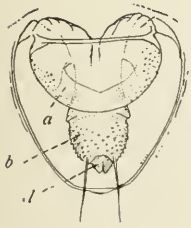

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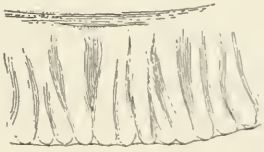

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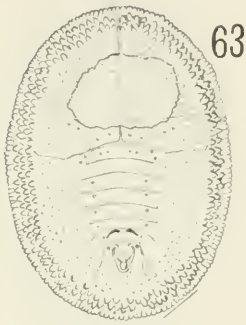
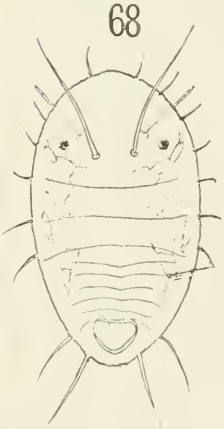
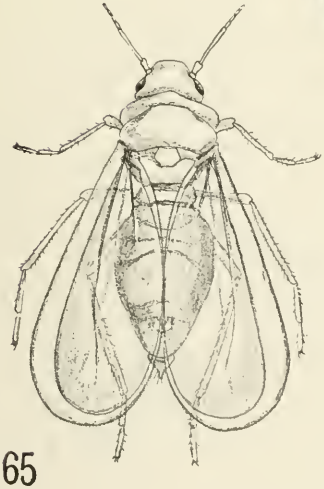
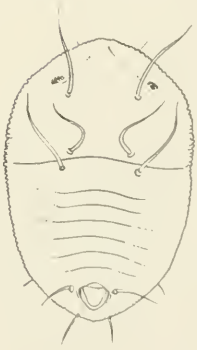


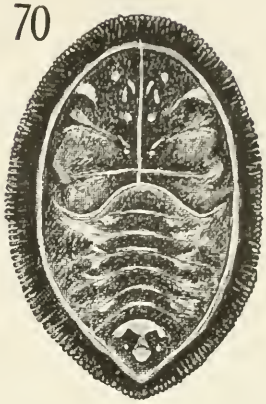


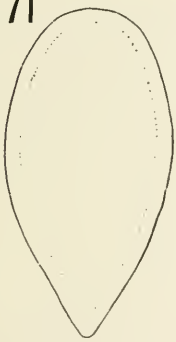


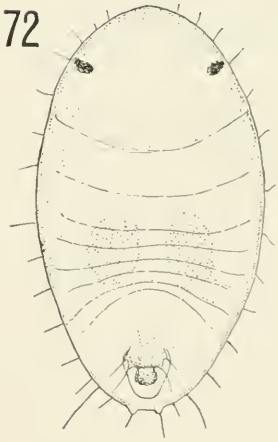


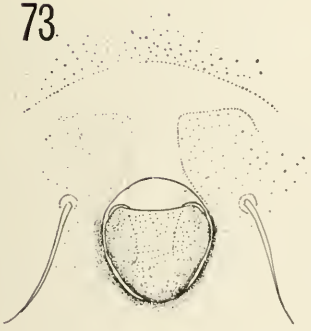
ALEYRODIDÆ OF CALIFORNIA.

FOR EXPLANATION OF PLATE SEE PAGE 537.









ALEYRODIDÆ OF CALIFORNIA.

FOR EXPLANATION OF PLATE SEE PAGE 537.

STUDIES IN OLD WORLD FORFICULIDS OR EARWIGS, AND BLATTIDS OR COCKROACHES.

By James A. G. Rehn.

Of the Academy of Natural Sciences of Philadelphia.

The notes contained in the following pages are based on material in the collections of the Academy of Natural Sciences of Philadelphia, and of the United States National Museum.

The Hirase material from Japan, the Harrison and Hiller collection from Sumatra, the Abbott material from Trong, Siam, and the collections made by Koebele of Australian and New Zealand forms were the larger faunal collections examined.

The author wishes to express his thanks to Dr. W. H. Ashmead for the privilege of examining the material from the United States National Museum.

Family FORFICULIDÆ.

Genus LABIDURA Leach.

1815. "*Labidura* Leach, Edinb. Encycl., IX, p. 118."

Type.—"*Labidura gigantea*" = *Forficula riparia* Pallas.

LABIDURA HUSEINÆ (Rehn.)

1901. *Apterygida huseinæ* Rehn, Proc. Acad. Nat. Sci. Phila., p. 273; Sheikh Husein, Gallaland, Africa.

On second examination this species is seen to be a member of the genus *Labidura* and to represent a form of the *riparia* group. The recent treatment of this group by Kirby[a] is substantiated as far as our material goes.

This species belongs to the same section of the group as *inermis* Brunner, *marginella* Costa, *auditor* Scudder, *crenata* Olivier, and *saturalis* Burmeister. From *inermis* it differs in having the internal border of the male forceps more heavily dentate, the median tooth being very distinct; from *marginella* it differs in the somewhat larger size and crenulate basal section of the male forceps; from *auditor* in

[a] Ann. and Mag. Nat. Hist., 7th ser., XI, pp. 63–66.

the shape of the forceps, which are curved upward, and in the moderately dentate character of the internal margin of the same; from *crenata* in the unequal and less extensive crenulations on the internal margin of the female forceps, and very different coloration; while from *suturalis* Burmeister it is separable by the crenulate character of the internal margin of the female forceps, as well as the smaller size.

The nominal African species of this group, with their type localities, are as follows:

Labidura auditor Scudder. [Natal.]

Labidura bengalensis Dohrn. [Bengal.]

Kirby[a] considers a specimen from Sokotra as probably representing this form.

Labidura crenata (Olivier). [South Africa.]

Labidura herculeana (Fabricius). [St. Helena.]

Labidura huseinæ (Rehn). [Sheikh Husein, Gallaland.]

Labidura pallipes (Fabricius). [Cape Verde Islands.]

Labidura terminalis Serville. [Mauritius.]

Genus ANISOLABIS Fieber.

1853. *Anisolabis* FIEBER, Lotos, III, p. 257. Included *A. maritima* and *mœsta*.

ANISOLABIS STÅLI (Dohrn).

1864. *F[orcinella] stali* DOHRN, Entom. Zeitung, Stettin, XXV, p. 286; Java.

One female; Batu Sangkar, Padangsche Bovenland, Sumatra. August and September, 1901. (A. C. Harrison, jr., and Dr. H. M. Hiller.) [A. N. S. Phila.]

This species appears to be broadly distributed through the Malayan region, reaching Hindostan and Farther India, besides being recorded from the island of Nossi-Bé, off the northwest coast of Madagascar.

Genus APTERYGIDA Westwood.

1840. *Apterygida* WESTWOOD, Introd. Class Ins., Synop. Gen., p. 44.

Type.—*Forficula pedestris* Bonelli=*albipennis* Megerle von Muehlfeld.

APTERYGIDA ATHYMIA, new name.

1880. *Forficula japonica* DE BORMANS (not of De Haan, 1842), Anales Soc. Españ. Hist. Nat., IX, p. 512; Japan, on seashore.

Three specimens; one damaged, sex unknown, and two immature females; Japan.[b] (Dr. H. C. Wood.) [A. N. S. Phila.]

[a] Ann. and Mag. Nat. Hist., 7th ser., XI, p. 64.

[b] Dr. Wood has very kindly given me the following information regarding the specimens collected by him in Japan: My collections were all made in the district bounded by Kioto on the south and Nikko or Tokio on the north, going well back into the center of the country, as we made the trip along the Nakasendo road, the old highroad in Japan between North and South Japan, running along the central ridge of the island.

As De Bormans' name is preoccupied by De Haan's *Forficula gigantea* var. *japonica*,[a] a new name is required, and I propose that of *athymia* in relation to the rather weak build of the insect.

The immature individuals are rather darker in general coloration than the mature specimen.

Family BLATTIDÆ.

Subfamily ECTOBIINÆ.

Genus ECTOBIUS Stephens.

1835. *Ectobius* Stephens, Illust. Brit. Entom., Mandib., VI, p. 45.

Type.—By elimination and selection. *Blatta lapponicus* Linnæus.[b]

ECTOBIUS MAORI, new species.

Type.—Male; New Zealand. (Koebele.) [Cat. No. 6943, U.S.N.M.]

Allied to *E. tasmanicus* Brancsik[c] and *E. marcidus* Erichson[d] from Tasmania. From *tasmanicus* it differs in the general larger size, and in the very much larger pronotum, which also bears a different disk pattern. From *marcidus* it differs in the smaller size, and the lighter abdomen. The description of the latter species is very imperfect.

Size small; form elongate elliptical; surface moderately polished. Head projecting beyond the pronotum; the interspace between the eyes about twice that between the ocelli; eyes subreniform; antennæ not quite equaling the body in length. Pronotum transverse, the greatest width posterior; anterior margin subtruncate; posterior margin broadly arcuate; lateral margins arcuate, the anterior angles not at all apparent, the posterior angles obtusely rounded; lateral portions rather abruptly depressed. Tegmina reaching to the tip of the abdomen, lanceolate, apex rather blunt; basal field rather broad, short, but slightly exceeding one-fourth the tegmina in length, subcoriaceous; discoidal vein extending to the tip of the tegmen, costal branches numerous and rather regular; anal sulcus arcuate, slightly

[a] Verh. Natuur. Gesch. Nederl. Overz. Bezitt., Orth., 1842, p. 240.

[b] The originally included species are as follows:
germanicus—*Phyllodromia* Serville, 1839.
pallens.
lapponicus.
perspicillaris.
Panzeri.
nigripes.
lividus.
pallidus?
Of the seven uneliminated species *lapponicus* can readily be selected as the type, as Brunner figured this species and it is the best known.

[c] Jahresheft Naturwiss. Verein. Trenceséner Comitat., XVII–XVIII, 1895, p. 244, pl. VII, fig. 1.

[d] Archiv. f. Naturgesch., VIII, Pt. 1, 1842, p. 248.

sinuate about the middle of its length, anal field subpyriform in outline. Wings equaling the tegmina in length. Supra-anal plate transverse; apical margin subtruncate, the median portion produced into a blunt, rounded process. Cerci fusiform, bluntly acuminate, moderately depressed, exceeding the subgenital plate by half their length. Subgenital plate rotundate, the apex produced into an acuminate process. Limbs rather robust. Anterior femora with three median, two apical spines, and five minute spines between the other groups on the anterior margin; the apical spines very large, genicular spines short and stout; tibiæ slightly shorter than the femora; tarsi about equal to the tibiæ in length. Median femora with seven evenly distributed spines on the anterior margin, the apical and median exceeding the other in size; genicular spine very long, slender, and curved; tibiæ not quite equaling the femora in length; tarsi slightly exceeding the tibiæ in length and about equal to the femora. Posterior femora with four large spines on the distal portion of the anterior margin, the apical exceeding the others in size; genicular spine slender, elongate, and curved; tibiæ equal to the femora in length; tarsi slightly shorter than the tibiæ, the metatarsi exceeding the other joints in length, arolia moderately large.

General color ochraceous brown of two tints. Head rufescent brown, eyes pale. Pronotum with the disk bearing a complicated pattern of the darker tint on the paler, margin subpellucid. Tegmina with the basal field, costal margin, and veins and nervures of the paler tint on the darker. Limbs of the pale tint mottled with the darker.

MEASUREMENTS.

	mm.
Length of body	8.5
Length of pronotum	2.3
Posterior width of pronotum	3
Length of tegmina	6.5
Greatest width of tegmina	2.5

Two additional specimens of the species from the type locality were also examined.

Genus ANAPLECTA Burmeister.

1838. *Anaplecta* Burmeister, Handb. d. Entom., II, p. 494.

Included *A. minutissima* (De Geer), *lateralis* Burmeister, *dorsalis* Burmeister, and *unicolor* Burmeister.

ANAPLECTA PLATYCEPHALA, new species.

Type.—Female; Cairns, Queensland. (Koebele.) [Cat. No. 6944, U.S.N.M.]

This species appears to be allied to *A. fulva* Brunner,[a] from Burma, but differs in the wholly hyaline tegmina and the different proportions of the pronotum.

[a] Ann. Mus. Civ. Stor. Nat. Genova, XXXIII, 1893, p. 12.

Size rather small; form ovate. Head strongly depressed, with the anterior margin arcuate, projecting considerably beyond the pronotum; interspace between the eyes slightly less than the long diameter of the eye; eyes elongate reniform. Pronotum transverse, depressed, hemispherical; anterior margin shallowly and broadly emarginate; posterior margin rotundato-truncate; lateral margins obtusely rounded. Tegmina lanceolate, apex subacute, costal margin more arcuate than the sutural; basal field very broad, occupying almost half the basal width of the tegmina, extending about two-thirds the length of the tegmen, but the distal half narrowed by the mediastine vein, and not more than half the basal width; discoidal vein straight, extending to the apex of the tegmen; costal veins regularly disposed, arcuate, the convexity toward the apex of the tegmen; anal sulcus indistinct arcuate, joining the sutural margin at a point distant one-third the entire length from the base. Wings about equal to the tegmina in length when in repose. Supra-anal plate rather small, triangularly produced, apex deeply and narrowly fissate. Cerci elongate, narrow, moderately depressed, apex bluntly acuminate. Subgenital plate produced, broadly channeled, apex truncate. Posterior tibiæ slightly exceeding the femora in length.

General color pale ochraceous hyaline, suffused on the disk of the pronotum; costal margin of the wings and body with reddish ochraceous; eyes umber.

MEASUREMENTS.

	mm.
Length of body	8.5
Length of pronotum	2
Greatest width of pronotum	3.6
Length of tegmina	7.5
Greatest width of tegmina	3

Subfamily PSEUDOMOPINÆ[a] (*Blattinæ* Auct.).

Genus BLATTELLA Caudell (*Phyllodromia* Auct.).

1903. *Blattella* Caudell, Proc. Ent. Soc. Wash., V, p. 234.

Type.—Blatta germanica Linnæus.

BLATTELLA GERMANICA (Linnæus).

1767. [*Blatta*] *germanica* Linnæus, Syst. Nat., 12th ed., p. 688. [Denmark.]

Four specimens; three females, one immature individual.

Chemulpo, Korea (Dr. W. H. Jones) [A. N. S. Phila.]. Kioto, Japan (Y. Hirase) [A. N. S. Phila.]. no. 38. Japan (Koebele) [U.S.N.M.]. Trong, Lower Siam (Dr. W. L. Abbott) [U.S.N.M.].

[a] According to Rehn, Trans. Amer. Ent. Soc., XXIX, 1903, p. 260.

Genus ELLIPSIDION Saussure.

1864. *Ellipsidion* Saussure, Mélanges Orthoptérologiques, I, p. 18.
——. *Apolyta* Brunner, Nouv, Syst. Blatt., p. 112, 1865.

Type.—*Thyrsocera australis* Saussure=*Apolyta pellucida* Brunner.

ELLIPSIDION HISTRIONICUM, new species.

Type.—Male; Australia. (Koebele.) [Cat. No. 6945, U.S.N.M.]

Apparently allied to *E. australe* Saussure[a] (=*pellucida* Brunner) and *E. quadripunctatum* Tepper.[b] From the former it differs in the truncate posterior margin and general shape of the pronotum, the longer antennæ, and the brownish instead of blackish limbs. From *quadripunctatum* it differs in the larger size and the indefinite character of the maculations on the pronotum.

Size medium; form ovoid, the apex posterior. Head slightly projecting beyond the pronotum, anteriorly truncate; interspace between the eyes exceeding the long diameter of one of the latter; eyes reniform; lower surface of head deplanate; antennæ about equal to the body in length, closely and densely plumose. Pronotum transverse, subovate; anterior margin narrow, truncate; posterior margin truncate, about twice the width of the anterior margin; lateral margins obtuse angulate, anterior angle well rounded, posterior angle broadly obtuse; pronotum as a whole arched transversely. Tegmina elongate, subparallel, extending a considerable distance beyond the tip of the abdomen; apex bluntly angulate; basal field equal to one-third the length of the tegmina, coriaceous in character; discoidal vein arcuate basally, extending to the apex of the tegmen, costal veins regularly disposed, diagonal; anal sulcus arcuate basally, anal field subpyriform. Wings equal to the tegmina in length when in repose; apex narrowly rounded, costal margin arcuate, proximal costal veins apically incrassate; ulnar vein with five complete rami. Abdomen with the lateral angles of the segments slightly produced posteriorly. Supra-anal plate broad, shallow, triangularly produced, apex with a shallow V-shaped fissure. Cerci lanceolate, depressed, apex acuminate. Subgenital plate triangularly produced, apex deeply and narrowly fissate. Anterior femora with one large apical spine on the external margin; posterior margin with three spines in the distal half, the apical one largest, genicular spine large; tibiæ not equal to the femora, but equaling the tarsi in length. Median femora with seven spines on the anterior margin, the apical one surpassing the others in size, posterior margin with five spines, the apical surpassing the others, genicular spine strong; tibiæ very slightly shorter than the femora; tarsi slightly shorter than the tibiæ. Posterior femora with the anterior

[a] Mélanges Orthoptérologiques, I, p. 18.
[b] Trans. and Proc. and Rep. Royal Soc. South Aust., XVII, p. 45.

and posterior margins each armed with six evenly disposed spines, genicular spine strong; tibiæ slightly exceeding the femora in length; tarsi about two-thirds the length of the tibiæ, arolia large.

General color orange ochraceous. Head with the lower surface black; eyes, interspace between the same and antennæ deep red-brown. Pronotum with the disk reddish orange, with an overlaid irregular pattern of dull brownish. Tegmina of the general tint, veins and nervures subpellucid. Wings of the general tint strongest on the costal margin, the apex with a suffusion of umber. Abdomen above blackish brown; beneath, the same tint, each segment, except the apical ones, margined both posteriorly and laterally with cream color; cerci straw yellow. Coxæ blackish brown with a narrow lateral margin of cream color. Femora, tibiæ, and tarsi, red-brown, the femora with blackish-brown genicular patches.

MEASUREMENTS.

	mm.
Length of body	11.5
Length of pronotum	3.5
Greatest width of pronotum	5.8
Length of tegmina	13.1
Greatest width of tegmina	5

Genus THYRSOCERA Burmeister.

1838. *Thyrsocera* Burmeister, Handb. der Ent., II, p. 498.
—— *Hemithyrsocera* Saussure, Societas Entomologica, VIII, 1893, p. 57.

Of the ten included species (*spectabilis*, *cornicornis*, *cincta*, *affinis*, *flavipes*, *laticornis*, *histrio*, *oblongata*, *annulicornis*, and *hirticornis*) all are congeneric with *oblongata* (the type of *Pseudomops* Serville), except *spectabilis* and *histrio*, of which the former may be considered the type.

THYRSOCERA NIGRA Brunner.

1865. *Th*[*yrsocera*] *nigra* Brunner, Nouv. Syst. Blatt., p. 120; East Indies.

One female; Trong, Lower Siam. (Dr. W. L. Abbott.) [U.S.N.M.] This species has also been recorded from Burma and Tenasserim.

THYRSOCERA HISTRIO Burmeister.

1838. *Thyrsocera histrio* Burmeister, Handb. der Entom., II, p. 499; Java.

Two males; Goenong, Soegi, Lampong, Sumatra. Oct.–Nov., 1901. (A. C. Harrison, jr., and Dr. H. M. Hiller.) [A. N. S. Phila.]

THYRSOCERA TESSELLATA, new species.

Type.—Male (immature); Trong, Lower Siam. (Dr. W. L. Abbott.) [Cat. No. 6946, U.S.N.M.]

This peculiar form does not appear to be closely related to any of the previously known forms.

Size small; form ovoid; apex anteriorly depressed; surface polished. Head projecting very slightly beyond the pronotum; the interspace between the eyes considerably greater than that between the ocelli; eyes reniform. Pronotum with the greatest width posteriorly; anterior margin narrow, truncate; posterior margin subtruncate, three times the width of the anterior margin; lateral margin arcuate, anterior angles well rounded, posterior angles narrowly rounded. Abdomen strongly depressed, each segment of the lateral margin slightly projecting posteriorly; ventral segments, except the two apical ones, bearing evenly distributed longitudinal folds, which extend about the whole depth of the segment. Supra-anal plate transverse, very slightly produced, apex very slightly and very shallowly emarginate. Cerci fusiform, very slightly depressed, the apex acuminate, supplied with long stiff bristles. Subgenital plate not prominent, the apical margin slightly produced, truncate; styles unequal, one stout and acuminate, the other minute. Anterior femora with twelve spines on the anterior margin, restricted to the median and distal portions, the proximal two and apical two the largest in the series; posterior margin with five spines restricted to the median and distal portions, no genicular spine; tibiæ two-thirds the length of the femora; tarsi equal to the femora in length. Median femora with six spines on each margin, genicular spine slender; tibiæ about equal to the femora in length; tarsi shorter than the tibiæ, the metatarsi equal to the other joints in length. Posterior femora with six spines on each margin, genicular spine slender and about equal in length to the apical spine on the anterior margin; tibiæ slightly exceeding the femora in length; tarsi about two-thirds the length of the tibiæ, metatarsi about equal to the remaining tarsal joints in length, arolia rather small.

General color whitish gray, mottled and sprinkled with blacki Head with the lower surface evenly sprinkled with spots of dark brown, interspace between the eyes with three longitudinal streaks of brown; eyes mahogany brown. Pronotum heavily blotched centrally with black, the overlying tint forming distinct spots as the lateral margins are approached, and also decreasing in size; median portion of the pronotum bearing two longitudinal streaks of whitish gray. Mesonotum and metanotum with a color pattern very similar to that of the pronotum, except for the absence of spots on the lateral portions and the infuscation of the posterior margin. Abdomen with the basic tint black, the folds of the segments and the apical portions of the two terminal segments dull grayish; ventral surface of the abdomen blackish centrally, blackish and grayish marmorate laterally. Cerci grayish, a touch of black on the basal portion of the upper surface. Limbs yellowish gray, each longitudinal marked with a single distinct line of black, which is more or less broken.

MEASUREMENTS.

	mm
Length of body	7.5
Length of pronotum	2.7
Greatest width of pronotum	3.5

Subfamily EPILAMPRINÆ.

Genus CALOLAMPRA Saussure.

1893. *Calolampra* Saussure, Societas Entomologica, VIII, p. 57.

Type.—*C. gracilis* (Brunner).[a]

CALOLAMPRA GRACILIS (Brunner).

1865. *Epilampra gracilis* Brunner, Nouv. Syst. Blatt., p. 170, pl. IV, fig. 20; Port Adelaide and Sydney, Australia; Tasmania.

Three females; Australia. (Koebele.) [U.S.N.M.]

CALOLAMPRA PEDISEQUA, new species.

Type.—Male; Trong, Lower Siam. (Dr. W. L. Abbott.) [Cat. No. 6947, U.S.N.M.]

Allied to *C. aspera* Tepper,[b] from Australia, but differing in the coloration and the differently shaped pronotum. Nothing further can be determined from Tepper's description.

Size medium; form depressed, ovate; surface rugulose. Head slightly projecting beyond the pronotum; interspace between the eyes half again as wide as that between the ocelli; lower surface of head deplanate; eyes subpyriform, the posterior portion strongly compressed; antennæ not equal to half the length of the body, third joint slightly exceeding the basal one in length. Pronotum hemispherical in outline; anterior and lateral margins arcuate; posterior margin subtruncate, slightly produced centrally; postero-lateral angles very narrowly rounded. Mesonotum and metanotum with the posterior margins concave, the latter being slightly produced in the middle, these margins bearing a transverse series of longitudinally disposed folds or scars. Abdomen with the postero-lateral angles of the segments not produced; each segment bearing a series of "scars" similar to those on the mesonotum and metanotum, though somewhat larger in size and more distinct in character; ventral surface with evenly distributed pustules. Supra-anal plate transverse, the apex broadly and shallowly emarginate. Cerci short, stout, conical, not equaling the supra-anal plate in length. Subgenital plate strongly transverse, narrow, with a moderately deep V-shaped emargination; styles minute and lateral. Anterior femora with the anterior border bearing three or four sub-

[a] According to Rehn, Trans. Amer. Ent. Soc., XXIX, 1903, p. 274.

[b] Trans. and Proc. and Rep. Royal Soc. South Aust., XVII, p. 62.

median and one apical large spine, between which groups are ranged a series of minute, comb-like spines, posterior margin with five rather even and regularly distributed spines, no genicular spine present; tibiæ not quite two-thirds the length of the femora; tarsal joints about equal to the tibiæ in length. Median femora with four rather short and stout spines on the anterior margin, posterior margin with five spines, no genicular spine present; tibiæ almost equaling the femora in length; tarsi slightly shorter than the tibiæ; metatarsi very distinctly longer than the terminal joint. Posterior femora with four well-spaced, blunt median and one apical spine on the anterior margin; posterior margin with four spines, basal one very small, none apical, genicular spine rather short, but quite distinct; tibiæ exceeding the femora by about one-third the length of the latter; metatarsi about equal to the other tarsal joints in length, external face of the metatarsi bearing a longitudinal row of fine teeth, inferior face bearing two parallel, closely placed rows of the same, pulvilli triangular and apical, arolia minute.

General color wood brown. Head with the superior surface and the interocular interspace pale ochraceous, finely punctate with brown; ocelli pale ochraceous; lower surface, eyes, and antennæ blackish brown. Abdomen with the "scars" slightly darker in color than the surrounding tint. Femora darker in color than the other portions of the limbs; trochanters very pale wood brown.

MEASUREMENTS.

	mm.
Length of body	23
Length of pronotum	6
Length of pronotum	10.5
Greatest width of abdomen	12.7

Genus EPILAMPRA Burmeister.

1838. *Epilampra* Brunner, Handb. d. Entom., II, p. 504.

Type.—*E. nebulosa* Burmeister.[a]

EPILAMPRA TRONGANA, new species.

Types.—Male and female; Trong, Lower Siam. (Dr. W. L. Abbott.) [Cat. No. 6948, U.S.N.M.]

Allied to *E. lineaticollis* Bolivar,[b] from Trichinopoly, and *E. geminata* Brunner,[c] from Kina Balu, Borneo. From the former it differs in the very different coloration and from the latter in the nonemarginate apex of the tegmina. The description of the latter is so unsatisfactory that little can be made out of it. The common

[a] According to Rehn, Trans. Amer. Ent. Soc., XXIX, 1903, p. 271.
[b] Ann. Soc. Ent., France, LXVI, p. 298.
[c] Abhandl. Senckenb. Naturforsch. Gesellsch., XXIV, Pt. 2, p. 208.

East Indian species *E. nebulosa* Burmeister differs in theform of the pronotum, the elongate anal field of the tegmina, the more acuminate apex of the tegmina, and the broader subgenital andmore rounded supraanal plates of the male.

Male.—Size medium; form elongate-ovate. Head projecting considerably beyond the pronotum, the anterior margin subtruncate; interspace between the eyes and that between the ocelli equal; ocelli large, touching the eyes; eyes irregularly reniform, the greatest depth anteriorly; antennæ not quite equaling the body in length. Pronotum heptagonal; anterior margin truncate; posterior margin obtuse angulate; postero-lateral margins shorter than any of the others; all angles blunt and rounded; lateral portions of the pronotum depressed. Tegmina elongate, considerably exceeding the apex of the abdomen; costal margin gently arcuate, sutural margin straight, apex very obtusely rounded; basal field equal to one-third the length of the tegmina; costal viens numerous and sublongitudinal in character; ulnar vein with seven distinct rami; anal sulcus very slightly arcuate, anal field reaching two-fifths the way to the apex of the tegmen. Supra-anal plate produced, bilobate, the centrally fissure quite deep. Cerci broken. Subgenital plate produced, subtruncate. Anterior femora with five large median, one apical, and an intermediate series of minute spines on the anterior margin, posterior margin with five medium-sized spines, no genicular spine present; tibiæ about three-fourths the length of the femora; tarsi exceeding the tibiæ and not equaling the femora in length. Median femora with four evenly distributed spines on the median and distal portions of the anterior margin, posterior margin with four spines, none of which are apical, genicular spine rather short; tibiæ equal to the femora in length; tarsi considerably shorter than the femora, metatarsi almost equal to the remaining tarsal joints. Posterior femora with four spines on each margin, genicular spine of moderate size; tibiæ one and one-fourth the length of the femora; tarsi three-fifths the length of the tibiæ, metatarsi equal to the remaining joints in length, the two lateral and two ventral angles supplied with rows of moderate-sized teeth, pulvilli rotundate, apical, arolia triangular and of rather large size.

Female.—Size rather large. Head with the interspace between the eyes almost twice that between the ocelli; ocelli not touching the eyes; antennæ equal to about three-fifths the length of the body. Pronotum similar to the male, except that the anterior and antero-lateral margins form a continuous arc. Wings equal to the tegmina in length when in repose; costal margin strongly arcuate apically, apex subangulate; ulnar vein bearing about sixteen complete rami and a number of incomplete ramifications. Supra-anal plate produced, bilobate, the fissure -shaped. Cerci elongate fusiform, depressed, apex acuminate, not equaling the supra-anal plate in length. Subgenital plate very large, rotundate;

apex with a very shallow, hardly perceptible emargination; the broad, shallow cercal emargination bordered externally by a sharp dentiform process.

General color ashy-gray brown, clouded more or less distinctly with wood brown. Head with the interorbital and the interocellar regions dark wood brown in the male, unmarked in the female; eyes and antennæ dark wood brown. Pronotum without a distinct pattern, but closely and finely punctate with the darker tint; in the male the posterior margin bears several short transversely distributed longitudinal streaks of dark brown. Tegmina with the peculiar markings characteristic of the paler species of the genus; base of the discoidal vein and the entire anal sulcus brokenly marked with black. Wings with the median costal margin suffused with orange yellow, the apex with wood brown.

MEASUREMENTS.

	Male.	Female.
	mm.	*mm.*
Length of body	29.2	33
Length of pronotum	6.5	8.5
Greatest width of pronotum	8	10.2
Length of tegmina	29.7	35.5
Greatest width of tegmina	8.5	9.5

EPILAMPRA BADIA Brunner.

1865. *E*[*pilampra*] *badia* Brunner, Nouv. Syst. Blatt., p. 189; Java.

Four specimens; one male, three females; Trong, Lower Siam. (Dr. W. L. Abbott.) [U.S.N.M.]

EPILAMPRA MOLOCH, new species.

Type.—Female, Trong, Lower Siam. (Dr. W. L. Abbott.) [Cat. No. 6949, U.S.N.M.]

This magnificent and striking form does not appear to be closely allied to any of the previously described species of the genus. In general superficial appearance it resembles *E. badia* very closely, but it is readily differentiated by the form of the supra-anal plate and the proportions of the posterior tarsal joints.

Size large; form elongate ovate. Head projecting somewhat beyond the pronotum, anterior margin very slightly arcuate; interspace between the eyes almost twice as wide as that between the ocelli; ocelli of medium size, not touching the eye; eyes elongate, strongly compressed in the median and posterior portions; antennæ almost equaling the body in length. Pronotum subheptagonal in outline; anterior and antero-lateral margins arcuate; posterior margins obtuse angulate, postero-lateral margins very short; all the angles very broadly rounded except the posterior and the lateral pair which are blunt; lateral por-

tions considerably depressed. Tegmina elongate, considerably exceeding the tip of the abdomen; costal margin broadly arcuate, apex damaged; basal field rather elongate, almost equaling the anal field in length, subcoriaceous; anal sulcus rather evenly arcuate. Supra-anal plate strongly produced, bilobate, apex of the lobes much nearer the internal than the external margin, fissure between the lobes V-shaped and moderately deep. Cerci elongate, narrow, subequal, apically acuminate, slightly depressed. Subgenital plate broad; median portion subtruncate, with two slight rounded lobes centrally, cereal emarginations slight. Anterior femora with three to five spines on the anterior margin, two of which are apical, the others median, posterior margin with four or five spines, one of which is apical, no genicular spine; tibiæ two-thirds the length of the femora; tarsal joints almost equal to the femora in length, metatarsi not more than three-fifths the length of the terminal joint. Median femora bearing three or four spines on the median and distal sections of the anterior margin, posterior margin with five spines, the apical one small, genicular spine short; tibiæ equal to the femora in length; tarsi equal to the tibiæ or femora in length, metatarsi slightly longer than the terminal joint. Posterior femora with four subequal spines on the anterior margin, posterior margin with four spines, none of which are apical, genicular spine about equal to the other femoral spines in size; tibiæ one and two-thirds the length of the femora; tarsi equal to the femora in length, metatarsi exceeding the remaining joints in length, lower surface bearing two longitudinal, subcontiguous rows of minute teeth; pulvilli triangular and apical; arolia triangular and of medium size.

General color, dark vinaceous. Head and under surface, dull ochraceous brown; tibiæ and tarsi of the posterior limbs of the general tint, the larger spines with a pale median annulus. Eyes dull umber; antennæ pale red-brown. Pronotum minutely punctate with blackish brown, also with a few clouded irregular blotches of red-brown along the posterior margins.

MEASUREMENTS.

	mm.
Length of body	49.6
Length of pronotum	11.1
Greatest width of pronotum	15.5
Length of tegmina	46+
Greatest width of tegmina	14.9

Genus RHICNODA Brunner.

1893. *Rhicnoda* Brunner, Ann. Mus. Civ. Stor. Nat. Genova, XXXIII, p. 30.

Included species, *R. rugosa* and *R. spinulosa* Brunner. Of these, *rugosa* may be selected as the type.

RHICNODA RUGOSA Brunner.

1893. *R[hicnoda] rugosa* Brunner, Ann. Mus. Civ. Stor. Nat. Genova, XXXIII, p. 31; Carin Chebà, Carin Ghecù (1,300–1,400 meters), mountains of Catcin Cauri, Kokareet, Burma; Mooleyit, Tenasserim (1,200–1,400 meters); Palon Pegu; Java.

One immature female; Goenong Soegi, Lampong, Sumatra. Oct.–Nov., 1901. (A. C. Harrison, jr., and D. H. M. Hiller.) [A.N.S. Phila.]

RHICNODA DESIDIOSA, new species.

Type.—Female (immature); Trong, Lower Siam. (Dr. W. L. Abbott.) [Cat. No. 6950, U.S.N.M.]

Apparently closest allied to *R. reflexa* Saussure and Zehntner,[a] from Nicaragua, from which it differs in the broader pronotum, in the larger size, and the broader supra-anal plate. No relationship exists with either of the Old World species (*rugosa* and *spinulosa* Brunner), or with *R. laminata* Brunner, from St. Vincent.

Size rather large; form ovate, depressed; surface rugose. Head completely hidden under the pronotum, anterior border subtruncate; interspace between the eyes slightly less than that between the ocelli; ocelli rather small, touching the eyes; eyes elongate, median and posterior sections strongly depressed; antennæ short, not equal to half the length of the body; lower surface of the head deplanate, the interantennal region concave. Pronotum transverse, subtriangular, apex anteriorly; lateral margins uncurved, meeting at an angle anteriorly; posterior margin very broadly obtuse angulate, lateral angles very narrowly rounded, the posterior margin supplied with a transverse series of nodes or folds; disk and cephalic boss of the pronotum well elevated above the comparatively flat lateral portions. Mesonotum and metanotum with their posterior margins emarginate, in the metanotum with a slight median projection, each supplied on the median portion of the posterior margin with a transverse series of eight to ten longitudinal folds. Abdomen with the lateral portions of each segment produced posteriorly, but not into a sharp dentiform process; posterior margin of each segment bearing a transverse series of longitudinally placed folds. Supra-anal plate produced, triangular, the apex with a wide triangular emargination. Cerci short, strongly depressed, apex blunt. Subgenital plate large, transverse, the median portion subtruncate, the apical region very broadly arcuate, cercal emargination slight. Anterior femora with the anterior margin bearing four or five large median, one or two large apical, and an intermediate series of very short, minute spines, posterior margin with five spines, no genicular spine present; tibiæ about half the length of the femora; tarsi equal to the tibiæ in length. Median femora bearing four or

[a] Biol. Cent.-Amer., Orth., I, p. 68, pl. IV, fig. 35.

five spines on the anterior margin, one of which is apical and the others median, posterior margin with six spines, two of which are subapical, genicular spine short; tibiæ about three-fourths the length of the femora; tarsi not equaling the tibiæ in length. Posterior femora with four spines on the distal half of the anterior margin, posterior margin with three median spines, genicular spine very short and stout; tibiæ one and one-fourth the length of the femora; tarsi about half the length of the femora, metatarsi slightly shorter than the other joints combined, pulvilli of the metatarsi extending to the base of the joint as a narrow line, flanked by a row of minute teeth; arolia of rather large size.

General color, wood brown, on the thoracic segments obscurely punctate with darker brown. Cephalic boss and disk of the pronotum and the median portions of the meso- and metanotum reddish brown. Posterior margins of the thoracic and abdominal segments edged with dark brown. Eyes blackish brown, mottled with paler brown. Antennæ gray brown, except the basal joint, which is umber.

MEASUREMENTS.

	mm.
Length of body	26.5
Length of pronotum	8.5
Greatest width of pronotum	14.0
Greatest width of mesonotum	17.5
Greatest width of abdomen	15.0

Subfamily BLATTINÆ (*Periplanetinæ auct*)

Genus DORYLAEA Stål.

1877. *Dorylaea* STÅL, Öfversigt af Kongl. Vetenskaps-Akadem. Förhandlingar, 1877, No. 10, p. 37.

Type.—D. brunneri Stål.

DORYLAEA RHOMBIFOLIA (Stoll).

1813. [*Blatta*] *Rhombifolia* STOLL, Natuurlijke Afbeeldingen en Beschrijvingen; De Kakkerlakken, pp. 5 and 14, pl. III *d*, fig. 3.

One male; Mananjara, Madagascar, May 28, 1895. (Dr. W. L. Abbott.) [U.S.N.M.]

DORYLAEA PICEA (Brunner).

1865. *Periplaneta picea* BRUNNER, Nouv. Syst. Blatt., p. 223; Sambelong Island, Nicobar group.

One male and one female; Trong, Lower Siam. (Dr. W. L. Abbott.) [U.S.N.M.]

Genus BLATTA Linnæus.

1758. *Blatta* LINNÆUS, Syst. Nat., 10th ed., p. 424.

Type.—Blatta orientalis Linnæus.

BLATTA ORIENTALIS Linnæus.

1758. [*Blatta*] *orientalis* LINNÆUS, Syst. Nat., 10th ed., p. 424; "America, Oriente: imprimis in farina, Pane, etc., hodie in Russiæ adjacentibus regionibus frequens: incepit nuperis temporibus Holmiæ, uti dudum in Finlandia."

Three immature males: Yokohama, Japan. (Rev. H. Loomis.) [A. N. Caudell.] Kioto, Japan. (Y. Hirase.) [A. N. S. Phila.]

BLATTA SENECTA, new species.

Type.—Female: Zulu Mission, South Africa. [A. N. S. Phila.]

Closely allied to *B. anthracina* (Brancsik)[a] from the Zambesi region, but differing in the smaller size, the truncate sixth dorsal abdominal segment, and the undivided supra-anal plate.

Size medium; form subovate; dorsal surface, except the anterior and lateral margins of the pronotum punctate, becoming rugose and subcoriaceous in character on the abdomen. Head projecting beyond the pronotum, the anterior border arcuate; interspace between the eyes one and two-thirds of that between the ocelli; ocelli rather small, well removed from the eyes; antennæ almost equaling the body in length, second and third segments subequal in length; eyes rather elongate, irregularly reniform, the greatest depth anterior. Pronotum broader than long; the anterior and lateral margins rather evenly arcuate, a slight truncation anteriorly; posterior margin truncate, lateral angles rather narrowly rounded; the pronotum arcuate transversely. Mesonotum and metanotum with the posterior margins broadly and evenly emarginate. Tegmina very slightly exceeding the mesonotum in length, costal margin arcuate, apex subtruncate. Abdomen with the posterior margins of the dorsal aspect of the six basal segments truncate or subtruncate; seventh segment with the margin sinuate, the slightly produced median portion being very broadly and very shallowly emarginate. Supra-anal plate produced, subtriangular, tectate; apex broadly rounded. Cerci subfusiform, depressed greatest width proximal, apex acuminate. Subgenital plates together rostrate, triangular, the apical angles acute. Anterior femora with twelve spines on the median and apical portions of the anterior margin, the median and extreme apical ones largest, posterior margin with two spines on the apical portion, the terminal one very large, no genicular spine present; tibiæ about three-fourths the length of the femora; tarsi slightly exceeding the tibiæ in length, metatarsi slightly exceeding the terminal tarsal joint in length, pulvilli extending two-thirds the way to the base of the metatarsi. Median femora with six spines on the median and distal portions of the anterior margin, posterior margin with five evenly distributed spines, genicular

[a] Jahresheft des Naturwissenschaftlichen Vereines des Trencséner Comitates, XVII–XVIII, p. 244, pl. VII, fig. 2.

spine equal to the spines on the posterior margin in length; tibiæ about equal to the femora in length; tarsi slightly shorter than the tibiæ, metatarsi not quite equal to the remaining joints in length, pulvilli extending almost to the base of the metatarsi. Posterior femora with five spines on the median and distal portions of the anterior margin, posterior margin with five spines, geniculars spine rather small; tibiæ about one and one-fourth the length of the femora; tarsi equal to the femora in length, metatarsi equal to the remaining joints of the tarsi in length, pulvilli of the metatarsi small and apical, the lower surface bearing two parallel rows of moderately sized spines, arolia rather small.

General color dull blackish to blackish brown. Apical margins of the clypeus and labrum dull orange.

MEASUREMENTS.

	mm.
Length of body	17.5
Length of pronotum	5.0
Greatest width of pronotum	7.0
Greatest width of metanotum	8.5
Length of tegmina	3.0
Greatest width of tegmina	2.1
Greatest width of abdomen	8.7

Genus PERIPLANETA Burmeister

1838. *Periplaneta* Burmeister, Handb. d. Entom., II, p. 502.

Type.—Blatta americana Linnæus.[a]

PERIPLANETA PALLIPALPIS (Serville).

1839. *Kakerlac pallipalpis* Serville, Orthoptères, p. 71; Java.

Nine specimens; two males, seven females; Kioto, Japan. (Y. Hirase.) no. 37. [A. N. S. Phila.]

PERIPLANETA AUSTRALASIÆ (Fabricius).

1793. [*Blatta*] *australasiæ* Fabricius, Ent. Syst., II, p. 7; "Capta frequens in nave e mari pacifico & regionibus Australasiæ revertente."

Seven specimens; two females; five larvæ; Trong, Lower Siam. (Dr. W. L. Abbott.) [U.S.N.M.] Batu Sangkar, Padangsche Bovenland, Sumatra. Aug.–Sept., 1901. (A. C. Harrison, jr., and Dr. H. M. Hiller.) [A. N. S. Phila.] Africa. [A. N. S. Phila.]

PERIPLANETA TRUNCATA Krauss.

1892. *Periplaneta truncata* Krauss, Zoologischer Anzeiger, XV, p. 165; Teneriffe; Brazil; New Britain.

Six specimens; two males, two females, two immature individuals; Batu Sangkar, Padangsche Bovenland, Sumatra. Aug.–Sept., 1901. (A. C. Harrison, jr., and Dr. H. M. Hiller.) [A. N. S. Phila.]

[a] According to Rehn, Trans. Amer. Ent. Soc., XXIX, 1903, p. 279.

Genus TEMNELYTRA Tepper.

1893. *Temnelytra* TEPPER, Trans. and Proc. and Rep. Royal Soc. South Aust., XVII, p. 39.

Type.—*T. harpuri* Tepper.

TEMNELYTRA HARPURI Tepper?

1893. *Temnelytra harpuri* TEPPER, Trans. and Proc. and Rep. Royal Soc. South Aust., XVII, p. 39; Cygnet River and Karatta, Kangeroo Island, South Australia.

One larval specimen; Australia. (Koebele.) [U.S.N.M.]

This specimen is referred here with some little doubt, as the coloration does not wholly agree with the original description. This, of course, may be due to the immature condition, as the specimen is not as far advanced as the larva mentioned by Tepper.

Genus DEROPELTIS Burmeister.

1838. *Deropeltis* BURMEISTER, Handb. d. Entom., II, p. 486.

Type.—*D. erythrocephala* (Fabricius).[a]

DEROPELTIS GABOONICA, new species.

Type.—Female; Gaboon River, West Africa. (Rev. M. Nassau.) [Acad. of Nat. Sci. Phila.]

Allied to *D. schweinfurthi* Saussure,[b] from East Africa, but differing in the broader pronotum, the stouter and heavier limbs, the very much shorter posterior metatarsi, and the broader and more rounded supra-anal plate. From *D. speiseri* Brancsik,[c] from the Zambesi region, it can be immediately differentiated by the much smaller size; while *D. tullbergi* Borg,[d] from the Kamerun country, appears to be very different in character, though little comparison can be instituted, as it is based on the male.

Size rather large; form robust, very slightly depressed, subovate; surface covered with exceedingly minute reticulations. Head projecting, anterior border very slightly arcuate; interspace between the ocelli about three-fifths that between the eyes; ocelli very small, distant from the eyes; eyes elongate pyriform, the greatest depth anteriorly; antennæ about two-thirds the length of the body, third joint slightly longer than the first joint. Pronotum transverse; the ante-

[a] The original genus contained two species—*verticalis* Burmeister (= *capensis* Fabricius) and *erythrocephala* Fabricius. Of these two the latter can be selected as the type.

[b] Ann. Mus. Civ. Stor. Nat. Genova, XXXV, p. 79.

[c] Jahresheft des Naturwissenschaftlichen Vereines des Trencséner Comitates, XVII–XVIII, p. 245, pl. VII, fig. 3.

[d] Bihang till K. Svenska Vet.-Akad. Handl., XXVIII, 1903, no. 10, p. 16.

rior margin truncate, lateral margins arcuate, the antero-lateral angles rounded; posterior margin truncate, the postero-lateral angle produced posteriorly into an acute process; the pronotum as a whole strongly arched transversely. Mesonotum and metanotum with the posterior margin emarginate, the latter having a low acute median process; lateral angles developed similar to the postero-lateral angles of the pronotum. Abdomen with the four basal and the sixth dorsal segments with the posterior margins truncate; fifth segment arcuate, with a very wide and shallow median emargination; seventh segment roundly produced, apex undulate, a distinct cercal emargination is developed, which is bordered externally by a distinct spiniform, posteriorly directed process, a structure developed on the lateral angles of all the segments. Supra-anal plate produced, arcuate. Cerci short, not equaling the supra-anal plate, hastate, apex acuminate, very slightly depressed. Subgenital plate transverse; median portion produced, the margin very obtuse angulate. Anterior femora with twelve spines on the anterior margin, posterior margin bearing one apical spine; tibiæ about two-thirds the length of the femora; tarsi equal to the tibiæ in length, terminal joint slightly longer than the metatarsi, the pulvilli of the latter being triangular and apical. Posterior femora with five spines on the anterior margin, the apical exceeding the others in length, posterior margin with four spines, the basal one small, genicular spine equal to the apical spine on the anterior margin in size; tibiæ distinctly quadrate, one and one-third the length of the femora; tarsi not quite equal to the femora in length, terminal joints slightly shorter than the metatarsi, the pulvilli of the latter triangular and apical, the lower surface of the metatarsi supplied with two longitudinal rows of depressed teeth, arolia quite small.

General color very dark vinaceous, almost black; limbs reddish-brown; tarsal joints very pale; lower margins of the clypeus and labrum dull ochraceous.

MEASUREMENTS.

	mm.
Length of body	25.5
Length of pronotum	8
Greatest width of pronotum	12
Greatest width of mesonotum	14
Greatest width of abdomen	15

Subfamily PANCHLORINÆ.

Genus PYCNOSCELUS Scudder.

1863. *Pycnoscelus* SCUDDER, Boston Journ. Nat. Hist., VII, p. 421.

Type.—*Pycnoscelus obscurus* Scudder = *Blatta surinamensis* Linnæus.

PYCNOSCELUS SURINAMENSIS (Linnæus).

1758. [*Blatta*] *surinamensis* LINNÆUS, Syst. Nat., 10 ed., p. 424; Surinam.

Five specimens; one female, four immature specimens; Trong, Lower Siam. (Dr. W. L. Abbott.) [U.S.N.M.] Batu Sangkar, Padangsche Bovenland, Sumatra. Aug.–Sept., 1901. (A. C. Harrison, jr., and Dr. H. M. Hiller.) [A. N. S. Phila.]

Genus GYNA Brunner.

1865. *Gyna* BRUNNER, Nouv. Syst. Blatt., p. 266.

Type.—*G. capucina* Gerstaecker (= *maculipennis* Brunner, not of Schaum).[a]

GYNA BUCHHOLZI Gerstaecker.

1883. *Gyn*[*a*] *Buchholzi* GERSTAECKER, Mittheil. Naturwissensch. Ver. Neu-Vorpomm. und Rügen, XIV, p. 72; Fernando Po and Cameroons, West Africa.

One female; Gaboon River, West Africa. (Rev. M. Nassau.) [A. N. S. Phila.]

Subfamily POLYPHAGINÆ.

Genus DYSCOLOGAMIA Saussure.

1893. *Dyscologamia* SAUSSURE, Revue Suisse de Zoologie, I, Pt. 2, p. 297.

Included *cesticulata* Sauss., *carunculigera* (Gerstaecker), *nepalensis* Saussure, *capucina* (Brunner), and *capensis* Saussure. Of these the first may be selected as the type.

DYSCOLOGAMIA CESTICULATA Saussure.

1893. *Dyscologamia cesticulata* SAUSSURE, Revue Suisse de Zoologie, I, Pt. 2, p. 298; Singapore.

One female; Trong, Lower Siam. (Dr. W. L. Abbott.) [U.S.N.M.] Kirby[b] has recorded this species from Selangore.

Subfamily PERESPHÆRINÆ.

Genus PARANAUPHŒTA Brunner.

1865. *Paranauphœta* BRUNNER, Nouv. Syst. Blatt., p. 397.

Type.—*P. circumdata* (Haan). This is selected as the type on the basis of Brunner's figure.

[a] I have selected this as the type of the genus, as Brunner has given a figure of the same.

[b] Ann. and Mag. Nat. Hist., 7th ser., XI, p. 406.

PARANAUPHŒTA LYRATA Burmeister.

1838. *N[auphœta] lyrata* Burmeister, Handb. d. Entom., II, p. 508; Java.

Two females: Trong, Lower Siam. (Dr. W. L. Abbott.) [U.S.N.M.]

This species has been recorded from Borneo, Java, Sumatra, Malacca, Johore, and Assam.

Subfamily PANESTHINÆ.

Genus PANESTHIA Serville.

1831. *Panesthia* Serville, Ann. Sci. Nat., XXII, p. 38.

Type.—*P. javanica* Serville.

PANESTHIA JAVANICA Serville.

1831. *Panesthia javanica* Serville, Ann. Sci. Nat., XXII, p. 38; Java.

Four females (three larval); Trong, Lower Siam. (Dr. W. L. Abbott.) [U.S.N.M.]

This species has been recorded from Burma and Cambodia to Java.

PANESTHIA CETRIFERA, new species.

Type.—Female: Australia (Koebele) [U.S.N.M.] Closely allied to *P. ferruginipes* Brunner,[a] from an unknown locality, but differing in the more reddish-brown coloration, and the bispinose anterior femora.

Size medium; form depressed, elongate ovoid, apex anterior; surface punctate, very sparsely so anteriorly and increasing in intensity until on the supra-anal and subgenital plates it is distinctly cribrose. Head projecting slightly beyond the pronotum, the anterior border arcuate; interocular space very broad, considerably greater than that between the ocelli; ocelli very minute, distant from the eyes; antennæ hardly equal to the pronotum in length, third joint not quite equal to the first; eyes pyriform, apex posteriorly. Pronotum transverse; anterior margin subtruncate; lateral margins arcuate; the antero-lateral angles rounded; posterior margin subtruncate, slightly emarginate laterally; postero-lateral angles obtuse, the extreme angle rounded; pronotum as a whole arcuate transversely. Mesonotum and metanotum with the median portion and lateral angles of the posterior margins moderately produced. Abdomen with the posterior margin of the first and second dorsal segments arcuate, of the third and fourth transverse, of the fifth and sixth shallow emarginate, the lateral angles of all bluntly produced posteriorly; seventh dorsal segment large, with the posterior margin truncate, the lateral angles produced posteriorly as sharp dentiform processes. Supra anal plate large, transverse, the posterior margin arcuate, distinctly crenulate,

[a] Ann. Mus. Civ. Stor. Nat. Genova, XXXIII, 1893, p. 53.

the cercal emargination distinct and bordered internally by a strongly developed, broad, dentiform process. Cerci very short and broad, triangular, depressed. Subgenital plate very broad, the margin rotundate; the cercal emarginations quite distinct, and bordered externally by a very distinct shoulder. Anterior femora with the anterior margin bearing two closely placed median spines, posterior margin with a very stout apical spine, no genicular spine present; tibiæ about two-thirds the length of the femora; tarsi about two-thirds the length of the tibiæ, the terminal joint equal to all the others in length. Median femora with both margins unarmed, no genicular spine present; tibiæ almost equal to the femora in length; tarsi slightly shorter than the tibiæ, metatarsi about equal to the terminal joint in length. Posterior femora with the margins unarmed, no genicular spine present; tibiæ exceeding the femora by about one-fourth the length of the latter; tarsi about two-thirds the length of the tibiæ, metatarsi and the terminal joints subequal, arolia absent.

General color dark reddish-brown, becoming ochraceous brown on the limbs. Eyes pitch black. Lower portion of clypeus golden ochraceous, the labrum ochraceous brown.

MEASUREMENTS.

	mm.
Length of body	19
Length of pronotum	4.5
Greatest width of pronotum	7
Greatest width of mesonotum	8.5
Greatest width of metanotum	9.1
Greatest width of abdomen	10

STUDIES IN AMERICAN MANTIDS OR SOOTHSAYERS.

By James A. G. Rehn,
Of the Academy of Natural Sciences of Philadelphia.

The specimens treated in the following pages are contained in the collections of the United States National Museum and the Academy of Natural Sciences of Philadelphia. The greater part of the material is from the Costa Rican collection of Messrs. Schild and Burgdorf, and the Cuban collection made by Messrs. Palmer and Riley.

The author wishes to thank Dr. W. H. Ashmead of the United States National Museum for the privilege of examining the material from the collections under his charge.

Subfamily ORTHODERINÆ.

Genus CHŒRADODIS Serville.

1831. *Chœradodis* Serville, Ann. Sci. Nat., XXII, p. 50.

Included *strumaria* (Fabricius), *hyalina* (Stoll), and *laticollis* Serville.

CHŒRADODIS RHOMBICOLLIS (Latreille).

1833. *Mantis rhombicollis* Latreille, in Humboldt and Bonpland, Rec. Observ. Zool., II, p. 103, pl. xxxix, figs. 2 and 3; Equatorial America.

One male; San Juan del Norte, Nicaragua. [U.S.N.M.]

Subfamily MANTINÆ.

Genus ACONTISTA Saussure.

1838. *Acontistes* Burmeister, Handb. der Entom., II, p. 542. (Not of Sundevall, 1835.)

1870. *Acontista* Saussure, in Mélang. Orthoptérolog., Pt. 3, p. 175.

Type.—*Mantis tricolor* Burmeister=*Mantis concinna* Perty.[a]

[a] The originally included species were as follows:
sancta—*Stagmatoptera*.
supplicaria—*Stagmatoptera*.
cingulata—*Thecoclytes*.
tricolor.
prasina—*Calidomantis* (*Miomantis* auct.).
The type is seen to be *tricolor* (=*concinna* Perty), the only uneliminated species.

ACONTISTA MEXICANA Saussure and Zehntner.

1894. *Acontista mexicana* SAUSSURE and ZEHNTNER, Biol. Cent.-Amer., Orth., I, p. 135; Cordova, Atoyac, Guerrero, Mexico; Chontales, Nicaragua; Bugaba (800–1,500 feet), Volcan de Chiriqui (2,000–3,000 feet), Panama.

Two females; Piedras Negras and Turrialba, Costa Rica. (Schild and Burgdorf.) [U.S.N.M.]

The specimen from Turrialba is quite different from the other individual in the intensity of the coloration, but the pattern is almost identical. Even after due consideration of the importance of color characters in this genus, I have no hesitation in referring it to *mexicana*, but to aid future workers I have appended a description of the coloration.

General color dull lemon yellow, the tegmina with several very obscure diagonal streaks of pale brownish. Eyes pale wood brown. Wings with the basal portion of the posterior field bright lemon, which color also suffuses two-thirds of the anterior field; band of the wing dark chocolate, equal to half the length on the posterior field, narrowing to a rather small blotch on the anterior field, and not reaching the costal margin; apex of the wing and half of the periphery of the posterior field pellucid, widest toward the costal margin, gradually narrowing and vanishing posteriorly.

ACONTISTA FRATERNA Saussure and Zehntner.

1894. *Acontista fraterna* SAUSSURE and ZEHNTNER, Biol. Cent.-Amer., Orth., I, p. 136; Caché, Costa Rica.

One female; Tucurrique, Costa Rica. (Schild and Burgdorf.) [U.S.N.M.]

ACONTISTA VITREA Saussure and Zehntner.

1894. *Acontista vitrea* SAUSSURE and ZEHNTNER, Biol. Cent.-Amer., Orth., I, p. 138, pl. VI, fig. 9; Atoyac, Mexico; Costa Rica; Volcan de Chiriqui (2,000–3,000 feet), Panama.

Two males; Piedras Negras, Costa Rica. (Schild and Burgdorf.) [U.S.N.M.]

As suggested by the original describers[a] this species probably represents the male of *A. fraterna*.

Genus STAGMOMANTIS Saussure.

1869. *Stagmomantis* SAUSSURE, Bull. Soc. Ent. Suisse, III, p. 56.

Type.—Gryllus carolinus Linnæus.[b]

[a] Biol. Cent.-Amer., Orth., I, p. 136.

[b] Originally included species; *carolina*, *tolteca*, *stollii*, *ferox*, *domingensis*, *nahua*, and *azteca*. As none of these have been eliminated, *carolina* may be selected as the type.

STAGMOMANTIS NAHUA Saussure.

1869. *St*[*agmomantis*] *nahua* SAUSSURE, Bull. Soc. Entom. Suisse, III, p. 65; Mexico.

One male; San José, Costa Rica. (Schild and Burgdorf.) [U.S.N.M.]

STAGMOMANTIS HETEROGAMIA Saussure and Zehntner.

1894. *Stagmomantis heterogamia* SAUSSURE and ZEHNTNER, Biol. Cent.-Amer., Orth., I, p. 142, pl. VII, figs. 2 and 3; Bugaba (800–1500 feet), Panama.

Three males; Tucurrique, Costa Rica. (Schild and Burgdorf.) [U.S.N.M.]

STAGMOMANTIS THEOPHILA, new species.

Type.—Male; Turrialba, Costa Rica. (Schild and Burgdorf.) [Cat. No. 6952, U.S.N.M.]

Allied to *S. venusta* and *S. heterogamia* Saussure and Zehntner,[a] but differing from both in the much greater size, the denticulate margins of the pronotum, and in the absence of fuscous maculations on the tegmina and wings.

Size rather large; form elongate and slender. Head considerably broader than deep; eyes ovoid when viewed laterally; facial shield strongly transverse, obtuse angulate; ocelli closely placed; antennæ extending somewhat beyond the posterior margin of the pronotum. Pronotum with the collar broader than any portion of the shaft, the latter strongly compressed centrally, the longitudinal median carina faint and not visible on the posterior third; supracoxal dilations not strongly marked; margins of the collar, lobes, and anterior half of the shaft with well-marked denticles. Tegmina transparent, elongate, slightly exceeding the abdomen in length; sutural and costal margins subparallel, apex subangulate; costal field comparatively wide, of appreciable width for about half the length of the tegmina, surface sparsely and irregularly reticulate; stigma transparent and hardly visible. Wings elongate, slightly exceeding the tegmina in length when in repose, transparent. Abdomen elongate, slender, very considerably depressed. Supra-anal plate small, triangular, apex rounded. Cerci exceeding the subgenital plate in length, very strongly depressed; apex rather blunt. Subgenital plate rather large, triangularly produced; apex narrowly truncate and supplied with two very minute, simple styles. Anterior coxæ supplied with five or six large dentiform spines on the lower margin; femora rather slender, exceeding the coxæ by over one-fourth of their length, external margin bearing four large spines, discoidal spines four in number; apical half of the internal margin bearing a continuous row of alternating large and small spines; tibiæ about equal to half the length of the femora, spines

[a] Biol. Cent.-Amer., Orth., I, pp. 142 and 145.

on the external margin eleven or twelve in number, increasing in size toward the apex, the basal portion of the margin unarmed, internal margin with thirteen or fourteen spines, the series continuing to the proximal portion of the joint; tarsi very slender, metatarsi exceeding the other joints in length and but slightly shorter than the tibia (without apical claw). Median and posterior limbs slender; metatarsi of the median limbs shorter than the remaining joints, of the posterior limbs subequal. General color pale pea green, becoming brownish on the pronotum. Eyes, antennæ, and coxal spines rich wood brown. Tegmina hyaline, the costal margin with a faint greenish-white suffusion, the region of the anterior radial vein bearing a line of pale pea green. Wings hyaline, costal margin with a very pale suffusion of pea green. Cerci and median and posterior tarsal joints (exclusive of the metatarsi) wood brown.

MEASUREMENTS.

	mm.
Length of body	60.0
Length of pronotum	19.5
Greatest width of pronotum	3.5
Length of tegmina	39.5
Greatest width of tegmina	9.5
Length of anterior femora	12.5

STAGMOMANTIS TOLTECA (Saussure)?

1861. *Mantis* (*Stagmatoptera*) *tolteca* Saussure, Revue et Magasin de Zoologie, 2d ser., XIII, p. 127; Tropical Mexico.

Four males; Panama. Piedras Negras and Turrialba, Costa Rica. (Schild and Burgdorf.) [U.S.N.M.]

These specimens are rather doubtfully assigned to this species, as the males of this section of the genus resemble one another very much.

STAGMOMANTIS DIMIDIATA (Burmeister).

1838. *Mantis dimidiata* Burmeister, Handb. d. Entom., II, p. 539; South America.

One female; San José, Costa Rica. (Schild and Burgdorf.) [U.S.N.M.]

STAGMOMANTIS LIMBATA (Hahn).

"1835. *Mantis limbata* Hahn, Icones ad Mon. Cimic., I, t. A, fig. 2; Mexico."

Five specimens; two males, three females; Mexico. Durango, Mexico; July, 1896. (Dr. E. Palmer.) [U.S.N.M.] Mazatlan, Mexico. (W. W. Lockington.) [A. N. S. Phila.]

STAGMOMANTIS DOMINGENSIS (Beauvois).

1805. *Mantis domingensis* Beauvois, Ins. Rec. d'Afr. et d'Amér., p. 61, pl. VII, fig. 2; Santo Domingo.

Two males, two females; Baracoa, Cuba. February 4, 1902. (Wm. Palmer.) [U.S.N.M.] Haiti. [A. N. S. Phila.]

The female specimen from Haiti is a perfectly typical individual, with the transverse callous stigma, while the Cuban female is slightly smaller, with the anterior femora comparatively weaker and the stigma smaller and ovate. The two males from Haiti are identical in form and coloration.

Genus CALLIMANTIS Stål.

1877. *Callimantis* STÅL, Bihang till K. Svenska Vet.-Akad. Handlingar, IV, no. 10, p. 39.

Type.—Callimantis antillarum (Saussure).

CALLIMANTIS ANTILLARUM (Saussure).

1859. *M[antis] antillarum*, SAUSSURE, Revue et Magasin de Zoologie, 2d ser., XI, p. 60; St. Thomas.

One female; Haiti. [A. N. S. Phila.] This species has previously been recorded from St. Thomas, Santo Domingo, Culebra Island, and Botafogo, near Rio de Janeiro, Brazil. The latter locality appears rather questionable.

Genus LITANEUTRIA Saussure.

1892. *Litaneutria* SAUSSURE, Societas Entomologica, VII, p. 123.

Type.—L. ocularis Saussure.

LITANEUTRIA MINOR (Scudder).

1872. *Stagmatoptera minor* SCUDDER, Rep. U. S. Geol. Surv. Nebraska, p. 251; Nebraska City, Nebraska.

One female; Casas Grandes, Chihuahua, Mexico. September, 1902. (Dr. W. E. Hughes.) [A. N. S. Phila.] This is the first Mexican record for this species.

Genus ANGELA Serville.

1839. *Angela* SERVILLE, Orthoptères, p. 171.

Originally included *quinquemaculata*, *versicolor*, *infumata*, and *brachyptera*. Of these, *brachyptera* may be selected as the type.[a]

[a] As the generic name *Thespis* Serville (Ann. Sci. Nat., XXII, 1831, p. 54) is closely involved with *Angela*, the type of the former is seen on elimination to be *parva* (Olivier).

purpurascens—Angela, 1839.
fasciata—Tenodera, 1838.
quinquemaculata—Angela, 1839.
parva.

ANGELA PERPULCHRA Westwood.

1889. *Angela perpulchra* Westwood, Rev. Ins. Fam. Mantid., p. 30; Nicaragua.

Two females; Carillo and Tucurrique, Costa Rica. (Schild and Burgdorf.) [U.S.N.M.] One of these specimens has the disk of the wings sulphur yellow; the other has the same area very pale greenish white.

Genus MIOPTERYX Saussure.

1870. *Miopteryx* Saussure, Bull. Soc. Ent. Suisse, III, p. 236.

Type.—By elimination and selection, *M. granadensis* Saussure.[a]

MIOPTERYX GRANADENSIS Saussure.

1870. *M[iopteryx] granadensis* Saussure, Bull. Soc. Entom. Suisse, III, p. 237; Bogota.

Four specimens; Bartica, British Guiana. April 24 and May 4, 7, and 11, 1901. (R. J. Crew.) [A. N. S. Phila.]

Genus PSEUDOMIOPTERYX Saussure.

1870. *Pseudomiopteryx* Saussure, Bull. Soc. Entom. Suisse, III, pp. 225, 228.

Included *P. spinifrons* and *P. bogotensis* Saussure.

PSEUDOMIOPTERYX INFUSCATA Saussure and Zehntner.

1894. *Pseudomiopteryx infuscata* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 163; Presidio, Cordova, Mexico; San Juan, Las Mercedes (3,000 feet), Volcan de Atitlan (2,500–3,500 feet), Zapote, Guatemala; Chontales, Nicaragua; Bugaba (800–1,500 feet), Caldera (1,200 feet), and Volcan de Chiriqui (2,500–4,000 feet), Panama.

Four specimens; three males, one female; Piedras Negras, Costa Rica. (Schild and Burgdorf.) [U.S.N.M.]

As the female has never been described, some notes on this specimen may be of interest.

Size, rather small; surface rugulose. Head slightly broader than deep; eyes, rotundate-ovate when viewed laterally; vertex raised above the eyes, straight, the juxta-ocular lobes rounded and but slightly separated from the other portion of the vertex; ocelli disposed in a low triangle; facial shield transverse, the superior margin very broadly obtuse-angulate. Pronotum rather stout; collar narrow; supra-coxal dilations rectangulate; anterior and lateral margins denticulate except for a small basal portion of the latter; dorsal aspect

[a] The genus originally comprised the following species:
granadensis.
argentina.
madagascarensis—Platycalymma Westwood.
lactea—Nanomantis Saussure.
pellucida—Calidomantis Rehn (=*Miomantis* Saussure).

with two pairs of short dentiform processes on the collar and two pairs on the shaft, one pair placed anteriorly and wide apart, the other median and close together, posterior margin with a median process; longitudinal carina present on the shaft, most apparent posteriorly. Tegmina and wings hardly visible. Abdomen fusiform, depressed. Supra-anal plate produced, triangular, apex acute angulate, lateral margins slightly arcuate, dorsal surface longitudinally carinate. Cerci small, not exceeding the supra-anal plate in length, depressed. Subgenital plate compressed, produced, not equaling the supra-anal plate in length, apex developed into a little rounded knob. Anterior coxæ slightly exceeding the pronotum in length, lower margins both supplied through their entire length with dentiform spines, those of the internal margin being decidedly the smaller; femora very stout and heavy, external margin with five spines, one of which is apical, discoidal spines three in number; tibiæ about half the length of the femora, external and internal borders bearing eight spines, which increase in size toward the apical claw; metatarsi exceeding the remaining tarsal joints in length. Median and posterior limbs slender.

General color brownish black, becoming very dull rufescent on the internal faces of the anterior coxæ; limbs obscurely mottled and annulate with dull ochraceous.

MEASUREMENTS.

	mm.
Total length	20
Length of pronotum	5.5
Greatest width of pronotum	3
Greatest width of abdomen	5.7

Genus PARAMUSONIA, new name.

1894. *Musonia* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 64 (not of Stål, 1877).[a]

Type.—By selection, *Thespis cubensis* Saussure.

PARAMUSONIA CUBENSIS (Saussure).

1869. *Th[espis] cubensis* Saussure, Bull. Soc. Ent. Suisse, III, p. 70; Cuba.

One male; Pinar del Rio, Cuba. March 27, 1900. (Palmer and Riley.) [U.S.N.M.]

[a] Stal's genus *Musonia* (Bihang till K. Svenska Vet. Akad. Handlingar, IV, no. 10, p. 45), contained but two species—*surinama* Saussure and *lineativentris* Stal. Both of these were placed in *Mionyx* by Saussure and Zehntner (Biol. Cent. Amer., Orth., I, pp. 166–167). As no included species are given in the original of *Mionyx* (Societas Entomologica, VII, 1892, p. 122), the treatment in the Biologia is the first to give us any of the included species. Thus *Mionyx* Saussure becomes a synonym of *Musonia* Stål, while a new name is required for the *Musonia* of Saussure and Zehntner.

Genus MUSONIA Stål.

1877. *Musonia* STÅL, Bihang till K. Sven. Vet. Akad. Handlingar, IV, no. 10, p. 45.

Type.—Of the two originally included species *surinama* may be considered the type.

MUSONIA SURINAMA (Saussure).

1869. *Thespis surinama* SAUSSURE, Bull. Soc. Entom. Suisse, III, p. 70; Surinam.

One male; Trinidad. [A.N.S.Phila.]

Genus HARPAGONYX Saussure.

1892. *Harpagonyx* SAUSSURE, Societas Entomologica, VII, p. 122.

Type.—By selection, *H. gryps* Saussure and Zehntner.[a]

HARPAGONYX CARLOTTÆ, new species.

Type.—Male; San Carlos, Costa Rica. (Schild and Burgdorf.) [Cat. No. 6953, U.S.N.M.]

Closely allied to *H. dohrnianus* Saussure and Zehntner[b] from Guatemala, but differing in the more globose eyes, the truncate vertex (except for the supraocular processes), and in the more acuminate supra-anal plate.

Size medium; form slender. Head slightly transverse; eyes rotund-ovate when viewed laterally; vertex truncate, the juxtaocular lobes triangular, low; ocelli triangularly disposed, the median one very much exceeding the others in size; facial shield transverse, arcuate, the superior margin with the median portion truncate; antennæ slightly exceeding the pronotum in length, pilose. Pronotum slender, evenly tuberculate; collar gradually expanding into the supracoxal lobes which are not strongly marked; shaft subequal, a faint median carina present throughout the whole length; entire margins, except the narrow anterior and posterior ones, denticulate. Tegmina shorter than the wings when in repose; rather broad, subequal in width, apex rounded; costal margin closely hirsute through the entire length, sutural margin with shorter hairs; costal field moderately expanded in the basal half, entirely filled by large, irregular cells, the whole tegmina having the secondary nervures irregularly forked, the resulting cells being very unsymmetrical. Wings broad, almost subequal in width, apex with the costal margin curved backward and the posterior section obliquely truncate; all margins finely haired; anterior ulnar vein forked in the apical third. Abdomen slender, bacilliform. Supra-

[a] As the original description did not mention any of the included species, they must be taken from the next work, which is the Biologia. Of the three there mentioned (*gryps, dohrnianus*, and *maya*), *gryps* is the only one figured and it may be selected as the type.

[b] Biol. Cent.-Amer., Orth., I, p. 176.

anal plate acute triangular, tectate, the median ridge developed into a very distinct carina. Cerci sub-filiform, hirsute, slightly exceeding the subgenital plate in length. Subgenital plate produced, apex truncate, styles stout, short, and hirsute. Anterior coxæ slender, about four-fifths the length of the pronotum; femora very slender, about equaling the pronotum in length, spines only on the distal half, external margin with five spines, one of which is apical and quite small, internal margin bearing eleven spines which, if reduced to a formula, would read from the apex posteriorly 1111111, discoidal spines three in number, straight, the anterior one very long; tibiæ very short and weak, with claw not exceeding one-third the length of the femora, external margin bearing four closely adpressed apical spines, internal margin bearing four small, short basal spines and four moderately long apical ones; metatarsi not quite equal to the following joints in length. Median and posterior limbs slender.

General color dull umber, mottled with an obscure ochraceous; wings hyaline, though infuscate with smoky brown, which tint is of greatest intensity at the apex, where a few small blotches of dull ochraceous are also visible; limbs dull ochraceous, obscurely annulate with dull chocolate brown.

MEASUREMENTS.

	mm.
Length of body	32.5
Length of pronotum	9
Greatest width of pronotum	1.9
Length of tegmina	20.5
Greatest width of tegmina	5
Length of wings	19.5

Genus SPANIONYX Saussure.

1892. *Spanionyx* Saussure, Societas Entomologica, VII, p. 122.

Type.—As this case is much the same as *Harpagonyx*, we can select *S. bicornis* as the type.

SPANIONYX BIDENS Saussure and Zehntner.

1894. *Spanionyx bidens* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 177, pl. x, figs. 1–3; Ruatan Island, Honduras.

One female; Turrialba, Costa Rica. (Schild and Burgdorf.) [U.S.N.M.]

This specimen measures as follows:

	mm.
Total length	53
Length of pronotum	17
Greatest width of pronotum	2.5
Length of anterior femora	11
Length of posterior femora	9.6

Subfamily HARPAGINÆ.

Genus ACANTHOPS Serville.

1831. *Acanthops* Serville, Ann. Sci. Nat., XXII, p. 53.

Type.—*Mantis fuscifolia* Olivier = *sinuata* Stoll.

ACANTHOPS TUBERCULATA Saussure.

1870. *A*[*canthops*] *tuberculata* Saussure, Bull. Soc. Ent. Suisse, III, p. 243; Guiana.

One immature female; Tucurrique, Costa Rica. (Schild and Burgdorf.) [U.S.N.M.]

This species previously has only been recorded from Guiana. As the female is undescribed, I have made a few remarks on the specimen in hand.

Size rather large; form depressed, abdomen very broad. Head slightly longer than broad; eyes acute mammillate; vertex truncate; ocelli very small; facial shield transverse, slightly arcuate, the superior margin with the median section subtruncate; antennæ filiform, not exceeding half the length of the pronotum. Pronotum of moderate length, collar gradually expanding into the well-rounded supracoxal lobes; shaft with the median portion compressed; margins with no appreciable spines except on the shaft, the lateral margins of which bear short dentiform processes; dorsal surface with a pair of mammillate processes on the collar, and another pair on the supracoxal region. Tegmina and wings not developed. Abdomen very strongly depressed, the fourth and fifth segments developing subquadrate foliaceous processes from their lateral margins, those of the fourth segment being about three times the size of the appendages on the fifth segment. Supra-anal plate produced, rounded, the apex broadly and triangularly emarginate. Cerci strongly depressed, apex expanded and obscurely bilobate. Subgenital plate transverse, moderately produced, apex deeply and very narrowly cleft; styles very minute, stout. Anterior coxæ with both of the lower margins supplied with five denticles; femora equal to the pronotum in length, the superior face bearing a distinct carinate ridge for the greater part of its length; external face heavily granulate; external margin with seven short and stout spines, one of which is apical; internal margin bearing seventeen subequal spines, one of which is apical; discoidal spines three in number, distal one exceeding the others in size; tibiæ about equal to two-thirds the length of the femora, each lower margin supplied with a comb-like series of spines, which are of greatest length distally; the external margin bears about twenty-six in its series, the internal margin seventeen; metatarsi equal to the remaining tarsal joints in length. Posterior and median limbs short and stout; the femora depressed; the

tibiæ with a narrow foliaceous ridge on the proximal half of their superior margin.

General color red-brown, becoming ochraceous on the anterior limbs; eyes umber; pronotum with the median portion of the shaft bearing on each side a lunule of velvetinous blackish brown.

MEASUREMENTS.

	mm.
Total length	38.5
Length of pronotum	12
Greatest width of pronotum	4.5
Length of anterior femora	11.5
Dilation of abdomen (including lateral appendages)	17

Genus PARACANTHOPS Saussure (*Pseudacanthops* auct.).

1870. *Paracanthops* SAUSSURE, Bull. Soc. Ent. Suisse, III, p. 243.

Included species *cælebs* and *spinulosa* Saussure, of which the former may be considered the type.

PARACANTHOPS CÆLEBS (Saussure).

1869. *H*[*ymenopus*] *cælebs* SAUSSURE, Bull. Soc. Ent. Suisse, III, p. 73; Patria? Mexico.

One male; Bolivia. [A. N. S. Phila.]

This record very considerably extends the range of this species.

Subfamily VATINÆ.

Genus STAGMATOPTERA Burmeister.

1838. *Stagmatoptera* BURMEISTER, Handb. d. Entom., II, p. 537.

Type.—By elimination and selection *S. rogatoria* Burmeister. [a]

STAGMATOPTERA ROGATORIA Burmeister.

1838. *M*[*antis*] (*Stagmatoptera*) *rogatoria* BURMEISTER, Handb. d. Entom., II, p. 540; South America.

1870. *St*[*agmatoptera*] *predicatoria* SAUSSURE, Bull. Soc. Ent. Suisse, III, p. 232; Brazil.

One female; Pebas, Peru. [A. N. S. Phila.]

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[a] The originally included species were:

lineola—Epaphrodita.
bioculata—Sphodromantis.
bimaculata—Sphodromantis.
musarum—Epaphrodita.
latipennis—Stagmomantis.
carolina—Stagmomantis.
dimidiata—Stagmomantis.
præcaria.
rogatoria.
pavonina.
unipunctata—Parastagmatoptera.

Of the uneliminated forms *rogatoria* may be selected as the type.

The specimen measures as follows:

	mm.
Length of body	80
Length of pronotum	31
Greatest width of pronotum	6.5
Length of tegmina	47
Greatest width of tegmina	18.5
Length of anterior femora	22.5

STAGMATOPTERA SANCTA (Stoll).

1787. [*Mantis*] *sancta* Stoll, Natuurlyke Afbeeldingen en Beschryvingen; De Spooken, pp. 52, 78, pl. xvii, fig. 63; Surinam.

One female; Para, Brazil. [A. N. S. Phila.]

STAGMATOPTERA INSATIABILIS, new species.

Type.—Female; Turrialba, Costa Rica. (Schild and Burgdorf.) [Cat. No. 6954, U.S.N.M.]

This form is allied to *S. sancta* Stoll, but differs in the armature of the anterior coxæ, the character of the pronotal dilation, and the spine structure of the same portion of the body.

Size large; form robust, abdomen depressed. Head slightly transverse; eyes subovoid when viewed laterally; vertex very slightly arcuate; ocelli very small, triangularly disposed; facial shield transverse, the superior margin arcuate, lower margin subtruncate; antennæ filiform, hardly exceeding the depth of the head in length. Pronotum moderately elongate; collar broad, very gradually expanding into the slight supracoxal lobes; shaft subequal in width, supplied with a median carina which is very distinct anteriorly and obsolete posteriorly; lateral margins of the collar and shaft supplied with stout moderately long dentiform spines, which become weak and low toward the posterior margin of the shaft, lateral margins of the supracoxal lobes with the spines shorter than either anteriorly or posteriorly. Tegmina elliptical, costal margin rather strongly arcuate, sutural margin moderately arcuate, apex rounded anteriorly and rectangulate posteriorly; costal field broad, equal to one-third the width of the tegmina, irregularly reticulate; stigma longitudinal, narrow. Wings slightly exceeding the tegmina in length when in repose; costal margin straight, except apically, where it is strongly curved to meet the very obtuse-angulate apex; anterior ulnar vein bifurcate. Abdomen depressed, fusiform. Supraanal plate rotundate, a slightly marked cercal emargination. Cerci moniliform, hirsute, apex blunt. Subgenital plate large, rounded; median portion produced, compressed, and with a deep median incision. Anterior coxæ slightly exceeding half the length of the pronotum, lower margin bearing five large dentiform spinous processes, between which are placed a much smaller process of similar shape; femora slightly exceeding the coxæ in length, external face concave, anterior portion of the external margin bearing

four large spines, anterior portion of the internal margin bearing sixteen large and small spines which from the distal extremity read IIIIIIIIIIIII, discoidal spines four in number, the second one from the distal extremity larger than the others, posterior portion of the lower face of the femora bearing a row of seven small denticles; tibiæ (without apical claw) not equal to half the length of the femora, external margin bearing twelve spines, the internal thirteen, the external with an unarmed basal area; metatarsi over half again as long as the remaining tarsal joints. Median and posterior limbs moderately slender; the metatarsi of the median limbs considerably shorter than the remaining tarsal joints; metatarsi of the posterior limbs equal to the remaining tarsal joints in length.

General color pea green, suffused with brown on the head, pronotum, and limbs; eyes rich sienna, darkest above; anterior limbs with the spines on the internal margin of the tibiæ and the larger coxal spines red brown; wings hyaline with the costal margin, longitudinal veins and transverse nervures yellowish green; abdomen below margined with bluish green; median and posterior femora obscurely annulate with wood brown.

MEASUREMENTS.

	mm.
Total length	69
Length of pronotum	28.5
Greatest width of pronotum	6.2
Length of tegmina	34
Greatest width of tegmina	14
Length of wings	31

An additional female from the type locality was also examined.

Genus VATES Burmeister.

1838. *Vates* Burmeister, Handb. d. Entom., II, p. 543.

Type.— *Vates cnemidotus* Burmeister = *Mantis subfoliata* Stoll.[a]

VATES TOWNSENDI, new species.

1901. *Vates* sp. Rehn, Trans. Amer. Ent. Soc., XXVII, p. 221; Cuernavaca, Morelos, Mexico.

Type.—Female; Zapotlan, Jalisco, Mexico, July 8, 1902. (C. H. T. Townsend.) [A. N. S. Phila.]

This species agrees with *V. tolteca* Saussure and *V. annectens* Rehn in the rotundate emargination of the marginal field of the tegmina and the lobed abdomen, and shows affinity, on the other hand, with *V. parænsis* Saussure in the elongate frontal processes. The peculiar position of the species was recognized when an immature specimen from Cuernavaca was examined, but on such evidence I deferred

[a] According to Rehn, Canad. Entom., XXXIII, p. 24.

description. The receipt of an adult female, kindly presented by Mr. C. H. T. Townsend, clears all uncertainty, and I take pleasure in dedicating the species to the collector of the type.

Size rather large. Head transverse; frontal processes as long as the interspace between the eyes, apical portions curved upward and acuminate; eyes subreniform when viewed laterally; facial shield transverse, inferior margin subtruncate, superior margin obtuse-angulate with a rounded projecting median lobe. Pronotum elongate, the shaft trigonal in section; collar subequal; supracoxal lobes prominent subangulate; shaft slightly expanded posteriorly, as a whole narrower than the collar; median carina very fine, but distinct on the shaft, replaced on the collar by a slight sulcus; lateral margins denticulate, stronger on the collar than elsewhere, almost absent on the posterior portion of the shaft. Tegmina exceeding the abdomen in length; the costal field abruptly rotundate-emarginate and absent in the apical third. Abdomen depressed; posterior part of the lateral margins of the segments bearing rotundate lobes. Anterior coxæ about half the length of the pronotum; femora slightly more than half the length of the pronotum, external margin supplied with four large spines, internal margin with fifteen or sixteen spines rather regularly alternating large and small, discoidal spines four in number; metatarsi slightly longer than the remaining tarsal joints. Median and posterior femora with the usual foliaceous lobes well developed and rounded.

General color dull reddish brown, transversely barred with ochraceous on the limbs. Tegmina opaque pea-green, washed with faint yellowish, bearing two oblique transverse bars, as is customary in this genus.

MEASUREMENTS.

	mm.
Length of head and body	61.7
Length of frontal processes	3.5
Length of pronotum	26.2
Greatest width of pronotum	6.0
Length of tegmina	35.0
Greatest width of tegmina	11.0
Length of anterior femora	16.0

A REVIEW OF THE JAPANESE FISHES OF THE FAMILY OF AGONIDÆ.

By David Starr Jordan and Edwin Chapin Starks.
Of Stanford University.

In this paper is given a review of the species of fishes belonging to the family of *Agonidæ*, known in English as sea poachers or alligator fishes, in Japanese as tokubire or sachi, found in the waters of Japan. The material studied is preserved in the United States National Museum, in the Museum of the Leland Stanford Junior University, and in the Museums of Tokyo and Sapporo, in Japan. Most of the species are fully described in Jordan and Evermann's Fishes of North and Middle America, and only those not represented there are described in full in this paper. The new plates are by the Japanese artists, Sekko Shimada and Kako Morita.

Family AGONIDÆ.

Body angular, commonly 8-angled, the caudal peduncle 6-angled, covered with 8 to 12 longitudinal rows of imbricated, radially striated plates, the anterior edge of each plate overlying the posterior edge of the plate next in front of it; plates spinous or not. Teeth small, even, in villiform bands on jaws, and in most species on vomer and palatines, sometimes wholly obsolete; gills $3\frac{1}{2}$, no slit behind the last; pseudobranchiæ large, extending down the inner side of opercle; gill rakers small; gill membranes united, free, or joined to isthmus; ventral fins thoracic, narrow, their rays I, 2; vent usually close behind ventrals; spinous dorsal large, small, or absent; anal without spines; caudal rounded, about 3 times as long as wide at base, with 10 to 12 long rays; base of pectorals usually broad, the lower rays sometimes produced; all rays of all fins simple; branchiostegal rays 6; myodome (tube of *recti* muscles) with membranaceous roof; basisphenoid absent; posttemporal not bifurcate, continuously articulated with epiotic and pterotic; pyloric cæca few, about 4 to 7; vertebræ numerous, 35 to 50.

Proceedings U. S. National Museum, Vol. XXVII—No. 1365.

Fishes of the cold seas, living among rocks or kelp, most of them of small size and fantastic form, not valued as food.

a. TILESININÆ: Spinous dorsal present, the spines 18 or 19 in number; anal rays more than 20; soft dorsal short ..... *Tilesina*, 1

aa. Spinous dorsal present, its spines 5 to 12 in number.

b. Gill membranes free from the isthmus.

c. PERCIDINÆ: Body compressed; lower jaw not projecting; plates of body spinous; first dorsal at nape.

d. Lower pectoral rays not free.

e. Teeth on vomer; no occipital spines; no barbel on snout ..... *Percis*, 2

ee. No teeth on vomer; snout with a long barbel; occipital spines present. *Agonomalus*, 3

dd. Lower pectoral rays, 7 or 8, wholly free; body short and high. *Hypsagonus*, 4

cc. BRACHYOPSINÆ: Body more or less depressed; lower jaw projecting; plates of body spinous or not; first dorsal behind nape.

f. Chin without terminal barbel.

g. Bones of snout short (not produced in form of a tube); plates of body spinous; vomer and palatines with some teeth; breast with large plates ..... *Occa*, 5

gg. Bones of snout produced into a long tube which bears the short jaws at the end; body rather robust, the plates with spines. *Brachyopsis*, 6

ff. A barbel at tip of chin, snout long (produced into form of a tube, as in *Syngnathidæ*); body subterete, very slender, its plates not spinous ..... *Pallasina*, 7

bb. AGONINÆ: Gill membranes joined to isthmus, with or without a narrow free fold behind.

j. Tip of snout without free median plate or spine; mouth inferior, lower jaw short.

k. Vomer without teeth.

l. Lower side of snout with barbels.

m. Gill membranes without barbels; a pair of complex barbels under tip of snout; one pair horizontal and one pair recurved spines at tip of snout. Lower jaw very weak; teeth feeble, sometimes wanting; plates of body mostly with spines.

n. Dorsal and anal fins very large, each with 14 to 16 soft rays ..... *Draciscus*, 8

nn. Dorsal and anal fins moderate, each with 8 to 12 soft rays ..... *Podothecus*, 9

k. Vomer with teeth.

o. Dorsal fins rather long, the rays shortened behind, the last one attached by membrane to the body; no large knife-like spine above eye.

p. Plates on body largely unarmed; no teeth on palatines; gill membranes without cirri. *Sarritor*, 10

aaa. ASPIDOPHOROIDINÆ: Spinous dorsal absent; body not compressed, its plates not spinous; mouth small, terminal; gill membranes free from the isthmus.

q. Nasal spines present; body slender. *Aspidophoroides*, 11

qq. Nasal spines wanting; body slender. *Anoplagonus*, 12

1. TILESINA Schmidt.

Tilesina SCHMIDT, Faune mer du Japon., etc., 1903, p. 16 (*gibbosa*); name only.

This genus is distinguished from all other *Agonidæ* by the very long spinous dorsal of 18 or 19 spines, and by the very long anal of 23 to 26 rays. Japan Sea.

(Named for Wilhelm Theophilus Tilesius).

1. TILESINA GIBBOSA Schmidt.

Tilesina gibbosa SCHMIDT, Fauna de la mer du Japon., etc., 1903, p. 16; Japan Sea.

This species is mentioned without description in Dr. Schmidt's paper on the fauna of the seas of Japan and Ochotsk. In a letter, dated in St. Petersburg, December 30, 1902, Dr. Schmidt gives these characters, "D. XVIII or XIX, 7 or 8; A. 23 to 26; P. 14 or 15; lateral plates 49 to 50. Peter the Great Bay (Vladivostok); Broughton Bay (Korea)."

(*gibbosus*, gibbous.)

2. PERCIS Scopoli.

Percis SCOPOLI, Int. Hist. Nat., 1777, p. 454 (*japonicus*).

Hippocephalus SWAINSON, Nat. Hist. Fishes, etc., II, 1839, p. 272 (*superciliosus*).

Body moderately elongate, compressed throughout; back elevated behind nape; 2 rows of strong, curved spines along whole length of each side (spines of the other series smaller); first dorsal fin beginning behind nape; dorsals far apart; anal fin long. Vent far back from base of ventrals. Head narrow anteriorly, abruptly broader behind; mouth terminal; median rostral plate none; nasals united in front of maxillary pedicles. Interorbital space broad, the supraocular ridges very prominent, with large, flat, triangular supraocular spine or shelf; no occipital spines. Teeth on jaws and vomer, none on palatines. Gill membranes united, free from isthmus. North Pacific.

($\pi\epsilon\rho\kappa\acute{\iota}\varsigma$, a synonym of $\pi\acute{\epsilon}\rho\kappa\eta$, perch.)

2. PERCIS JAPONICA (Pallas).

Cottus japonicus PALLAS, Spicilegia Zoologia, VII, 1772, p. 30, pl. v, figs. 1–3, dry specimen; Kuril Islands (coll. G. W. Steller).—TILESIUS, Krusenstern's Reise um die Welt, IV, 1813, pl. LXXXVII.

Agonus curilicus TILESIUS, Mém. Acad. St. Petersb., IV, 1811, p. 416; after Pallas and Steller.

Agonus stegophthalmus TILESIUS, Memoirs Soc. Naturalists, Moscow, II, 1809, p. 219, Gulf of Patience, Sakhalin Island; Mém. Acad. St. Petersb., IV, 1811, p. 427, pl. XII.—GÜNTHER, Cat., II, 1860, p. 214.

Aspidophorus lusiza LACÉPÈDE, Hist. Nat. des Poiss., III, 1802, p. 224; after Pallas.

Asidophorus superciliosus CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 215; Kuril Islands, after Pallas and Tilesius.

Percis japonicus SCOPOLI, Inst. Hist. Nat., 1777, p. 454.—JORDAN and EVERMANN, Fish. North and Middle Amer., II, 1898, p. 2034; Ochotsk Sea.—SCHMIDT, Fauna Mer. Japon., 1903, p. 16; Vladivostok.

Agonus japonicus BLOCH and SCHNEIDER, Systema Ichthyologia, 1801, p. 105.
Phalangistes japonicus PALLAS, Zoog. Rosso-Asiat., III, 1811, p. 112.
Hippocephalus superciliosus SWAINSON, Nat. Hist. Fishes, etc., II, 1839, p. 272.
Hippocephalus japonicus JORDAN and GILBERT, Synopsis, 1883, p. 723.—CRAMER, Proc. Cal. Ac. Sci., 1894, p. 194, with figure.

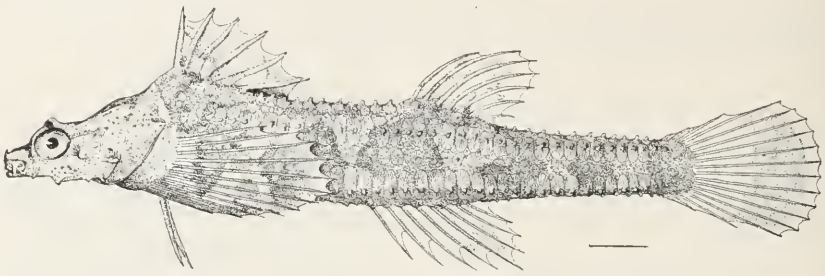

FIG. 1.—PERCIS JAPONICA.

This species has been known in recent years from a single specimen from Ochotsk Sea in the California Academy of Science, described and figured by Mr. Cramer. This account is copied by Jordan and Evermann, to whose work the reader is referred.

3. AGONOMALUS Guichenot.

Agonomalus GUICHENOT, Mém. Soc. Sci. Nat. de Cherbourg, IX, 1866, p. 252, pl. IX (*proboscidalis*).

Head and body strongly compressed, the latter entirely armed with angular osseous plates. Teeth excessively small on both jaws, none on vomer or palatines. Dorsal fins separate; a long, fleshy barbel on tip of snout; mouth small; a very high, broad, somewhat recurved spine or bony projection above each orbit; origin of first dorsal above nape, the profile from nape to fin very steep; pectoral rays somewhat exserted; gill membranes probably united and free from isthmus. Closely related to *Hypsagonus*.

(*agonus;* ὁμαλός, level, even, or flat, i. e., compressed.)

a. Lateral line pale; spines on head ridge-like; first dorsal spine slightly longer than second; anal rays 11 ..... *proboscidalis.* 3.

aa. Lateral line black; spines on head sharp; first dorsal spine notably longer than second; anal rays 13 or 14 ..... *jordani.* 4.

3. AGONOMALUS PROBOSCIDALIS (Valenciennes).

Aspidophorus proboscidalis VALENCIENNES, Comptes Rendus de l'Acad. des Sciences, XLVII, 1858, p. 1040; Port of Emperor Nicholas (Nicolaevsk), Gulf of Tartary.

Agonomalus proboscidalis GUICHENOT, Mém. Soc. Sci. Nat. Cherbourg, 1865, p. 254, pl. IX.—SAUVAGE, Nouv. Arch. Museum Hist. Nat., Paris (2), I, 1878, p. 157.—JORDAN and EVERMANN, Fish. North and Middle Amer., II, 1898, p. 2037, after Guichenot.—SCHMIDT, Faune Mer Japon, 1903, p. 16; Vladivostok, Japan Sea.

Head 4 in length to base of caudal; depth at base of ventrals, 4. Dorsal IX—6; anal, 11; lateral line plates 27. Eye, $3\frac{3}{4}$ in head; greatest interorbital width between tips of supraocular spines, 2; maxillary, $3\frac{1}{5}$; snout, 4.

Supraocular spine triangular; its posterior side sloping at about the same angle as its anterior side; its base extends above the entire eye and its apex is directly above the pupil; at its base posteriorly is a small spine placed above a point midway between posterior border of pupil and posterior border of eye. The anterior border of the large spine forms a steep unbroken curve around front of eye to a level with lower margin of eye, becoming nearly vertical in front of eye. Interorbital space widely V-shaped, a slight longitudinal ridge at its middle. A ridge runs backward from supraorbital rim and ends in a blunt upward and outward directed spine with a small spine at its base anteriorly; between this and its opposite fellow is a depression. Nasal spines sharp, rather long, and curved backward. A blunt spine above opercle, probably on post-temporal, and a similar one on edge of preopercle, not widening outward and curving backward, making a deep notch behind it, as in *Agonomalus jordani*. A spine, sharper than the others, just behind lower posterior orbital margin. A small, sharp spine just above base of upper pectoral ray. A longer curved spine behind it above middle of pectoral. Maxillary reaching to below anterior margin of pupil. Teeth fine, villiform, in narrow bands on jaws; none on vomer or palatines. Snout nearly horizontal to nasal spines, then turning nearly vertically downward to mouth. Lower jaw included. A long barbel, half as long as head, at tip of snout; it is widened at the base and extends around the entire front of snout.

A row of 26 plates bearing hooked spines extends along the side of back from below fourth dorsal spine to the caudal; the second spine is smaller than the adjoining spines and slightly out of line with them. A row of 29 similar, slightly larger spines extends along the lower part of sides to the caudal. A row of 6 small blunt spines on side of belly curves inward to the first anal ray. A couple of tiny spines at side of interval between dorsals. The area on side of body between the upper and lower series is concave. The caudal peduncle is four cornered in section, with the long sides bowed inward toward each other. The lateral line runs along a series of small plates which are rather scattered posteriorly.

Spinous dorsal double curved in its upper outline; convex at each end and concave at its middle; the length of the first spine is contained $3\frac{2}{3}$ in body or equal to depth of body below it; the second spine is but slightly shorter; the last spine is $1\frac{3}{5}$ in head; it is connected to the body by a wide membrane which covers 5 plates. The first dorsal spine is rough, with small prickles. The rays of the second dorsal are very stiff; the first is five-eighths of the second in length; the

second and third are equal; the others decrease gradually to the last, which is one-half the length of the second, and is adnate to the body for its whole length. The base of the last anal ray is directly under the base of the last dorsal ray, but the tips of the last rays reach much farther posteriorly. The third from the last anal ray is considerably the longest; the last ray is equal in length to the second; the first ray, between which and the third from the last the rays are graduated in length, is equal in length to the distance from the tip of the snout to the posterior margin of the pupil. The pectoral has 11 rays; the fourth from the top is the longest; it fails to reach the first anal ray by a distance equal to two-thirds of the diameter of the eye; the lower pectoral rays are much produced beyond the membrane, but not disconnected, as in the genus *Hypsagonus*. The surface of the upper part of the pectoral, and especially the upper ray, is rough with small

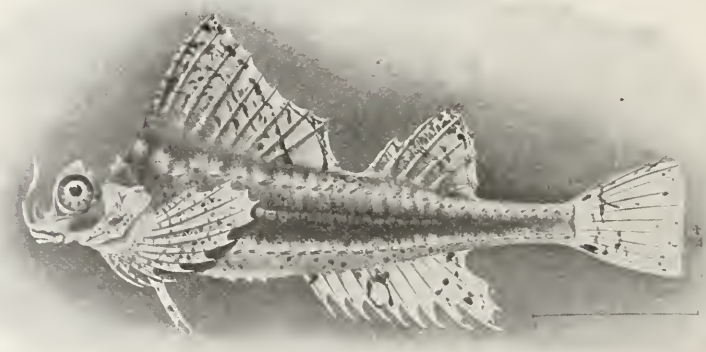

FIG. 2.—AGONOMALUS PROBOSCIDALIS.

prickles; similar prickles cover the base of the pectoral. Ventral two rayed, the inner ray the longer, just reaching to the middle of the vent. Caudal broad and rounded behind; its length is $1\frac{1}{4}$ in head.

Color.—Body pinkish, fins white; nearly everywhere with sharp irregular brown "freckles;" those on the body fewer and lighter than on fins, fading out on caudal peduncle; on spinous dorsal they are elongate and are irregularly placed in series suggesting curved bands; on posterior part of spinous dorsal is a large white oval spot with brown spots around it; the spots more sparse on anal than on other fins; very thickly scattered over pectoral; barbel at tip of snout white.

Here described from a specimen loaned by the Sapporo museum; collected at Hakodate. It is 10 cm. in length. The species is evidently identical with the type of Guichenot.

(*proboscidalis*, having a long snout.)

4. AGONOMALUS JORDANI Schmidt.

Agonomalus jordani Schmidt Manuscript, Aug. 13, 1903; Ochotsk Sea.

Head $4\frac{1}{4}$ in length to caudal base; depth $4\frac{2}{3}$. Dorsal IX–7; anal 13 or 14. Eye $3\frac{2}{3}$ in head; interorbital width directly above pupil 3; maxillary $3\frac{1}{5}$.

Superorbital spine sharp and slender as compared with *A. proboscidalis;* its point directed upward and backward; it is placed above posterior margin of pupil about where the second superorbital spine is in *A. proboscidalis.* Its base is short, not extending anterior to pupil; its anterior margin does not follow down the front of eye in a simple unbroken curve; there is no second superorbital spine. Interorbital space broadly V shaped. Vertex depressed between the backward-extending ridges from superorbital rim. Spine at parietal region sharp, directed backward and upward, without a small spine at its

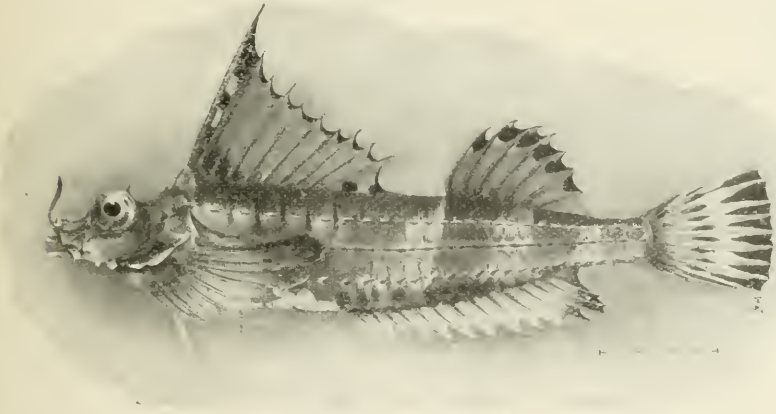

Fig. 3.—Agonomalus jordani.

base. Nasal spines slender and sharp. Spine at post-temporal region very sharp and directed backward. The spine at edge of preopercle is wide and flat, growing wider outward and turning sharply back, thus forming a deep notch between it and the head; toward its end it divides into several small sharp points, each of which is at the end of a slight ridge. A sharp spine just behind lower posterior orbital margin. A small sharp spine just above the base of the upper pectoral ray, but no large spine on body behind it above middle of pectoral, as in *A. proboscidalis.*

Maxillary reaching to below anterior orbital margin. Teeth in narrow bands in jaws, none on vomer or palatines. Lower jaw included. Barbel apparently as in *A. proboscidalis* (specimens have been dried).

Upper lateral row of spines, 25 in number, differing from those of *A. proboscidalis* in being slenderer and sharper, the first under third

dorsal spine, the second not smaller and out of line with the adjoining ones. Lower row similar, of 28 spines. The spines at side of belly very much sharper and longer than in *A. proboscidalis*.

Spinous dorsal nearly straight in its upper outline; the spines are all produced more than in *A. proboscidalis*, and the first spine is conspicuously longer than the second. First spine $3\frac{1}{3}$ in length to caudal base; $\frac{2}{3}$ to $\frac{1}{2}$ longer than depth of body below it; second spine equals length of head; last spine $1\frac{1}{3}$ in head. The soft dorsal more rounded or less triangular in outline than in *A. proboscidalis*, the tips of the rays more produced beyond the membrane. The distance between the dorsals is the same, and the membrane connecting the last spine to body is the same. Anal longer, but similar in shape; the third ray from the last is $1\frac{1}{3}$ in head. Pectoral similar in shape, number of rays, and in the relationship of its tip to front of anal to *A. proboscidalis;* its greatest length exceeds that of head by half the diameter of eye. Ventrals reaching to vent. Caudal rounded; its length 1 to $1\frac{1}{6}$ in head.

Color.—Back brown; sides lighter; a dark, irregular band along base of anal; with or without dark brown spots just above and below anterior spines of lower lateral series; lateral line running in a narrow, sharp, very dark band; a dark streak following suborbitals, and another around edge of preopercle; barbel at tip of snout dark; on membrane between first and second dorsal spines are three or four dark, conspicuous spots with translucent interspaces; the first brown spot at upper margin of membrane, one or two small dark spots on membrane between last spine and body; the membrane between each spine is narrowly edged with brown blended downward; the membrane of soft dorsal margined with much larger spots between the rays; the tip of each dorsal spine and ray white, softly blended downward; the body of the dorsals uniform dusky; caudal with a cross band at its middle formed by dark blended spots on the membranes between each ray; a long dark spot on the posterior end of membrane between each ray; the rays tipped with white; pectoral dark above, somewhat mottled toward end; anal and ventrals white, the former dark brown toward its posterior end.

The species differs from *Agonomalus proboscidalis* in having all of the spines on the head sharp and directed backward; the superorbital spine single and placed posteriorly; the first dorsal spine conspicuously longer than the second; the upper outline of the fin not so deeply concave; the anal longer; the color very different. Other and less conspicuous differences are indicated above.

This species is in Dr. Schmidt's collection from the Ochotsk Sea. Dr. Schmidt writes of it: "Das ist wohl die schönste neue Species die ich in meinen Sammlungen gefunden habe." In view of the possible priority of Dr. Schmidt's paper we suppress the name we had devised for this fish.

Our description is from a dried specimen, 158 mm. in length, from Shiraoi, Hokkaido, presented by Dr. Bashford Dean. It is numbered 7731, Ichthyological Collections, Leland Stanford Junior University Museum. Four dried specimens were secured at Hakodate. One of them is preserved in the U. S. National Museum.

(Named for David Starr Jordan.)

4. HYPSAGONUS Gill.

Hypsagonus Gill, Proc. Ac. Nat. Sci. Phila., 1861, p. 259 (*quadricornis*).
Cheiragonus Herzenstein, Bull. Acad. Imp. Sci. de St. Petersb., XIII, 1890, p. 116 (*gradiens* = *quadricornis*).

Body compressed, elevated, depth greater than length of head, more than $\frac{1}{3}$ of body; head small, separated from first dorsal by a very deep nuchal depression; top of head very uneven, 1 pair of large

Fig. 4.—Hypsagonus quadricornis.

supraocular and 1 pair of large occipital spines, strong, blunt; mouth terminal, jaws about equal, a large barbel or none at tip of snout; teeth on jaws, none on vomer or palatines; gill membranes united, free from isthmus; scales or plates large, radially striated, with a central spine or tubercle; 2 rows of strong and 2 of weaker spines along side of body; dorsal fin long, high, beginning immediately behind nape, the spines strong, the first serrated; pectorals short, procurrent, the lower 8 or 9 rays free; ventrals small; vent nearly halfway between ventrals and anal.

This genus differs from *Agonomalus* in having a row of small spines along base of dorsals, continuous on dorsal side of caudal peduncle as a median row; in having the row of spines at side of belly continuous along base of anal and median ventral surface of caudal peduncle, and in having the lower 7 or 8 pectoral rays free.

(ὑψι – high; *Agonus*.)

5. HYPSAGONUS QUADRICORNIS (Cuvier and Valenciennes).

Aspidophorus quadricornis Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 221; Kamchatka. (Coll. Dr. Collée. Type in British Museum.)

Hypsagonus (Cheiragonus) gradiens Herzenstein, Bull. Acad. Imp. des Sci. de St. Petersb., XIII, p. 116, May 29, 1890; Kamchatka, Avatcha Bay, Port Petropavlovsk.

Agonus quadricornis Günther, Cat., II, 1860, p. 215.

Hypsagonus quadricornis Gill, Proc. Ac. Nat. Sci. Phila., XIII, 1861, p. 167.—Jordan and Gilbert, Synopsis, 1883, p. 722.—Gilbert, Rept. U. S. Fish Comm., 1893 (1896), p. 439.—Jordan and Evermann, Fish. North and Middle Amer., II, 1898, p. 2038; Aleutian Islands, Bristol Bay, Puget Sound.—Schmidt, Faune Mer Japon., 1903, p. 16 (Aniva Bay, Sakhalin), Ochotsk Sea.

This species is fully described by Mr. Cramer in Jordan and Evermann's Fishes of North and Middle America, to which account we have nothing to add.

5. OCCA Jordan and Evermann.

Occa Jordan and Evermann, Fish North and Middle Amer., II, 1898, p. 2043.

This genus differs from *Brachyopsis* in the short snout, which is not tubular. From *Stellerina* it is separated by the large plates on the breast, and by the presence of at least a few teeth on the vomer and palatines. North Pacific.

(*occa*, a harrow.)

a. No spine on suborbital stay; dorsal IX or X, 7 or 8 ..... *dodecaedron*, 6.
aa. A spine developed on suborbital stay; dorsal XII, 8 or 9..... *iburia*, 7.

6. OCCA DODECAEDRON (Tilesius).

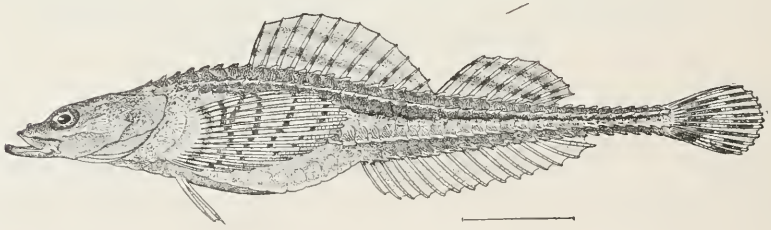

Fig. 5.—Occa dodecaedron.

Agonus dodecaedron Tilesius, Mém. Acad. Petersb., IV, 1810, pl. XIII; Kamchatka (Coll. W. T. Tilesius).—Günther, Cat., II, 1860, p. 214.

Phalangistes loricatus Pallas, Zoog. Rosso-Asiat., III, 1811, p. 114, pl. XIX; Kamchatka.

Aspidophorus dodecaedrus Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 209.

Brachyopsis dodecaedrus Jordan and Gilbert, Synopsis, 1883, p. 723.

Occa dodecaedron Jordan and Evermann, Fish. North and Middle Amer., II, 1898, p. 2043; Bristol Bay.—Jordan and Gilbert, U. S. Fur Seal Commission, III, 1898, p. 479; Iturup Island.—Schmidt, Faune Mer Japon., 1903, p. 16; Aniva Bay, Vladivostok.

Kamchatka and Kuril Islands.

The species is fully described by Mr. Cramer in Jordan and Evermann's Fishes of North and Middle America, to which the reader is referred.

(*δώδεκα*, twelve; *ἕδρα*, surface, side.)

7. OCCA IBURIA Jordan and Starks, new species.

Head $4\frac{1}{2}$ in length to base of caudal; depth $7\frac{1}{2}$. Dorsal XII—8 or 9; anal 16; lateral line plates from upper end of gill opening 43. Eye $5\frac{2}{5}$ in head; snout $4\frac{1}{4}$; interorbital space $4\frac{1}{2}$; maxillary $2\frac{5}{6}$.

Body to posterior third of caudal peduncle depressed. Spines present on all dorso-lateral plates and median dorsal plates of caudal peduncle; the latter very small, but evident. Spines on all inferior lateral series of plates behind tip of pectoral, and on all superior lateral series. Spines on ventro-lateral series from tips of ventral to end of anal; the anterior spines rather blunt; all of them smaller than

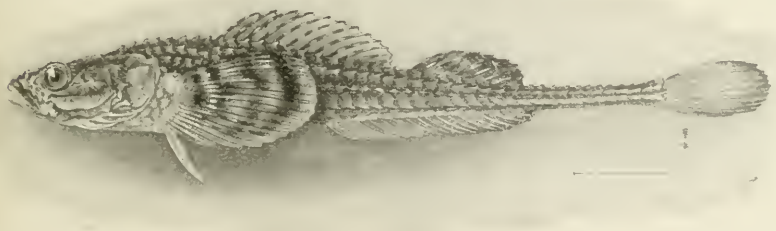

FIG. 6.—OCCA IBURIA.

in the other series. Posterior to the middle of the pectoral the lateral line plates are small, not nearly so large as those of the adjoining series; they bear small spines, which are enlarged anteriorly, back to opposite the middle of the soft dorsal. There are thirteen plates between the base of the last dorsal ray and the caudal fin; four or five of these are single plates, eight or nine are paired; the membrane of the last dorsal ray covers a little over three plates. Between the base of the last anal ray and the caudal are eleven plates, two of which are single median plates. A strong ridge of blunt plates runs from the lower pectoral ray to the gill opening, where it meets a ridge bordering the gill opening from the upper pectoral ray to the isthmus. Breast, the region covered by the pectorals and a portion about anus are rough with small tubercles. A triangular area on branchiostegal membrane and a Y-shaped area at chin between mandibles are rough with prickles.

Lower jaw strongly projecting. Teeth, fine, villiform, in narrow bands on jaws, vomer, and palatines. Maxillary reaching to below

anterior edge of pupil. Nasal spines well developed, but not very sharp. A spine developed at the center of the bony buckler on cheek. A very strong ridged spine at angle of preopercle, and three smaller ones below on edge of preopercle; the lowest represented by a very small, blunt tubercle. Superorbital rim produced in a rough ridge. A low, rough ridge curves back from superorbital rim to over parietal region. Top of head concave. A thin, flat tentacle at end of maxillary.

First dorsal spine between the seventh and eighth plates on back. The spinous dorsal covers eleven plates, and the membrane of the last spine covers a little over three plates. There are four plates between the dorsals counting between the bases of the rays. The length of the third dorsal spine is equal to the length of the snout and the eye combined. The soft dorsal covers seven plates to the base of the last ray. The longest rays are scarcely equal in length to the longest spines. The anal covers fifteen plates. The tip of the last anal ray reaches past that of the last dorsal ray a space covering nearly two plates. The longest anal rays equal the length of the snout and half the eye. One of our specimens has two ventral rays, as in *O. dodecaedron*. The other has a third inner ray developed half as long as the other rays. The length of the ventrals is $2\frac{1}{5}$ in head. The pectoral is very broadly rounded behind; there is only a little difference between the upper ten rays in length (scarcely half the diameter of the eye); below the rays rapidly decrease in length. The pectoral barely fails to reach to opposite the first anal ray. Caudal rounded; its length $1\frac{3}{5}$ in head.

Color.—Dull brown on back, fading just below lateral line into the white of under parts; no irregular dark stripe along side, as in *O. dodecaedron*, or no sharp black points on pectorals; lower lip dark brown, under part of head otherwise white; maxillary tentacle milk white; pectoral with three or four irregular, wide, brown, blended crossbars; spinous dorsal with slight, inconspicuous brown spots on the spines indicating oblique cross lines; soft dorsal with two brown oblique bars, the second one very wide and bordering the fin posteriorly; anal white; its posterior third or fourth dusky; ventrals white; caudal dark brown.

This species differs from *Occa dodecaedron* in having the spines better developed on the ridges of the body, in having a greater number of dorsal spines, in having spines developed on nasals and cheeks, in having the plateless regions under pectoral and on breast rougher and in color. (Compared with specimens of *O. dodecaedron* collected by the U. S. Fish Commission steamer *Albatross* at station 3239, Alaska.)

The type from Tomakomaki in Iburi, Hokkaido, is 20 cm. in length and is numbered 7730 Ichthyological Collections, Leland Stanford Junior University Museum. A cotype very similar, from the same locality, is loaned by the Sapporo Museum.

6. BRACHYOPSIS Gill.

Brachyopsis Gill, Proc. Ac. Nat. Sci. Phila., XIII, 1861, pp. 167, 259 (*rostratus*).
Siphagonus Steindachner, Ichth. Beiträge, V, p. 140; Sitzb. Acad. Wiss. Wien, LXXIV, July, 1876 (*segaliensis*).

Body moderately elongate, tapering nearly uniformly from head to caudal; depressed, 8-hedral (6-hedral on peduncle); depth about 8, width about 6 in length; head broad, depressed, about 4½ to 5 in standard length. Snout long, almost tubular, bearing the short jaws at the end. Plates in dorsal series about thirty-five to forty or more; a barbel at tip of each maxillary; median rostral plate none; nasal spines minute or absent; supraocular and occipital spines none; gill membranes united, free from isthmus; anal fin long, with twelve or thirteen rays, first dorsal usually long; mouth oblique, lower jaw projecting; teeth present on jaws, vomer, and palatines; at least some of the plates on body spinous; plates on breast usually with interspersed small prickles or tubercles.

(*βραχύς*, short; *ὄψις*, face.)

a. Eye in front of middle of head; no spines on suborbitals.....*rostratus*, 8.
aa. Eye behind middle of head; two spines on suborbitals.....*segaliensis*, 9.

8. BRACHYOPSIS ROSTRATUS (Tilesius).

Agonus rostratus Tilesius, Mém. Acad. Petersb., IV, 1810, pl. xiv; Sakhalin, Gulf of Aniva. (Coll. Tilesius.)
Phalangistes fusiformis Pallas, Zoog. Rosso-Asiat., III, 1811, p. 116; Sakhalin, Gulf of Aniva, Kuril Islands. (Coll. Steller and Merk.)
Agonus rostratus Günther, Cat., II, 1860, p. 214.
Aspidophorus rostratus Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 212.
Brachyopsis rostratus Jordan and Evermann, Fish. North and Middle Amer., II, 1898, p. 2046.—Jordan and Gilbert, Rept. U. S. Fur Seal Comm., II, p. 471, pl. lxx; Iturup Island, Hokkaido.—Schmidt, Faune Mer Japon., 1903, p. 16; Vladivostok, Aniva Bay.

This species is fully described by Mr. Cramer in Jordan and Evermann's work.

A large dried specimen 10½ inches long was found at Hakodate, and three smaller ones were loaned by the Sapporo Museum, taken at Tomakomaki, near Mororan. They agree very well with a specimen from Iturup Island, from which Cramer's description was made, except that they show a greater variation in fin rays. The specimen from Hakodate has the dorsal rays VIII, 8; and the anal, 13. The other three are as follows: Dorsal IX, 7; anal, 11; dorsal VIII, 7; anal, 12; dorsal IX, 8; anal, 13.

North Pacific, recorded from Sakhalin, Gulf of Aniva, Petropavlovsk, and the Kuril Islands.

(*rostratus*, pertaining to the *rostrum* or snout; "not because it has a beak, but because its head and snout are more contracted than in the others.")

9. BRACHYOPSIS SEGALIENSIS (Tilesius).

Syngnathus segaliensis Tilesius, Mém. Soc. Imp. Nat. de Moscow, II, 1810, p. 216, pl. XIV; Bay of Patience, Sakhalin. (Coll. Krusenstern.)

Siphagonus segaliensis Steindachner, Ichth. Beiträge, V, p. 140, and Sitzb. der k. Acad. der Wiss., LXXIV, 1876.—Jordan and Gilbert, Synopsis, 1883, p. 723.

Agonus laevigatus Tilesius, Mém. Acad. Petersb., IV, 1810, p. 436; Sakhalin; Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 214.

Phalangistes laevigatus Pallas, Zoog. Rosso-Asiat., III, 1811, p. 116.

Brachyopsis segaliensis Jordan and Evermann, Fish. North and Middle Amer., II, 1898, p. 2048 (copied).

This species from the island of Sakhalin is unknown to recent writers. A brief description is given by Cuvier and Valenciennes, condensed by Jordan and Evermann in the work above cited.

(Name from Sakhalin.)

7. PALLASINA Cramer.

Pallasina Cramer, Proc. Cal. Ac. Sci., 1895, p. 815 (*barbata*).

Form of *Syngnathus;* body slender, depressed; 4-hedral anteriorly, 8-hedral under dorsals; 6-hedral on peduncle; snout produced in a tube; lower jaw projecting beyond upper, turned upward at tip, a long barbel at the symphysis; teeth on jaws and vomer, a single row on palatines; gill membranes free from isthmus, united; both dorsals present; ventrals very short; plates of body slightly keeled, without spines; vertebræ about 45.

(Named for Petrus Simon Pallas, naturalist and explorer, the accomplished author of Zoographia Rosso-Asiatica, 1811.)

10. PALLASINA BARBATA (Steindachner).

Siphagonus barbatus Steindachner, Ichth. Beiträge, V, p. 140, pl. v; Sitzb. der k. Acad. der Wiss., LXXIV, July, 1876; Japan.—Jordan and Gilbert, Synopsis, 1883, p. 725.—Jordan, Cat., 1885, p. 113.—Schmidt, Fauna mer Japon., 1903, p. 16; Aniva Bay, Vladivostok.

Pallasina barbata Cramer, in Jordan and Evermann, Fish. North and Middle Amer., II, 1898, p. 2049; Bristol Bay, Bering Strait, Tareinsky Bay, Port Clarence.—Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, 1898, p. 471; Iturup Island, Yakutat.

Head, 4 to 4½ in length. Dorsal V to VII–7 or 8; anal, 9 to 11. Lateral line, 46 to 51. Body slightly depressed in front, depth at base of pectorals five-sixths or six-sevenths of width, slender, width about 12 in length. Ridges of the dorso and ventro lateral series strong, the dorsal and lateral halves of the plates form a right angle; no ridge on the inferior lateral row and the plates of the superior lateral row absent anteriorly, so that the body is 4-hedral in front of first dorsal, with dorsal and ventral faces flat or a little concave and the lateral convex. Under first dorsal the superior lateral series begins with keeled plates, the ridge of the inferior lateral series becoming more prominent, so

that under the dorsals the body is 8-hedral; dorsal and ventral faces grooved, and depth equaling length. Caudal peduncle strongly depressed, nearly 4-hedral (median dorsal and ventral ridges extremely low); 49 or 50 plates in the dorsal series, 4 or 5 pairs between dorsals, 13 or 14 pairs from ventrals to anal; 3 or 4 large plates in a median longitudinal row on breast, with about 1 row of 4 or 5 small ones between it and the series forming the edge of breast; plates radially striated and a little elevated at the center; none between ventrals and vent. Branchiostegal membrane naked posteriorly, 2 or 3 plates anterolaterally. Narrow nude surface of lower jaw with a series of several plates; 2 or 3 plates in front of pectoral. Head very long and narrow, gently tapering, nearly as high as wide. Orbits nearly circular, the longitudinal diameter 5⅓ to 6 in head and 2½ in snout. Interorbital space moderately concave, nearly 2 in orbit. Supraocular ridges moderate, occipital ridges scarcely defined, temporal ridges moderate, all spineless; no suborbital ridge; suborbital bone spineless; a sharp spine at posterior angle of preopercle and 2 smaller flat ones below; a longitudinal series of 4 or 5 poorly developed plates on lower part of cheek, between the long horizontal limb of preopercle and orbit.

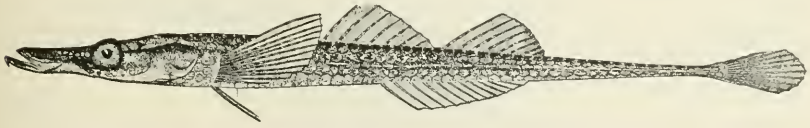

FIG. 7.—PALLASINA BARBATA.

Snout long, tubular, about 2½ in head. Frontal bones much elongated forward, an additional bony plate in front of preorbital and overhanging the maxillary; several small plates in membranaceous interval between preorbital and frontal in front of orbit. Posterior inferior angle of maxillary produced backward, reaching a little more than halfway to orbit. Median rostral plate absent. Lower jaw long, curved upward in front, projecting beyond the upper and entering profile; mouth oblique. Teeth in narrow bands on jaws and vomer, about 1 row on palatines. A single barbel of variable length in specimens from Nemuro; it is little developed, shorter than eye; in those from Aomori, at its longest; it is longer than head at tip of lower jaw. Gill membranes united behind, free from isthmus. First dorsal with 12 to 14 pairs of plates between it and the occiput; anal long, beginning under middle of first dorsal; pectorals long, 5½ to 6 in body, width at their base about 4 in their length; ventrals about 3 in pectorals and 4 in head in female, 2 in pectorals and 2⅔ in head in male. Color reddish or grayish brown with innumerable minute black points; ventral surface pale, from front of anal to caudal progressively darker with minute black spots; a dark band extends along the side of snout, across orbit and preopercle; anterior dorsal dusky, darker behind;

second dorsal indefinitely cross-banded with short streaks of darker on rays; caudal dusky; pectoral pale, indefinitely banded with short streaks of darker on rays; ventrals pale in both sexes; anal pale.

North Pacific, south to Japan and Oregon; Arctic Ocean near Bering Sea (W. J. Fisher, Steindachner); Bering Sea, Bristol Bay (Gilbert); Tareinsky Bay (Barrett-Hamilton); Port Clarence, Alaska (Scofield). A variable species. The specimens here described are four from Aomori, the longest 12 cm. in length, and an equal number from Nemuro, loaned us by the Sapporo Museum. Still others are from Mororan. This is much the most abundant of the Agonidæ of Japan, occurring in eel grass in shallow bays.

(*barbatus*, provided with a barbel.)

8. DRACISCUS Jordan and Snyder.

Draciscus Jordan and Snyder, Proc. Cal. Acad. Sci., 1901, p. 379 (*sachi*).

Closely allied to *Podothecus*, from which it differs in the extraordinary size of its soft dorsal and anal fins, each of which has 14 to 16 rays.

(δράκο, a dragon.)

11. DRACISCUS SACHI Jordan and Snyder.

Draciscus sachi Jordan and Snyder, Proc. Cal. Ac. Sci., 1902, p. 379, pl. xix; Aomori, Kayabe, Hokkaido.

Head $3\frac{1}{2}$ in length; depth $7\frac{1}{5}$; snout 2 in head; eye $4\frac{2}{3}$; D. VIII–14; A. 16; P. 15; spines in lateral line 44.

Body formed about as is usual in *Podothecus;* caudal peduncle long and slender, contained about four times in the length. Snout long and pointed; two spines on tip of snout above; two small, closely apposed spines behind middle of snout, at the end of its second third; ridge of mouth with a small double spine at its extremity; a stout spine above eye. Bones of sides of head with granular, radiating ridges. Tip of upper jaw and angles of mouth with clusters of barbels; their length equal to more than one-half the diameter of eye. Sides of body with 4 longitudinal rows of spinous plates, the spines stout, hooked; the upper row begins at nape and extends to base of second dorsal; the other 3 rows run from head to base of caudal. Plates on breast without spines.

First dorsal rather high; its first spine highest, contained about $2\frac{2}{5}$ times in head. Soft dorsal inordinately high; its middle rays longest, $2\frac{2}{3}$ in length. Anal still larger, a little higher and beginning farther forward, the highest rays behind the middle; its height about $2\frac{2}{3}$ in length; pectorals rather long, $4\frac{3}{5}$ in body; some of the lower rays produced and with free tips. Ventrals short, $3\frac{2}{5}$ in head.

Color.—Brownish, with some dark blotches on back. Vertical fins dusky, becoming black on distal portion, each fin with irregular rows

of round, white spots in the dark marginal areas. Pectorals pale, with a dusky blotch at base. Ventrals pale.

The type is a single dried specimen 240 mm. long, presented to the Museum of Leland Stanford Junior University by Mr. Sotaro Saito, Director of the Museum of Aomori, Japan. It is type No. 6431 on the Stanford Museum register. It was taken in the Bay of Aomori, where the species is locally known as Sachi.[a]

No specimens were taken by us in Japan, but other dried specimens were seen, the expanded fins rendering it one of the local curiosities. One of these, 385 mm. long, in the Imperial Museum of Japan, numbered 817, from Hokkaido, agrees closely with the type specimen. (D. VIII–13; A. 15; P. 16; scales 40.) Another from Hokkaido differs

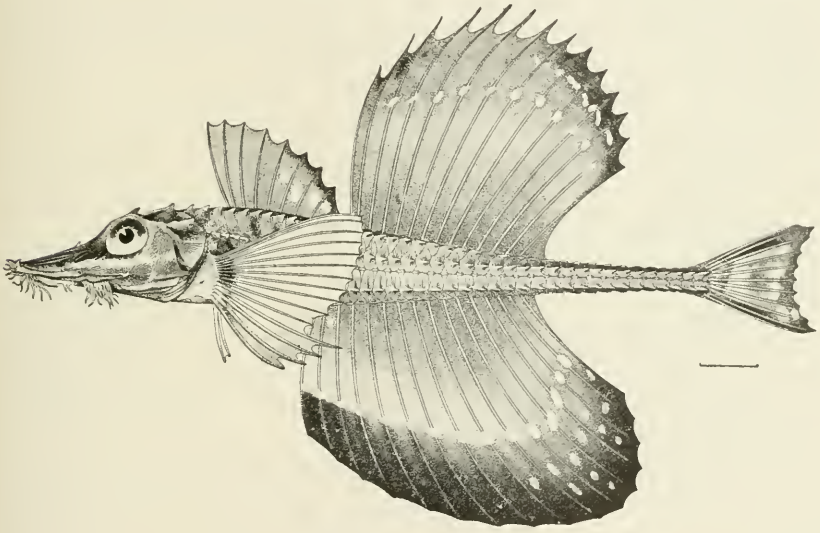

FIG. 8.—DRACISCUS SACHI.

slightly in markings of the fins. In the museum of Hakodate is a specimen from Kayabe, called by the local name of "Tokuhire," by euphony Tokubire, meaning "handy fins." There is also another specimen in the Museum of Aomori from Aomori Bay.

9. PODOTHECUS Gill.

Podothecus GILL, Proc. Ac. Nat. Sci. Phila., XIII, 1861, pp. 77, 259 (*peristethus*=*acipenserinus*).

Paragonus GILL, Proc. Ac. Nat. Sci. Phila., XIII, 1861, pp, 167, 259 (*acipenserinus*).

Body tapering nearly uniformly from head to caudal, about as high as or higher than wide anteriorly; depth about 6 to 8 inches in length; head about 4, compressed; plates in dorsal series about 35 to 40, 4 or 5

[a] *Blepsias draciscus* is called Sachiko; that is, child of the Sachi. Sachi in Japanese means good fortune.

pairs between occiput and first dorsal fin; gill membranes joined to isthmus, without free fold; no scattered barbels under lower jaw or on branchiostegal membranes; 2 complex groups of barbels on under side of tip of snout, another group at each angle of mouth; usually a few barbels at sides of pores under lower jaw; tip of snout with usually 2 pairs of sharp slender spines, the anterior directed forward, the posterior outward and backward. Mouth small, inferior, snout projecting far beyond it. Teeth on both jaws few and weak, sometimes wanting on one or both jaws; none on vomer and palatines; plates of body spinous; 1 pair of supraocular and 1 pair occipital spines; both dorsals present. This genus is very close to *Agonus*, differing mainly in the spinous plates of the body. The numerous species differ much among themselves.

(πούς, foot; θήκη, box; from the groove for the receptacle of the ventrals which appears through the shrinking of the naked skin in preserved specimens.)

a. Plates on caudal peduncle all or nearly all armed each with a spine.
  b. Barbels below snout very numerous and large; angle of mouth with many barbels.
    c. Soft dorsal with 13 rays; fins low; ventrals short; pectorals large. . *tokubire*, 12.
    cc. Soft dorsal with 8 or 9 rays.
      d. Dorsal rays VIII–9; teeth well developed; fins all very high, the pectoral emarginate in the adult, its longest ray $1\frac{1}{7}$ in head; ventral long; anal rays 10 ..... *accipiter*, 13.
      dd. Dorsal rays IX–8; teeth small; fins high; pectoral emarginate; ventral short; anal rays 10 ..... *sturioides*, 14.
      ddd. Dorsal rays XI–8; teeth present; fins moderate; pectoral not emarginate; ventral short; anal rays 9 ..... *hamlini*, 15.
  bb. Barbels comparatively few and slender.
    c. Dorsal rays VIII–8; teeth in upper jaw almost obsolete; fins moderate; pectoral not emarginate, $1\frac{1}{2}$ in head; ventral very short; anal rays 9. *gilberti*, 16.
    cc. Dorsal rays IX–6; fins small; ventrals long; sides and top of head with very large crests; anal rays 6 ..... *thompsoni*, 17.
aa. Plates on caudal peduncle mostly not ending in spines; fins rather low, the anal rays 7 or 8.
    c. Teeth wanting in the adult; barbels rather small and sparse; body not everywhere deeper than wide; the caudal peduncle very long, slender, and depressed ..... *veternus*, 18.

12. PODOTHECUS TOKUBIRE Ishikawa.

TOKUBIRE or TOKUHIRE (HANDY FINS).

* *Podothecus tokubire* Ishikawa Manuscript, 1902; Hokkaido.

The type of this species, a stuffed example in the Imperial Museum of Tokyo, is thus described by Dr. Ishikawa in a letter to the writers:

Head 80 mm.; snout to occiput 56; depth of head 36; D. IX–13; lateral plates 40–41; pectoral 17; eye 15; snout 43; second and third

dorsal rays 29; caudal 36; upper ray of pectoral 53; longest ventral ray (seventh) 30 mm.

The body elongated, angular; the head irregularly triangular as viewed from above; the mouth entirely inferior, crescent-shaped, wide, the lower jaw shutting behind the upper by the distance equal to two-thirds the longitudinal diameter of the eye; a few teeth along the sides of the upper jaw, villiform teeth in the lower jaw; no palatine or vomerine teeth. A patch of barbels below the snout in front of the mouth, a patch of fewer ones at the symphysis of the mouth. A pair of short rostral spines pointing forward; another pair of slightly larger spines pointing upward, backward, and slightly outward is seen a little behind the base of the rostral spines. These second series of spines form the front edge of the ridges which bound the elongated groove, in the middle of which is a sharp spine; the ridges approach each other until they meet at halfway between the nostril and the anterior border of the eye, where they end in a pair of sharp spines pointing upward, backward, and outward. A pair of large spines above the posterior border of the eye, and a pair of large ones at the occiput, which is continuous with the spine above the eye by a sharp ridge; a curved ridge running from the superior rim and ending in a small spine just above the opercle; two small spines along this ridge, the anterior one rather sharp, and the posterior broad, and lies midway between the supraorbital spine and the supraopercular spine; a ridge on the suborbital continuous from the rostrum along the lower edge of the preorbitals and ending in a rather sharp spine on the lower third of the suborbital below the middle point of the eye; this ridge is high and fine serrated on the greater part of the preorbitals and with a spine directed outward. The interorbital space slightly more than the vertical diameter of the eye, deeply concave, with a pair of ridges on each side, converging forward; a diagonal depression on the occiput, traversed by a rather broad transverse ridge. Dorsal ridges converging from the occiput to behind the soft dorsal, uniting on the second plate behind the base of the last dorsal ray, continued as a single ridge on about 8 plates, where it becomes obsolete; the upper lateral ridge follows the course of the lateral line to the ninth plate, where the latter slants downward and outward as parallel rows to the base of the tail; the lower lateral ridge runs parallel with and converging anteriorly with the upper, and becomes obsolete on the second plate behind the base of the pectoral; a single spine above the base of the pectoral indicating an obsolete ridge between the lateral ridges; abdominal ridges widely apart in front between the pectoral fins, uniting behind the anal, and run backward till to the base of the caudal, where it becomes nearly obsolete; all ridges with sharp, recurved spines with the exception of the abdominal ridges behind the eighth anal ray, where the dorsal and anal rays disappear;

the caudal peduncle assumes the quadrangular shape, the corners being framed by the spines of the lateral ridges; no row of spines around base of caudal or pectoral. Dorsal and anal fins not very high; the origin of the dorsal on the fourth dorsal plate, and covers 8 plates, the membrane covering 2 more; the first dorsal spine probably the longest, "a membrane connecting the last spine to the body for the whole length;" the second dorsal begins at 2 plates behind the first, and covers 12 plates, a membrane covering two-thirds of a plate more; the dorsal fin being in part broken; the longest rays are not to be recognized; the last ray is connected to the body by a membrane; this fin begins at about behind the last ray of the first dorsal, and continues to the penultimate ray of the anal; the pectoral fin very broad and large, the tips of the first ray reaching to the twelfth lateral plates if laid backward. The origin of the ventrals slightly in front of the pectorals; very short, with their tips reaching to the third ventral plate; the caudal moderate, probably truncated.

The color of the body not recognizable, being very much faded, but most probably like that of the American species.

A single stuffed specimen from Hokkaido, with the total length of 310 mm.

13. PODOTHECUS ACCIPITER Jordan and Starks.

Podothecus accipiter JORDAN and STARKS, Proc. Cal. Ac. Sci., 1895, p. 816, pl. LXXXVIII; Robben Island.—JORDAN and EVERMANN, Fish. North and Middle Amer., II, 1898, p. 2055.

Of this species, fully described by Jordan and Starks, only the type is known.

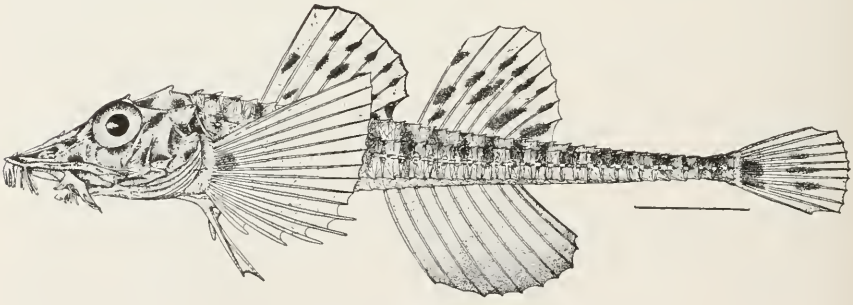

FIG. 9.—PODOTHECUS ACCIPITER.

Okhotsk Sea; one specimen collected at Robben Island by Capt. J. G. Blair. It is 8 inches in length.

(*accipiter*, a hawk; in allusion to the large fins.)

14. PODOTHECUS STURIOIDES (Guichenot).

Paragonus sturioides GUICHENOT, Nouv. Archiv. Mus., p. 202, pl. XII, fig. 3; China.

Podothecus sturioides JORDAN and EVERMANN, Fish. North and Middle Amer., II, 1895, p. 2063 (copied).

This species from the coast of northern China is known only from Guichenot's description, translated by Jordan and Evermann. A single specimen, 10½ inches long. China. (Guichenot.) Guichenot's figure gives one more ray in anterior dorsal than the description, and gives the caudal fin as strongly concave.

(*sturio* sturgeon; εἶδος, likeness.)

15. PODOTHECUS HAMLINI Jordan and Gilbert.

Podothecus hamlini JORDAN and GILBERT, Rept. Fur Seal Invest., 1896, III, 1898, p. 472; Shana Bay, Iturup Island, Kuril group (type 5662, L. S. Jr. Univ. Mus., Coll. *Albatross*).—JORDAN and EVERMANN, Fish. North and Middle Amer., II, 1898, p. 2056; Iturup Island.

This species is fully described by Jordan and Evermann. A specimen in the Museum of Hakodate from Kayabe seems to belong to it. The types are two specimens from the U. S. Fish Commission steamer *Albatross* station 3653, off Shana Village, Iturup Island, in 18 fathoms.

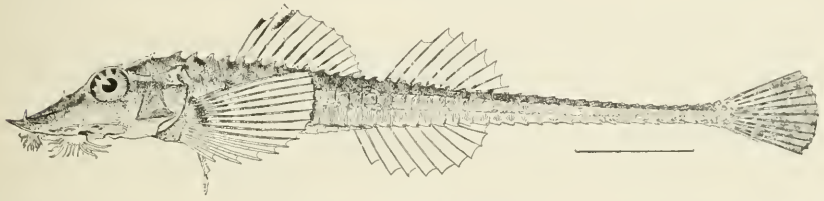

FIG. 10.—PODOTHECUS HAMLINI.

A young individual from *Albatross* station 3646, off Robben Island, 18 fathoms, seems to belong to the same species, but has the snout less produced and the dorsal VIII, 6; anal 8. Dr. Schmidt regards the species as the young of *P. gilberti*. This is possibly the case.

(Named for Charles Sumner Hamlin, late Assistant Secretary of the Treasury, under whose auspices the fur-seal investigations of 1896 and 1897 were carried on by the United States Fur Seal Commission.)

16. PODOTHECUS GILBERTI (Collett).

Agonus gilberti COLLETT, Proc. Zool. Soc. London, 1894, p. 670, pl. XLV; Kamchatka. (Coll. Henry Lund. Types, Mus. Christiania; cotype, 2783, L. S. Jr. Univ. Mus.)

Podothecus gilberti JORDAN and EVERMANN, Fish. North and Middle Amer., II, 1898, p. 2058, from one of Collett's types from Petropavlovsk.

This specimen, originally known from Kamchatka, is recorded from off Cape Pestschnuzoff, Korea, by Peter Schmidt.

(Named for Charles Henry Gilbert.)

17. PODOTHECUS THOMPSONI Jordan and Gilbert.

Podothecus thompsoni JORDAN and GILBERT, Rept. Fur Seal Invest., III, 1896, p. 473, pl. LXXII; off Shana Bay, Iturup Island, at *Albatross* station 3653, in 18 fathoms (type No. 5667, L. S. Jr. Univ. Mus., Coll. *Albatross*).—JORDAN and EVERMANN, Fish. North and Middle Amer., II, 1898, p. 2060; Iturup Island.—SCHMIDT, Faune Mer Japon, 1903, p. 16; Japan Sea, Ochotsk Sea.

Shana Bay, Iturup Island, Kuril group. Recorded by Dr. Peter J. Schmidt, off Cape Pestschnizoff, Korea, in lit. 1903.

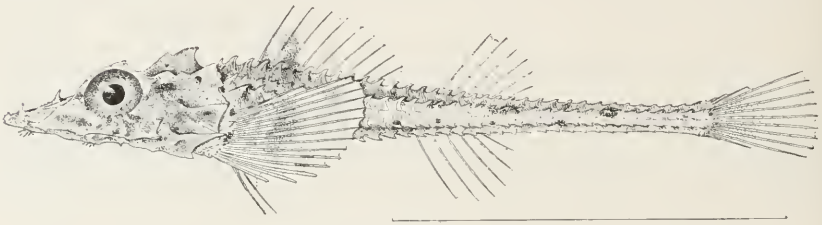

FIG. 11.—PODOTHECUS THOMPSONI.

(This species is named in honor of D'Arcy Wentworth Thompson, of the University at Dundee, commissioner of Great Britain in the fur-seal investigations in Bering Sea in 1896 and 1897.)

18. PODOTHECUS VETERNUS Jordan and Starks.

Podothecus veternus JORDAN and STARKS, Proc. Cal. Ac. Sci., 1895, p. 819, pl. LXXXIX; Robben Island (Coll. Captain Blair. Type presented by Alaska Commercial Company to L. S. Jr. Univ. Mus., No. 4823).—JORDAN and EVERMANN, Fish. North and Middle Amer., II, 1898, p. 2063, same type.

A single specimen, about 8 inches in length, collected by Captain Blair at Robben Island. This species is related to *P. acipenserinus*

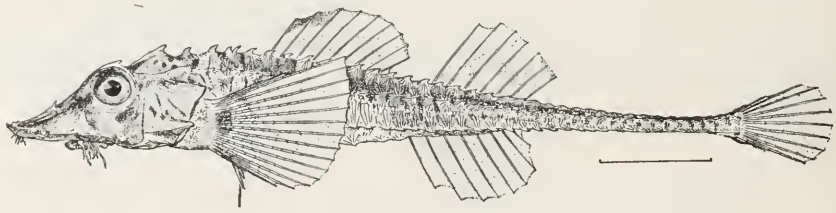

FIG. 12.—PODOTHECUS VETERNUS.

and *P. gilberti*, differing from the former in having fewer and shorter barbels, teeth on jaws obsolete, keel and preopercle larger, dorsal ridges without spines posteriorly, and the spines on the preorbital ridge different in shape; from the latter in having the body different in shape, not everywhere deeper than wide, but the reverse posteriorly; anal much shorter and lower, no teeth on jaws, and the spines on preorbital ridge better developed and different in shape.

(*veternus*, an old man, veteran, in allusion to the want of teeth.)

10. SARRITOR Cramer.

Sarritor Cramer, in Jordan and Evermann, Check-List Fishes, 1896, p. 448 (*frenatus*).

Body tapering uniformly to base of caudal; head 4 to 4½, depth 6 to 8 in standard length. Plates on body nearly all without spines. Plates in dorsal series 38 to 45, 5 to 6 pairs between occiput and first dorsal. No large knife-like plate over eye. Both dorsal fins present, rather long, the rays growing shorter behind the last adnate to back. Four to 6 pairs of barbels about mouth, 1 pair under tip of snout. A pair of recurved spines near tip of snout. One pair of supraocular and 1 or 2 pairs of occipital spines. Teeth on jaws and vomer, none on palatines. Gill membranes joined to isthmus, without free fold; no barbels on gill membranes. Lower rays of pectorals with free exserted tips. Vertebræ, 40 to 46. This genus is very close both to *Podothecus* and to *Odontopyxis*, differing from the former in the presence of vomerine teeth and from the latter in the absence of a free median plate at the tip of the snout. Its relations to *Averruncus* are still closer, the chief difference being in the smooth plates of the body and in the absence of cirri on the gill membranes.

(*sarritor*, one that scrapes.)

a. Snout moderate, about half length of head; ventrals dark in male..... *frenatus*, 19.
aa. Snout very long, produced in a flat, triangular piece, exserted for two-thirds length of orbit; ventrals pale..... *leptorhynchus*, 20.

19. SARRITOR FRENATUS (Gilbert).

Odontopyxis frenatus Gilbert, Rept. U. S. Fish. Comm., 1893, p. 437 (1896); north of Peninsula of Alaska, type 48727, U.S.N.M.—Jordan and Evermann, Fish. North and Middle Amer., II, 1898, p. 2078; same specimens.—Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, 1898, p. 474; Povorotnaya, Kamchatka.—Schmidt, Faune Mer Japon, 1903, p. 16; Japan Sea.

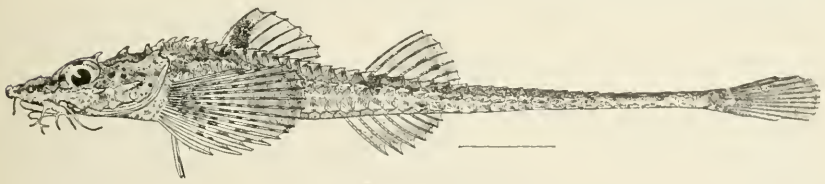

Fig. 13.—Sarritor frenatus.

This species, fully described in the work of Jordan and Evermann, is recorded by Schmidt from Vladivostok.

(*frenatus*, bridled.)

20. SARRITOR LEPTORHYNCHUS (Gilbert).

Odontopyxis leptorhynchus Gilbert, Rept. U. S. Fish Comm., 1893 (1896), p. 437; Bering Sea, north of Alaska Peninsula, at Albatross Station 3267, lat. 55° 23′ 30″ N., long. 163° 29′ W. (Type No. 48727. Coll. *Albatross.*)

Sarritor leptorhynchus Jordan and Evermann, Fish. North and Middle Amer., II, 1898, p. 2073; about the Peninsula of Alaska.—Schmidt, Faune Mer Japon, 1903, p. 16; Japan Sea.

This species, otherwise known from north and south of the Alaskan peninsula, is recorded off Cape Pestschnuzoff, Korea, by Peter Schmidt. It is described in the work of Jordan and Evermann.

(λεπτός, slender; ῥύγχος, snout.)

11. ASPIDOPHOROIDES Lacépède.

Aspidophoroides Lacépède, Hist. Nat. Poiss., III, 1802, p. 228 (*tranquebar-monopterygius*).

Canthirhynchus Swainson, Nat. Hist. Fishes, etc., II, 1839, p. 272 (*monopterygius*).

Body and head very slender; head 4 to 6, width 5 to 8 in length of body; 8 longitudinal rows of plates, the lateral line in upper lateral row; about 40 plates in the dorsal series. Terminal rostral plate present, unarmed; snout with hooked spines directed upward; mouth terminal; teeth on jaws, vomer, and palatines. Supraocular and occipital spines absent; plates of body more or less keeled, without spines. First dorsal absent; second dorsal and anal small, opposite each other, each with 4 to 7 rays. Gill membranes united, narrowly joined to isthmus anteriorly, free behind.

(ἀσπίς, shield; φορέω, to bear; εἶδος, form.)

21. ASPIDOPHOROIDES BARTONI Gilbert.

Aspidophoroides bartoni Gilbert, Rept. U. S. Fish Comm., 1893 (1896), p. 434; Aleutian Islands, Bristol Bay, Alaska (Coll. *Albatross*).—Jordan and Evermann, Fish. North and Middle Amer., II, 1898, p. 2092; Aleutian Islands, Bristol Bay, Pribilof Islands.—Jordan and Gilbert, Rept. U. S. Fur Seal Comm., III, 1898, p. 475; Pribilof Islands, Unalaska, Medni Island.

Aleutian Islands; taken very abundantly both north and south of the Aleutian Islands and in Bristol Bay, at depths of 17 to 121 fathoms. Also found about the Pribilof Islands. A specimen from Kayabe Island off Hokkaido is in the Imperial Museum of Tokyo.

(Named for Mr. Barton A. Bean.)

12. ANOPLAGONUS Gill.

Anoplagonus Gill, Proc. Acad. Nat. Sci. Phil., 1861, p. 259 (*inermis*).

This genus differs from *Aspidophoroides* in the absence of nasal spines.

(ἄνοπλος, unarmed; *Agonus*.)

22. ANOPLAGONUS INERMIS Günther.

Aspidophoroides inermis Günther, Cat., II, 1860, p. 524; Vancouver Island.—Lütken, Ulkefiske, Vidensk. Meddel. Naturhist. Foren. Kjöb., 1876, p. 385.—Jordan and Gilbert, Synopsis, 1883, p. 725.—Jordan, Cat. Fishes N. A., 1885, p. 113.—Jordan and Evermann, Fish. North and Middle Amer., II, 1898, p. 2093; Vancouver Island, Bristol Bay, Aleutian Islands.—Schmidt, Faune Mer Japon, 1903, p. 16; Japan Sea.

Anoplagonus inermis Gill, Proc. Ac. Nat. Sci. Phila., XIII, 1861, p. 167.

Coast of Alaska, south to Vancover Island; not abundant; recorded from Vancouver Island (Günther); eastern Aleutian Islands, 34 to 59 fathoms, and Bristol Bay. (Gilbert.) Specimens were taken by Peter Schmidt off Cape Pestschnuzoff, Korea.

(*inermis*, unarmed.)

SUMMARY.

Family AGONIDÆ.

1. *Tilesina* Schmidt.

1. *gibbosa* Schmidt.

2. *Percis* Scopoli.

2. *japonica* (Pallas).

3. *Agonomalus* Guichenot.

3. *proboscidalis* (Valenciennes); Hakodate.
4. *jordani* Schmidt; Shiraoi; Hakodate.

4. *Hypsagonus* Gill.

5. *quadricornis* (Cuvier and Valenciennes)

5. *Occa* Jordan and Evermann.

6. *dodecaedron* (Tilesius); Iturup Island.
7. *iburia* Jordan and Starks; Tomakomaki.

6. *Brachyopsis* Gill.

8. *rostratus* (Tilesius); Iturup Island, Hakodate.
9. *segaliensis* (Tilesius).

7. *Pallasina* Cramer.

10. *barbata* (Steindachner); Nemuro, Aomori, Mororan.

8. *Dracisceus* Jordan and Snyder.

11. *sachi* Jordan and Snyder; Kayabe, Aomori.

9. *Podothecus* Gill.

12. *tokubire* Ishikawa.
13. *accipiter* Jordan and Starks; Robben Island.
14. *sturioides* (Guichenot).
15. *hamlini* Jordan and Gilbert; Iturup Island, Kayabe.
16. *gilberti* (Collett).
17. *thompsoni* Jordan and Gilbert; Iturup Island.
18. *veternus* Jordan and Starks; Robben Island.

10. *Sarritor* Cramer.

19. *frenatus* (Gilbert).
20. *leptorhynchus* (Gilbert).

11. *Aspidophoroides* Lacépède.

21. *bartoni* Gilbert; Kayabe.

12. *Anoplagonus* Gill.

22. *inermis* Günther.

THE OSTEOLOGY OF SOME BERYCOID FISHES.

By Edwin Chapin Starks
Of Stanford University.

The material upon which this paper is based represents five families of Berycoid fishes, as follows:

Trachichthyidæ, represented by *Hoplostethus japonicus* Hilgendorf.

Berycidæ, represented by *Beryx splendens* Lowe.

Holocentridæ, represented by *Holocentrus ascensionis* (Osbeck) and *Myripristis occidentalis* Gill.

Polymixidæ, represented by *Polymixia japonica* Günther.

Monocentridæ, represented by *Monocentris japonicus* (Houttuyn).

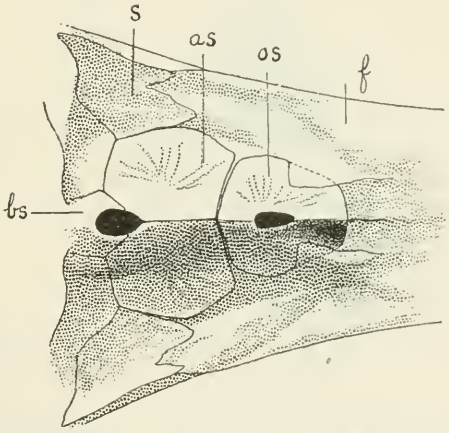

Fig. 1.—View of lower side of cranium of Beryx splendens, showing the orbitosphenoid. The parasphenoid has been removed. *as*, alesphenoid; *bs*, basisphenoid; *f*, frontal; *os*, orbitosphenoid; *s*, sphenotic.

These families are held together by some very constant characters, the most important of which, aside from the increased number of ventral rays, is the presence of well-developed orbitosphenoids.[a]

When such diverse families as these possess so important a character, seconded as it is by several minor ones, it seems justifiable to base a group upon it.

[a] It is remarkable to find this archaic character among the spiny-rayed fishes, though it is well in keeping with the pneumatic duct to the esophagus, which some of the Berycoid fishes are said to have.

The presence of orbitosphenoids is common among the lower forms from the Bony Ganoids up to and including the Salmonoids. So far as the author can ascertain, they hitherto have not been found in forms more specialized than the last. They have been searched for in vain in the following: *Aulopus*, *Synodus*, *Esox*, *Fundulus*, *Aphredoderus*, and nearly all of the families of Hemibranchs, Synentognaths, and Percesoces.

SYNOPSIS OF CHARACTERS OF THE BERYCOIDEA.

Orbitosphenoids present; meeting each other at their inner edges, and joined at an angle, either by simple suture or by ankylosis. Exoccipitals broadly joined to each other, and to the basioccipital, together forming a simple concave occipital condyle. The pit of the basioccipital above the middle of the bone, or near the middle of the entire condyle.[a] Atlas more or less modified or convex to fit the occipital condyle; never deeply concave; the pit more or less obliterated, never deep and at the middle of the centrum. Interorbital septum always single. Myodome large in front, closed abruptly behind, or open to the exterior posteriorly only through a pore. Basisphenoid with a descending process. Head usually with conspicuous mucous cavities. A suborbital shelf present on the suborbital ring. Maxillary with a large

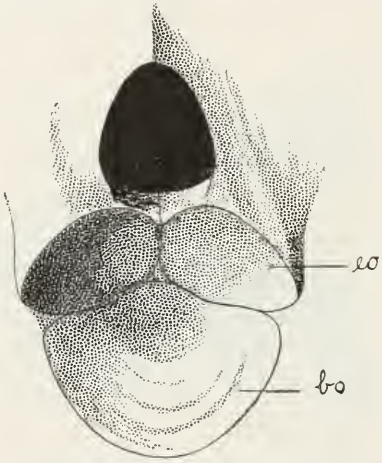

FIG. 2.—OCCIPITAL CONDYLE OF HOPLOSTETHAS JAPONICUS. *bo*, BASIOCCIPITAL; *co*, EXOCCIPITAL.

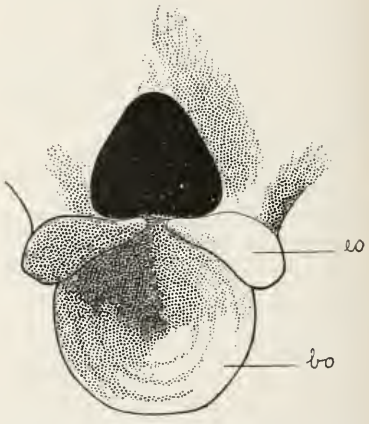

FIG. 3.—OCCIPITAL CONDYLE OF A TYPICAL PERCOID FISH. *bo*, BASIOCCIPITAL; *co*, EXOCCIPITAL.

supplemental bone. Nasals usually very large. Actinosts placed high; at least three of them on the hypercoracoid. Inner edge of pelvic bones, when thoracic, elevated and united; the opposite sides arching away from each other and meeting or nearly meeting below, inclosing a chamber between them; the bones usually deep, sharp, and compressed at the anterior end. Superior pharyngeals, 2 or 3. Ventral soft rays usually more than 5 (reduced in number in *Monocentris*). A pneumatic duct connecting the air bladder with the esophagus said to be present in some of the families. Vertebræ 24 to 30. Anal long or moderately long.

[a] Typically in the spiny-rayed fishes, the basioccipital forms a concave condyle, with a deep pit directly at its middle. The exoccipitals are separate, or narrowly connected, and present flat oblique zygapophyses for the atlas, which has a deep pit directly at the middle of the centrum.

REJECTED FAMILIES.

Several forms have been examined which have been placed with the Berycoids at different times, but which are not related, or at least not closely enough to be retained in the group.

The family Mullidæ has been associated with the Polymixidæ because both families have barbels at the anterior end of the hyoids, though they differ in most other respects.

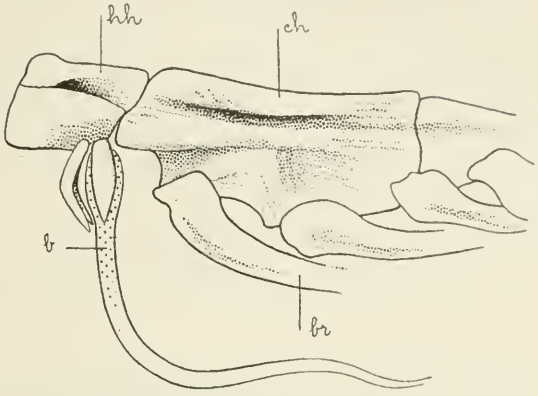

FIG. 4.—HYOID OF POLYMIXIA JAPONICA. *b*, BARBEL; *br*, BRANCHIOSTEGAL RAY; *ch*, CERATOHYAL; *hh*, HYPOHYAL.

Though apparently similar the barbels are not exactly of the same character. In the Polymixiidæ each barbel is suspended from the lower edge of the hypohyal, where three modified branchiostegal rays curve around its thickened base (as described elsewhere in this paper). In the Mullidæ the barbel is suspended from the extreme tip of a slender, nearly straight ray of bone attached to the end of the ceratohyal, which is exserted beyond the hypohyals. This bone forms an integral part of the barbel, appearing as its ossified base.

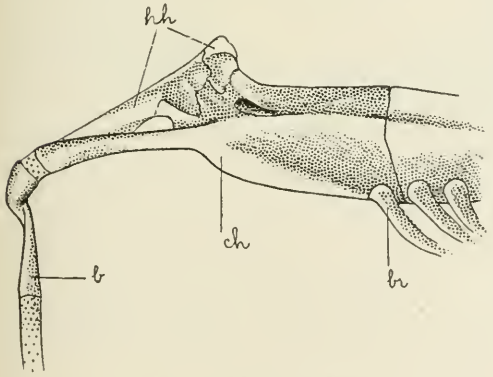

FIG. 5.—HYOID OF MULLOIDES AURIFLAMMA. *b* BARBEL; *br*, BRANCHIOSTEGAL RAY; *ch*, CERATOHYAL; *hh*, HYPOHYALS.

The family Aphredoderidæ has little in common with the Berycoid fishes, except the increased number of ventral rays. The orbitosphenoids are absent. There are two interorbital septa, which are widely separated. The exoccipitals are rather broadly connected, but the atlas is unmodified. The myodome, basisphenoid, suborbital shelf, and supplemental bone to the maxillary are all absent. The pelvic bones are forked,[a] and only

[a] It appears probable that parts of some skeleton other than that of *Aphredoderus* have become mixed with Doctor Boulenger's specimen. He states that the pelvic bones are not forked, as described by Cope and Woodward, and that there is a suborbital shelf. In my specimens the pelvic bones are distinctly and widely forked, and, though I have carefully examined three specimens, I have found no process on the inner edge of the suborbital ring.

loosely joined to each other by a ligament between the tips of the inner forks. The anal is very short. The vent is in front of the base of the ventrals.

The family Pempheridæ can not be admitted to the group. It shows some relationship to the Bramidæ, and possibly belongs near that family. The orbitosphenoids are absent. The exoccipitals are broadly united, but the basioccipital and atlas are unmodified, and the pit of each is deep and located at the center. The maxillary has no supplemental bone. The ventral soft rays number 5. The pelvic girdle is not compressed anteriorly but reaches to a sharp point, and is otherwise as in the Percoid fishes.

DESCRIPTIONS OF SKELETONS.

HOPLOSTETHUS JAPONICUS Hilgendorf.

CRANIUM.

The cranium has very high ridges, the walls of which are pierced by large holes, allowing communication between the cavities. The frontals above the middle of the orbital cavity, the bridge connecting the frontal ridges, and a region at the middle of the nasals are thin and honeycombed by small holes of irregular size, giving the bone a lace-like texture. A high ridge beginning at the anterior median line between the frontals diverges and runs back to the posterior end of each frontal above the parietal. A ridge curves back on each frontal from the anterior outer angle to the posterior end below the parietal, and is connected at about its middle to the upper frontal ridge by a wide horizontal bridge. Posteriorly between these ridges, and from the end of the connecting bridge, is a ridge running to the end of the parietal. A median ridge on the nasals runs forward from the median frontal ridge and diverges in front. From the anterior end of this ridge a ridge runs outward and backward on each nasal and forks near its middle, the anterior fork running to the side of the nasal, the posterior one to the posterior outer angle. The auditory bulla is large and has a very large cartilaginous area bounded by the parasphenoid, the exoccipital, the basioccipital, the opistholic, and the prootic. The myodome is large, but its mouth is somewhat constricted.

The basioccipital spreads very wide over the lower surface of the auditory bullæ. Its posterior end forms about half of the occipital condyle. The pit is near its upper edge. The supraoccipital does not project between the posterior ends of the frontals. Its crest does not extend above the rest of the cranium. The epiotic is but slightly covered by the parietal. It has no shelf projecting backward. The pterotic has a pair of rather sharp outward-projecting processes. The opisthotic is thickened, and the lower limb of the posttemporal is articulated closely to it without the agency of a ligament. The frontals end squarely in front, and do not extend beyond the pre-

frontals. The basisphenoid sends a process down to the parasphenoid. The process is extremely slender above, but grows wide below. The alisphenoids do not meet at the median line. The orbitosphenoids are moderate in size, and no suture is visible between them. There is a median hole in front of which they are drawn out into a very sharp, thin keel. The parasphenoid sends up large basitemporal wings, and spreads widely over the lower surface of the auditory bullæ. It extends posteriorly over the anterior fourth of the basioccipital, ending in a very small, slender, sharp process. The prefrontals are large bones pierced at their center by the olfactory foramen. They are separated only by cartilage except at their upper ends anteriorly, where the small ethmoid is interposed. The ethmoid is almost obsolete. It is a small thin bone, overlying cartilage, and it does not extend half the distance between its upper edge and the vomer. The

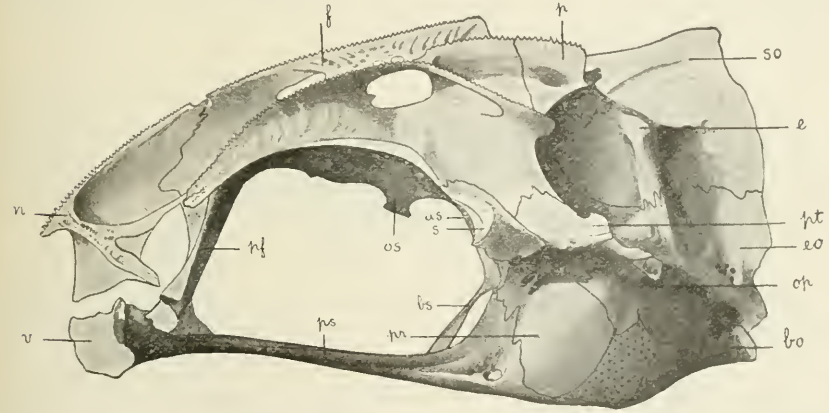

FIG. 6.—HOPLOSTETHUS JAPONICUS. *as*, ALISPHENOID; *bo*, BASIOCCIPITAL; *bs*, BASISPHENOID; *e*, EPIOTIC; *eo*, EXOCCIPITAL; *et*, ETHMOID; *f*, FRONTAL; *n*, NASAL; *op*, OIPSTHOTIC; *os*, ORBITOSPHENOID; *p*, PARIETAL; *pf*, PREFRONTAL; *pr*, PROOTIC; *ps*, PARASPHENOID; *pt*, PTEROTIC; *s*, SPHENOID; *so*, SUPRAOCCIPITAL; *v*, VOMER.

nasals are very large bones, attached for nearly their whole length to each other, and by their entire posterior end to the wide frontals. They arch widely over the prefrontals, inclosing a chamber behind them.

FACE BONES.

The hyomandibular has an undivided head. From its inner upper edge a slender process descends toward a shorter one on the metapterygoid, but does not nearly reach it. The metapterygoid has no foramen. Its lower part is scarcely ossified. The symplectic is long and slender. Between its lower side and the angle of the preopercle there is a large open space. The preopercle is long, and the edges of its vertical limb are parallel. At its angle two bridges of lace-like bone span a large, deep channel; the lower one is much the larger and projects back as a stout spine. The subopercle is scarcely ossified. The angular is present. There is a large channel along the lower side

of the mandible, which is bridged once at the articular and twice at the tip of the dentary. There is no open space between the upper edge of the articular and the upper limb of the dentary. The premaxillary is long and slender, and has a moderate process. There is a very large supplemental bone on the upper edge of the maxillary, extending down over its outer surface nearly to its lower edge. The preorbital is not differentiated from the suborbitals. The suborbital ring is wide and cavernous. On the second suborbital is a slender triangular suborbital shelf, hooked backward. The other face bones are as in the Percoids.

HYOID.

The ceratohyal has a very large foramen through its middle. There are six branchiostegal rays on the ceratohyal and two on the epihyal. The hypohyals are wide and flat; the lower one is much the larger. The urohyal has a pair of small longitudinal basal wings. No glossohyal is present.

PHARYNGEALS.

The lower pharyngeals are slender and separate. There are two superior toothed pharyngeals on each side; that of the second arch is small and slender; that of the third and fourth is a large elongate patch, rounded behind and reaching to a point in front.

SHOULDER GIRDLE.

The hypocoracoid arches widely away from the clavicle, leaving a wide space between. Its lower limb is very slender. The hypercoracoid meets the hypocoracoid in a long straight suture. Its foramen is moderate and near its center. Three of the actinosts are on the hypercoracoid and one on the hypocoracoid. The first ray of the pectoral works directly on the hypercoracoid, as usual. The postclavicle is a single piece, formed as when in two pieces, the upper part widened into a thin plate, the lower a slender ray. A rather long superclavicle is present. The posttemporal is widely forked. Its upper fork is developed backward in a thin plate, which bears a large ridge ending in a stout spine behind.

PELVIC GIRDLE.

The opposite halves of the pelvic girdle are attached only for a short distance at their points and posteriorly at the ends of short projecting processes, leaving a space between them at their middle. Anteriorly the upper and lower edges of each arch inward inclosing a chamber between.

VERTEBRAL COLUMN AND APPENDAGES OF VERTICAL FINS.

Abdominal vertebræ 11 + caudal 14 + hypural = 26. The atlas is shallowly concave and the pit is near its upper edge. The sixth vertebra bears the first parapophyses. The opposing parapophyses are connected, and a haemal canal is formed. Posteriorly they are

lengthened, and are scarcely differentiated from the haemal spines. There are two auxiliary interneurals. The interneurals nearly agree in number with the neural spines. The first interhaemal is not enlarged or otherwise differentiated. Spines from the last two vertebræ assist the hypural in supporting the caudal fin.

BERYX SPLENDENS Lowe.

CRANIUM.

The cranium as viewed from above is widest at the pterotics; it thence narrows forward in long, regular curves to the nasals. It is much depressed in the parietal region. A long ridge runs from the anterior end of the frontal, meeting its fellow of the opposite side above the ethmoid; thence runs back across the frontals, sphenotic, and pterotic, at the posterior end of which it ends.

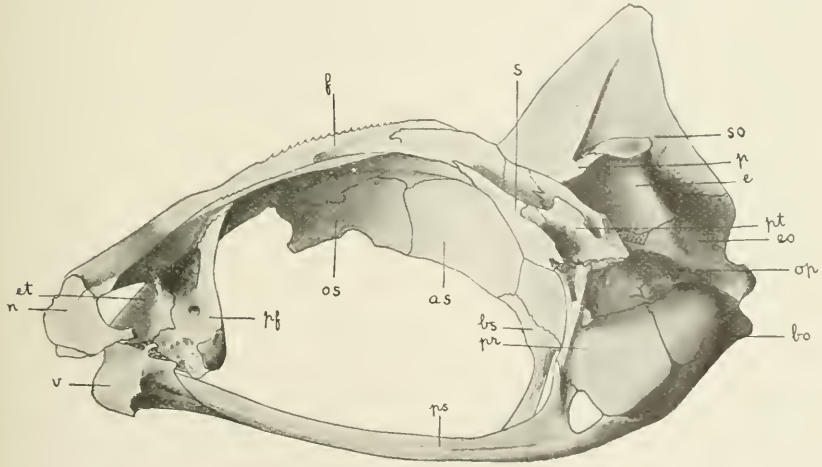

FIG. 7.—BERYX SPLENDENS.
For lettering see fig. 6.

As the cranium is viewed directly from the side the supraoccipital crest is seen to be high and triangular, rising far above the rest of the cranium. Its apex is directly above the epiotic. It appears to end anteriorly above the alisphenoids, as shown in the drawing. It, however, is continued anteriorly by the frontals to above the anterior fourth of the orbital cavity, being hidden in this view by the high frontal ridges. The occipital condyle projects far posterior to the pterotic region. The posterior ventral outline of the cranium is rounded steeply downward and forward to below the beginning of the orbital cavity, and continues in a more gentle curve over the parasphenoid. The auditory bulla is large and projecting. Its investing bones are thin and polished. At the junction between the pterotic, epiotic, exoccipital, and sphenotic there is an area of cartilage. On the auditory bulla there is a similar area between the prootic, basi-

occipital, exoccipital, and parasphenoid. The myodome is very large at its mouth, but abruptly grows narrow a short distance back. It does not open to the exterior posteriorly. The cranial cavity is entirely closed anteriorly except in two places, one small hole through the orbitosphenoid and one between the basisphenoid and alisphenoid.

The basisphenoid widens over the base of the auditory bulla. It forms but little over a third of the occipital condyle. The supraoccipital is but little covered by the parietals. It ends squarely at the frontals, without dividing them at their ends. A strengthening ridge runs upward on its crest from the base to the point. The parietals are elongate and project anteriorly beyond the supraoccipital. Posteriorly they cover the top of the epiotic to the articulation of the post-temporal. The epiotics have no backward projecting process. The surface over which the post-temporal lies is large and nearly horizontal. The opisthotic covers the suture between the exoccipital and the pterotic below. It has a slight nodule developed, to which the lower limb of the post-temporal is closely joined. The parasphenoid is long and narrow. It sends basitemporal wings upward at the mouth of the myodome, which join descending processes from the prootics, inclosing behind a large lateral opening into the myodome. The parasphenoid grows broad over the floor of the myodome, and then abruptly narrow, running backward in a depression in the basioccipital. It ends in a point some distance from the end of that bone. The basisphenoid sends a long, slender process down to the parasphenoid. Anteriorly the basisphenoid extends partly around a hole into the cranial cavity. The large alisphenoids meet broadly at the median line. Posteriorly they are notched by the hole between them and the basisphenoid. The orbitosphenoids are large. They meet at an angle and ankylose. There is a small hole at the median line opening into the cranial cavity. The frontals project widely over the ethmoid to opposite the front of the vomer. Anterior to the ethmoid they are divided, leaving a large notch. The prefrontals are in contact behind, but are separated in front by the ethmoid. The olfactory foramen pierces them transversely across the cranium. There is an area of cartilage between the ethmoid and the vomer. The nasals are large and are attached to the ends of the projecting frontals. They nearly touch each other in front and develop laterally around the end of the snout, inclosing a chamber behind.

FACE BONES.

The opercle has a prominent ridge and two slight ones radiating from a common center. Between each ridge its posterior edge is concave. Its upper end extends above the head of the hyomandibular. The subopercle is very thin and flexible, and only slightly calcified. The preopercle is deeply channeled and has two rough spines at the

angle of its prominent ridge. Its lower edge is sharply denticulate. The interorbital is rather broad, but is almost completely covered by the preopercle. Its lower edge is sharply denticulate. The hyomandibular has an undivided head. Its form is elongate and rather simple. There is no opening between it and the metapterygoid, or symplectic. The metapterygoid is a simple flat bone without any foramen or outer wing. There is a space between the upper edge of the articular and the upper limb of the dentary. The angular is present. A very large auxillary bone extends along more than half of the posterior upper edge of the maxillary, and reaches down over the face of it to the lower edge. The suborbital ring is long and narrow, and with a deep channel. The suborbital shelf is elongate and narrow.

SHOULDER GIRDLE.

The hypocoracoid arches away from the clavicle, leaving a wide open space between. The hypercoracoid foramen is small and just above the middle of the bone. The four actinosts are in contact for their whole length, leaving no open space between. They grow larger downward. They are all on the hypercoracoid except about half of the lower one. The upper ray of the pectoral works directly on a condyle on the hypercoracoid. The postclavicle is in two pieces, the upper piece wide and thin, the lower long and slender. The supraclavicle is present. The post-temporal is widely forked and normally attached to the cranium.

PELVIC GIRDLE.

Each side of the pelvic girdle extends upward anteriorly at its inner edge, so that it is deeper than wide, and compressed to a thin vertical edge. Its upper angle is produced into a slender process which extends between the two sides of the shoulder girdle a distance above the points of the clavicles. At its posterior end between the fins is a triangular sharp process.

HYOID ARCH.

Branchiostegals seven; five of which are borne by the ceratohyal and two by the epihyal. The ceratohyal has a large foramen through its center. The hypohyals are wide and flat, the inferior the larger. The glossohyal is very small. The urohyal is a large, triangular, thin bone, without ridges or wings.

PHARYNGEALS.

The inferior pharyngeals are large, separate, their inner edges in contact. There are three toothed superior pharyngeals on each side. That of the second arch is long and narrow, that of the third and fourth together forming an ovate patch, having the line of separation at the posterior third.

VERTEBRAL COLUMN AND APPENDICES OF THE UNPAIRED FINS.

Abdominal vertebræ 10+caudal 14+hypural=24. The atlas is irregularly convex to fit the modified occipital condyle. The sixth vertebra has the first pair of parapophyses developed. The posterior pairs are unconnected by a bridge at their bases. The first two vertebræ bear only single rays in line with the intermusculars, which are developed only on the first few ribs. The neural spines are directed rather irregularly. The interneurals are in greater number than the neural spines below them. Posteriorly the interneurals become directed backward so that they meet the neural spines at an angle, though the latter at this point are somewhat turned forward. The appearance of the interneurals indicate that while holding their connection with the neural spines the dorsal rays have become crowded together. There are four auxiliary interneurals in front of the ray-bearing ones. The first interhæmal is enlarged and expanded in front into a wide, flat plate of bone. The interhæmals exceed the hæmals in number, three or four to one.

HOLOCENTRUS ASCENSIONIS (Osbeck).

CRANIUM.

The top of the cranium is transversely uniformly convex. The occipital crest is developed backward, and not at all above the rest of the cranium. The auditory bulla is moderately large, elongate, tube-like, opening to the exterior at its posterior end in a rather large, round hole, which is stopped by a lateral anterior process from the air bladder. The hole is bounded on its inner and lower edges by the basioccipital, on its outer edge by the prootic, and above by the exoccipital. The myodome is large, but is not continued back in a tube. The anterior opening to the cranium is restricted to a very small slit in the middle of the anchylosed orbitosphenoids, and a slightly larger hole, inclosed at its sides and posterior end by the basisphenoid, at its anterior end by the united alisphenoids.

The supraoccipital shows very little of its upper surface, being covered by the frontals, but projecting slightly between their posterior ends. Its crest is confined entirely to its posterior vertical surface. The basioccipital and exoccipitals form the occipital condyle as usual, though the notch between them is deeper than in the other families. The pit in the basioccipital is near its upper edge. Just anterior to the condyle, and between the openings to the auditory bullæ, the basioccipital is compressed. The frontals are exceedingly large, projecting posteriorly almost to the posterior angle of the cranium, where the cranium drops off at a right angle, and becomes vertical. They cover almost the entire parietals, which in turn cover the upper surface of the epiotics, the supraoccipital, as described, and much of the

upper surface of the pterotics. Anteriorly they do not project beyond the ethmoid. Between their anterior ends there is a large pit for the reception of the premaxillary processes. On their upper surface, behind the eyes, they are armed with stout, smooth, radiating ridges, each ending in a spine posteriorly. The epiotic has a large articular facet, for the accomodation of the post-temporal, projecting laterally to a point. The opisthotic is entirely inferior, presenting a nodule to the lower limb of the post-temporal. The basisphenoid sends a very long, strong process down to the parasphenoid. The alisphenoids meet at the median line. The orbito-sphenoids meet at a right angle and are fused into a solid plate, which has a small slit through its middle. The parasphenoid sends out a long lateral wing on each side, below the orbital cavity. Behind the basitemporal wings, which it sends up to the prootics, is a small opening into the myodome. Posteriorly it ends in a point without reaching to the occipital condyle.

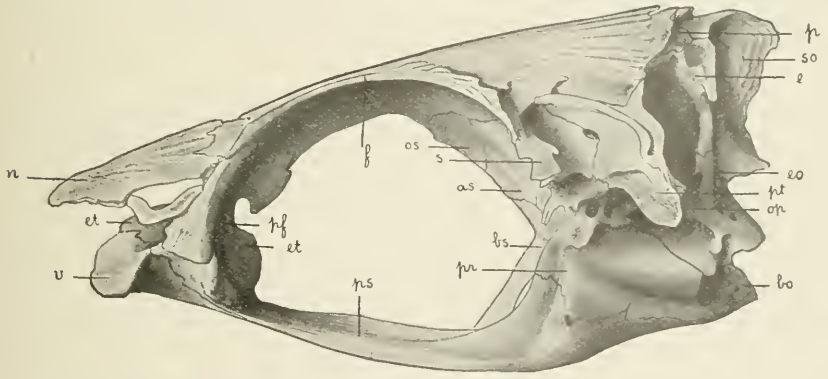

FIG. 8.—HOLOCENTRUS ASCENSIONIS.
For lettering see fig. 6.

The prefrontals are nowhere in contact, the ethmoid projecting both before and behind them. The olfactory foramen is between the ethmoid and the prefrontal, each bone forming about half of it. The nasals are about twice as long as wide, projecting far over the ethmoid, leaving an olfactory chamber beneath. At each side there is a small, curved, auxilary nasal, which arches away from the base of the nasal on the prefrontal and joins it again at about the middle of its outer edge, inclosing a round space (probably the nostril). The same bone is present in *Myripristis*.

FACE BONES.

The opercular bones all have smooth ridges, each ending in a small, sharp spine. The preopercle is scarcely channeled. The hyomandibular has a divided head. There is a small opening between the metapterygoid and the hyomandibular. The former has a very slight outer wing developed. The symplectic is large and bent to conform

to the angle of the preopercle. The angular is present. There is a large space between the upper edge of the articular and the upper limb of the dentary. The maxillary has two supplemental bones; the anterior very small and round, the posterior very large, extending along more than the posterior half of the upper edge of the maxillary and over its outer surface to a longitudinal ridge near its lower edge. The premaxillary has very large backward extending processes. The suborbital chain is narrow and is not channeled on its outer side. The suborbital shelf is very large, extending nearly around the entire chain.

HYOID.

The cerato and epihyals have a deep channel along their outer surface near their upper edge. Neither of them is pierced. Six branchiostegal rays are on the former and two on the latter. The lower hypohyal is much larger than the upper one. The glossohyal is large and flat. The urohyal is large and triangular, and there is the beginning of a longitudinal lateral wing along its lower edge.

SHOULDER GIRDLE.

The hypocoracoid arches away from the clavicle, leaving a wide space between. There is a very large foramen through the center of the hypercoracoid. Three and a half of the actinosts are on the hypercoracoid, and a half of the lower one is on the hypocoracoid. The postclavicle is in two pieces. The superclavicle is present. The posttemporal is widely forked. Its upper fork is widened into a large "surface plate," which is denticulate behind.

PELVIC GIRDLE.

The pelvic girdle is triangular as viewed from the side, being deep and compressed anteriorly and depressed posteriorly. The inner edges arch up and meet at the median line, inclosing below them a large chamber. At the posterior end there is a wing developed posteriorly and laterally over the base of the fins. From the under side of the posterior end a pair of long slender processes project anteriorly.

PHARYNGEALS.

The lower pharyngeals are somewhat triangular. Half of their inner edges are in contact but are not connected. There are three superior pharyngeals on each side. That of the second arch is very slender, carrying scarcely more than a single row of fine teeth. That of the third arch is the largest, somewhat triangular, and better separated from the third pharyngeal than in the other families. The third pharyngeal is ovate in shape and of about half the size of the second.

VERTEBRAL COLUMN AND APPENDAGES OF VERTICAL FINS.

Abdominal vertebræ 11 + caudal 15 + hypural = 27. The atlas is irregularly convex to conform to the occipital condyle. The upper half is separated from the lower by a transverse ridge, under the middle of which is a slight depression. The sixth vertebra bears the first pair of parapophyses. The posterior parapophyses are connected with their fellows of the opposite side by a bridge of bone, forming a hæmal canal beneath. The first two vertebræ bear only intermuscular rays. Each anterior rib is longitudinally widened above into a thin plate. The posterior ones are widened transversely, the last pair being extremely wide and forming wing-like processes at each side of the first interhæmal spine. The intermusculars extend posterior to the abdominal cavity. The interspinous rays of the spinous dorsal coincide in number with the vertebral spines. Those of the soft dorsal and anal exceed them about two to one. The first interhæmal is exceedingly long and stout. It is formed by the fusing of three spines. There are two auxiliary interneurals anterior to the spine-bearing ones. The spines of the last two vertebræ assist the hypural in supporting the caudal fin. The two vertebræ immediately in front of these have the spines above and below flattened into plates.

MYRIPRISTIS OCCIDENTALIS Gill.

CRANIUM.

The cranium differs from that of *Holocentrus* in having the mucous channels better developed and the bones not so thick and solid. The posterior part of the cranium does not turn vertically downward at a right angle with the top. The frontals are not so large and do not project over the parietals so much. The epiotic is not covered by the parietal. The depression for the reception of the premaxillary process is small and scarcely extends between the frontals. The condition of the anterior opening to the brain case is as in *Holocentrus*. The alisphenoids are joined at the median line, and the orbitosphenoids are fused into a single V-shaped plate. The ethmoid does not project backward between the prefrontals, which are in contact behind. The olfactory foramen is through the prefrontal, rather than between it and the ethmoid. The auditory bulla does not extend back tube like and open in a round hole, but the entire side of the bulla is open. The open space is surrounded by the same bones that it is in *Holocentrus*. The air bladder sends lateral processes forward in the same way, covering the opening. The rest of the skeleton is essentially as in *Holocentrus*.

POLYMIXIA JAPONICA Günther.

CRANIUM.

The top of the head is slightly depressed in the region above the alisphenoids. The frontals have each a thin bony tunnel, which opens anteriorly at the nasals, and laterally a short distance behind the prefrontal. A thin high ridge runs from the posterior end of the pterotic, along the frontal, becoming low anteriorly, and disappearing a little in front of the orbital cavity or opposite the anterior end of the supraoccipital crest. The supraoccipital crest rises well above the rest of the cranium. The myodome is large and is continued backward as a tube, which narrowly opens to the exterior posteriorly under the end of the parasphenoid. The anterior opening to the brain case is unobstructed except by the orbitosphenoids, which narrowly bridge the alisphenoids. The auditory bulla is moderate, not much projecting, and formed by thin polished bones. There is an area of cartilage at the junction between the epiotic, the parietal, and the pterotic.

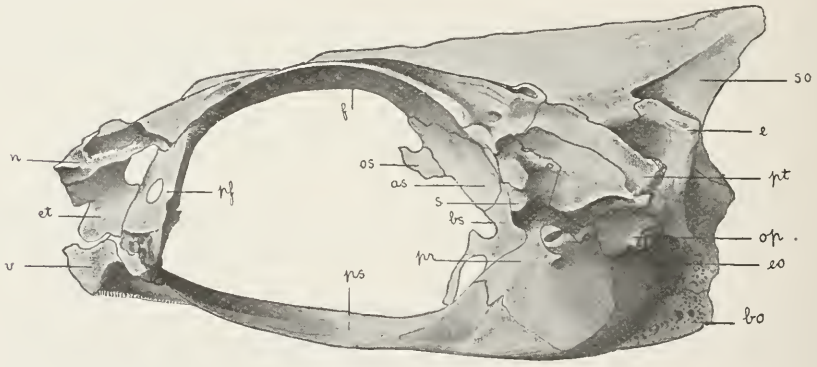

FIG. 9.—POLYMIXIA JAPONICA.
For lettering see fig. 6.

The posterior end of the basioccipital slopes toward the exoccipitals, as is typical for the group. Its usual depression is at its upper edge, and is inclined downward. The epiotics are but slightly covered by the parietals. The surface to which the posttemporal articulates does not project backward as a shelf. The supraoccipital comes between the frontals as a long wedge, separating them for two-thirds of their length. The opisthotics are well developed. They overlie the suture between the pterotic and the exoccipital below. To their posterior surface is developed a nodule, to which the lower limb of the posttemporal is closely attached. The parasphenoid is rather wide. Posteriorly it broadens out over the floor of the myodome and is articulated broadly to the prootic, without leaving an open space, as in *Beryx*. It reaches back and ends bluntly at the occipital condyle. The basisphenoid has a slender descending process, which fails to reach the

parasphenoid. Behind it is a small opening. The alisphenoids do not nearly meet at the median line, but are bridged by the small orbitosphenoids. The orbitosphenoids meet at an angle and are fused into a small Λ-shaped plate which is placed between the alisphenoids near their anterior end, leaving a small space anteriorly between them and the frontals. The frontals do not project over the ethmoid anteriorly. The prefrontals are united behind, but are separated by the ethmoid anteriorly. The olfactory foramen, which is near their inner edge, is rather large. The nasals are not very large, nor do they inclose a chamber between them, as in *Beryx*. They are attached to each other and to the ethmoid by rough suture.

SHOULDER GIRDLE.

The hypocoracoid arches away from the clavicle leaving a large open space between. The hypercoracoid foramen is very large and near the middle of the bone. The four actinosts are all on the hypercoracoid except about half of the lower one. They are elongate, cylindrical, not in contact except at the ends, and grow longer downward. The upper ray of the pectoral works directly on a condyle on the hypercoracoid. The postclavicle is in two pieces, arranged as usual, with the upper piece thin and wide and the lower long and slender. The supraclavicle is present. The posttemporal is widely forked.

PELVIC GIRDLE.

The pelvic girdle is abdominal but anterior. Its anterior point in a specimen 8½ inches long is nearly three-fourths of an inch from the union of the tips of the clavicles below. It is not high and vertical as in *Beryx*, but wide and depressed. The two halves are joined posteriorly, and only for a short distance at their points, leaving a wide open space between them at their middle. The posterior union is peculiar. A long spur is developed on each side toward the opposite side at a right angle to the ventral fins. They overlap each other for their whole length, that of the right side being uppermost. A long sharp process is developed posteriorly from each side between the ventral fins.

LATERAL BONES OF HEAD.

The head of the hyomandibular is divided where it articulates with the cranium. The anterior edge of the hyomandibular sends a process down to articulate with the metapterygoid, leaving an open space behind. The metapterygoid has a slight outer wing developed which partly extends over the opening between it and the hyomandibular. The symplectic extends in a channel about half way down the inner surface of the quadrate. The preopercle has a large ridge with the usual channel behind it. Its lower edge is sharply toothed. The interopercle is wide but is nearly covered by the peopercle. The

opercle has a strengthening ridge developed on its inner surface extending back from its articulation with the hyomandibular. The lower jaw has a very small angular. There is no space between the upper edge of the articular and the upper limb of the dentary. The maxillary has a large thin supplemental bone on its upper edge near the posterior end. The premaxillary is long and slender and reaches nearly to the end of the maxillary. The suborbital ring has a very long narrow shelf which tapers nearly to each end of it but does not extend on the preorbital. On its outer side there is a deep channel.

HYOID ARCH.

The interhyal is rather long and is attached by a ligament at its lower end to the upper part of the interopercle as well as to the symplectic at its upper end. There is a channel running the length of the ceratohyal and extending on the epihyal. The urohyal is simple and flat without lateral wings or ridges. The hypohyals are paired on each side as usual. There are four unmodified branchiostegal rays; one and a half on the epihyal, and two and a half on the ceratohyal. On the lower hypohyal are too small, curved rays of bone, one fitting closely against and on the inner side of the other, so that it is nearly covered when viewed from the side. The hyoid barbel springs from a point just posterior to the base of these, and around its slightly swollen base they curve and are attached. To the outer side of the barbel is attached a third bone, very thin and flat, which also springs from the hypohyal. These are doubtless modified branchiostegal rays, so the entire number on each side is seven.

PHARYNGEALS.

The lower pharyngeals are straight on their inner edges, and in contact but are not united. There are two toothed superior pharyngeals. That of the second arch is long and narrow, that of the third and fourth is large, ovate, and cut rather square behind.

VERTEBRAL COLUMN AND THE APPENDAGES OF THE UNPAIRED FINS.

Abdominal vertebræ 12+ caudal 15+ hypural =28. The first vertebra is not concave in front, but is modified to fit the unevenly concave occipital condyle. It has a small pit near its center. The third vertebra has the first parapophysis developed. The parapophyses grow more downward posteriorly, and the last two are connected near their bases with their fellows of the opposite side. The first two vertebræ, as usual in the spiny rayed fishes have only small single rays more in line with the intermusculars than with the ribs. The row of intermusculars follows along the parapophyses, a little above the base of the ribs to the last abdominal vertebra, where it arches upward and runs along the sides of the neuropophyses nearly to

opposite the posterior end of the soft dorsal. A lower row of intermusculars runs low along the posterior ribs and is continued on the hæmal spines nearly to opposite the posterior end of the anal. Spines from the last two vertebræ assist the hyplural in supporting the caudal fin. The interspinous rays of the fins exceed in number the spines. The first interhæmal is enlarged (doubtless formed of the united first two or three interhæmals), and is tubular for the reception of the posterior end of the air bladder, as in the genus *Eucinostomus*.

MONOCENTRIS JAPONICUS (Houttuyn).

CRANIUM.

The top of the cranium is full of deep cavities between high ridges which form a complex pattern. The ridges are all very rough on

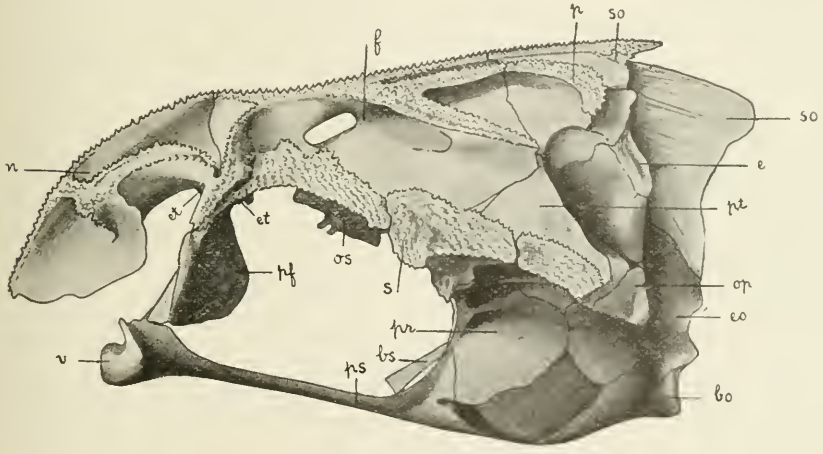

FIG. 10.—MONOCENTRIS JAPONICUS.
For lettering see fig. 6.

their upper edges. On the frontals extending their whole median length the ridges form a diamond. From the posterior point of the diamond the supraoccipital ridge extends back. From the anterior point a ridge runs forward on the nasals, diverging anteriorly. A ridge on each nasal runs backward and outward from the point of divergence of the median nasal ridge to the outer posterior angle of the nasal. From the outer angle of the diamond on each side a pair of ridges diverge backward; the upper one runs over the frontal and parietal, the lower one over the frontal and supratemporal. From the middle of each anterior side of the diamond a ridge runs forward and outward to the anterior outer angle of the frontal. A ridge runs along the supraorbital rim across the sphenotic to the pterotic. The supraorbital rises but slightly above the rest of the cranium. The exoccipitals and the basioccipital mutually assist in forming a

single concave occipital condyle, as described elsewhere. The auditory bulla is rather prominent and there is a very large area of cartilage between the exoccipitals, parasphenoid, basioccipital, and prootic. The myodome is moderate in size and is not continued back in a tube.

The supraoccipital slightly separates the posterior ends of the frontals. Its crest is developed posteriorly, scarcely extending above the rest of the cranium. The epiotic is somewhat covered by the parietal. The surface that receives the posttemporal slopes steeply downward. The opisthotic bends up at a right angle around the posterior surface of the exoccipitals and pterotic. The frontals are wide and truncate anteriorly; they do not extend forward of the ethmoid. The parasphenoid sends up the usual basitemporal wing, but without an opening behind it into the myodome. It ends in a sharp point on the basioccipital some distance from the occipital condyle. The basisphenoid sends down a slender process, which just reaches to the parasphenoid. The alisphenoids do not meet at the median line, leaving a wide opening between them into the cranial cavity. The orbitosphenoids are large, meeting at their inner edges at about a right angle and uniting in a simple suture. The ethmoid is a very small, thin, horizontal plate of bone, lying under the front of the frontals, between the extreme upper end of the prefrontals. Below it is a wide open space between the prefrontals extending down to the vomer. The prefrontals are nowhere in contact. They are not pierced by the olfactory nerve, but deeply notched on their inner edge. The vomer is supported anteriorly only at the extreme upper corners, which touch the prefrontals. The nasals are very large bones, broadly united to the frontals and to each other. They arch widely over the anterior part of the cranium and inclose a chamber behind them.

FACE BONES.

The hyomandibular has an undivided head. There is a small opening between its lower anterior edge and the metapterygoid, which runs downward behind the latter, though no wing is developed in front of it. There is a deep channel around the side of the preopercle connecting with a similar one along the lower part of the mandible. The angular is present. There is a small space between the upper edge of the articular and the upper limb of the dentary. The mesopterygoid has a patch of teeth on its inner surface. The maxillary has a large supplemental bone along the posterior half of its upper edge, and extending down over its surface to its lower edge. The premaxillary processes are rather long and stout. The suborbital ring is very wide and deeply channeled, completely covering the cheek. There is a prominent process on the inner surface of the preorbital, and a long triangular process (the suborbital shelf), hooked downward, on the second suborbital. Other face bones are essentially as in the Percoids.

HYOID.

The interhyal is very long. The ceratohyal is pierced at its middle by a small long foramen. The lower pair of hypohyals is larger than the upper. Seven of the branchiostegal rays are borne by the ceratohyal and one by the epihyal. The urohyal is wide and thin and without longitudinal wings or ridges.

PHARYNGEALS.

The lower pharyngeals are not united but are in contact at the median line. The first branchial arch bears the usual styliform, toothless pharyngeal, but in addition the upper gill-raker is broadened and toothed, and appears as a very small pharyngeal. The pharyngeal of the second arch is very small. That of the third and fourth arches is united into an exceedingly large oval patch, much wider behind than in front. Along the basibranchials and basal ends of the epibranchials are toothed patches, similar in appearance to the surface of the lower pharyngeals.

SHOULDER GIRDLE.

The hypocoracoid arches away from the clavicle, leaving a large opening between. The hypercoracoid foramen is large, and through the middle of the bone. The four actinosts are in contact with each other for their whole length, and all are on the hypercoracoid except the lower one. The first pectoral ray works directly on the hypercoracoid. The postclavicle is a single elongate piece. The supraclavicle is present. The posttemporal is widely forked.

PELVIC GIRDLE.

The pelvic girdle is thoracic, wide, and of complex shape, deep and compressed anteriorly. The ventral spine is locked out by a powerful twisting motion, bringing in close contact roughened surfaces, which engage only on closing the fin.

VERTEBRAL COLUMN AND APPENDAGES OF VERTICAL FINS.

Abdominal vertebræ 11 + caudal 14 + hypural = 26. The anterior vertebræ bear no ribs or intermusculars. The first pair of parapophyses is on the seventh vertebra. The parapophyses grow long posteriorly and are joined in pairs, appearing almost identical with the hæmal spines. The slender ribs are joined to their extreme tips. The pit in the atlas is small, though larger than in the other families. The first interhæmal is scarcely enlarged. The interneural spines of the spinous dorsal equal in number the neural spines under them. Those of the soft dorsal slightly exceed them in number. The interhæmals exceed the hæmal spines two to one. The dorsal spines have oblique bases and open obliquely outward alternately to the right and left. The spines of two vertebræ anterior to the hypural assist in supporting the caudal fin.

A NEW GENUS AND TWO NEW SPECIES OF CRUSTACEANS OF THE FAMILY ALBUNEIDÆ FROM THE PACIFIC OCEAN; WITH REMARKS ON THE PROBABLE USE OF THE ANTENNULÆ IN ALBUNEA AND LEPIDOPA.

By James E. Benedict,
Assistant Curator of Marine Invertebrates.

During 1889 the U. S. Fish Commission steamer *Albatross*, engaged in explorations off the coast of California and Lower California, in the course of which a considerable amount of zoological material was obtained. Among the invertebrates transmitted to the U. S. National Museum were three specimens of an anomuran crustacean, of an undescribed genus and species, which are characterized below. I take this opportunity to describe also a new species of *Albunea*, based on a single specimen obtained by Mr. C. N. E. Eliot at Samoa. It gives me great pleasure to associate with this species the name of the collector, a well-known officer of the British diplomatic service, and an ardent student of zoology.

LOPHOMASTIX, new genus.

Eye peduncle very slender, not articulated in the middle. Antennæ without accessory joint. Flagellum of antennæ rather long, with nine joints, each about two and one-half times as long as broad; joints setose. Antennulæ much shorter than antennæ, sparsely setose, multiarticulate. The exopod of the outer maxillipeds has a slender ribbon-like second article, the distal end of which bears a long dense tuft of hair. The carpal and propodal joints of the maxillipeds are broad, the distal article is very much narrower and presents an elongated oval surface. The distal inner margin of the merus is armed with two spines.

Type.—L. diomedeæ.

LOPHOMASTIX DIOMEDEÆ, new species.

The eyestalks are slender, slightly swollen at the cornea. The basal article of the antenna is broad and pectinate; the following joint is about as broad as long, while the third is very short and seems to be nearly conate with the penultimate, which is long and cylindrical; the

distal joint is cylindrical and as long as the two preceding; the flagellum is composed of nine nearly equal segments, the outer ones of which are very slightly longer.

The front is armed with three prominent teeth with pectinate edges. The rostral tooth has concave edges, running back to a point at the outside of the eyestalk, where it meets the inner edge of the lateral tooth, running nearly parallel to the median line; this makes the figure of a broad W, the outer lines of which are almost parallel. The outer margin of the lateral teeth does not cut back as far as the inner margin, but unites with the margin beyond, which ends in a deep sinus formed by the forwardly directed antero-lateral spine. The small spines which form the comb of the frontal margin are more crowded in the W; the terminal spines of the three frontal teeth are the largest. Outside of the lateral tooth the little spines are more scattered, becoming smaller near the sinus at the antero-lateral angles. Behind the gastric region there is a deep bow-shaped groove, which extends nearly to a ridge which runs from the side upon the branchial nearly to the gastric region. In front of this is a transverse ridge, with a depression in front which is slightly sigmoid in shape. The outer end of this ridge ends in a sharp spine. Behind the cardiac area is another impressed line of the same shape as the one behind the gastric area, but with more pronounced curves which extends nearly to the sides.

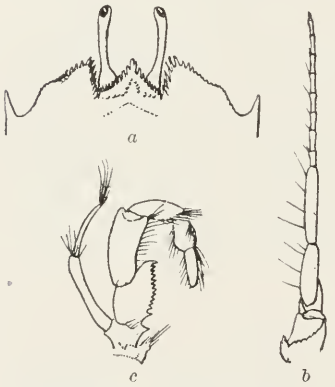

FIG. 1.—LOPHOMASTRIX DIOMEDÆ. *a*, FRONT; *b*, ANTENNÆ; *c*, MAXILLIPED.

The anterior portion of the larger specimen and the greater part of the carapace and chelipeds is well preserved. The abdomen and ambulatory feet are detached and in bad condition. Width of carapace between antero-lateral spines, 13 mm.; eyestalks, 3 mm. long; distance from the apex of the rostral tooth to the posterior line of the gastric area, 10 mm.; width of the carapace of the second specimen between points of antero-lateral teeth, 6 mm.; width of carapace of smallest specimen between points of antero-lateral teeth, 4 mm.

The surface of the gastric area is evenly and coarsely granular in front. The posterior middle part has numerous short raised lines clothed with short hair. The posterior portion of the carapace has longer lines with little depressions in front. These raised lines support a series of granules and numerous short hairs. The postero-lateral sides are armed with short, sharp, conical teeth crowded together, the points of each of which are directed forward. The hands of the anterior feet are more like those of Albunea and Lepidopa than

like Blepharipoda. The carpus and merus partake more of the character of Blepharipoda. There is a single spine on the merus at the lower outer angle; the anterior upper angle of the carpus is very much like that of Blepharipoda; the movable finger of the hand is more nearly vertical to the axis of the hand than in the latter genus. The outer surface of the hand has a straight ridge running from the apex of the immobile finger to the lower portion of the articulation of the carpus; from this point also a ridge runs to the articulation of the finger separating the crest of the hand by a depression. The crest is coarsely granular, while the granules of the outer surface are generally coarser and more scattered.

Three specimens were collected at Station 2913 in 26 fathoms, off Cortes Bank, California.

Type.—Cat. No. 28774, U.S.N.M.

ALBUNEA ELIOTI, new species.

The eyestalks are subovate, about one-fifth longer than broad; the cornea is situated in a little notch in the outer margin near the extremity. The cornea in connection with the stalk reminds one of the seed of some of the Legumens. Irregular depressed lines run down the stalk from the cornea, separating near the middle and converging at the base. The inner margin is set with bristles arranged in bunches; the white outline shows between the bunches, giving it a superficial appearance of an armature of small teeth. The ocular sinus has the shape of a wide open W. On each side of the sinus is a row of seven teeth; there is no variation between corresponding teeth; the one at the angle of the sinus is broad at the base; the two following teeth are smaller; the largest teeth are the fifth and sixth, while the fourth and seventh are intermediate in size.

FIG. 2.—ALBUNEA ELIOTI.

The carapace is broadest between the spines of the antero-lateral angles; longitudinally, it is very little arcuate, but transversely, much more so. The transverse rugose lines are numerous and strong; they show the remains of numerous bristles.

This species is probably nearly related to *A. microps* Miers. Length of the carapace, about 16 mm.; breadth, 18 mm.; length of eyestalks, 2 mm.; breadth, 1.6 mm.

Described from a single female from Samoa which unfortunately lacks the anterior and some of the ambulatory feet. Collected by Mr. C. N. E. Eliot, for whom it is named.

Type.—Cat. No. 26169, U.S.N.M.

NOTE ON THE PROBABLE USE OF THE ANTENNULÆ IN ALBUNEA AND LEPIDOPA.

The great length of the antennulæ in Albunea and Lepidopa led to a rather interesting experiment to ascertain as far as possible the special use of organs so extraordinarily developed and so different from those in other Decapod Crustacea.

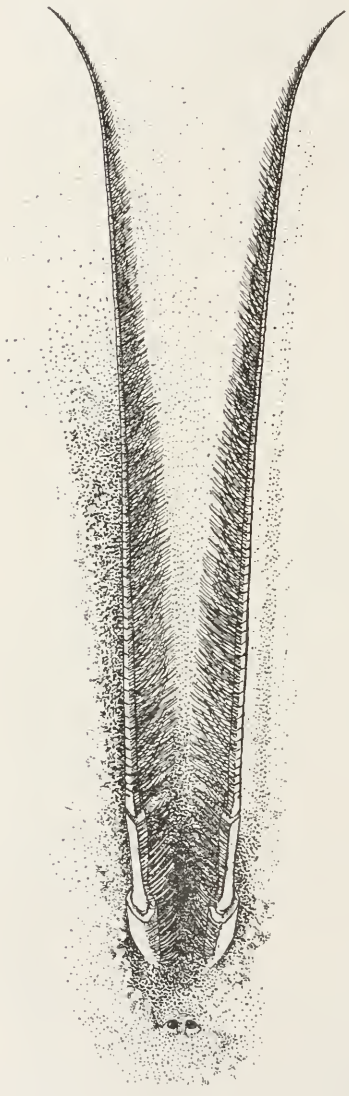

FIG. 3.—ALBUNEA GIBBESII, PARTIALLY COVERED WITH SAND. (MUCH ENLARGED.)

In the first place it must be borne in mind that the antennulæ in Albunea are from two to three times the length of the carapace, while in Lepidopa they are often five times as long. An examination shows that the lateral motion is slight while the motion in the other direction is very free and strong, the flagellum easily changing from a direction vertical to the carapace to an opposite direction, or through an arc of more than 180 degrees. This motion is provided for by the pedunceles, which are compressed, presenting an edge to the sand in one direction and a relatively broad and flattened surface in the other. The flagelli are very stiff, the outer one-third only acting as a true leash.

The experiment, if so it can be called, consisted in placing an alcoholic specimen of Albunea in a nearly vertical position in clean white sand, until only the cornea and the antennulæ were exposed. In this natural position the antennulæ seemed to lie upon the surface of the sand nearly perpendicular to the lower surface of the specimen. Alcohol was then added in sufficient quantity to cover the specimen, when it was noticed that the sand was held back from the mouth parts by the numerous stiff hairs, the hair along the flagelli preventing its washing in between them. These seemed to be placed there for that purpose, for, arranged in two rows at nearly right angles to each other, the angle so formed opposes the open angle of the other flagellum. The hairs are longer near the base, becoming short near the more flexible outer ends. The result of this arrangement is

that near the peduncles the hairs protect the passage from every side, while beyond the flagelli form the long leaders of this natural weir. It is evident that particles can be gently guided along between the leaders until within range of the mouth part or the hands. Another factor which may assist in keeping the region about the mouth parts free from sand, is the flow of water from the branchial chambers.

Placed in the sand in this position facing the beach, the antennulæ could readily guide any of the little synaptas, worms, or small crustacea washed up by the waves and brought back by the receding water, and as the wave advances it would not be at all impossible for the antennulæ to be reversed and so add to its chances by working the advancing wave. But this may not be the only way the antennulæ can be used, for if the animal backed into the sand the antennulæ would be placed together, and here again the bristles would be effective in keeping a passage between them free from sand, and synaptas, worms, etc., moving in the sand would find it easy to enter the passage while egress at the sides would be impeded by the hairs backed with sand.

ALBUNEA GIBBESII Stimpson.

Albunea gibbesii Stimpson, Ann. Lyc. Nat. Hist. New York, VII, 1862, p. 78, pl. 1, fig. 6.—Miers, Journ. Linn. Soc. Lond., XIV, 1879, p. 329.

Several specimens of this species are in the collection from Key West, Florida. One fine specimen was taken at Santa Rosa Island, off Pensacola, Florida, where it was taken in company with *A. oxyopthalma*.

Fig. 4.—Albunea gibbesii. ×1½.

Fig. 5.—Albunea oxyopthalma. ×2.

The eyes can not be relied on to distinguish *gibbesii* from *oxyopthalma*. The terminal segment of the abdomen of *A. gibbesii* is "narrow and acuminate at its extremity, forming a long, narrow projection," as described and figured by Dr. Stimpson. The dactyles of the second and third pair of feet differ in having a wider projection than in the related species.

A NEW SPECIES OF ARGULUS, WITH A MORE COMPLETE ACCOUNT OF TWO SPECIES ALREADY DESCRIBED.

By Charles Branch Wilson.
Department of Biology, State Normal School, Westfield, Mass.

In a paper already published in these Proceedings[a] four new species of Argulus were described. But the diagnosis of each was necessarily very brief and only specific differences could be noted. Such accounts answer very well for preserved material, and may be allowed to stand until further information is obtained from a study of living specimens. But as soon as such information is obtained it becomes expedient to give a more detailed description together with as much of the habits and mode of life as may be of value.

Such an attempt has been made in the present paper upon two of the species previously described, *A. americanus* and *A. versicolor*, the only ones which have been obtained alive. In addition a diagnosis is given of a third species which proves to be new.

ARGULUS AMERICANUS Wilson.

Argulus americanus Wilson, Proc. U. S. Nat. Mus., XXV, p. 718.

Much of the anatomy of this interesting species has already been given in the paper referred to, but it was disconnected and mingled with that of many other species. It is here gathered together and completed and supplemented by an account of the development.

The species was obtained by Prof. Jacob Reighard at Ann Arbor, Michigan, from some *Amia calva* kept in aquaria and was sent to the author in the winter of 1901–2. It was diagnosed as a new species and described supposedly for the first time.

But shortly afterwards a manuscript upon The Vermine and Crustacean Parasites of Fresh-Water Fishes, by Dr. R. R. Gurley, was sent to the author from the U. S. Fish Commission. This manuscript was evidently prepared with considerable care and labor about ten years ago, but has never been published.

In it are included two new species of Argulus, one of which is evidently the same as *A. americanus*, since it corresponds in every detail.

[a] Proc. U. S. Nat. Mus., XXV, pp. 635–742.

The account also includes a partial description of the eggs and larvæ, and it is unfortunate that the manuscript name could not have been given to the species, since this description so far antedates that of the author.

In the present account acknowledgment has been made of such facts as have been taken from Dr. Gurley's manuscript.

At present this species has been found only upon the dog-fish, *Amia calva*. Professor Reighard writes that it is found over the outside of the fish generally, the larger number on the anterior part of the body and the head, but some on the fins. They are most numerous on the ventral side of the body in front of the pelvic fins. They are never found on the gills or anywhere else internally. They are not noticeable until the fish have been for some time in the aquarium.

This is one of the largest of the American fresh-water species and is the best of any the author has seen for purposes of study, since it is particularly transparent when alive and also when cleared in clove oil. There is no difficulty in making out all the details of the internal anatomy even to the nervous system and its connections.

It is pale brownish white in color, sparsely covered on the dorsal and ventral surfaces with small pigment spots of a reddish hue. In all the living specimens seen by the author there were eight faint reddish bars running transversely across the dorsal surface. Gurley, however, says:

> The ground color is faint grayish or grayish green. The most conspicuous markings are the rose to purplish red bars, which are most distinct marginally where they form well-defined spots.

Probably the color as well as the distinctness of the bars varies considerably in different lots of individuals.

The dorsal surface of the ovary and semen receptacles in the female and the abdomen of the male in the vicinity of the testes are heavily pigmented with circular spots of a rich dark brown. The structural details are as follows:

General form.—*Dorsal surface.*—The carapace is obovate and fully as wide as and often wider than long; the antero-lateral sinuses are distinct, leaving a well-defined frontal lobe which, however, does not project very far, since it is flattened anteriorly. The posterior sinus is narrow and about one-third the entire length of the carapace, and is squarely truncated at its base. Its sides converge rapidly in passing backward so that the broadly rounded lobes of the carapace overlap considerably at their tips (fig. 1).

The sutures dividing the carapace into its respective areas are characteristically arranged. The two central longitudinal ribs (*r*) are fairly close together for such a broad carapace and are almost parallel except at their anterior ends. The horseshoe suture (*hs.*) separating the cephalic from the other areas is comparatively short and narrow.

This makes the lateral areas wide anteriorly and leaves a thoracic area (*t*) posterior to the suture which is actually longer than it is wide, a condition rarely found among the Argulidæ. From the sides of the horseshoe suture near its anterior ends a well-defined secondary suture (*ss*) extends backward on either side in a broad outward sweep through the center of the lateral area nearly parallel with the margin of the carapace. These sutures divide each lateral area into an outer and an inner portion, the former of which can be flexed on the latter.

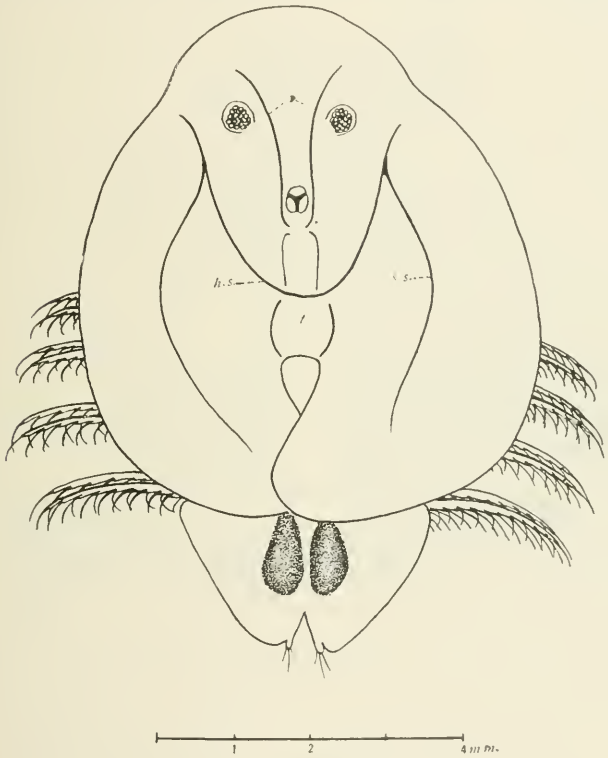

FIG. 1.—DORSAL VIEW OF MALE ARGULUS AMERICANUS.

thereby greatly increasing the mobility of the carapace. The free thorax is entirely concealed beneath the overlapping lobes of the carapace which also cover the anterior third of the abdomen, giving this argulid a very compact appearance in dorsal view. The abdomen is broadly triangular, one-half wider than long, with all its angles well rounded. The lateral margins project forward slightly, suggesting a heart shape. The anal sinus is triangular, cut less than a third the length of the abdomen and carries the anal papillæ upon its lateral margins close to the tips of the lobes. The papillæ are somewhat club-shaped, rather short and blunt, and each is tipped with three setæ of medium length.

Ventral surface (fig. 2).—The frontal lobe is plainly divided into an anterior and posterior portion by a line parallel with the edge of the carapace except at either end where it curves around abruptly to the base of the antennæ. From the center of this line there projects backward into the posterior portion a triangular area (the post-frontal triangle) whose ventral surface is on the same level as the rest of the carapace. But the remainder of the posterior portion on either side of the triangle is hollowed out for the antennæ. The ventral surface of the triangle, the anterior rim, and the anterior half of the lateral

FIG. 2.—VENTRAL VIEW OF FEMALE ARGULUS AMERICANUS.

areas are thickly covered with sharp triangular spines of considerable size, which must hold the creature very firmly on its host.

Antennæ (fig. 3).—These are small but well armed with stout hooks and spines.

The proximal portion of the basal joint of the first pair carries two stout spines on its inner border, the posterior of which is strongly curved backward. The distal portion of this joint has the usual hooks on the outer and anterior margins and two spines upon its posterior margin, one of which is long and stout, while the other is very slender. The terminal portion of this antenna is two-jointed and projects considerably beyond the basal portion. The second antennæ are four-jointed, and each carries two large triangular spines on its inner

margin and a smaller and sharper one on the posterior margin of its basal joint. The latter is reenforced by several setæ. All these hooks and spines are of a rich yellow color.

Eyes.—These are small, made up of numerous facets, and quite widely separated.

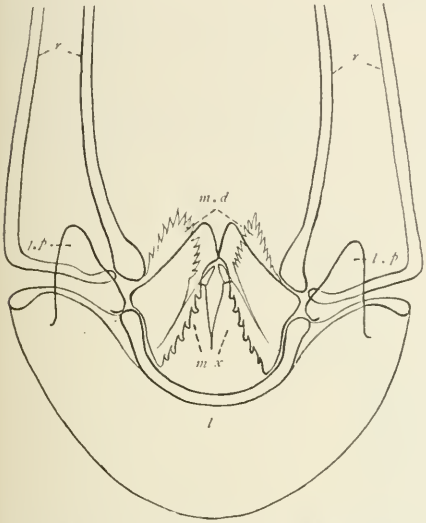

FIG. 4—MOUTH PARTS OF ARGULUS AMERICANUS. *l*, LOWER LIP; *lp*, LABIAL PALP; *md*, MANDIBLES; *mx*, MAXILLÆ; *r*, CHITIN RIBS.

FIG. 3.—ANTENNÆ OF FEMALE ARGULUS AMERICANUS.

Mouth (fig. 4).—This organ has a peculiar, almost trapezoidal, form, and its lateral margins are strongly serrated. The lower lip (*l*) has a sharper curve than in *A. foliaceus* and the labial palps (*lp*) are relatively smaller. But the greatest difference is in the mandibles (*md*); instead of being broadly sickle-shaped, with teeth along the inner margin only, they are widened into a spatula form, with long and sharp teeth on both the inner and outer margins and around the end, twelve or fifteen of them in all. The maxillæ (*mx*) are also much stouter than in *foliaceus*, but the single tooth at the tip is shorter and blunter. As a whole the proboscis is only slightly club-shaped and is rather smaller than would be expected on so large an Argulus. The chitin framework, while agreeing in its general make-up with that of *foliaceus*, differs in several details. The longitudinal ribs (*r*) are not forked at their distal ends, and the transverse ribs are less complicated.

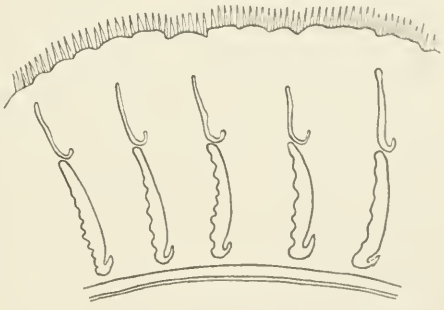

FIG. 5.—BORDER OF SUCKING DISK IN ARGULUS AMERICANUS.

Anterior maxillipeds.—These are small, not more than one-sixth the width of the carapace, and close together. The shape of the chitinous rods which support the membranous edge and the arrangement of the fringe are peculiar. There

are two concentric rows of the rods, the inner about twice the length of the outer, while outside of the latter is a wide free margin (fig. 5).

The rods in both rows are shaped like the letter J when viewed from the inside, the bases of those in the outer row articulating with the tips of those in the inner row. Around the edge of the membrane is a fringe of elongated finger-like papillæ, each terminated by three or four slender hairs.

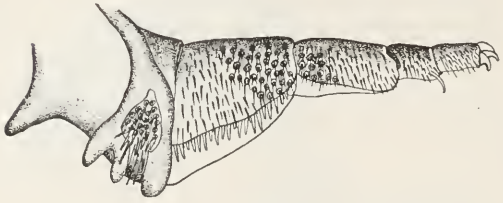

FIG. 6.—POSTERIOR MAXILLIPEDS ARGULUS AMERICANUS.

Posterior maxillipeds (fig. 6).—These are small but well armed. Of the five joints, the three terminal ones are much smaller than the two basal ones. The basal plate has an elongated triangular form and carries upon its posterior margin three teeth so wide and so squarely truncated as to be plates rather than teeth, as is also the case in *A. catostomi*. The plates are reenforced by a pair of stout, blunt spines near the median line just behind the mouth. The papillated area is small, but has a bunch of long and sharp setæ on its posterior margin; the remainder of its surface and the entire ventral surface of the four terminal joints are covered with short, stiff hairs, each with a swollen base.

The terminal joint ends in three small, rather blunt claws of about the same size, arranged in a broken row anteriorly, while opposed to them posteriorly is a short, rounded papilla or thumb.

Swimming legs.—These are long and slender, projecting well beyond the edge of the carapace, the two anterior pairs with recurved flagella. The basal lobes on the posterior pair are large and boot-shaped, with a distinct heel. They are fringed along the posterior margin with a row of plumose setæ, and the toe of the boot carries two much longer setæ, also plumose.

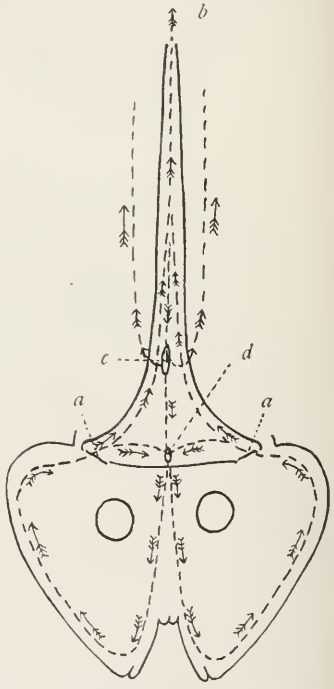

FIG. 7.—DORSAL VIEW OF THE HEART OF ARGULUS AMERICANUS (DIAGRAMMATIC). *a*, PAIRED LATERAL OPENINGS; *b*, ANTERIOR OPENING OF AORTA; *c*, ANTERIOR; *d*, POSTERIOR VENTRAL OPENING.

Tactile papillæ.—These, for ovipositing, are large, long, and quite widely flaring in the female, but reduced to mere stumps in the male.

Circulation.—This, while agreeing with that in other species, differs markedly in the structure and working of the heart (fig. 7). This is

of the usual shape, but has only five openings instead of six, the ventral one consisting of a single longitudinal slit.

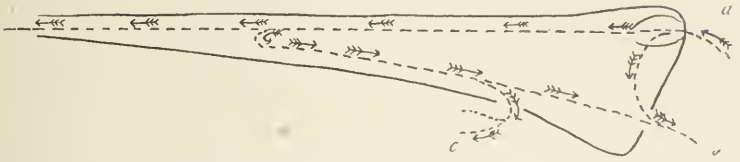

FIG. 8.—SIDE VIEW OF THE HEART OF ARGULUS AMERICANUS (DIAGRAMMATIC). FOR LETTERING SEE FIG. 7.

All the blood enters through the lateral valved openings (*a*); a part of it passes out of the aorta (*b*) anteriorly and another part out of the

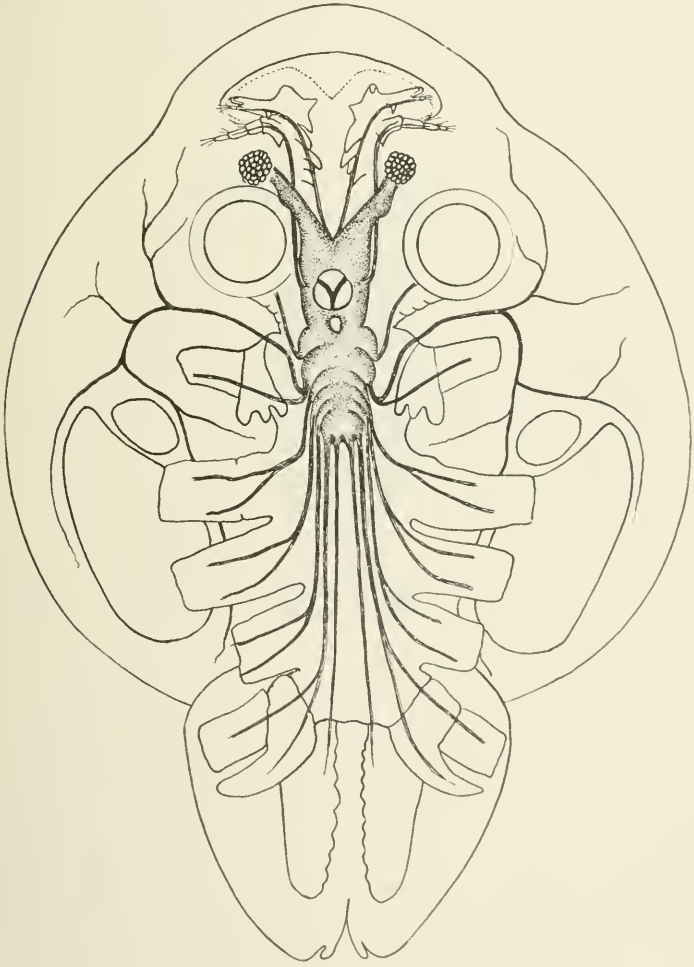

FIG. 9.—THE NERVOUS SYSTEM OF ARGULUS AMERICANUS.

posterior median aperture (*d*); each of these streams follows the usual course (fig. 8), but the greater bulk turns downward and passes out of the ventral median slit (*c*).

This stream pours around the intestine and separates naturally into two side streams running forward past the bases of the swimming legs and sending out lateral streams into each of them, finally joining the anterior streams from the aorta under the brain. On its return the blood percolates through the lateral sinuses of the carapace and, joining the streams from the borders of the abdomen, enters the openings at the sides of the triangular base of the heart.

Nervous system (fig. 9).—This consists of a dorsal brain and a ventral chain of six ganglia. The brain is rather small, but well pigmented,

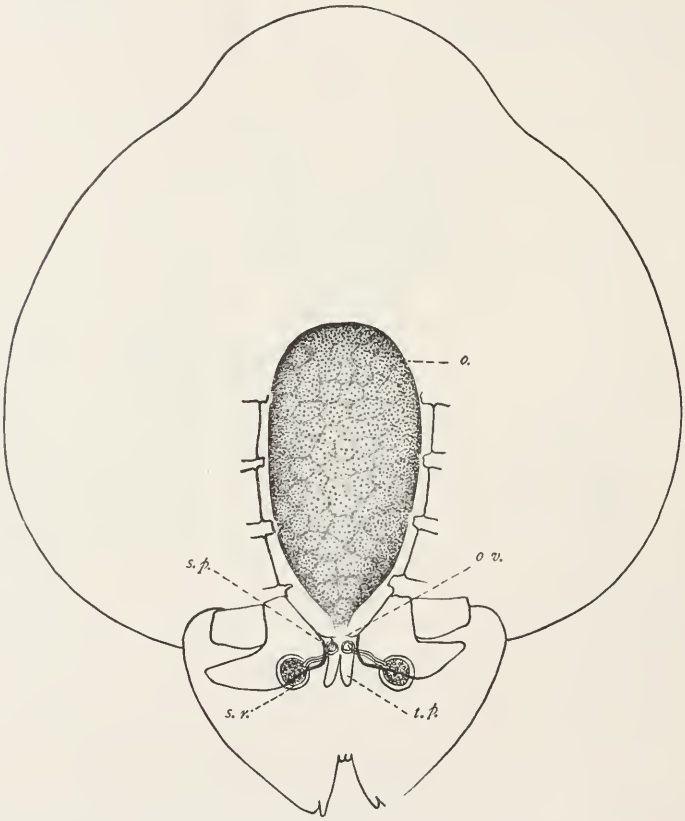

FIG. 10.—SEXUAL ORGANS OF FEMALE ARGULUS AMERICANUS. *o*, OVARY; *o. v.*, OVIDUCT; *s. p.*, SEMEN PAPILLÆ; *s. r.*, SEMEN RECEPTACLE; *t. p.*, TACTILE PAPILLÆ AT THE OPENINGS OF THE OVIDUCT.

so as to be prominent by contrast with the light-colored carapace. Its ventral portion extends quite a distance in front of the pigmented dorsal portion and is nearly three times as wide. From the anterior border of this ventral portion a pair of nerves extend forward to the anterior antennæ. Another pair arise from about the center of the lateral borders and lead to the posterior antennæ. These two pairs are the only cranial nerves. The ventral ganglia diminish in size rapidly; they are distinctly lobed along the sides, but fused through

the center. Each of the five anterior ones gives off a single pair of nerves, while the sixth and last one gives off two pairs. The nerves from the first ganglion, which is considerably the largest of the six, go to the sucking disks; a branch arises from this nerve very soon after it leaves the ganglion and passes forward to the mouth parts. The nerves from the second ganglion are a little larger than any of the others, which is fully accounted for when it is found that they quickly divide, one large branch going to the second maxillipeds and the other innervating the lateral areas of the carapace.

The nerves from the third, fourth, and fifth ganglia and the first pair from the sixth ganglion supply the swimming legs in order on either side. The last pair of nerves which are given off from the posterior border of the sixth ganglion innervate the reproductive organs.

Reproductive organs (fig. 10).—These are beautifully typical and can

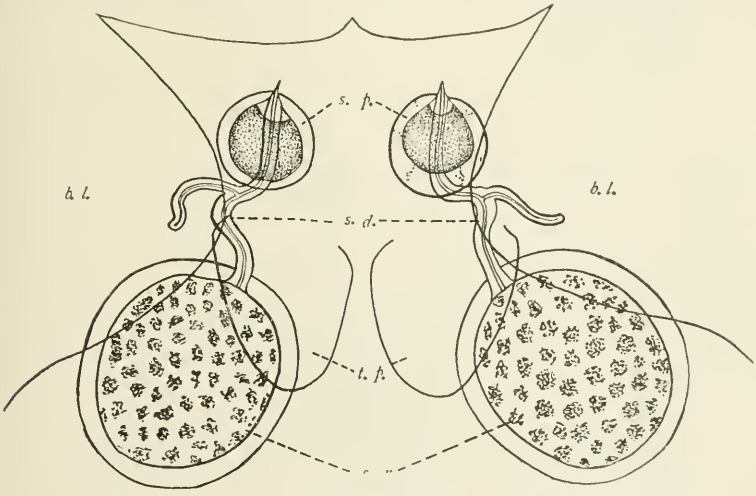

FIG. 11.—SEMEN RECEPTACLES AND PAPILLÆ OF ARGULUS AMERICANUS FEMALE UNDER GREATER ENLARGEMENT. *b. l.*, BASAL LOBES OF POSTERIOR LEGS; *s. d.*, DUCTS LEADING FROM THE RECEPTACLES TO THE PAPILLÆ; *s. p.* SEMEN PAPILLÆ; *s. r.*, SEMEN RECEPTACLES; *t. p.*, TACTILE PAPILLÆ.

be plainly seen through the outer covering, even in preserved and mounted specimens. In the female the semen receptacles (*s. r.*, fig. 11) are large and close together; the semen papillæ (*s. p.*) are also large and the hardened chitinous tip of the duct which leads to them from the receptacles projects forward rather than inward toward its fellow on the other side. In the figure the tactile papillæ (*t. p.*) used for ovipositing are much smaller than the average, and the specimen was selected for this reason, since these papillæ would conceal the underlying organs as little as possible.

The relative size shown in the full-length figure of the female (fig. 2) is nearer the average.

In the male the essential organs (fig. 12) are quite typical, but the accessory organs surpass those of any species so far examined. In

addition to the regular peg and semen receptacle on the fourth and third legs, respectively, we find on the anterior surface of the third leg a long club-shaped projection, which arises from the outer end of the basal joint and projects diagonally forward and outward past the distal basipod joint and far out on the exopod (fig. 13). Its surface is smooth and even and it seems to be tactile in function. There is another conical projection, a trifle smaller, on the posterior surface

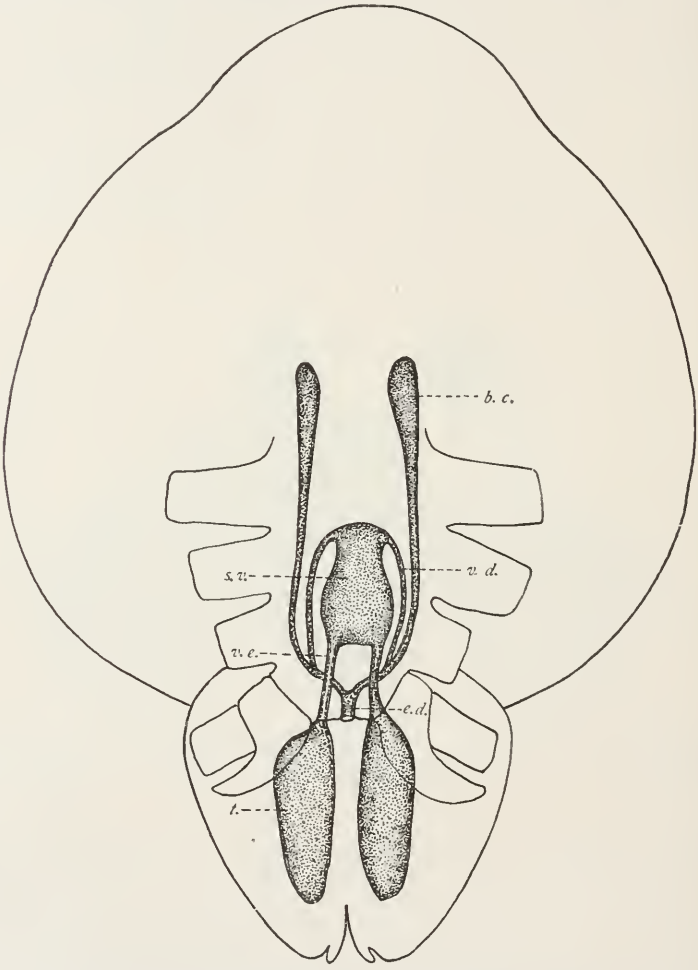

FIG. 12.—SEXUAL ORGANS OF MALE ARGULUS AMERICANUS. *b. c.*, BLIND CAPSULE; *e. d.*, EJACULATORY DUCT; *s. v.*, SEMEN VISICLE; *t.*, TESTES; *v. d.*, VAS DEFERENS; *v. e.*, VAS EFFERENS.

of the preceding pair of legs, exactly opposite the one just described. This also has a smooth surface and a probable tactile function. To increase this probability both projections are well innervated and their surfaces are plentifully covered with short setæ. There are also small projections, varying considerably in different individuals, upon the opposite surfaces of the same joints as bear the large ones.

Eggs and development.—Gurley, in the manuscript already referred to, has given an outline of development, with a description of the larva. But, again, the present author had obtained ripe females from Professor Reighard at Ann Arbor, Michigan, and had successfully reared the larvæ before Gurley's manuscript was placed in his hands. It is a pleasure to find that these two accounts agree in every detail.

FIG. 13.—POSTERIOR LEGS AND ABDOMEN OF ARGULUS AMERICANUS.

The eggs are laid in single rows (fig. 14), exactly as those of *A. megalops*, and not at all resembling either *A. foliaceus* or *A. catostomi*. But the eggs themselves are more like those of *A. catostomi* than of any other species whose eggs are known.

They are arranged end to end, the heads all pointing in one direction, but with every third or fourth one reversed. The jelly in which they are enveloped, on hardening in the water, assumes an appearance very similar to that on the eggs of *A. catostomi*—that is, it is raised into ridges running lengthwise of the egg, each ridge composed of a row of club-shaped papillæ standing out at right angles to the surface of the egg (fig. 15). There are about six of these rows on the free surface of the eggs, including those along the sides where the eggs are attached to

FIG. 14.—MICRO-PHOTOGRAPH OF EGG STRING OF ARGULUS AMERICANUS, SHOWING THE JELLY PROTUBERANCES AND THE LARVÆ PARTIALLY DEVELOPED.

the surface on which they are laid. The rows coalesce at the ends and are most widely separated at the center.

In addition to these crenated ridges there are also a few large scattered masses of jelly, some of which are nearly two-thirds as large as

the entire egg. They also stand out nearly at right angles to the surface of the egg, and while they are really attached at random, yet there is an average of about one on either side of each egg in the row, so that, viewed as a whole, they are at fairly regular intervals. This feature is sufficient to distinguish the eggs at once from any others that are known.

The eggs are small, measuring 0.375 by 0.275 mm. exclusive of the jelly, light yellow in color and quite clear when first laid. But they speedily turn darker in color and become opaque within the first two

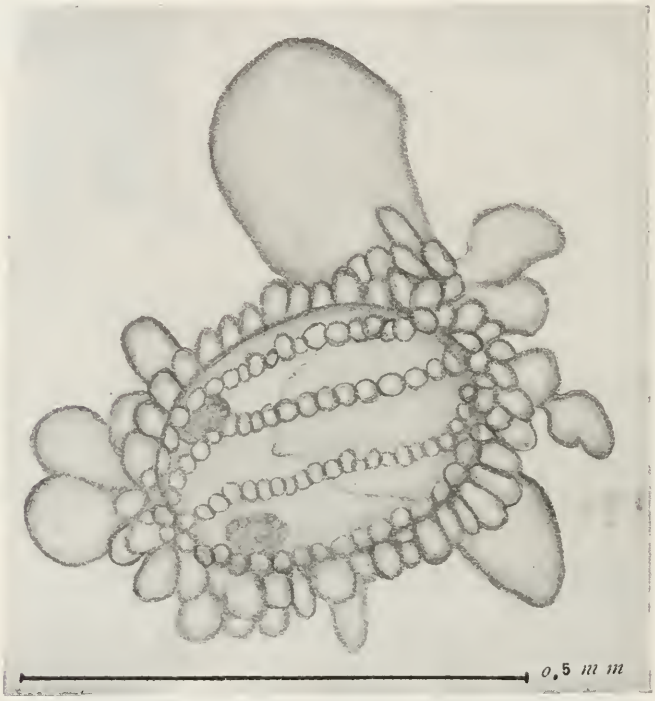

FIG. 15.—AN EGG OF ARGULUS AMERICANUS APPROACHING MATURITY. THE FULLY FORMED LARVA CAN BE SEEN THROUGH THE JELLY ENVELOPE.

days. Toward the middle of the second week, about the tenth day, the eyes appear as two jet black large-sized spots near one end of the egg. These spots are elliptical in shape, with their longer diameters inclined toward the central axis of the egg, which is also that of the embryo.

The egg now begins to clear and becomes more and more transparent up to the time of hatching. Through the membranes and the jelly can be seen the outline of the embryo's body and appendages. These can not be distinguished as plainly as in *megalops*, for many reasons. The jelly covering the egg is not as transparent as in *megalops* and the papillæ render it still more opaque. Again, the partial development of the appendages renders it possible to pack the

embryo in a much smaller space, with a resultant confusion of the parts.

Such close packing explains, furthermore, the small size of the egg, and we are forced again to the conclusion that the size of a copepod's egg has very little to do with the size of the adult female. It is,

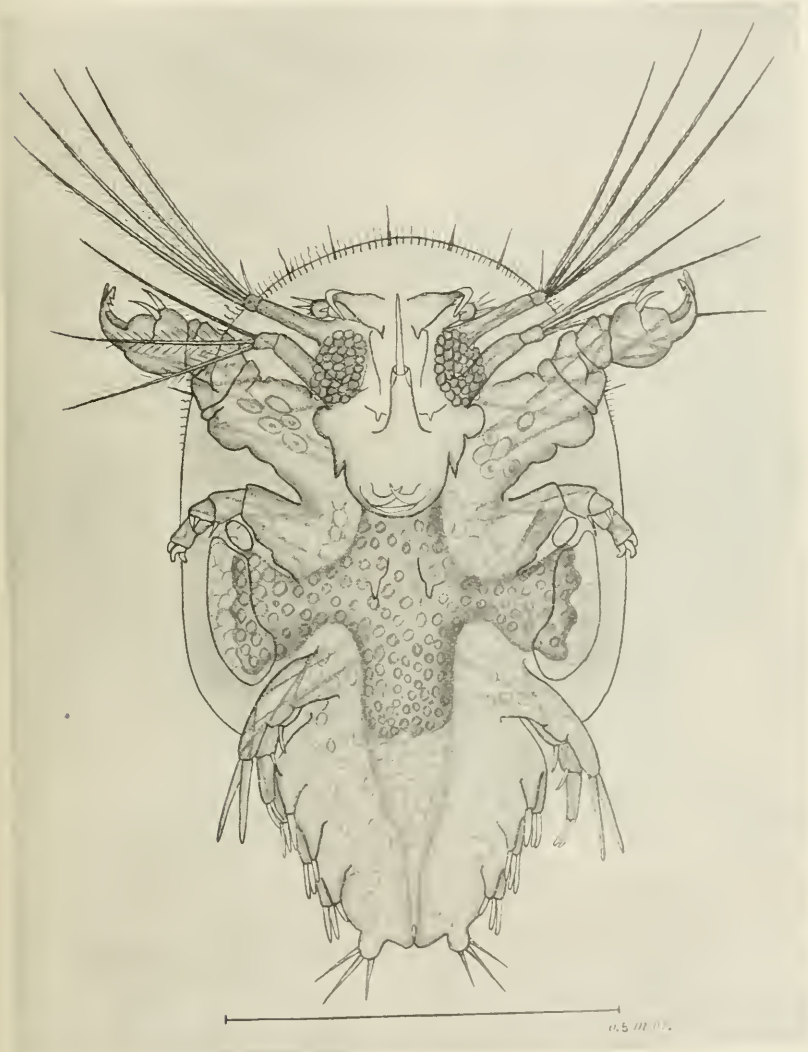

FIG. 16.—NEWLY HATCHED LARVA OF ARGULUS AMERICANUS.

rather, dependent upon the length of time the embryo is to remain within the egg and the degree of development it is to attain before hatching. An adult *americanus* is much larger than a *megalops*, and yet the eggs of the two are about the same size. This is explained by the fact that the *megalops* larva spends sixty days or more inside the

egg, and comes forth a miniature adult, while the *americanus* larva spends only sixteen or seventeen days in the egg and comes forth in a typical cyclops stage to undergo many subsequent transformations before reaching the adult form.

The temperature of the aquarium was about 72° F., or a few degrees warmer than our fresh-water ponds during the summer season. The eggs which were laid June 8 began to hatch the 25th, a period of only seventeen days, about half the length of time required by the eggs of *A. foliaceus* and *catostomi* and only one-fifth of that required by *A. stizostethii* and *megalops*.

The newly hatched larvæ (fig. 16) are not as lively as those of *megalops*, which would be expected from the fact that they are not provided with as good organs of locomotion, but they are also more sluggish than the *catostomi* larvæ, which have exactly the same structure. Furthermore, when first hatched they stick to the bottom of the dish and do not swim up and toward the light until the third or fourth day. And when they do get up to the surface they prove to be negatively heliotropic, in sharp contrast with all the other Argulus larvæ thus far studied, which are positively heliotropic to a very marked degree.

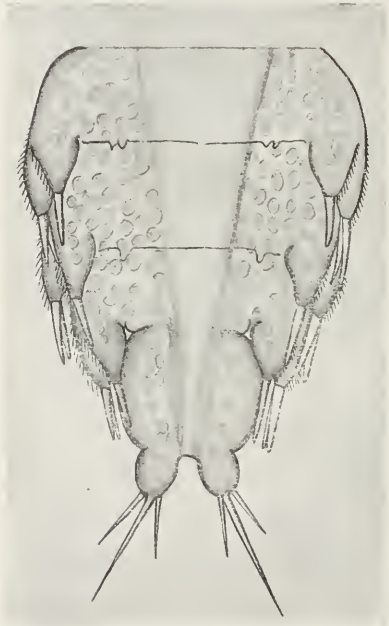

FIG. 17.—FREE THORAX AND ABDOMEN OF ARGULUS AMERICANUS LARVA.

Owing both to the position and incomplete development of the temporary locomotor organs, the motion of these nauplii is jerky and cyclops-like. They are not as transparent as the other larvæ and do not furnish as favorable objects for study, owing to the presence of a large area of rust-colored pigment over the stomach and anterior intestine which hides much of the internal anatomy.

In general shape they are short and broad, the carapace being well rounded anteriorly, with a broad and shallow posterior sinus, while the free thorax and abdomen form a broad triangle, relatively shorter than that of *foliaceus* and *catostomi*. Around the anterior margin of the carapace can be seen large tactile hairs similar to those found upon other species. But they are much fewer in number and more scattered than in *megalops*, and the intervening cilia are very minute

and situated not at the very margin, but a little way back on the ventral surface.

The first free segment of the thorax (fig. 17) is about half the width of the carapace, while the succeeding segments diminish rapidly in size. The abdomen is about the same width as the last thorax segment, is well rounded at the sides, and terminates posteriorly in a pair of anal papillæ which are large, almost spherical in shape, and tipped with three long, sharp spines.

The first antennæ (fig. 18) are three jointed, as in other species, but the basal joint is relatively much smaller; in fact, it is but a trifle larger than the two spherical terminal joints, but is armed with the usual stout sickle-shaped hook. The bristles and spines on these terminal joints are rather more numerous than in other species.

FIG. 18.—FIRST ANTENNÆ OF THE NEWLY HATCHED LARVA OF ARGULUS AMERICANUS.

The second antennæ are modified into locomotor organs, and both in the segments and in the number and arrangement of the long plumose rowing setæ they are exactly like those of *foliaceus* and *catostomi* nauplii. The temporary mandibular palps are also like those of the species just named, but are attached somewhat farther forward relative to the other mouth parts.

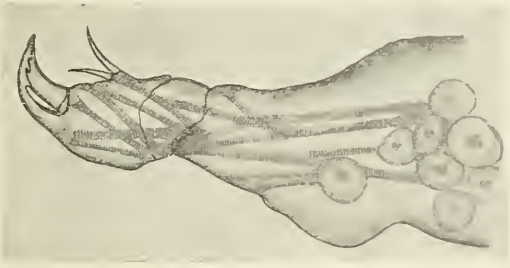

FIG. 19.—ANTERIOR MAXILLIPED OF THE NEWLY HATCHED ARGULUS AMERICANUS.

The anterior maxillipeds (fig. 19) are stout, four jointed, and terminate in the usual pair of sickle-shaped hooks, the ventral one of which is barbed. The basal joint of these appendages is very stout, and in its interior can be seen the group of large cells which are to form the sucking disks in later development.

The posterior maxillipeds (fig. 20) are much smaller, five jointed, and very rough on their ventral surface, while the outer border of every joint is armed with one and often two or more sharp spines.

These appendages terminate in two small but stout claws capable of independent motion and a conical papilla tipped with two short spines. The basal joint has no spine upon its posterior border.

The swimming legs are the same as in *foliaceus* and *catostomi*, the first pair only being developed, while the rest are immovable stumps. This first pair (fig. 21) consists of two basal joints well roughened and armed with numerous spines upon their ventral surface, a two-jointed endopod tipped with two short spines, and a one-jointed exopod tipped with two long rowing setæ.

The only difference here from other larvæ already described is that the endopod has only two instead of three joints.

The leg stumps attached to the other thoracic segments all show the endopods and exopods clearly, the former being tipped with a single spine, the latter with two.

FIG. 20.—SECOND MAXILLIPED OF THE NEWLY HATCHED LARVA OF ARGULUS AMERICANUS.

In their internal structure the most noticeable difference from other larvæ is the almost complete absence of skin glands.

The *megalops* larva, with its sixty days of incubation, came forth with a wonderfully well developed system of skin glands; the *foliaceus* and *catostomi* larvæ, with about half as long an incubation, showed a little more than half as many glands.

And now these *americanus* larvæ, with an incubation of only seventeen days, show almost no glands at all. We can not escape the conviction that these glands are developed quite slowly and that they do not appear until comparatively late in larval life. It would seem also that they must be developed independently of the incubation period, so that while the latter is changed greatly, being doubled in some species and halved in others, the glands apparently always require about the same time for development. In these *americanus* larvæ we find but a single small group of glands, six or seven in number, on either side near the posterior edge of the carapace lobes. They are much smaller than in *megalops*, and the ducts are not at all distinct. There are also a few scattered glands along the dorsal surface of the carapace, thorax, and abdomen, but they are all very small, and none of them show the structure given for *foliaceus* and *megalops*. They have rather the appearance of being in an immature and partially developed condition.

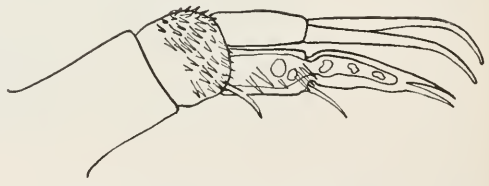

FIG. 21.—FIRST SWIMMING LEG OF THE NEWLY HATCHED LARVA OF ARGULUS AMERICANUS.

The paired shell glands are invisible, due to the opacity of the

surface pigment, which is so dense just in front of the side branches of the stomach where these glands are situated, and also in many other places, as to conceal all details of internal structure. The circulation is similar to that described in other larvæ except for the absence of a well-defined peripheral sinus in both the abdomen and the cephalo-thorax.

The internal cellular lacunæ appear about the same, but the currents are not as well defined, especially those of the abdomen. This larval circulation is carried on chiefly by means of certain muscles in the cephalo-thorax and abdomen, similar in both position and function to those already described for *megalops*. The heart has not yet appeared, and hence those differences which make the adult circulation peculiar can not yet be detected. The transverse dorso-ventral band or curtain at the place occupied later by the posterior wall of the heart is not as well developed as in *megalops* larvæ, another natural result of the differences in the period of development.

Furthermore, in view of the immature condition of all the swimming legs except the first pair, the muscles in the basipods of those appendages can not aid circulation to any appreciable extent. In fact, the undeveloped condition of most of the larval organs may well explain the feeble circulation.

As soon as the heart acquires definite form after the first moult we should expect to find the circulation showing the same peculiarities as in the adult.

The nervous and reproductive systems present no peculiarities worthy of special note, but are similar to those already described in the adult.

ARGULUS VERSICOLOR Wilson.

Argulus versicolor Wilson, Proc. U. S. Nat. Mus., XXV, p. 716.

This is a very clean-looking Argulus and by far the most beautiful of any American species. It can be distinguished from all others at a glance by its brilliant coloration, which is as variegated as that of an old-fashioned patch-work quilt or the traditional Joseph's coat. The ground color is a soft yellow-green, which forms a wide border around the edge of the carapace and extends inward in a series of bands and irregular spots, the former being a deeper green than the margin, while the latter have somewhat of a rusty tinge. One of these bands runs from the marginal border on either side just behind the sucking disks diagonally backward to the base of the central longitudinal ribs. From the center of each diagonal band another narrower one extends backward parallel with the edge nearly to the posterior margin of the carapace. These longitudinal bands are joined with the marginal border at about their center by a short radial band, which shows the same rusty tinge as the spots. These latter are found just outside the suck-

ing disks and also opposite the base of the first swimming legs in the lateral lobes.

The rest of the surface is filled in with orange-yellow of varying intensity, the posterior portion of the carapace lobes being tinged with brown, while the side branches of the stomach give more or less of a reddish hue to the parts overlying them.

Through this variegated groundwork the ribs, the digestive tube, and the reproductive organs stand out prominently. The ribs are a bright golden orange, the two central longitudinal ones being bordered with yellow green.

The digestive tube, when the parasite has taken a full meal, is deep wine red in the carapace and thorax, but fades to a green-yellow in the abdomen. It has a dark-green border on either side which occupies all the thoracic segments outside the intestine itself and extends forward anteriorly to the frontal border and posteriorly to the extreme tip of the abdomen lobes.

The testes and semen receptacles are a rich purple-red, so deep as to be almost opaque.

The eyes and brain are large and of a brilliant black.

With such a rich variety of color it would be natural to suppose that these copepods would fade quickly in preservatives, but such is not the case. After being hardened in chrome-acetic, corrosive-acetic, and Perenyi's, they have been kept nearly three years in alcohol with so little change as hardly to be distinguished from fresh specimens. They can also be run up through the alcohols, cleared in xylol or clove oil, and mounted in balsam without change of color. Indeed, eau-de-javelle is the only agent yet tried which will bleach the color. This removes it entirely and leaves the Argulus perfectly transparent.

Thus far the species has been found only upon the common pickerel (*Lucius reticulatus* Le Sueur), but is likely to be found upon other fish also at the breeding season.

Actual experiment has proved that they are capable of living on red-fin shiners, bream, etc., for a long time.[a]

This single host is, however, very widely distributed throughout the United States, and in all probability the parasite has an equal distribution. Not more than two or three specimens are found upon a single fish, and these are always in the gill cavity. Often also it is necessary to examine fifteen or twenty fish before finding a single parasite, so that they could be easily overlooked and a good summer catch of fish might not reveal their presence. For this reason winter is the best time to secure them upon fish caught through the ice, and as they remain alive for some time after the fish is dead an entire day's catch can be looked over. In this manner as many as thirty have been obtained in a single afternoon from three adjacent ponds. Thus far

[a] Proc. U. S. Nat. Mus., XXV, 1902, p. 647.

they have not been sought in a single locality without success. When kept in aquaria they are lively, moving about and changing from one fish to another more often than other species. The long plumose setæ upon the swimming legs make powerful oars and enable them to dart about with great rapidity. One of their favorite movements is to leave the side of the aquarium and, turning back downward, scuttle swiftly along the under side of the surface film of the water after the manner of the very much slower aquatic snails.

General form—*Dorsal surface* (fig. 22).—Carapace almost perfectly orbicular, the antero-lateral sinuses shallow, but leaving a well-rounded frontal lobe; the posterior sinus is one-third the length of the carapace and only one-sixth its width, so that the lateral lobes are broad

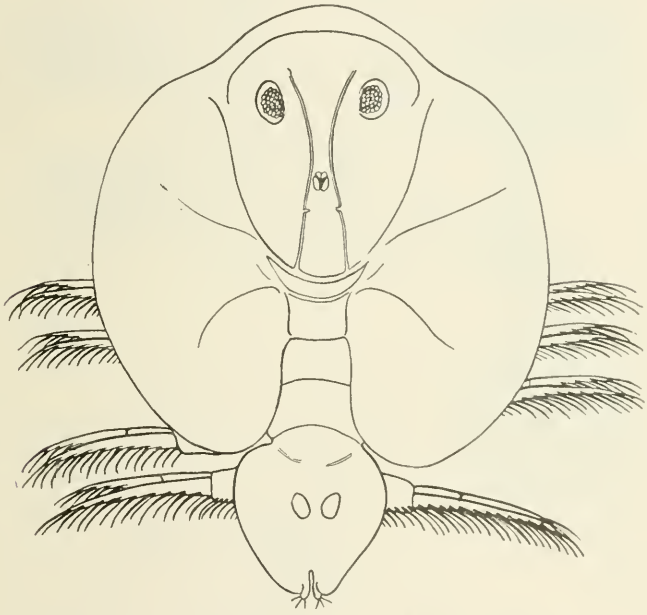

Fig. 22.—Dorsal view of female Argulus versicolor.

and well rounded. In the female they just reach the abdomen; in the male they overlap it somewhat. The free thoracic segments are twice as wide as long and are half concealed beneath the carapace lobes on either side. The abdomen has a very graceful oval outline in the female and is about three-sevenths the length of the carapace. In the male it is more nearly triangular, but narrows considerably anterior to the testes, and the lateral margins project forward in a well-defined and rounded lobe on either side. The anal sinus is very short and slit-like, with the papillæ subterminal.

The arrangement of the grooves dividing the carapace into its areas is very symmetrical. The longitudinal ribs are close together, and the joints in them just behind the brain can be clearly seen. The

horseshoe suture is longer and narrower than in *americanus*, and from near its base two sutures radiate outward into the lateral area. The thoracic area is separated into an anterior crescent-shaped and a pos-

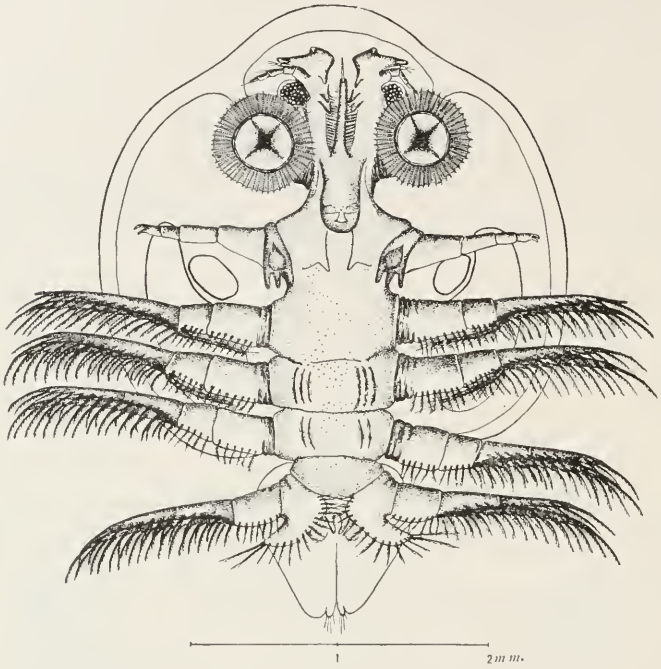

FIG. 23.—VENTRAL VIEW OF FEMALE ARGULUS VERSICOLOR.

terior rectangular portion, the former of which is much wider than the latter and follows closely the posterior curve of the horseshoe.

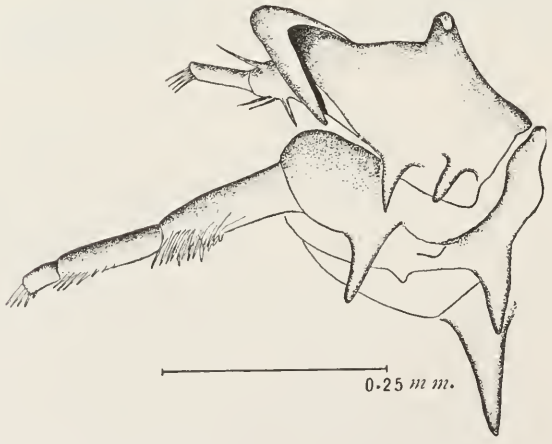

FIG. 24.—DETAIL OF ANTENNÆ OF ARGULUS VERSICOLOR.

Ventral surface (fig. 23).—The frontal lobe is simple and, together with the anterior half of the lateral areas, is covered with inconspicuous triangular spines. The antennæ are of good size and well armed;

the hooks upon the basal joint of the first pair are large and powerful, while the spines are very long and sharp. The two terminal joints carry numerous setæ, but do not project much beyond the lateral hook (fig. 24). The second antennæ are 4-jointed, the basal joint having a long spine on its posterior margin, while each of the remaining joints has a tuft of stout setæ at its distal end. The eyes are large, somewhat lunate, and inclined toward the longitudinal ribs; the facets are small and numerous and crowded closely together.

On the median line between the eyes and posterior to the large spines which arm the base of the second antennæ there is a groove for the reception of the stylet (fig. 25). It extends back as far as the base of the proboscis, and is lined on either side with a heavily corrugated layer of chitin.

The mouth differs considerably from that of other described species, and presents a peculiar appearance by reason of the arrangement of its chitin framework. The mouth opening is narrowed antero-posteriorly and elongated sidewise so as to appear like a narrow transverse slit, broken at the center by the protruding under lip (fig. 26). On examining the chitin skeleton, we find the same four longitudinal ribs connected at the latitude of the mouth by a transverse framework. But the structure and arrangement of this latter is very different from anything yet described, as can be readily seen in fig. 26. The most noticeable differences are the elliptical loops on either side of the mouth and a trapezoidal projection which extends down into the center of the upper lip to the very edge of the mouth opening.

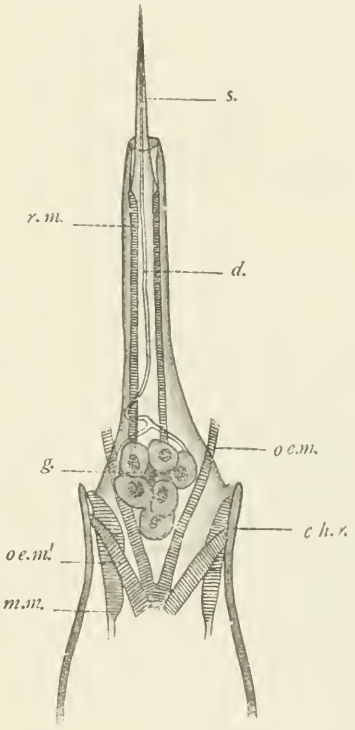

FIG. 25.—STING AND POISON GLAND OF ARGULUS VERSICOLOR. *ch.r.*, CHITIN RIB OF PROBOSCIS; *d.*, DUCTS OF POISON GLAND; *g.*, POISON GLAND; *m.m.*, MANDIBLE MUSCLES; *oe.m.*, OESOPHAGUS MUSCLE; *oe.m.'*, SIDE MUSCLE OF OESOPHAGUS; *r.m.*, RETRACTOR MUSCLE; *s.*, STING.

The transverse rib also, which is situated at the junction of the upper and under lips on either side, turns outward at the joint nearest the mouth and protrudes like a knob through the side of the proboscis. The rudimentary palp alongside this joint is very small. Inside the lips may be seen a part of the long, sickle-shaped mandibles, edged with sharp saw teeth. The maxillæ have not yet been seen.

The anterior maxillipeds are large, well separated, and placed far forward close to the margin of the antero-lateral sinuses. The mem-

branous edge is quite wide, and is supported by chitin ribs whose construction is peculiar. The stiffened circle which serves as an attachment for the powerful muscles of these maxillipeds, as well as the membranous edge, is raised into knobs at equal intervals around its circumference (fig. 27). From each knob a chain of four slightly oblong chitin plates extends outward to the edge of the membrane. These are placed end to end and diminish regularly in size, the distal one being less than half as large as the proximal. Each is convex at the proximal and concave at the distal end, the convexity of one plate fitting into the concavity of the one next inside it. In the first and second plates the concavity is eccentrically situated, but in the two outer ones it is approximately symmetrical. The plates are arranged end to end and do not quite touch one another, but leave narrow open spaces of membrane. Thus, while strengthening the membrane they still leave it very flexible.

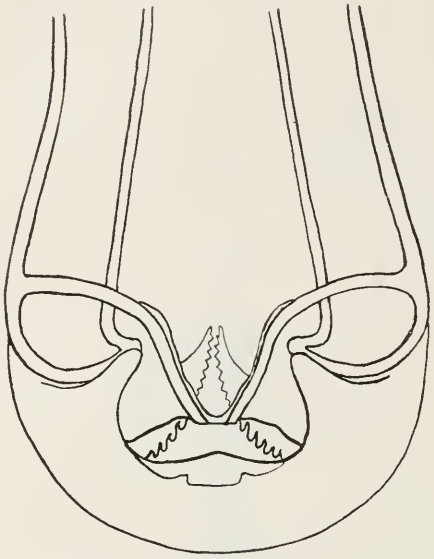

FIG. 26.—CHITIN SKELETON OF THE PROBOSCIS IN ARGULUS VERSICOLOR.

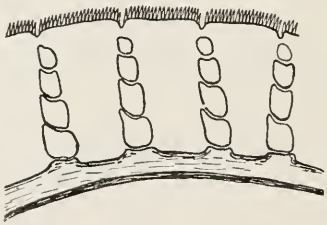

FIG. 27.—CHITIN RIBS IN THE MARGIN OF THE SUCKING DISKS OF ARGULUS VERSICOLOR.

Posterior maxillipeds (fig. 28).—These are also large and well armed. The joints diminish in size much more regularly than those of *americanus;* the plate on the basal joint is triangular, with long, stout, and not very sharp teeth; the papillated area is comparatively large and armed with strong setæ.

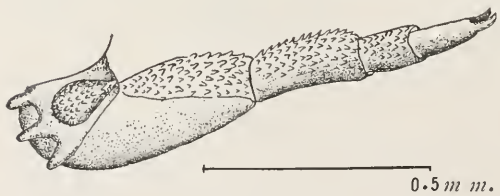

FIG. 28.—POSTERIOR MAXILLIPED OF ARGULUS VERSICOLOR.

The anterior half of the second joint and the entire ventral surface of the remaining three joints are covered with good-sized papillæ, each carrying a toothed scale. These papillated scales are similar to those on *americanus*, and consist of a hemispherical or hemiellipsoidal papilla, upon whose summit is borne the toothed scale. The latter is inclined at an angle of 10

or 15 degrees to the body and is an elongated ellipse in outline (see *a* in fig. 29). Its basal half, which is fused with the summit of the papilla, is solid, but the free half is cut into from two to six long and acuminate teeth. In general the scales nearer the anterior margin of the maxilliped have the larger number of teeth. Often one of the outer teeth is short and stands out at an angle from the others like a thumb. Evidently such an arrangement forms a surface which must give the copepod a firm hold even through the slimy coat of the fish's body.

FIG. 29.—SCALES ON VENTRAL SURFACE OF THE POSTERIOR MAXILLIPEDS OF ARGULUS VERSICOLOR.

The terminal joint of these maxillipeds ends in three hooks of unequal size; the anterior one is much the largest, with a thick, blunt tip armed with a single short, sharp seta. The other two are more slender and strongly curved (fig. 30).

Swimming legs.—These are long and slender and reach far beyond the edge of the carapace. They are fringed with stout plumose setæ and enable this argulus to swim with great power and rapidity. The flagella upon the first two pairs have a double curve, as can be seen in fig. 31, which is a dorsal view looking through the carapace in a bleached specimen. The basal lobes upon the posterior legs are very long and their tips extend beyond the edge of the abdomen. They have the usual boot shape, with a single seta on the toe of the boot much longer than the rest. The chitin rings in the lateral lobes of the carapace extend farther forward than those in *americanus*, and the concavity in the posterior one into which the smaller ring fits is on the inner margin a short distance back from the anterior end instead of at the end itself.

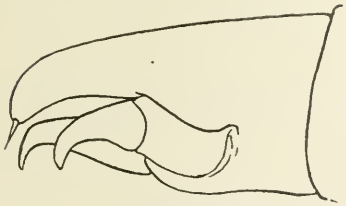

FIG. 30.—TERMINAL JOINT OF POSTERIOR MAXILLIPED OF ARGULUS VERSICOLOR.

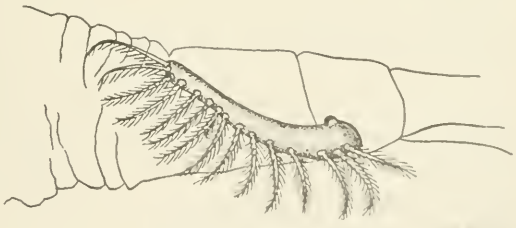

FIG. 31.—DORSAL SURFACE OF THE ANTERIOR LEG ON THE RIGHT SIDE OF ARGULUS VERSICOLOR, SHOWING SIZE AND ATTACHMENT OF NORMAL FLAGELLUM.

Tactile papillæ.—These are long and slender in the female and curve in toward each other at the tips, while in the male they are so rudimentary as to be almost invisible.

Circulation.—This is the same as that given for *A. foliaceus*.

Reproductive organs.—These are similar in position and arrangement to those of *americanus*, but the unpaired seminal vesicle in the male is quite different in shape, being nearly spherical, with an emarginate anterior border. Another difference was the fact that, after removing the pigment from several males, no trace of any accessory blind capsules could be seen. The second legs of the male have a large conical projection on their posterior surface at the outer end of the basal joint (fig. 32). There is a similar much smaller one in a corresponding position on the third legs, and these legs also have a rounded knob on the anterior surface of the second joint at the end next the body.

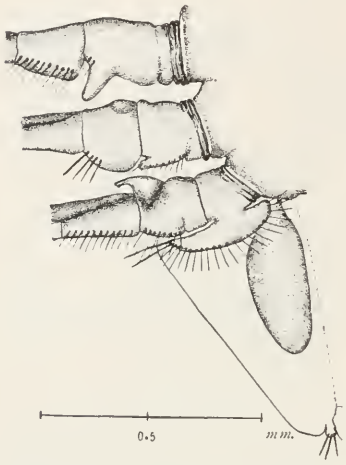

FIG. 32.—THREE POSTERIOR PAIRS OF LEGS IN THE MALE ARGULUS VERSICOLOR.

But the chief interest, both in this species and *americanus*, lies in the fact that it was possible to ascertain in them from actual observation the structure and exact function of the semen receptacle and peg upon the bases of the third and fourth legs, respectively. The peg consists of two parts, basal and terminal; the basal portion is a blunt papilla whose walls are stiff and covered with rough tubercles (fig. 33). It does not appear to be hollow, but readily permits of the withdrawal of the terminal part inside itself. This terminal portion is a slightly curved conical tube, with walls as flexible as rubber and so thin as to be perfectly transparent and colorless. The tip of the tube is somewhat enlarged and surrounded by a row of minute hairs. Inside both tube and papilla can be seen a muscle strand which extends from the tip of the tube diagonally backward to the posterior margin of the leg. By means of this muscle, together with the circular muscles in its own walls, the tube can be withdrawn inside the papilla or protruded at pleasure.

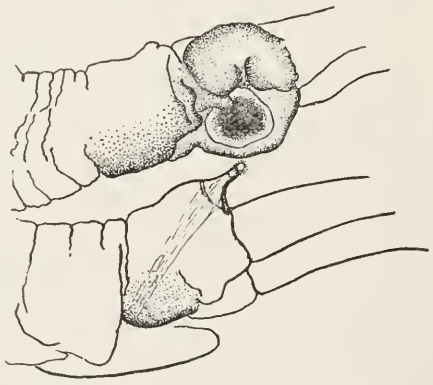

FIG. 33.—BASAL JOINTS OF THE TWO POSTERIOR LEGS OF MALE ARGULUS VERSICOLOR, SEEN FROM THE VENTRAL SURFACE.

The semen receptacle is a cavity in the posterior part of the distal end of the basal portion of the third legs; the opening into this cavity is on the ventral surface, near the posterior margin. This opening is guarded by a strong sphincter muscle.

Just in front of the opening, upon the anterior part of the ventral surface, are two rounded papillæ, covered with rough tubercles. This receptacle is filled with semen from the testes, probably through the agency of the peg, though this was not actually observed. Once filled, however, it operates as follows: The sphincter muscle around the opening relaxes enough to allow the entrance of the peg on the fourth leg. Being protruded as far as possible and the sides of the basal papilla being compressed by internal muscles, the peg tube acts like a pipette and becomes filled with semen from the receptacle. It is then withdrawn and inserted in the opening of the duct leading to the semen receptacle in the abdomen of the female. The sides of the basal papilla are again compressed, the internal muscles being aided by the rough papillæ on the ventral surface of the fourth leg, which bend over and seize the base of the peg securely, one on either side. By this means the peg is emptied of its contents again very similarly to a pipette.

ARGULUS TRILINEATA, new species.

The U. S. Fish Commission recently received from Messrs. King and Oliphant, pharmacists, of Macon, Georgia, a single specimen of a female Argulus taken from one of their goldfish. This was forwarded to the author for identification, and proves to be a new species, with characters as follows:

Carapace elliptical, reaching well beyond the base of the abdomen, with the longitudinal and transverse diameters in the proportion of 14:12.5 (fig. 34). The posterior sinus is three-sevenths the length of the carapace and a little more than twice as long as wide. The anterolateral sinuses are so shallow as to be scarcely perceptible, so that the cephalic area does not project appreciably. The central longitudinal ribs are close together and nearly parallel; the joints in them behind the brain are indistinct and easily overlooked. The horseshoe suture is long and narrow and comparatively pointed at the posterior end, leaving the lateral areas very symmetrical and about the same size anteriorly and posteriorly. The thoracic area of the carapace, behind this suture, is a short strip one-fourth as long as wide and only half the length of the first free thoracic segment.

These thoracic segments increase in length from in front backward, the posterior one being more than twice as long as the anterior. They also increase somewhat in breadth, and since the posterior sinus of the carapace is about the same width, the free thorax is almost entirely exposed.

The abdomen is very small and spindle shaped, one-quarter the length of the rest of the body and two-thirds as wide at the center as it is long. The anal sinus is cut just to the center, and is narrow but of uniform width, leaving stout, bluntly conical lobes; the anal papillæ are small and basal.

Ventral surface (fig. 35).—Both pairs of antennæ are relatively small and weak, but are fairly well armed with hooks and spines. The anterior and lateral hooks on the basal joint of the first pair are slender, but the spine on the posterior border is above the average size.

The terminal portion of these first antennæ is slender and does not project beyond the lateral hook (fig. 36).

The basal joint of the second antennæ is as long as, and much thicker than, the two terminal joints, and the latter are attached obliquely to

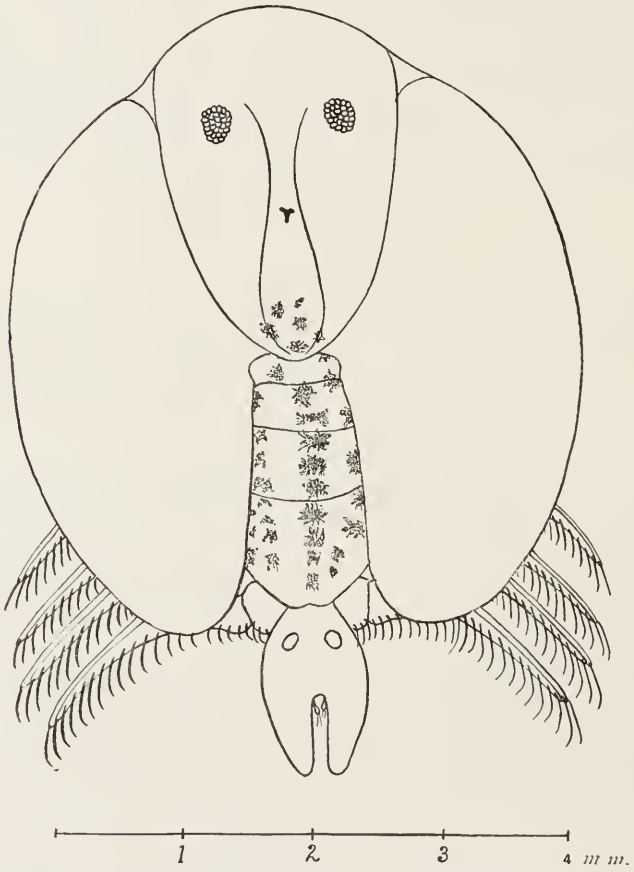

FIG. 34.—DORSAL SURFACE OF A FEMALE ARGULUS TRILINEATA.

one of its distal corners, so that the two portions of the antennæ stand nearly at right angles to each other.

The basal joint carries a stout spine on its posterior margin just where it joins the head, and two long, slender spines on the ventral surface at the distal end. The second joint has a single long spine on its anterior border at the distal end, while the terminal joint carries five or six large and stout spines. The spines along either side of the mid line of the body opposite the bases of the antennæ, those on the

posterior border of the basal joints of the antennæ, and the lateral hooks on the first antennæ are deep yellow in color and opaque; all the others are transparent and colorless.

The eyes are small, lunate, and more or less inclined to the central axis; they are situated well forward and widely separated.

The sucking disks are small, not more than one-eighth the width of the carapace; they are situated far forward and are widely separated.

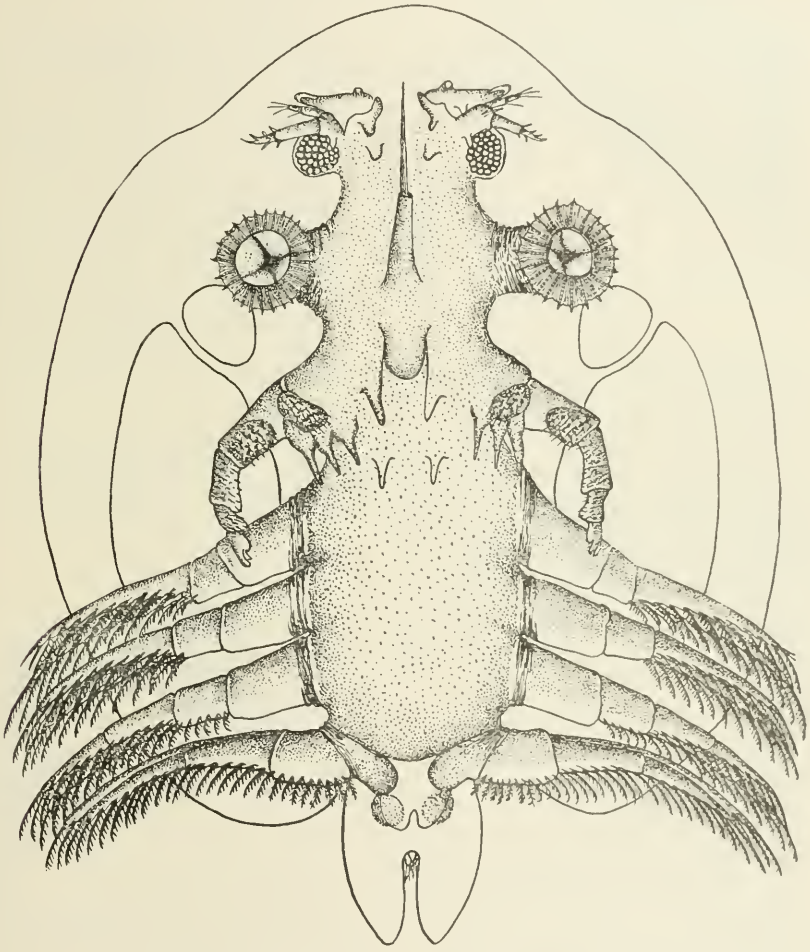

FIG. 35.—VENTRAL SURFACE OF A FEMALE ARGULUS TRILINEATA.

The chitin ribs, which support the membranous border, are made of trough-like scales overlapping one another, very similar to those in *A. megalops*.

Posterior maxillipeds.—These are large and very fully armed, to offset the slender antennæ (fig. 37). The basal joint has an oval papillated area, which is placed obliquely, is elevated considerably above

the surrounding surface, and entirely covered with short conical spines. The three teeth on the posterior border of this joint are very long, stout, and acute. The second joint carries on its distal end a papillated area even larger than that on the basal joint. The third and fourth joints are enlarged at their distal ends, and their whole ventral surface is covered with spines and papillæ. The terminal joint is tipped with two curved claws and a fleshy "thumb."

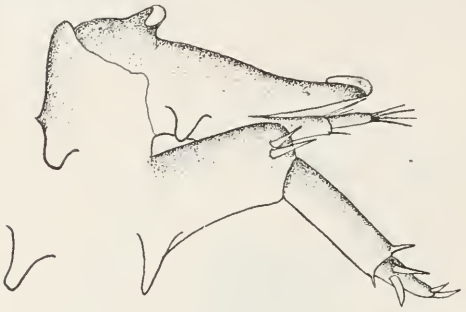

FIG. 36.—FIRST AND SECOND ANTENNÆ OF ARGULUS TRILINEATA.

Swimming legs. — These reach well beyond the edge of the carapace, and the two anterior pairs have recurved flagella. The distal joints of all four pairs carry a row of plumose setæ along their posterior border. The lobes on the basal joints of the last pair are small and well rounded. The tactile papillæ at the opening of the oviduct are broad and pretty thoroughly fused with the ventral surface of the abdomen.

Of the chitin rings in the lateral lobes of the carapace the anterior one is small and egg shaped, and is situated very close to the base of the sucking disks, while the posterior one is large and so broad that its inner border reaches to the bases of the swimming legs. The contrast in the size of these two rings is greater than that of any other species so far examined. The ventral surface of the anterior portion of the carapace is covered with triangular spines as large and as numerous as those in *americanus*.

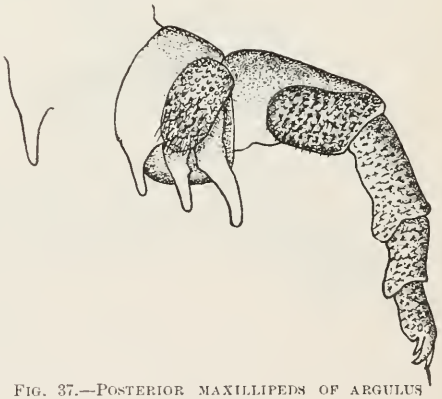

FIG. 37.—POSTERIOR MAXILLIPEDS OF ARGULUS TRILINEATA.

Nothing could be definitely ascertained with reference to the nervous and reproductive systems without danger of spoiling the specimen for a type, and therefore they are allowed to pass for the present. Of course the semen receptacles were visible. They prove to be large, spherical, and situated rather far forward. The papillæ connected with them are close together on the median line, well concealed beneath the tactile papillæ.

Total length, 4.5 mm.; length of carapace, 3.7 mm.; breadth of carapace, 3.3 mm.; length of abdomen, 1 mm.; breadth, 0.6 mm.

Color a uniform pale yellow, deeper along the central axis and lighter toward the margins. The dorsal surface of the thorax is ornamented with three well-defined rows of dark brown pigment spots which stand out prominently against the yellow background and catch the eye at once when the creature is viewed under a low power. The middle row is made up of a dozen large spots in single line along the central axis; the lateral rows are made up of numerous smaller spots arranged alternately in two broken lines. Under strong magnification these spots are seen to be transversely oblong and very irregular, the edges being cut repeatedly more than half the distance to the center (fig. 38). The large semen receptacles are also dark brown and show through the abdomen very prominently.

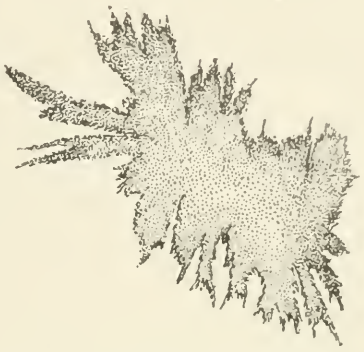

FIG. 38.—ONE OF THE PIGMENT SPOTS ON THE DORSAL SURFACE OF THE FREE THORAX OF ARGULUS TRILINEATA.

Locating this species in the artificial key already published[a] we should have:

A. Carapace lobes overlapping the base of the abdomen.
  B. Anterior swimming legs with a flagellum.
    C′. Carapace elliptical, considerably longer than wide.
      7, *a*. Sucking disks only 0.12, far forward and widely separated; abdomen small, spindle shaped, cut to the center. Color light yellow, with three rows of dark pigment spots on the dorsal surface of the thorax ..... *trilineatus*.

(*tres* = three, *lineatus* = arranged in lines.)

The author also desires to record the occurrence of *Argulus alosæ* at Casco Bay on the coast of Maine.

Several fine males were obtained from the common cunner (*Ctenolabrus adspersus* Walbaum), and they seemed fairly numerous. This is the first instance where this species has been positively identified north of Woods Hole since its original discovery by Dr. Gould. And it will increase the probability that the habitat may extend to the Gulf of St. Lawrence as doubtfully recorded by Mr. J. F. Whiteaves. Incidentally also it is the first species of this family to be obtained from the cunner, but as no females were found it may be inferred that this was only a temporary host used during the breeding season.

[a] Proc. U. S. Nat. Mus., XXV, 1902, p. 701.

CONTRIBUTIONS TO THE NATURAL HISTORY OF THE ISOPODA.

By Harriet Richardson,
Collaborator, Division of Marine Invertebrates.

V.

ISOPOD CRUSTACEANS OF THE NORTHWEST COAST OF NORTH AMERICA.[a]

The present paper contains a list of the Isopods collected by the Harriman Alaska Expedition, and in addition a number of species from California received from Dr. William E. Ritter, head of the zoological department of the University of California. Five species are described as new. A little-known species, *Idotea gracillima* (Dana) is figured for the first time and described more fully than heretofore; and *Asellus tomalensis* (Harford) also is redescribed and figured.

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Budde-Lund, G. Crustacea Isopoda Terrestria per familias et genera et species descripta, Hauniæ, 1885, pp. 261–262, 264.

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Dollfus, Adrien. Sur quelques Isopodes du Musée de Leyde. Notes from the Leyden Museum, XI, 1889, pp. 93–94, pl. v.

[a] Reprinted from the Harriman Alaska Expedition, X, Crustacea, 1904.

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LOCKINGTON, W. N. Description of Seventeen New Species of Crustacea. Proc. Cal. Acad. Sci., VII, 1877, p. 46.

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FLABELLIFERA or CYMOTHOIDEA.

Family CIROLANIDÆ.

CIROLANA HARFORDI (Lockington).

Æga harfordi LOCKINGTON, Proc. Cal. Acad. Sci., VII, 1877, Pt. 1, p. 46.

Cirolana californica HANSEN, Vidensk. Selsk. Skr., 6th ser., natur. og math. Afd., V, 1890, pp. 338–339, pl. III, figs. 2–2f.

Cirolana harfordi RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, pp. 822–823.

Locality.—Wilson Cove, California. (Dr. Ritter and party.)

Family ÆGIDÆ.

ROCINELA BELLICEPS (Stimpson).

Æga belliceps STIMPSON, Proc. Acad. Nat. Sci., Philad., XVI, 1864, p. 155.
Æga alaskensis LOCKINGTON, Proc. Cal. Acad. Sci., VII, 1877, Pt. 1, p. 46.
Rocinela alaskensis RICHARDSON, Proc. Am. Phil. Soc., XXXVII, 1898, p. 11.
Rocinella belliceps RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 827.

Locality.—Yakutat, Alaska. (Harriman Alaska Expedition.)

Family CYMOTHOIDÆ.

LIVONECA VULGARIS Stimpson.

Livoneca vulgaris STIMPSON, Bost. Journ. Nat. Hist., VI, 1857, p. 508, pl. XXII, fig. 9; Proc. Bost. Soc. Nat. Hist., VI, 1859, pp. 88, 89.—SCHIØDTE and MEINERT, Naturhistorisk Tidsskrift, XIV, 1883–1884, pp. 344–349, pl. XIV, figs. 1–5.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 830.

Locality.—San Francisco Bay. (Dr. Ritter and party.)

Family SPHÆROMIDÆ.

DYNAMENE TUBERCULOSA Richardson.

Dynamene tuberculosa RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 833.

Locality.—Bodega Bay, California. (Dr. Ritter and party.)

SPHÆROMA OREGONENSIS Dana.

Sphæroma oregonensis DANA, Proc. Acad. Nat. Sci. Philad., VII, 1854–55, p. 177; U. S. Expl. Exp., 1853, Crust., Pt. 2, XIV, p. 778, pl. LII, fig. 4.—STIMPSON, Bost. Journ. Nat. Hist., VI, 1857, p. 509.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 836.

Localities.—Pōpof Island (from fresh water), Yakutat, and Glacier Bay, Alaska; Greenville Channel and Lowe Inlet, British Columbia (Harriman Alaska Expedition).

SPHÆROMA PENTODON, new species.

Body elliptical in outline; color dark brown; surface minutely but densely granular.

Head transversely situated, with a prominent ridge on the anterior margin. Eyes post-laterally placed, and composed of many ocelli. First pair of antennæ extend to the posterior margin of the head; flagellum, eight jointed. Second pair of antennæ reach the middle of the second thoracic segment; flagellum composed of fifteen joints.

Segments of the thorax about equal in length, with the exception of the first, which is somewhat longer than any of those following. The lateral parts, which are not distinctly separated from the dorsal parts

of the segments, are drawn out in acute processes in the first three segments; those of the following segments are more nearly regular in outline.

The abdomen is somewhat broader than the thorax, although this expansion of the abdomen does not show in a dorsal view. The first segment is about equal in length to the last thoracic segment, and is marked on either side by two suture lines, indicative of coalesced segments. The terminal segment is entire and not produced, being evenly rounded in outline. The anterior portion of the segment is convex, with a longitudinal series of four small tubercles on either side of the median line, the two series being close together. The posterior extremity of the segment is marked by a prominent transverse elevation.

The inner immovable branch of the uropoda is narrow, elongate, and pointed posteriorly; it extends to the extremity of the abdomen. The outer mobile branch is furnished on its lateral margin with five strong teeth. Both branches are of equal length.

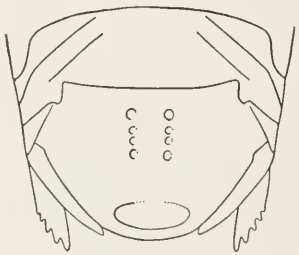


FIG. 1.—ABDOMEN OF SPHÆROMA PENTODON. ×8.

The first three pairs of legs are slender and are furnished with long hairs. The other four pairs are somewhat stouter.

Ten specimens were collected at Sausalito, California, by Dr. Ritter and party.

This species is perhaps more closely related to *Sphæroma sieboldii* Dollfus[a] from Japan than it is to any of the known species of the genus from the Pacific coast of North America. It differs, however, from that species in having a prominent transverse elevation on the posterior portion of the terminal segment, while in *S. sieboldii* the posterior part of the segment is distinctly concave; in having five teeth on the lateral margin of the outer uropod, while in *S. sieboldii* there are seven; in having fifteen joints to the flagellum of the second pair of antennæ, this organ in *S. sieboldii* having a flagellum composed of only ten joints; in having two longitudinal series of four small tubercles, one on either side of the median line on the terminal abdominal segment, while in *S. sieboldii* the granulations on the caudal segment form, in the middle, two divergent lines; and in having the body covered with minute granulations, in *S. sieboldii* the granulations being strong and more prominent.

The type is in the Museum of the University of California. The co-type is in the U. S. National Museum, Cat. No. 28768.

[a] Notes from the Leyden Museum, XI, 1889, pp. 93–94, pl. v.

VALVIFERA or IDOTEOIDEA.

Family IDOTEIDÆ.

CHIRIDOTEA ENTOMON (Linnæus).

Oniscus entomon LINNÆUS, Syst. Nat., 12th ed., II, 1766, p. 1060.—PALLAS, Spicil. Zool., IX, 1772, p. 64, pl. v, figs. 1–6.

(?) *Entomon pyramidale* KLEIN, Rem. sur les Crustacés, figs. 1–3.

Squilla entomon DE GEER, Mém. pour servir à l'Hist. des Insectes, VII, 1778, p. 514, pl. XXXII, figs. 1–10.

Asellus entomon OLIVIER, Encycl. Méth., 1789, p. 253.

(?) *Cymothoa entomon* FABRICIUS, Ent. Syst., II, 1793, p. 505.

Idotea entomon BOSC, Hist. Nat. des Crust., II, 1802, p. 178.—LATREILLE, Hist. Nat. Crust. et Ins., VI, 1803–4, p. 361; VII, pl. LVIII, figs. 2, 3.—(?) LAMARCK, Hist. des Anim. sans Vert., 1st ed., V, 1818, p. 159.—(?) DESMAREST, Consid. Crust., 1825, p. 289.—RATHKE, Nueste Schriften der naturf. Gesellsch. in Danzig, I, 1820, p. 109, pl. IV.—KRØYER, Vid. Selsk. Skrift., VII, 1838, p. 323.—MILNE EDWARDS, Hist. Nat. Crust., III, 1840, p. 128.—KRØYER, Nat. Tidsskr., II, 1847, p. 402.—WHITE, List Cr. Brit. Mus., 1847, p. 93.—BRANDT, Cr. in Middendorff's Sibirische Reise, II, Pt. 1, 1851, p. 145.—MEINERT, Nat. Tidsskr., 3d ser., XI, 1877, p. 84.—BRANDT, Comptes Rendus, 1880, p. 713; Ann. Mag. Nat. Hist., VI, 1880, p. 98.

(?) *Saduria entomon* ADAMS, in White, Sunderland's Voyage Baffin's Bay, etc., Appendix, 1852, p. ccvii.

Idotæa longicauda LOCKINGTON, Proc. Cal. Acad. Sci., VII, 1877, Pt 1, p. 45.

Glyptonotus entomon MIERS, Trans. Linn. Soc. London, XVI, 1883, pp. 12, 13, pl. I, figs. 1, 2 (see Miers for above synonymy).—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 843.

Localities.—St. Michael, Alaska (Dr. Ritter); Yakutat Bay, Alaska. (Harriman Alaska Expedition.)

IDOTEA RESECATA Stimpson.

Idotea resecata STIMPSON, Bost. Journ. Nat. Hist., VI, 1857, pp. 504–505, pl. XXII, fig. 7; Proc. Bost. Soc. Nat. Hist., VI, 1859, p. 88.—MIERS, Journ. Linn. Soc. London, XVI, 1883, pp. 45–46.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 844.

Locality.—Tomales Bay, California. (Dr. Ritter and party.)

IDOTEA GRACILLIMA (Dana).

Stenosoma gracillimum DANA, Proc. Acad. Nat. Sci. Philad., 1854–55, VII, p. 175.—STIMPSON, Bost. Journ. Nat. Hist., VI, 1857, p. 505.

Idotea gracillima MIERS, Journ. Linn. Soc. London, XVI, 1883, p. 35.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 844.

Locality.—California (Dana).

The description of this species given by Professor Dana is very short and rather vague. He describes the body as extremely narrow and filiform, the thoracic segments subquadrate, head quadrate. He refers to the linear post-abdomen, which is truncated at the apex, is three-jointed, and marked on either side with a suture. The antennæ

are described as being a little shorter than half the body, with a ten to twelve jointed flagellum.

No figure of the form has ever been given.

A species of *Idotea* was sent to the U. S. National Museum by Dr. Ritter. The specimens, which are eight in number, were collected by him at Bolinas, California. They are more closely allied to *I. gracillima* than to any other known species of *Idotea* from the Pacific coast of North America. Until evidence can be given of their distinctness, I shall consider them identical with *I. gracillima*.

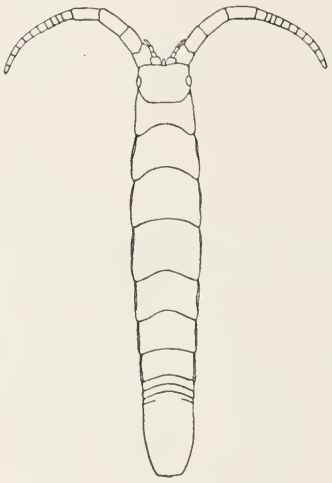


FIG. 2.—IDOTEA GRACILLIMA (DANA). ×5.

Description.—Body slender, about seven times longer than wide,[a] with the sides nearly parallel. Surface entirely smooth; color in alcohol uniformly pinkish. A note referring to the color of the specimens in life states that they are green, brown, and striped.

Head quadrate, with rounded antero-lateral margins, and a slight median excavation in the anterior margin. Eyes situated at the extreme lateral edge and about the middle of the head; they are small, but distinct. The first pair of antennæ are four-jointed and extend a little beyond the extremity of the second peduncular joint of the second pair of antennæ. The second pair of antennæ are equal to half the length of the body; the last two joints of the peduncle are subequal; in the smaller specimens the flagellum is composed of ten joints; in the larger ones there are eighteen joints.

FIG. 3.—ABDOMEN OF IDOTEA GRACILLIMA, SHOWING VARIATIONS.

The first thoracic segment is short in the middle but is produced antero-laterally on either side; it is not wider than the head. The second, third, and fourth segments are subequal in length, and are longer than the first segment. The fifth, sixth, and seventh segments gradually decrease in length. The epimera of all the segments are extremely narrow; those of the second and third segments extend but half the length of the segment; those of the fourth and fifth segments extend three-fourths the length of the segment; those of the last two segments extend the entire length of the segment.

[a] The female is figured. The body is somewhat broader than in the male.

The abdomen consists of three distinct segments, with suture lines on either side of another coalesced segment. The third or terminal segment has subparallel sides to about the middle, where the segment gradually becomes narrower to a truncate extremity. On the posterior margin of the terminal segment is a faint indication of a double emargination on either side of an obtuse median point.

Legs small and slender and devoid of hairs.

The five small specimens and one large one agree in having the terminal segment as described above. The two larger specimens show the emargination more distinctly, one of the specimens more so than the other. Figures, showing all three variations, are given.

The specimens agree in all other characters.

Dana's specimens were collected by Prof. J. Le Conte on the coast of California.

IDOTEA WOSNESENSKII Brandt.

Idotea wosnesenskii BRANDT, Middendorff's Sibirische Reise, II, Pt. 1, 1851, Crust., p. 146.
Idotea hirtipes DANA, Cr. U. S. Expl. Exp., XIV, Pt. 2, 1853, p. 704, pl. XLVI, fig. 6.
Idotea oregonensis DANA, Proc. Acad. Nat. Sci., Philad., VII, 1854, p. 175.
Idotea wosnesenskii STIMPSON, Bost. Journ. Nat. Hist., VI, 1857, p. 504.
Idotea wosnesenskii SPENCE BATE, Lord's Naturalist in British Columbia, II, 1866, p. 281.—MIERS, Journ. Linn. Soc. London, XVI, 1883, p. 40.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 846.

Localities.—Dutch Harbor on Unalaska Island; Humboldt Bay on Popof Island; Yakutat; Garforth Island in Muir Inlet, and Sitka, Alaska; Beaver Cove, on Vancouver Island; (Harriman Alaska Expedition.) Lands End, California. (Dr. Ritter and party.)

IDOTEA STENOPS Benedict.

Idotea stenops BENEDICT, Proc. Biol. Soc. Washington, XII, 1898, pp. 54–55.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 846.

Locality not given. (Dr. Ritter and party.)

IDOTEA OCHOTENSIS Brandt

Idotea ochotensis BRANDT, Middendorff's Sibirische Reise, II, Pt. 1, 1851, Crust., p. 145, pl. VI, fig. 33.—MIERS, Journ. Linn. Soc. London, 1883, XVI, pp. 32–34, pl. I, figs. 8–10.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 846.

Localities.—Lands End and Fort Point, California. (Dr. Ritter and party.) Humboldt Bay on Popof Island, Alaska. (Harriman Alaska Expedition.)

SYNIDOTEA RITTERI, new species.

Body, ovate in outline. Color, yellow, with markings of black; terminal segment almost entirely black.

Head with prominent, rounded antero-lateral angulations, at base of which, and just above the eyes, is a conspicuous horn-like projection,

hook-shaped, directed upward and forward, one on either side of the head. In the median excavation of the frontal margin on either side of the median line is a prominent tubercle. Between the eyes and in line with them on the posterior portion of the head are two low tubercles. The eyes are situated at the extreme lateral margins on the posterior portion of the head, and are somewhat elevated above the surface; they are black and conspicuous, and composed of many ocelli. The first pair of antennæ consist of four joints, the last joint being clavate and fringed with hairs; the second pair of antennæ have a five-jointed peduncle, and a flagellum composed of eight joints; the third joint of the peduncle has a prominent tubercle.

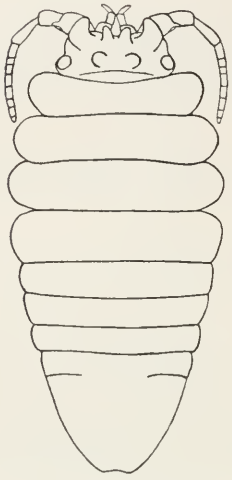


FIG. 4.—SYNIDOTEA RITTERI. × 10.

The first four segments of the thorax are longer than the last three. The lateral parts of all the segments are widely expanded, with margins well rounded. The lateral parts are not separated from the dorsal portion of the segments, but are firmly anchylosed.

The abdomen consists of one segment, with suture marks, one on either side, indicative of another partly coalesced segment. The abdomen tapers gradually to a broadly rounded extremity, which is slightly excavate in the median line.

The seven pairs of legs are but sparingly furnished with hairs. The upper half of the opercular valve is black, the lower half yellow.

There are three longitudinal lines of low swellings on the body, one median, the other two placed one on either side of the median line.

Only one specimen was taken at Lands End, California, by Dr. Ritter and party.

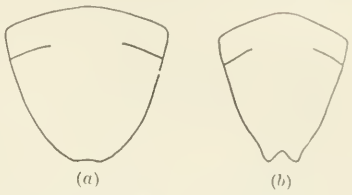
This species is closely allied to *Synidotea consolidata* (Stimpson),[a] but differs from that species in the shape and greater size of the tubercles in front of the eyes, the tubercles being hook-shaped and very prominent in *S. ritteri* and projecting far in front of the anterior margin of the head, while in *S. consolidata* they are small (Stimpson speaks of them as being minute), are not hooked, and do not project any considerable distance in front of the anterior margin of the head; in the greater size of the two median tubercles on the anterior division of the head (Stimpson does not mention these tubercles in his description, but in the specimens sent to the U. S. National Museum from Pacific Grove, California, by Mr. J. O. Snyder, and which

(*a*) (*b*)

FIG. 5.—HEAD OF (*a*) SYNIDOTEA RITTERI AND OF (*b*) S. CONSOLIDATA. × 10.

[a] Proc. Cal. Acad. Sci., I, 1856, p. 97; Bost. Journ. Nat. Hist., VI, 1857, p. 503.

Dr. James E. Benedict has identified with *S. consolidata*, and figured in his paper on the genus *Synidotea*,[a] these tubercles are present, but very minute); in the shape of the terminal segment of the body, it being much broader, and tapering very gradually to a broadly rounded extremity, which has a slight median notch or excavation in *S. ritteri*, while in *S. consolidata* the terminal segment of the body is narrower, and tapers to an extremity marked by two pronounced teeth or angulations separated by a deep median notch.



(*a*) (*b*)

FIG. 6.—ABDOMEN OF (*a*) SYNIDOTEA RITTERI AND OF (*b*) S. CONSOLIDATA. × 10.

Specimens of the same size were taken in making the above comparisons.

ASELLOTA or ASELLOIDEA.

Family JANIRIDÆ.

JANIROPSIS KINCAIDI, new species.

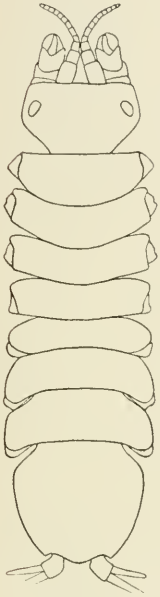


FIG. 7.—JANIROPSIS KINCAIDI. × 20½.

Color of body light brown, profusely and densely covered with black markings.

Head wider than long; frontal margin nearly straight, with lateral angles rounded. Eyes large, black, situated some little distance from the lateral margin. First pair of antennæ short; flagellum consisting of only eight joints in the female, of ten in the male. Second pair of antennæ lost in all the specimens. Maxillipeds with palp consisting of five joints, the first three of which are very much dilated.

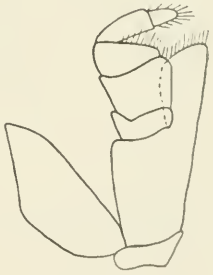


FIG. 8.—MAXILLIPED OF JANIROPSIS KINCAIDI. × 77.

FIG. 9.—LAST THORACIC SEGMENT, ABDOMEN, AND UROPODA OF JANIROPSIS KINCAIDI. × 20½.

First segment of thorax with lateral margins straight; epimera rather bilobed and occupying most of the lateral margin of the segment. Second, third, fourth and fifth segments with antero-lateral angles produced into rounded lobes. Epimera of second and third segments situated about the middle of the lateral margin; those of the fourth and fifth segments occupying more of a posterior position on the lateral margin. Epimera of the last two segments situated at the post-lateral angles of the segments.

[a] Proc. Acad. Nat. Sci. Philad., 1897, p. 393.

Abdomen broad, gradually becoming somewhat narrower toward the posterior extremity. Posterior margin produced in three lobes, two lateral lobes, one on either side of a broadly rounded median lobe; the two lateral lobes are acute. The uropoda are short, not longer than half the length of the terminal segment of the body; the basal segment is broad, quadrate in shape, and shorter than either branch; the inner branch is somewhat longer than the outer one. The middle piece of the operculum in the male is very similar to the figure given by Sars[a] of the type species of the genus, *Janiropsis breviremus*. It is produced and greatly dilated at the distal extremity.

FIG. 10.—UROPOD OF JANIROPSIS KINCAIDI. ×77.

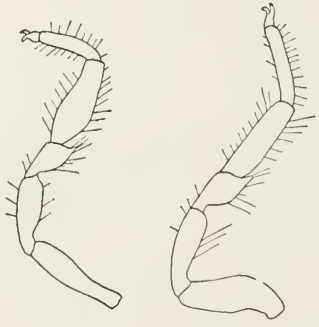
Nine specimens were obtained by the Harriman Alaska expedition at Yakutat, Alaska. They were collected by T. Kincaid, after whom the species is named. Five females and four males were collected. The first pair of legs in the male are not greatly longer than the others; they are longer in the type species of *Janiropsis*.

(*a*)

(*b*)

(*c*)

FIG. 11.—JANIROPSIS KINCAIDI; *a*, MIDDLE PIECE OF MALE OPERCULUM; *b*, LATERAL PLATE OF MALE OPERCULUM; *c*, SECOND PLEOPOD OF MALE. ×41.



(*a*) (*b*)

FIG. 12.—JANIROPSIS KINCAIDI; *a*, LEG OF FIRST PAIR; *b*, LEG OF SECOND PAIR. ×27.

The very short superior antennæ with few articulations, the greatly dilated joints of the maxillipeds, the form and shape of the middle piece of the male operculum with its dilated tip and the shortness of the uropoda, which are only half the length of the terminal segment of the body, are characters which undoubtedly place this species with *Janiropsis* Sars.

Type.—Cat. No. 28,717, U.S.N.M.

JANIROPSIS CALIFORNICA, new species.

Body narrow, elongate. Surface smooth; color uniformly whitish.

Head with a prominent rounded median lobe on the anterior margin; lateral angulations rounded; lateral margins straight and converging toward the base. Eyes black, distinct, but small, and simple in structure. First pair of antennæ are composed of six joints, and extend

[a] Crustacea of Norway, II, 1899, p. 102.

nearly to the middle of the fifth joint of the peduncle of the second pair of antennæ. Second pair of antennæ are about equal to one-third the length of the body; the flagellum is composed of nineteen or twenty joints.

The first thoracic segment is but little wider than the head; the margins are entire, with rounded lateral lobes. The second segment has the lateral margin straight with the epimeron showing slightly along the edge. The third and fourth segments have the antero-lateral lobe rounded, the posterior margin straight, with the epimeron showing as a rounded lobe. The fifth, sixth, and seventh segments have rounded lateral margins with epimera showing on the posterior part of the segments.

FIG. 13.—ANTERIOR PART OF BODY OF JANIROPSIS CALIFORNICA. ×27.

The terminal segment is rounded posteriorly with smooth margins and a median lobe between the uropoda.

Uropoda very short, about half as long as the terminal segment. Branches about equal in length, and twice as long as the peduncle.

Legs simple, ambulatory, similar in shape and size, and biunguiculate.

Only two good specimens, both females, were taken at Sausalito, California, by Dr. Ritter and party. Two imperfect specimens also are from the same locality.

Until now the only other known species of this genus was *Janiropsis breviremis* Sars.[a] As that author has pointed out, this genus differs from *Janira*, to which it is very closely related, in the much shorter uropoda; in the shorter second pair of antennæ; in the structure of the first pair of antennæ, which have the flagellum composed of only a restricted number of articulations; in the structure of the first pair of legs in the male, these being "remarkably developed, prehensile, much longer than any of the other pairs, with the carpal joint fusiformly dilated"—in the female, however, this pair do not differ from the other legs, all being ambulatory in character; in the greatly dilated joints of the maxillipeds, and in having the tip of the middle piece of the male operculum produced and dilated at the distal extremity.

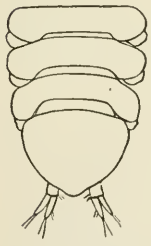


FIG. 14.—POSTERIOR PART OF BODY OF JANIROPSIS CALIFORNICA. ×27.

JANIRA OCCIDENTALIS Walker.

Janira occidentalis WALKER, Trans. Liverpool Biological Soc., XII, 1898, pp. 280–281, pl. XV, figs. 7–10.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 859.

Locality.—Puget Sound. (Harriman Alaska expedition.)

[a] Crustacea of Norway, II, 1899, p. 98.

Family ASELLIDÆ.

ASELLUS TOMALENSIS Harford.

Asellus tomalensis HARFORD, Proc. Cal. Acad. Sci., VII, 1877, pp. 54–55.

The description of this form is given in the following concise manner:

Head a little transverse, narrower than the body. Upper antenna not reaching to the extremity of the peduncle of the lower. Flagellum of lower antenna longer than its peduncle. Body narrow in front, gradually increasing in width toward the tail.

Peduncle of caudal appendages more than half the length of the terminal filaments. Length six-twentieths inch.

The description is from a single specimen.

Eight specimens of a species of *Asellus* were collected by the Harriman Alaska expedition at Lake Washington, Seattle. I have referred them to the above species, being unwilling to describe a new species of *Asellus* from a locality so close to that from which *A. tomalensis* was found (Tomales Bay, California), when so little is known about *A. tomalensis*. Some of the specimens were sent to Dr. William E. Ritter for comparison with the type and only specimen of *A. tomalensis* in the collection of the California Academy of Sciences. The result of his comparison is given in the following quotation from his letter:

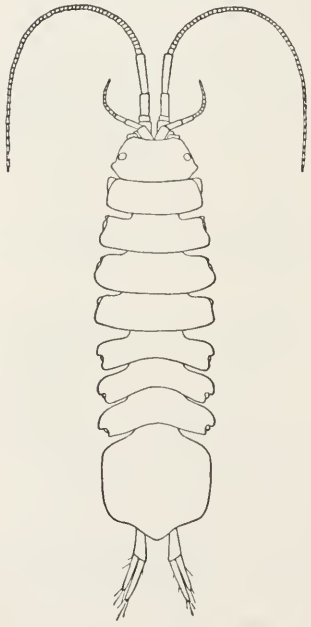


FIG. 15.—ASELLUS TOMALENSIS HARFORD. × 9.

> About the only difference that I am able to make out is in the fact that the inner ramus of the sixth pleopods (uropods?) of *A. tomalensis* is about half as long as the exopodite and that neither is armed with a tuft of hairs at the tip. This is the case with the one appendage present, but its mate is gone. It is possible that the hair tuft may have been broken off, but the tips of the rami themselves are perfectly smooth. They show no evidence of having lost anything. The fact, however, that the general hairiness of the Academy specimen is about the same as that of your specimen makes me suspicious that the tuft referred to has been removed. The antennæ and antennules differ in no essential respect so far as I can see. The chelipeds of the type specimen I am unfortunately unable to find.

Description of specimens.—Body narrow, elongate, gradually widening somewhat from the anterior to the posterior extremity.

Head but little narrower than the first thoracic segment and about twice as wide as long; frontal margin slightly excavate and without

median process between the antennæ; lateral margins straight, with a small lobe on either side near the base of the head. Eyes lateral, situated in the median transverse line. First pair of antennæ reach the extremity of the peduncle of the second pair of antennæ; flagellum contains about ten joints. Second pair of antennæ are about two-thirds the length of the body; the flagellum consists of about fifty-five joints.

FIG. 16.—MANDIBLE OF ASELLUS TOMALENSIS.

The first segment of the thorax has the epimeral lobes distinct and visible from a dorsal view at the antero-lateral angles of the segment. In the second and third segments the epimera are bilobed and occupy the anterior portion of the lateral margins. In the fourth segment the epimeron is a small lobe situated at the antero-lateral extremity of the segment. In the fifth and sixth segments the epimeron is a small lobe about the middle of the lateral margin. In the seventh segment it has more of a posterior position on the lateral margin.

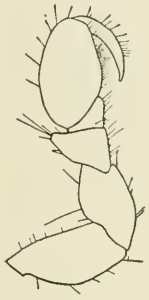


FIG. 17.—LEG OF FIRST PAIR OF ASELLUS TOMALENSIS. × 20½.

The abdomen is broad, with the sides nearly parallel. Posteriorly it is produced in the center in a large triangularly shaped lobe with rounded apex. The uropoda are slender appendages; the peduncle is somewhat shorter than the branches; the inner branch is about a fifth longer than the outer branch. The margins of all the segments, the uropods, and legs are fringed with hairs.

The legs of the first pair are cheliform; the propodus is elliptical in outline, with the inferior margin straight. The other legs are similar and ambulatory in character.

The color of the species is a light brown somewhat mottled.

Family MUNNIDÆ.

MUNNA sp.?

A very much mutilated specimen of a species of *Munna* was taken by the Harriman Alaska Expedition at the Pribilof Islands. The *Munnidæ* have not heretofore had any representatives from the Pacific coast. Although it is very probable that the present specimen is the type of a new species, it is not, however, in a sufficiently complete condition to warrant a description.

ONISCOIDEA.

Family LIGIIDÆ.

LIGIA OCCIDENTALIS Dana.

Ligia occidentalis Dana, U. S. Expl. Exp. Crust., XIV, Pt. 2, p. 742, pl. xlix, fig. 7; Proc. Acad. Nat. Sci. Philad., VII, p. 176.—Stimpson, Bost. Journ. Nat. Hist., VI, 1857, p. 506.—Harford, Proc. Cal. Acad. Sci., VII, 1877, p. 116.—Budde-Lund, Crust. Isop. Terrestria, 1885, p. 264.—Richardson, Proc. U. S. Nat. Museum, XXI, 1899, p. 866.

Localities.—Sausalito, California, and San Bartolomé Bay, Lower California. (Dr. Ritter and party.)

LIGIA PALLASII Brandt.

Ligia pallasii Brandt, Bull. Soc. Impér. des Natur. de Moscou, VI, 1833, p. 172.
Ligia dilatata Stimpson, Bost. Journ. Nat. Hist., VI, 1857, p. 507, pl. xxii, fig. 8.—S. I. Smith, Report of Progress of Geological Survey of Canada, 1878–79.
Ligia septentrionalis Lockington, Proc. Cal. Acad. Sci., VII, 1877, Pt. 1, p. 46.
Ligia stimpsoni Miers, Proc. Zool. Soc. London, 1877, p. 671 (see footnote).
Ligia pallasii Budde-Lund, Crust. Isop. Terrestria, 1885, pp. 261–262.

Locality.—Lowe Inlet, British Columbia. (Harriman Alaska Expedition.)

Family TRICHONISCIDÆ.

TRICHONISCUS PAPILLICORNIS, new species.

Body covered with low tubercles. Color, light brown. Head with sides produced at the antero-lateral angles in large lobes; front triangularly produced with a slight emargination at the apex of the triangle. Eyes situated on the lateral margins at the base of the antero-lateral lobes; they are small and black and apparently simple in structure. The peduncle of the antennæ consists of five stout joints, the last three of which have the inner margins beset with numerous strong tubercular-like papillæ, each surmounted with a tuft of short, stiff hairs or bristles; the fifth joint is also produced at the outer distal angle in an acute process. The flagellum is composed of about seven joints, the joints being rather indistinctly defined; the

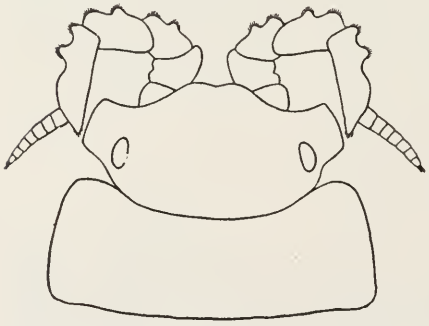


Fig. 18.—Head and first thoracic segment of Trichoniscus papillicornis. ×41.

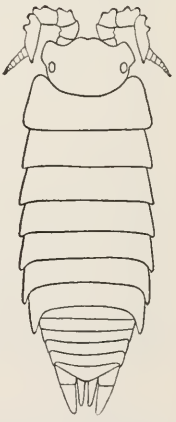


Fig. 19.—Trichoniscus papillicornis. ×15.

last joint is tipped with a bunch of hairs. The buccal mass is very prominent below.

The segments of the thorax are about equal in length. The postlateral angles of all the segments, except the first, are produced backward, very slightly in the case of the second, third, and fourth, but becoming gradually more so, until the last two segments show this character very markedly.

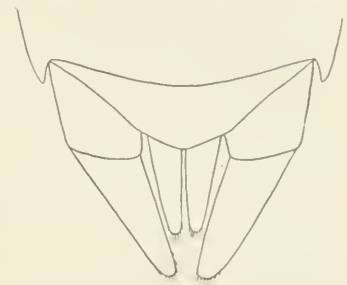


Fig. 20.—Uropod and last segment of abdomen of Trichoniscus papillicornis. × 77.

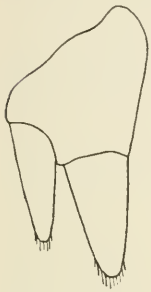


Fig. 21.—Uropod of left side of Trichoniscus papillicornis. × 77.

The abdomen is narrower than the thorax. All the segments are visible in entirety, not being covered laterally by the last thoracic segment. The terminal segment is triangularly produced with the apex somewhat rounded.

The uropoda are short, styliform; the outer branch is the stouter and extends a little beyond the extremity of the inner branch. Both branches are tipped with a few hairs.

Fig. 22.—Leg of first pair of Trichoniscus papillicornis. × 15.

Only a single specimen was obtained by the Harriman Alaska expedition, at Seldovia, Cook Inlet. It was found on the beach.

Type.—Cat. No. 28772, U.S.N.M.

VI.

ISOPODS COLLECTED AT THE HAWAIIAN ISLANDS BY THE U. S. FISH COMMISSION STEAMER ALBATROSS.

The U. S. Fish Commission is undertaking a systematic exploration of the marine fauna of the Hawaiian Islands, under the direction of Dr. D. S. Jordan. During the summer of 1902, under the immediate charge of Prof. C. H. Gilbert, the U. S. Fish Commission steamer *Albatross* was engaged in dredging in the vicinity, while a party of assistants explored the shore and shallow water.

The isopods collected were not numerous. Most of them are new to science, only two species in the collection, *Ligia hawaiiensis* Dana and *Cymothoa recta* Dana, having been previously recorded from the islands.

Two new genera of parasitic isopods, representing different families of *Epicaridea*, the *Dajidæ* and the *Bopyridæ*, are herein described. The Bopyrid genus is particularly interesting, because it is the first of that family known to occur in the visceral cavity of Decapods, the *Entoniscidæ* alone having been known to have that position in relation to their hosts, the Brachyurous Crustacea.

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Stebbing, T. R. R. History of Crustacea, New York, 1893, pp. 398–400, 408–419.

CHELIFERA or TANAIOIDEA.

Family APSEUDIDÆ.

APSEUDES sp.?

One mutilated specimen was obtained by the U. S. Fish Commission steamer *Albatross* off the south coast of Molokai Island, the Hawaiian Islands.

FLABELLIFERA or CYMOTHOIDEA.

Family ÆGIDÆ.

ÆGA QUADRATASINUS Richardson, new species.

Body (fig. 23) ovate, about two and a third times longer than broad. Color uniformly light yellow.

Head with frontal margin rounded and produced in a small median process between the basal joints of the first pair of antennæ; posterior margin nearly straight. Eyes situated on the antero-lateral margin, extending along each side from the posterior margin of the head to the proximal end of the third peduncular joint of the first pair of antennæ, and separated from each other on the anterior margin by a distance

equal to the length of one eye. The first pair of antennæ (fig. 24) have the peduncle composed of two short joints of equal length, and a long, slender joint equal to the length of the first two taken together; none of these joints are dilated; the flagellum is composed of twenty-four joints and extends to the posterior margin of the second thoracic segment. The second pair of antennæ have a five-jointed peduncle, the distal end of the fifth joint of which extends to the middle of the first thoracic segment; the flagellum is composed of twenty-four joints, and reaches the posterior margin of the third thoracic segment.

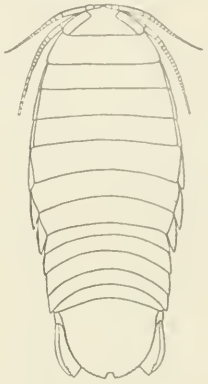


FIG. 23.—ÆGA QUADRATASINUS, NEW SPECIES. × 2¾.

The frontal lamina, or interantennal plate is cone-shaped, round and flat at its distal end, and produced at its proximal end to an acute point. The segments of the thorax are equal in length. The epimera of the second, third, and fourth segments are not produced posteriorly beyond the margin of the segment; those of the fifth, sixth, and seventh segments are produced backward.

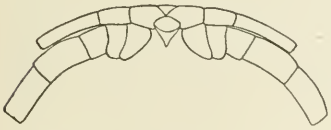


FIG. 24.—FRONTAL LAMINA AND PEDUNCLES OF BOTH PAIRS OF ANTENNÆ OF ÆGA QUADRATASINUS. × 9¾.

There is an arcuate carina on all the epimera which extends from the post-lateral external angle to the internal antero-lateral angle of the opposite side.

All six segments of the abdomen are distinct, the first segment being a little shorter than the four following. The sixth or terminal segment is well rounded posteriorly, with a pronounced and wide emargination, quadrangular in shape, in the median line. On either side of this emargination the posterior margin is crenulate for some distance, and is provided with minute spines, about eight on either side.

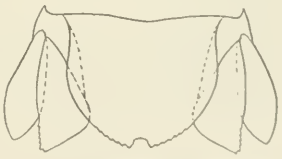


FIG. 25.—TERMINAL SEGMENT WITH UROPODA OF ÆGA QUADRATASINUS. × 5½.

The uropoda (fig. 25) are about equal in length, and are not longer than the terminal abdominal segment. The outer branch is oval in shape, denticulate, and provided with spines on the external and posterior margin. The inner branch is unlike the outer branch in shape, and tapers to a narrow extremity at the post-lateral side of the external margin, the external margin being almost straight; this branch is also crenulate and provided with small spines.

The first three pairs of legs are prehensile. On the third pair (fig. 26) there is one spine on the ischium, six on the merus, two on the

carpus, and one at the distal end of the propodus. The four following pairs of legs are gressorial, and are provided with spines on the ischium, merus, carpus, and propodus.

Only one specimen was obtained in 1902 from Kauai Island, the Hawaiian Islands, by the U. S. Fish Commission steamer *Albatross*.

Type.—Cat. No. 28971, U.S.N.M.

FIG. 26.—LEG OF THIRD PAIR OF ÆGA QUADRATASINUS. ×8.

This species approximates more closely to *Æga incisa*[a] Schiœdte and Meinert than to any other described species of the genus. It differs, however, in the shape of the abdomen, which is more triangular in *A. incisa;* in the shape of the terminal notch, which is V-shaped in *A. incisa*, more quadrangular in *A. quadratasinus;* in the smaller eyes, which do not meet in the median line as in *A. incisa*, but are separated by a space equal to the length of one eye; by the longer antennæ of both pairs, each containing also a greater number of joints in the flagellum; and in having the prehensile legs provided with numerous spines, while in *A. incisa* there is a single spine on the ischium and a single one on the carpus.

ÆGA DESHAYESIANA (Milne Edwards.)

Rocinela deshayesiana MILNE EDWARDS, Hist. Nat. Crust., III, p. 243.
Æga deshayesiana SCHIŒDTE and MEINERT, Naturhistorisk Tidsskrift, XII, (3), 1879–80, pp. 360–361, pl. VIII, figs. 7–9.

Locality.—Pailolo Channel, between Molokai and Maui Islands and North East Approach.

This species has been recorded from the Mediterranean (Milne Edwards); from the Adriatic, at Fayal, the Azores, and Palermo (Schiœdte and Meinert); from lat. 15° 40′ N., long. 23° 5′ 8″ W. (Studer).

A single specimen was obtained by the U. S. Fish Commission steamer *Albatross* which differs from those recorded as described and figured by Schiœdte and Meinert only in having seven spines instead of six on the merus, and in not having the single spine on the distal end of the propodus. Its occurrence in this locality is rather remarkable.

ROCINELA HAWAIIENSIS Richardson, new species.

Body (fig. 27) narrow, elongate, two and a half times longer than wide. Color uniformly yellow, with no markings.

Head triangular; front produced over the basal joints of the first pair of antennæ. Eyes very large and round, separated from each

[a] Naturhistorisk Tidsskrift, (3), XII, 1879–1880, pp. 373–374, pl. X, figs. 13–15.

other by a distance equal only to half the width of one eye. First pair of antennæ, with a flagellum of five joints, extend to the end of the peduncle of the second pair of antennæ. Second pair of antennæ, with a flagellum of seventeen joints, reach the posterior margin of the second thoracic segment.

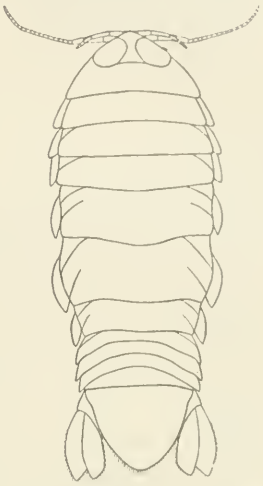


FIG. 27.—ROCINELA HAWAIIENSIS, NEW SPECIES. × 2¾.

First two segments of thorax subequal in length; third and fourth subequal and a little longer than the first two; fifth and sixth longest, each one nearly equal to the first two segments taken together; seventh segment shorter than the two preceding, about equal to the third or fourth. Epimera of the last four segments acutely pointed at their posterior extremities; those of the second and third segments more rounded posteriorly.

The first abdominal segment is entirely concealed by the seventh thoracic segment except at the sides; the three following segments are subequal, with acutely produced postero-lateral angles; the fourth segment has the sides not produced and mostly covered by the postero-lateral angles of the preceding segment; terminal segment narrowly rounded. Uropoda oar-like, subequal in length and equal in width. Both branches are faintly crenulate on the external margin. The basal joint of the uropoda extends only half the length of the inner branch.

FIG. 28.—LEG OF SECOND PAIR OF ROCINELA HAWAIIENSIS. × 5¾.

First three pairs of legs (fig. 28) prehensile, with long slender curved dactyli; the propodus is armed with three spines; the carpus with one spine, and the merus with three spines, except on the first pair of legs. The four gressorial legs are long and slender and armed with few spines.

Only one specimen was taken by the U. S. Fish Commission steamer *Albatross* at Kauai Island, the Hawaiian Islands, at a depth of 414 to 636 fathoms.

Type.—Cat. No. 28972, U.S.N.M.

This species is perhaps nearer to *R. orientalis* Schiœdte and Meinert[a] than to any other known species of the genus. It differs from that form, however, in the much larger eyes which are separated by a distance equal only to half the width of one eye, while in *R. orientalis* the eyes are separated by a distance equal to one-third the width of the head; in the narrower and more elongate body; in having the two branches of the uropoda of equal length and width, while in *R. orientalis* the outer branch is

[a] Naturhistorisk Tidsskrift, (3), XII, 1879–80.

narrower and shorter than the inner branch; in the shorter basal joint of the uropoda, it being equal to half the length of the inner branch, while in *R. orientalis*, the basal joint extends almost to the posterior extremity of the inner branch; and in the narrower terminal abdominal segment.

Family CYMOTHOIDÆ.

CYMOTHOA RECTA Dana.

Cymothoa recta Dana, U. S. Expl. Exp., Crustacea, XIV, pp. 751–752, pl. xlix, fig. 13*a–e*.

Locality.—Puako Bay, Hawaii.

Dana's specimens were obtained at Hilo, Hawaii, by Dr. C. Pickering.

Only one adult specimen was obtained, but a large number of young males (fig. 29), which are probably the young of this species, were taken from the following localities: Between Kauai Island and Modu Maru or Bird Island; north coast of Molokai Island; south coast of Oahu Island. Depth, 6½ to 299 fathoms. These young specimens are probably at a stage somewhat later than the young of the first and second stages described by Schiœdte and Meinert[a] for *C. œstrum* Linnæus and *C. eximia*, because all seven pairs of legs are present. The pleopods, uropods, and terminal segment are, however, fringed with hairs, and the first and second antennæ are very long, the first pair reaching the extremity of the first thoracic segment and composed each of ten joints, the second pair extending to the posterior margin of the third thoracic segment and composed each of sixteen long joints. The eyes are large and post-laterally situated, and the frontal margin of the head is well rounded. The antero-lateral angles of the first thoracic segment are not produced along the sides of the head as in the adult.

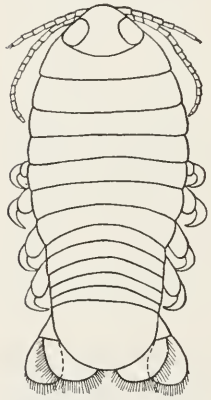


Fig. 29.—Young male of Cymothoa recta Dana. ×8.

ONISCOIDEA.

Family LIGIIDÆ.

LIGIA HAWAIENSIS Dana.

Ligia hawaiensis Dana, U. S. Expl. Exp., Crustacea, XIV, pp. 740–741, pl. xlix, fig. 4 *a–e*.

Locality.—Pearl Harbor.

A single specimen, without uropods, is referred to the above species, described by Dana, from the islands Oahu and Kauai, in the Hawaiian

[a] Naturhistorisk Tidsskrift, (3), XIV, 1883–84, pp. 276–278 and 281–282, pl. viii, figs. 10–13; pl. ix, fig. 11.

Archipelago. The specimen differs from the description in having shorter antennæ, which do not extend beyond the fifth thoracic segment. Difference in sex may account for this, as it has been shown that in this genus the antennæ of the females are shorter than those of the males.

Family ONISCIDÆ.

PORCELLIO LÆVIS Latreille.

Porcellio lævis Latreille, Hist. Crust. Ins., VII, p. 46.—Leach, Edinb. Encycl., VII, p. 406.—Milne Edwards, Hist. Nat. des Crust., III, p. 169.—Budde-Lund, Nat. Tidsskrift, (3), VII, p. 236; Crust. Isop. Terrestria, 1885, pp. 138–141. (See Budde-Lund for further synonymy.)

Locality.—Aiea, Oahu.

EPICARIDEA or BOPYROIDEA.

Family DAJIDÆ.

ZONOPHRYXUS Richardson, new genus.

Type.—*Zonophryxus retrodens* Richardson, new species.

Body of female provided on the ventral side with a border which surrounds it on all sides, and which is wider in the anterior or cephalic region. The posterior portion of the marginal border is provided with nine small triangular processes, four on either side of a median one, and undoubtedly indicates five coalesced abdominal segments. Five pairs of legs present on the anterior half of the ventral side. Five pairs of incubatory lamellæ on either side of the ventral surface meet in the median line, the fifth pair being narrow and elongate and concealing the second and third pairs, which are very small, and a part of the fourth pair. Dorsal surface convex, with only faint traces of segmentation, the boundaries of the three divisions of the body not being indicated. Small incisions at the side of the anterior half of the body on the marginal border probably indicate the place of separation of the head from the thorax, the first thoracic segment from the second, and the second from the third.

Male with the first thoracic segment fused with the head. All seven pairs of legs present. Segments of abdomen consolidated into one.

This genus differs from all the other *Dajidæ* in having the marginal border surrounding the body and in having the nine triangular processes on the posterior margin of this border, representing five coalesced abdominal segments.

It differs from *Dajus* Krøyer in having the segments of the abdomen fused in the female; in having but slight traces of segmentation in the thoracic region, and in both male and female lacking uropoda. It differs from *Branchiophryxus* Caullery in having five pairs of legs

and five pairs of incubatory lamellæ, only four pairs of legs and of incubatory lamellæ being true of *Branchiophryxus*, and in having a single pair of pleopoda, which are altogether wanting in that genus. It differs from *Notophryxus* Sars in the form of the abdomen and head and in having five pairs of incubatory lamellæ instead of a single pair. It differs from *Aspidophryxus* Sars in the form of the head and abdomen of the female, and in having no trace of segmentation or appendages to the abdomen of the male.

ZONOPHRYXUS RETRODENS Richardson, new species.

Body of female (fig. 30) rather quadrangular in shape, with only faint traces of segmentation on the dorsal surface. Dorsal surface very convex, with no distinct boundary between the three chief divisions of the body, the head, thorax, and abdomen being continuously one. On the ventral side a border surrounds the entire body, and is wider in the cephalic region. (Fig. 31.)

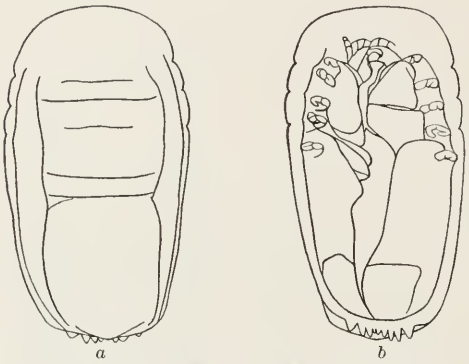


FIG. 30.—ZONOPHRYXUS RETRODENS, NEW SPECIES. *a*, DORSAL VIEW; *b*, VENTRAL VIEW. ×4.

The cephalic part projects in front as a broadly rounded area or border. On either side of the body on the anterior half of the body, the lateral border is incised with three small indentations, marking off the head from the first thoracic segment, the second from the first, and the third from the second. Five indistinct lines on the dorsal surface of the anterior half of the body mark off the head from the thorax and outline the first four thoracic segments. The posterior half of the body shows no trace of segmentation on the dorsal surface. The posterior margin of the border at the terminal part of the body is produced in 9 triangularly-shaped processes. These processes are arranged four on either side of a median one, and undoubtedly indicate the five coalesced abdominal segments.

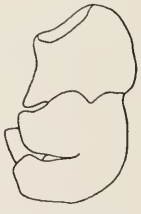


FIG. 31.—MAXILLIPED OF ZONOPHRYXUS RETRODENS. ×14⅔.

FIG. 32.—FIRST LAMELLA OF MARSUPIUM OF ZONOPHRYXUS RETRODENS. ×14⅔.

The legs are in five pairs and are confined to the anterior half of the body on the ventral side.

The incubatory lamellæ (fig. 32) consist of five pairs of plates, meeting in the median ventral line. The fifth pair overlap the second, third, and fourth pairs.

Only a single pair of pleopoda are present, which fold back upon the lower portion of the fifth pair of incubatory plates.

From the oral area there extends on the ventral side a long process, which subdivides and terminates in two lobes, one on either side, beneath the incubatory lamellæ.

The male (fig. 33) has the head fused with the first thoracic segment. The other six segments are free and distinct. All the segments of the abdomen are consolidated into one, which is somewhat oval and pointed posteriorly. All seven pairs of legs are present, the first pair being attached to the cephalic segment. The head is large, concave on its dorsal surface, the anterior margin produced into a rounded process, which is directed upward. Eyes are wanting. There are no pleopoda or uropoda.

FIG. 33.—ZONOPHRYXUS RETRODENS, MALE. ×8.

Only one specimen was obtained by the U. S. Fish Commission steamer *Albatross* from the south coast of Oahu Island, Hawaiian Islands, in 1902. The specimen was unattached.

Type.—Cat. No. 28970, U.S.N.M.

Family BOPYRIDÆ.

Subfamily ENTOPHILINÆ.

ENTOPHILUS Richardson, new genus.

Type.—Entophilus omnitectus Richardson, new species.

Body of female rather asymmetrical. Dorsal surface with segmentation indicated by depressions more or less clearly defined. All seven pairs of legs present. Marsupium bounded ventrally by five pairs of incubatory lamellæ. Seven pairs of plates, overlapping the dorsal surface and attached only to the bases of the legs, extend in two longitudinal series, one on either side of the thorax; these plates probably correspond to the epimeral plates.

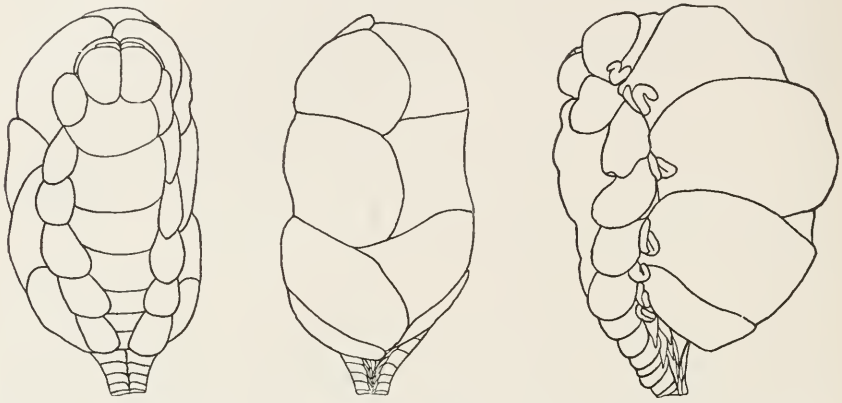
Two series of five plates each are present on either side of the abdomen, meeting along the median dorsal side and surrounding the abdomen at the sides, the lower plates nearly meeting again on the ventral side in the median line. Terminal part of abdomen truncate.

Pleopoda consisting of five pairs of double-branched lamellæ. Uropoda absent.

Male with the six segments of the abdomen clearly and distinctly defined, the last segment provided with a pair of single-branched uropoda; all the preceding segments of the abdomen provided with a pair of single-branched well-developed pleopoda. Seven pairs of thoracic legs attached to the seven thoracic segments.

ENTOPHILUS OMNITECTUS Richardson, new species.

Body of female (fig. 34) somewhat asymmetrical. Segmentation on dorsal surface more or less indistinctly defined. Marsupial pouch on



a *b* *c*

FIG. 34.—ENTOPHILUS OMNITECTUS, NEW SPECIES. *a*, DORSAL VIEW; *b*, VENTRAL VIEW; *c*, LATERAL VIEW. ×5⅓

ventral side extremely large and completely enclosed by incubatory lamellæ, which are visible from a dorsal view at the sides of the body.

Color of dorsal surface of thorax orange; head, abdomen, and incubatory plates white. The orange markings on the young within the marsupium give an orange appearance to the ventral side of the body.

FIG. 35.—MAXILLIPED OF ENTOPHILUS OMNITECTUS. ×14¼.

Head distinctly bilobed. Eyes absent. Both pairs of antennæ visible from a dorsal view, the first pair consisting of perhaps three indistinct joints; the second pair extend half the length of the head and consist of a number of indistinctly defined joints. (Fig. 35.)

The segments of the thorax are more distinctly defined in some specimens than in others. Along the lateral margins of the thorax is a series of plates, a pair for each segment; these plates overlap the dorsal surface of the thorax at the sides and are free on their whole surface, being attached only at the extreme lateral margin to the legs. (Fig. 36.)

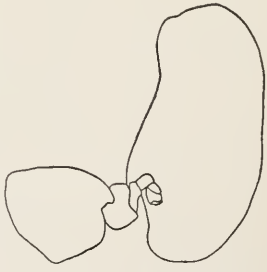


FIG. 36.—LEG OF FIFTH PAIR WITH FIFTH LAMELLA OF MARSUPIUM ATTACHED (ON RIGHT SIDE) AND FIFTH "LAME PLEURALE" OF ENTOPHILUS OMNITECTUS. ×9⅔.

Similar plates are also found on the abdomen, where they meet five from either side along the median dorsal line. The exact homology

of these plates is rather doubtful, but it seems probable that they correspond to the "lames pleurales" of Giard and Bonnier.

The five pairs of abdominal plates, which meet in the median line on the dorsal side, extend around the sides of the abdomen and gradually almost come together on the ventral side, the last pair being very much closer together than the first pair. The last two pairs of plates are almost concealed by the overlapping plates of the preceding segments.

FIG. 38.—FIRST LAMELLA OF MARSUPIUM OF ENTOPHILUS OMNITECTUS. × 14½.

The extremity of the abdomen is truncate and without uropoda. The pleopoda (fig. 37) are five pairs of double-branched tapering appendages, all similar in shape.

FIG. 37.—ONE DOUBLE-BRANCHED PLEOPOD OF ENTOPHILUS OMNITECTUS. × 17½.

There are five pairs of incubatory lamellæ, which form the ventral side of the marsupial pouch, enclosing it completely, the lamellæ overlapping in the median line. (Fig. 38.)

Seven pairs of small, feeble legs are present, a pair for each segment of the thorax.

The male (fig. 39) is narrow and elongate and without any color markings. The head is very large and without eyes. The seven segments of the thorax are about equal in length, each one carrying a pair of appendages, so that there are seven pairs of thoracic legs in all. The six segments of the abdomen are distinct, the terminal one being rounded and carrying a pair of single-branched appendages, the uropoda; the five preceding abdominal segments are provided each with a pair of single-branched, well developed pleopoda.

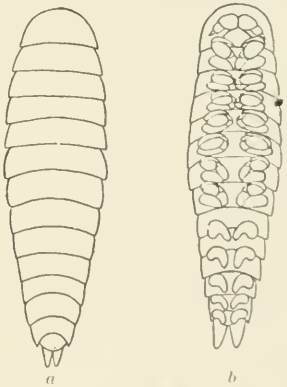


FIG. 39.—ENTOPHILUS OMNITECTUS. MALE. *a*, DORSAL VIEW; *b*, VENTRAL VIEW. × 14½.

A large number of specimens were obtained by the U. S. Fish Commission steamer *Albatross* on the north and northeast coast of Main Island, Hawaiian Islands, and the northeast approach to Pailolo Channel, between Main Island and Molokai Island.

The parasites were found in the visceral cavity of *Munnida normani* Henderson. This is the first instance of the discovery of a Bopyrid in that position in relation to its host, all the other known representatives of the family being either branchial or abdominal parasites. The *Entoniscida*, on the other hand, are always found in the visceral cavity.

Type.—Cat. No. 28967, U.S.N.M.

DESCRIPTION OF A NEW AFRICAN WEAVER-BIRD.

By Harry C. Oberholser,
Assistant Ornithologist, Department of Agriculture.

Three specimens of *Philetairus cabanisi* (Fischer and Reichenow),[a] collected by Dr. A. Donaldson Smith in western Somali Land, differ so much from the typical form of this species that they seem to represent an unnamed geographical race, which may be called

PHILETAIRUS CABANISI ENCHORUS, new subspecies.

Chars. subsp.—Similar to *Philetairus cabanisi cabanisi*, but darker, less tawny brown above; and pure white instead of strongly tinged with flesh color below.

Description.—Type, adult male, No. 177921, United States National Museum; Dabulli, western Somali Land, Africa, September 16, 1894; Dr. A. Donaldson Smith. Top and sides of head down to the cheeks, black; remainder of upper parts, including the wings, broccoli brown, somewhat more tawny on the cervix, and rather darker on the upper tail-coverts; tail sepia brown, the edges of the feathers slightly paler; cheeks and lower surface pure white, the sides of the body broccoli brown with broad black streaks; center of lower breast and upper abdomen streaked with black and dark brown; axillars white; under wing-coverts brownish white; "irides orange; bill silvery white; legs brownish flesh color."

The measurements (in millimeters) of our specimens are as follows:

Sex.	Date.	Locality.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe.
Male	September 16, 1894	Dabulli, Somali Land[a]	68	48	14	17	12.5
Male	do	do	69.5	51	14	18	13
Female	do	do	68	49	13.5	17.5	13
		Average	68.5	49.3	13.8	17.5	12.8

[a] Type.

These three examples were recorded by Doctor Sharpe in his account of Doctor Smith's whole collection,[b] and are noteworthy as greatly extending the known northward range of the species.

[a] *Nigrita cabanisi* Fischer and Reichenow, Journ. f. Ornith., 1884, p. 54 (Pare Mountains, Masailand, German East Africa).

[b] Proc. Zool. Soc. Lond., 1895, p. 465.

NEW DRAGON-FLY NYMPHS IN THE UNITED STATES NATIONAL MUSEUM.

By James G. Needham.
Of Lake Forest College, Lake Forest, Illinois.

The immature Odonata in the United States National Museum have come together during a long period of years from many diverse and almost accidental sources. Save for a few specimens collected by Dr. Charles V. Riley, and sent to Dr. H. Hagen many years ago, two Columbia River species donated to the Museum by Dr. H. Hagen, and a few Illinois species donated by myself, they have not hitherto been studied. Recently, while examining and naming the nymphs of this collection, it became apparent that some interesting undescribed forms were at hand, and that their careful study would throw light on the interrelationships of the groups to which they belong; and then the preparation of this paper was undertaken.

Concerning the sources of the material from the National Museum hereinafter described, I am indebted to Mr. Rolla P. Currie, of that institution, for the following data:

A number of nymphs were collected in Arizona in the summer of 1901 by Messrs. H. S. Barber and E. A. Schwarz; several bred specimens, and others, are from the collection of Messrs. H. G. Hubbard and E. A. Schwarz, and were taken, principally, in Michigan, Florida, and the West; a large number of nymphs were contained in the collection of insects from Java made in December, 1896, by Mr. D. G. Fairchild, of the United States Department of Agriculture; single species were obtained in the Congo by Mr. J. H. Camp, of Lima, Ohio; in Miyazaki, Japan, by Rev. Cyrus M. Clark; in Nicaragua, by Dr. Charles W. Richmond; in the Galapagos Islands, by Dr. G. Bauer, of Clark University; in the Yellowstone, by Dr. C. Hart Merriam, and in California by Mr. Albert Koebele, of the Department of Agriculture. In addition to these there is quite a collection from various parts of the United States made by the United States Fish Commission, though the majority of the specimens belonged to species the nymphs of which have previously been described.

To the Museum material I have added from my own collection specimens of fifteen additional species representing seven genera in which no immature stages have hitherto been described. These are species that have come from sources outside the geographical or systematic range of my former papers. They have been collected for me by generous correspondents and friends during the past ten years. Some from Mr. Adolph Hempel were collected near Gotha, Florida, and in São Paulo, Brazil. Some from Mr. F. G. Schaupp were collected at Shovel Mount, Texas.; some from Mr. F. C. Willard, at Tombstone, Arizona; some bred specimens from Stanford University collection were sent me by Prof. V. L. Kellogg; and good finds of single species were made by Dr. John M. Stowell, at San Jose, California, Mr. E. B. Williamson, at Fort Wayne, Indiana, Prof. R. C. Osburn and Mr. S. Bethel, at Seattle, Washington.

The following species are described herein:

Suborder ANISOPTERA.

	Species.	Locality.	Collector.
1.	*Gomphoides stigmatus*	Shovel Mount, Texas	F. G. Schaupp.
2.	*Phyllogomphus æthiops?*	Congo	J. H. Camp.
3.	*Ophiogomphus bison**	Lake Tahoe, California	Hubbard and Schwarz.
4.	*Gomphus minutus**	Florida	Do.
5.	*Gomphus confraternus?*	Oregon	Samuel Henshaw.
6.	*Gomphus sobrinus?*	Seattle, Washington	R. C. Osburn.
7.	*Dromogomphus spoliatus*	Fort Wayne, Indiana	E. B. Williamson.
8.	*Stauraphlebia reticulata*	Nicaragua	Charles W. Richmond.
9.	*Anax longipes?*	Jamaica	Hubbard and Schwarz.
10.	*Anax guttatus?*	Java	D. G. Fairchild.
11.	*Æschna galapagoensis*	Chatham Island (Galapagos)	G. Baur.
12.	*Cordulegaster dorsalis?*	Yellowstone	C. H. Merriam.
13.	*Cordulegaster diadema**	Arizona	F. C. Willard, H. S. Barber.
14.	*Paltothemis lineatipes*	California	A. Koebele.
15.	*Dythemis velox?*	Texas	U. S. Fish Commission.
16	*Rhyothemis phyllis?*	Java	D. G. Fairchild.
17.	*Crocothemis servilia?*	....do	Do.
18.	*Orthemis ferruginea**	Texas	F. G. Schaupp.
19.	*Orthetrum leptarum?*	Java	D. G. Fairchild.
20.	*Libellulid g'n.? sp.?*	....do	Do.
21.	*Libellula saturata**	California	J. M. Stowell, V. L. Kellogg
22.	*Libellula forensis**	Olympia, Washington	S. Bethel.
23.	*Sympetrum madidum?*	Twin Lakes, Colorado	Chauncey Juday.
24.	*Trithemis aurora?*	Java	D. G. Fairchild.
25.	*Diplacodes trivialis*	....do	Do.
26.	*Trithemis minuscula*	Florida	Adolph Hempel.
27.	*Micrathyria pallida*	Brazil	Do.
28.	*Tramea carpale?*	Java	D. G. Fairchild.

Suborder ZYGOPTERA.

29.	*Architestes grandis*	Arizona	F. C. Willard.
30.	*Argia fumipennis*	Florida	Adolph Hempel.
31.	*Argia sp.?*	Rocky Mountains	S. A. Forbes, T. D. A. Cockerell, and others.
32.	*Telagrion dæckii?*	Florida	Adolph Hempel.
33.	*Telebasis salva**	Texas	F. G. Schaupp.
34.	*Acanthagrion chelíferum**	Brazil	Adolph Hempel.
35.	*Hesperagrion heterodoxum**	Arizona	F. C. Willard.
36.	*Leptobasis sp?*	Porto Rico	August Busck.

Among these it will be observed are fifteen genera of which no nymphs have been described hitherto. New types of nymphal struc-

ture are represented by Nos. 1, 2, 8, 14, 16, 18, 25, 27, 29, and 32 of the list. In addition to the above there are included in this paper additional descriptive notes or figures, or both, of the following species which have already been noticed elsewhere:

	Species.	Locality.	Collector.
37.	*Epophthalmia elegans*	Japan	Rev. C. M. Clark.
38.	*Dythemis fugax?*	New Mexico	T. D. A. Cockerell.
39.	*Pantala flavescens*	Java	D. G. Fairchild.
40.	*Hyponeura lugens*	New Mexico	T. D. A. Cockerell.

Names followed by ? in the above list are of doubtful specific determination; the species marked with * were bred by the collector named. That so many not bred are not marked with ? is due to the fact that I have been able to examine satisfactorily the venation in the nymphal wings and to recognize the species thereby. This means of determining miscellaneous nymphs is of remarkable value. It has not been used by other authors, and was not used by myself in the work done for my earlier papers. Its application requires well-preserved specimens old enough to have the adult venation well developed yet not near enough transformation for the wings to be crumpled within their sheaths. If the cleaner, more transparent (more recently moulted) nymphs be selected, and their wings carefully removed by cutting off at the base with a sharp razor, mounted and examined with a microscope, the venation may be studied in them almost as well as in the adult. Save for ultimate fusions (as of the sectors of the arculus) the correspondence is exact.

Subfamily GOMPHINÆ.

GOMPHOIDES STIGMATUS Say.

Plate XXXVIII, fig. 1.

Nymphs and exuviæ and imagos, the last in some numbers, from Shovel Mount, Texas, collected by Mr. F. G. Schaupp.

Length 34 mm., abdomen 23 mm., hind femur 5.5 mm.; width of head 6 mm., of abdomen 7 mm.

Body elongate, depressed cylindric, hairy at the sides. Head thick, pointed and declined in front, with scar-like corrugations behind the eyes, and a conspicuous bare scar on either side of the median line in the rear. Antennæ declined upon the labrum, the two basal segments globular, the second half as large as the first, the third twice as long as both basal together, depressed, clavate, incurved at the apex, and scurfy hairy along its thick margins, the fourth segment a conspicuous upturned conic rudiment about as long as the second segment. Labium (Plate XLIII, fig. 1) of moderate size, the hinge reaching posteriorly as far as the mesothorax, mentum very gradually widened to the bases of

the lateral lobes. Median lobe very strongly convex, nearly semicircular, with a long fringe of flattened scales along its free border. Lateral lobes rather short, stout. Movable hook long, arcurate, end hook short and strong and moderately incurved. Inner margin with a series of about a dozen minute quadrangular teeth, diminishing in size proximally and extending upon the base of the end hook, where the last two or three are likewise smaller.

Thorax somewhat compressed. Prothoracic disk flattened, continuing the slope of the top of the head, bearing a pair of large bare scars connected by a line across the middle. Legs closely appressed to the body, the fore and middle tibiæ very hairy and armed with small recurved burrowing hooks. Middle legs slightly closer together at base than are the fore legs, and about half as far apart as are the hind legs. Wing cases reaching the middle of the fourth abdominal segment.

Abdomen widest before the middle, slowly tapering to the tip and little depressed. Dorsal hooks on segments 2–9 regularly increasing in length and sharpness posteriorly. Lateral spines on segments 7–9 minute, straight, appressed, much smaller than the dorsal hooks on the corresponding segments. Middle abdominal segments of equal length, segment 8 slightly longer, 9 one-fourth longer, and 10 one-half longer than these. Appendages as long as the ninth segment, slender and sharp, the laterals scarcely shorter than the others. The ventral longitudinal grooves of the abdomen end just within the lateral spines of the ninth segment.

But one of the nymphs is in a sufficiently good state of preservation for making out the venation of the wings, but in this one I have been able to compare the venation in close detail with that of the wings of *Gomphoides stigmatus*, and have found entire agreement.

PHYLLOGOMPHUS ÆTHIOPS Selys?

Plate XXXVIII, figs. 2, 3.

"No. 28914, Congo, J. H. Camp." Length 42 mm., abdomen 30 mm., hind femur 5 mm., width of head 6 mm., of abdomen 9 mm.

Body elongate, widest across the middle of the abdomen, moderately depressed. Head depressed, rather broadly triangular, with obtuse angles. Labrum prominent, with a dense fringe of tawny hair that is continued laterally beneath the eyes, ending there in a long, conspicuous tuft. Ocelli well marked, the lateral ones touching the eyes. Labium (Plate XXXVIII, fig. 3) reaching posteriorly as far as the rear of the prothorax; mentum flat, with parallel side; median lobe angulately concave in front, its border armed with about a dozen spinelike teeth on each side that are longest externally; lateral lobes moderate, with long movable hook; end hook arcurate, slender, with a comb of 12–15 straight spinelike teeth on its inner margin, longest proximally,

where they suddenly end opposite the base of the movable hook. Three scars (areas destitute of the general scurfiness of the skin) upon the rear of the head, with a low transverse ridge on the rear of the head behind them.

Prothorax depressed, with a pair of large dorsal scars. Legs short; burrowing hooks of the fore and middle tibiæ well developed; tarsi 2:2:3-jointed; femora and tibiæ with lateral bare lines, and lateral-fringes of long hair on their edges. Wing cases reach the middle of the fourth abdominal segment.

Abdomen bare; segments about equal in length as far as the ninth, the tenth triquetral, twice as long as the ninth; appendages almost as long as the ninth segment; equal. Dorsal hooks on segments 2–9, pointed on 2 and 3, obtuse on 4–7, pointed on 8 and 9, and longest on 9. Lateral spines on segments 8 and 9 short, divergent. Prominent lateral scars on segments 3–9.

A single full-grown specimen, taken at the beginning of transformation and pinned. It is a highly interesting form, very distinct from all that have been described hitherto. I have referred it to *Phyllogomphus* because its size and its locality allow this, and especially because I have been able to observe what are practically the adult structures in wings and antennæ, and these correspond very well. Unfortunately I have not seen the adult *Phyllogomphus*, and have been obliged to make my comparisons with the printed statements—not very detailed—of published descriptions. By removing the wings of one side from their loosened sheaths, softening them, and then spreading them out—an exceedingly delicate and tedious operation—I have been able to make out enough of the details of the venation of the adult to admit of settling the question of the correctness of the generic reference, at least, by anyone who has the adult *Phyllogomphus* for comparison.

Ante and post nodals are in the fore wing 17 and 13, and in the hind wing 12 and 16, respectively. The triangles and supertriangles are free from cross veins. The triangle of the fore wing is followed by 3:3:2:3:2:3 and then an increasing number of cells; of the hind wing, by 1:2:2:2:2:3:3:3:3 and then an increasing number. The bridge is long and there are in both wings four included cross veins between the subnodus and the oblique vein, and about three others included before the subnodus. The stigma has a brace vein at its inner end, and covers five cross veins besides (shown clearly only in hind wing of this specimen). In the fore wing there are eleven unbisected cells in the fork of veins M_1 and M_2. There appear to be three medio-cubital cross veins before the triangle in the fore wing, and two in the hind wing, and the cubitus seems to run to the hind angle of the triangle without being angulated in either wing. There is no anal loop, veins A_1 and A_2 being rather wide apart at base with two cells between

them, the number between increasing toward the hind margin. The anal triangle is three-celled. In the relative length of the apical segments of the abdomen the nymph seems to resemble *Phyllogomphus* rather than *Neurogomphus*.

OPHIOGOMPHUS BISON Selys.

Plate XXXVIII, figs. 4, 5.

Cast skin of female bred specimen. Collection of Hubbard and Schwarz, Lake Tahoe, California (no date); also, a cast skin of a male imago with fragments of the imago in alcohol; also two nymphs, one of which was very near transformation.

Length, 28; abdomen, 17 mm.; hind femur, 45 mm.; width of head, 5.5 mm.; of abdomen, 8 mm.

Body stout, moderately depressed, skin granulate; face strongly declivous; antenna with third segment strongly flattened, twice as long as the two basal segments together; segment four very rudimentary; a hairy tubercle between the base of the antenna and the eye; labium (Plate XXXVIII, fig. 5), with the mentum a little longer than wide; sides parallel, strongly contracted at basal third; median lobe well rounded with a border of flat brown denticles and a fringe of thin scales; lateral lobe small with a short stout movable hook and no end hook at all, but the end obtusely rounded and the inner edge straight, armed with a series of numerous minute, quadrate denticles. A transverse row of scars across the rear of the head, ending laterally upon the summit of the prominent hind angles. Legs short, thinly fringed with hair on their edges; burrowing hooks of fore and middle tibiæ small. The wing cases reach the base of the fifth abdominal segment.

Abdomen stout, chiefly narrowed posteriorly on the eighth and ninth segments; segments of about equal length as far as the ninth; the tenth much shorter, especially on its dorsal side. Appendages longer than the ninth segment, the superior declined at tip, as long as the inferiors, laterals one-fourth shorter. Lateral spines on segments 6–9 well developed, fringed with tawny hairs externally. Dorsal hooks strongly developed on segments 2–9, erect on the fore, and posteriorly directed on the hinder segments.

GOMPHUS MINUTUS Rambur.

Plate XXXVIII, fig. 6.

Male and female specimens bred. Collection of Hubbard and Schwarz, Crescent City, Florida.

Length, 30 mm.; abdomen, 20 mm.; hind femur, 5 mm.; width of head, 5 mm.; of abdomen, 6 mm.

Body slender. Skin scurfy pubescent. Antenna with the slender third segment four times as long as the second, the first twice as long as the second, the fourth segment a very minute rudiment. Labium

(Plate XLIII, fig. 2) moderate, reaching posteriorly between the bases of the fore legs; mentum one-third longer than broad, slightly widest in the middle and tapering both ways to the ends; median lobe narrow, convex, with a dense fringe of long scale-like hairs; lateral lobe short with stout movable hook, arcuate end hook, and about seven quadrangular teeth on the inner margin, largest in the middle, single microscopic setæ arising from the notches between the teeth. Rear of head with a transverse line of scars.

Dorsum of prothorax with two confluent scars. Burrowing hooks moderate; legs scantily hairy. Wing cases reach the base of the fourth abdominal segment.

Abdomen lanceolate, slightly depressed, with multiple scars on segments 3–9; lateral spines on segments 7–9, increasing in length posteriorly, those of segment 9 one-third as long as the tenth segment. Dorsal hooks wanting; there is a trace of an impressed median line on segments 4–6, and of a scurfy ridge on segments 7–9. Appendages as long as the tenth segment, and about equal each to each.

GOMPHUS CONFRATERNUS Selys?

"Crooked River, Oregon, 21st September, 1878, No. 540b, Henshaw."

Length, 28 mm.; abdomen, 17 mm.; hind femur, 6.5 mm.; width of head, 5.5 mm.; of abdomen, 7.5 mm.

Body lanceolate, depressed, hairy on edge of clypeus, sides of antennæ, sides of the head below the eyes, tibiæ externally, and lateral margins of the abdomen. Skin scurfy pubescent. Second segment of antennæ half as long as the basal segment, the third segment five times as long as both basal together, the fourth segment a minute rudiment. Mentum of labium (Plate XLIII, fig. 3) with parallel sides; median lobe very slightly rounded, densely fringed with hair-like scales; lateral lobes short, arcuate, with long movable hook, and short moderately incurved end hook six to nine quadrate teeth on the inner margin, diminishing in size toward the base.

Burrowing hooks of fore and middle tibiæ strong. Wing cases reaching nearly the apex of the fourth abdominal segment.

Abdomen lanceolate, widest across the middle, regularly tapering to the rather acutely pointed apex, with low, flat triangular pointed rudiments of dorsal hooks on segments 4–9, better developed posteriorly. Lateral spines on segments 6–9, increasing in length posteriorly, those on the ninth segment reaching the middle of the tenth segment. Appendages longer than the tenth segment, the laterals slightly shorter than the others.

I think the supposition as to name a very safe one, since the nymph clearly stands in about the same relation to that of *G. graslinellus* as the imago holds toward the imago of that species; this is perhaps the commonest *Gomphus* of the Northwest coast States.

GOMPHUS SOBRINUS Selys?

Several exuviæ were collected by Prof. R. C. Osburn at Seattle, Washington. This species occurs there, and is the only described regional species to which nymphs of this type can be supposed to belong.

Length, 40 mm.; abdomen, 27 mm.; hind femur, 5 mm.; width of head, 6 mm.; of abdomen, 8 mm.

Body elongate, depressed, smooth. Third segment of antenna hairy along its edges, more than four times as long as the two basal, of which the first is twice the second in size; fourth segment a minute rudiment. Labium (Plate XLIII, fig. 4) rather broad, mentum slightly widened anteriorly; median lobe slightly rounded on front margin and densely fringed with hairlike scales; lateral lobe short, stout, abruptly narrowed beyond the movable hook, where it is sharply incurved to form the end hook, before which on the inner margin are 4–5 low, broad teeth, increasing in size proximally. Hind angles of the head prominent, marked with narrow scars; hind margin with three broader scars.

Burrowing hooks small. Wing cases reaching the base of the fourth abdominal segment.

Dorsum of the abdomen with distinct impressed median line on segments 3–6, a pair of transverse small brown spots on either side the line on each of these segements; a flat, triangular rudiment of a dorsal hook on the apex of the ninth segment, perhaps also on the eighth. Prominent lateral spines on segments 6–9, about equal in size, those of segment 9 one-third as long as the tenth segment. Appendages longer than segment 10, and about equal in length each to each.

DROMOGOMPHUS SPOLIATUS Hagen.

Exuviæ, collected at Fort Wayne, Indiana, by Mr. E. B. Williamson, July 16, 1901. Imagos were observed commonly, flying along the canal at the same place and time.

Length, 34 mm.; abdomen, 21 mm.; hind femur, 6.3 mm.; width of head, 6 mm.; of abdomen, 8 mm.

Body little hairy, strongly depressed, widest across the middle of the lanceolately pointed abdomen. Head depressed, wedge-shaped, pointed anteriorly, the labrum nearly covered by the appressed and flattened antennæ. The two basal segments of the antenna are globular, the first a little larger, the third is more than twice as long as both basal ones together, depressed and concave superiorly and incurved at tip, and scurfy hairy on the thick margins, the fourth segment a very minute ovoid rudiment. Labium (Plate XLIII, fig. 5) moderate, hinge reaching posteriorly as far as the meso-thorax, the mentum with parallel sides beyond the narrower basal third, the front

border of the median lobe slightly concave, with minute double tooth in the middle and with the usual fringe of scales, the lateral lobes short and stout with long strong movable hook and without end hook, but with 7–8 backwardly serrate teeth on the inner margin, diminishing in size toward the base.

Legs depressed, hairy on edges, and marked with curved longitudinal bare scars, the fore and middle tibiæ armed with strongly developed and conspicuous burrowing hooks. The wing cases reach posteriorly as far as the fourth abdominal segment.

Abdomen strongly depressed, lanceolate, widest across the middle and sharply pointed at the apex. Dorsal hooks rudimentary, represented on segments 6–8 by low apical elevations and on 9 by an even longitudinal middorsal ridge, whose distal end is slightly projecting. Lateral spines on segments 6–9, on 6 very small, on 7 and 8 successively longer and stronger and a little divergent, on 9 almost as long as the tenth segment, sharp-edged and closely appressed. The middle abdominal segments are of about equal length, the eighth is slightly longer, the ninth is a third longer, and the tenth is half as long as the ninth. Appendages as long as the eighth segment, the laterals a fifth shorter than the others.

Subfamily ÆSCHNINÆ.

STAUROPHLEBIA RETICULATA Burmeister.

Plate XXXIX, figs. 1, 2.

"Nicaragua, Escondido River, 50 miles from Bluefields, September 3, 1892," collected by Dr. Charles W. Richmond. "Found on pile near water."

Length, 51 mm.; abdomen, 35 mm.; hind femur, 9 mm.; antenna, 5; width of head at front across eyes 9, across hind angles 8 mm.; of abdomen, 9 mm.

Body elongate, little depressed, not hairy. Head widest across the very prominent eyes; antennæ 7-jointed, pale; ratio of length of segments from base outward 1.5:1:1.5:1: 1.1:1.2:1.1. Labrum prominent, rounder in front, with granulate upper surface. Face with a submedian pair of low obtuse elevations; mandibles with a conspicuous, shelf-like lateral prominence that is armed with numerous short curved spines pointing forward. Vertex with the ocellar tubercle prominent, deeply bifid, ending above in two erect acute points; sides of head behind the eyes parallel as far as the rounded hind angles, above each of which is a longitudinal row of three or four tubercles; hind margin concave. Labium (Plate XXXIX, fig. 2) very long, the hinge almost reaching the bases of the hind legs; mentum narrow in its basal two-thirds, suddenly widened at distal end, where the margins are upcurved, sharp, and spinulose. Median lobe with a shallow

V-shaped notch separating two low rounded lobes, each of which bears a long, strong, straight, anteriorly directed spine, a short fringe of hairs on the portion of the margin external to the spine. Lateral lobes short, each with a long arcuate movable hook, and a smaller, more slender, more arcuate, sharply pointed end hook, the inner margin very finely denticulate.

Prothorax with the end of its dorsal disk laterally prominent and acute; supracoxal processes obtuse, equal. Minute tubercles covering the sides of the thorax, and rugulations on the bases of the wings. Legs long; femora and tibiæ thrice banded with brown; tarsi 3:3:3-jointed. Wing cases reaching the base of the fifth abdominal segment.

Abdomen triquetral, widest on segments 6 and 7, slowly narrowed posteriorly; segments 2–9 of about equal length; segment 10 one-half as long as the others, appendages longer than 9 and 10 together; superior appendages very slightly shorter than inferiors, with a round apical notch and a sharp dorsal carina; laterals one-half as long, straight on the external margin, convex on the internal margin, especially toward the tip, where suddenly contracted to a long point. Dorsal hooks represented by minute triangular rudiments on segments 9 and 10, that of the tenth segment twice the size of that of the ninth. Lateral spines on segments 6–10; on 6 minute; on 7 longer, but hardly reaching the apical suture; on 8 and 9 long, strong, prominent; those of 9 almost reaching the level of the apex of the tenth segment; those of the tenth segment short, triangular. The lateral margins of the eighth, ninth, and tenth segments and of the inferior appendages finely spinulose serrate.

A single female specimen. The venation is well enough indicated on its wing sheaths to allow generic determination, and but one species of *Staurophlebia* is known. The labium is very like that of the nymph of *Gynacantha*, and quite different from that of other known Æschninæ, but the tuberculate upper surface of the head and the external process of the mandibles mark this as an archaic member of the *Gynacantha* group of genera.

Genus ANAX.

Nymphs of this genus are common in every collection of aquatic insects. They are readily recognized by the shape of the head, with the eyes broadly overspreading its sides (see Plate XL, fig. 1), and generally by the possession of lateral spines on abdominal segments 7–9 only. *Anax junius* Drury is probably the commonest species in the whole collection of nymphs of the National Museum, and it is certainly present from a larger number of different localities than any other species. Descriptions and figures of this nymph have been published by both Cabot and myself, the figure by Miss Hart[a] being especially

[a] Bull. Ill. State Lab. Nat. Hist., VI, pl. 1, fig. 5.

good; and other species are so very similar, there is little use in detailed descriptions of all parts. The differences are chiefly in size, form of median and lateral lobes of the labium, and in the relative lengths of the lateral spines and appendages of the abdomen. The descriptions of the two following species will therefore be confined to a statement of those characters in which specific differences have been observed.

ANAX LONGIPES Hagen?

A single huge cast skin from Jamaica, collected by Hubbard and Schwarz, is here referred by supposition to this species. There is in this case, however, no satisfactory assurance that the reference is correct.

Length, 55 mm.; abdomen, 39 mm.; hind femur, 11 mm.; width of head, 10 mm.; of abdomen, 10.5 mm. The color pattern is well shown, even in this cast skin (Plate XL, fig. 1). The labium is as in *Anax junius*, with rather prominent median lobe, divided to the base by an almost completely closed median cleft. The superior margin of the superior abdominal appendage is distinctly more convex than in *A. junius*, and the lateral appendages are a little longer, being half as long as the superior—a little less than half as long in *A. junius*.

ANAX GUTTATUS Burmeister?.

Plate XL, fig. 2.

A number of nymphs from Buitenzorg, Java, collected by D. G. Fairchild, between April and December, 1896, all pinned, and some in bad condition.

The largest, apparently not fully grown, measures in total length 42 mm., abdomen 27 mm., hind femur 9 mm.; width of head 9 mm., of abdomen 10 mm. There is less development of color pattern in this species. The labium is similar as to its median lobe, but the end of the lateral lobe is less truncated, more rounded externally, and the rather stouter end hook, instead of being pointed directly backward, is inclined toward the opposite side of the body. The upper line of the superior appendage is very slightly convex, and the appendages are all rather shorter and stouter than in the preceding species.

The reason for referring the nymphs to this species is that this appears to be the common species of the East Indies, and the only one known from this locality. I am unacquainted with the adult.

ÆSCHNA GALAPAGOENSIS Currie.

Plate XL, fig. 3.

There are a few interesting little nymphs of this species, the largest of them hardly more than half grown, from Chatham Island (Galapagos), collected in 1891 by Dr. G. Baur and bearing the U. S. National

Museum Accession No. 26662. These are quite the most distinctly marked species of the genus that I have seen.

The largest measures in total length 32 mm., abdomen 21 mm., hind femur 6 mm.; width of head 7 mm., of abdomen 7.5 mm. The hinge of the labium (Plate XLIII, fig. 6) reaches backward barely as far as the metathorax. The median lobe is very short, and its middle cleft is tightly closed all its length. The end of the lateral lobe is squarely truncate, and not narrowed to the tip, and lacks end hook. The upper line of the superior appendage of the abdomen is straight—not convex in the least—and the laterals are three-fourths to four-fifths as long as the superior.

Lateral spines are obsolete on the sixth abdominal segment, and small on the seventh, but well developed upon the eighth and ninth, thus exhibiting a development that has hitherto been considered as distinctively characteristic of *Anax*. Mr. Currie pointed out in the original description of this species[a] that it is closely allied to *Æ. californica*, and in my description of the nymph of that species[b] I have mentioned the squarely truncated lateral labial lobes, correlated with less development of the lateral spines of the abdominal segments than is shown by nymphs of the more typical species of *Æschna*.

Subfamily CORDULEGASTERINÆ.

CORDULEGASTER DORSALIS Selys?

Plate XXXIX, fig. 3.

"Upper Firehole Basin, Yellowstone Park, 1872, C. H. Merriam."

Length, 35 mm.; abdomen, 23 mm.; hind femur, 7.5 mm.; width of head, 8.5 mm.; of abdomen, 8.5 mm.

Blackish, clothed with tawny hair only on sides of thorax, legs, and apical carinæ of abdominal segments. Head narrowed behind the eyes, hardly concave posteriorly. Labium broad; median lobe with the usual bifid middle tooth (fig. 1*b*), the divisions of which are truncate on the end, with a very shallow indentation on the side, followed by a straight row of five or six excessively minute denticles and the usual fringe of hairs. Lateral setæ, 6–7; mental setæ, 8–9 each side, the outer five in a separate, stronger series and closer together; teeth as usual.

Wing cases reaching to the middle of the fifth abdominal segment.

Abdomen regularly tapering to a sharp point; no dorsal hooks; no lateral spines; appendages decurved at apex, as long as the ninth and tenth segments together; lateral appendages one-fourth as long as the others.

[a] Proc. Washington Acad. Sci., III, 1901, p. 385.

[b] Bull. Ill. State Lab. Nat. Hist., VI, p. 45.

Doctor Hagen mentioned under this specific name three nymphs from California,[a] which agree with this one in the only diagnostic character stated—the absence of lateral spines from abdominal segments. Doctor Hagen did not describe the form of the median lobe of the labium carefully or mention the raptorial setæ at all.

CORDULEGASTER DIADEMA Selys?

"Bright Angel, Ariz., July 12. H. S. Barber, collector."

Male. Length, 35 mm.; abdomen, 23 mm.; hind femur, 7 mm.; width of head, 8 mm.; of abdomen, 8 mm.

Body rough, hairy all over; head with prominent eyes anteriorly; sides behind them at first parallel, then abruptly narrowed to the straight hind margin, before which is a pair of large scars. Frons with a shelf-like prominence fringed with stiff yellow hairs. Antennæ short, third segment as long as the first and second together, fourth half as long, and the remaining segments successively shorter. Labium ample; median lobe with the usual bifid tubercle (fig. 1*a*) at its apex, each half of which is again bifid (as in *C. diastatops*), the lower tooth hardly rising above the level of the fringe of hairs at the sides. Lateral setæ 5; mental setæ 8–9 each side, the four outermost constituting a separate and stronger series.

FIG. 1.—DIVIDED MEDIAN TOOTH OF MIDDLE LOBE OF NYMPHAL LABIUM. *a*, IN CORDULEGASTER DIADEMA; *b*, IN *C. DORSALIS*.

Abdomen regularly tapering, without dorsal hooks or lateral spines, with the usual apical fringes of incurved hairs on segments 2–9; appendages longer than segments 9 and 10 together, the laterals one-fifth to one-fourth as long as the others.

After the above description was written Mr. Currie sent me from the National Museum another specimen—a cast skin left by a nymph at transformation.[b] This, he suggested, should belong to *C. diadema*, since the imago of that species was collected in the same locality. It agrees closely with the younger nymph above described, except for larger size. Length, 47 mm.; abdomen, 34 mm.; hind femur, 8 mm.; width of head 9 mm.; of abdomen, 9 mm.

The wing cases reach only the fourth abdominal segment, and there are shaggy locks of hair on the sides of the body below them. The ninth segment is shorter on the ventral side, and the tenth segment is shorter on the dorsal side than preceding segments. The end of the abdomen is nearly destitute of stiff hairs, which abundantly fringe the high apical carinæ of the middle and basal segments.

Mr. F. C. Willard sent me a cast nymphal skin of this species from Tombstone, Arizona, in 1897.

[a] Trans. Amer. Entom. Soc., XII, 1885, p. 289.

[b] This is the one mentioned by him in Proc. Ent. Soc., Washington, V, 1903, p. 303.

Subfamily MACROMIINAE.[a]

EPOPHTHALMIA ELEGANS Brauer.

There is in the National Museum a single alcoholic specimen of nymph of this magnificent species, received through Oberlin College from Rev. Cyrus M. Clark, Miyazaki, Japan. It agrees entirely with the description given by Cabot of one in the Museum of Comparative Zoology, from Canton, China,[b] but is a larger specimen: Length, 40 mm.; abdomen, 25 mm.; hind femur, 14 mm.; width of head, 8 mm.; of abdomen, 14 mm. There are in the Cornell University collection a number of imagos received from the same source. I have compared the venation in the wings of nymph and imagos, and have fully satisfied myself that the nymph belongs to this species. The nymphal wings are distinctly spotted with blackish brown, as described in Cabot's paper, but it does not follow therefrom, as supposed in that paper, that the wings of the imago would be likewise spotted. In *Pantala flavescens* there are conspicuous spots of brown upon the nodus of the nymphal wings, which, as everybody knows, are wanting in the wings of the imago. I believe that these markings are ontogenetic and that the developmental tendency is generally toward hyalinity of wing membrane, and not toward infuscation.

This species differs from the more typical species of *Epophthalmia* by characters which I believe will be regarded as justifying its generic separation. Aside from its huge stature, its singular color pattern, its unusual proportions in length of male abdominal appendages, and its smaller number of cubito-anal cross veins, it has three other characters in contradistinction to the more typical species of *Epophthalmia* that I regard of generic importance: (1) Its cubital vein where it borders the subtriangle is straight and strong; in the others it is weak and angulate. (2) Its radial sector is gently and regularly curved; in the others it is broken and distinctly ajog opposite the distal end of the radial supplement. (3) Its ninth abdominal segment in the male bears above a truncated cone; in the others it bears two basal denticles.

Since this is the largest and one of the most peculiar members of the fauna of the Land of the Dragonfly, I would suggest as an appropriate name for a new genus to contain it the classical Japanese name Azuma.[c]

[a] The use of the name *Synthemiinæ* for this subfamily in Bull. Ill. State Lab. of Nat. Hist., VI, p. 5, was due to enforced haste in printing, whereby proof corrections made by me were not received by the printer in time for incorporation into the text.

[b] Immature State of the Odonata, Pt. 3, 1890, pp. 9–11, pl. 1, fig. 1–1d.

[c] My friend and pupil, Mr. S. Asada, of Tokio, informs me that the children with whom he played as boy would sometimes capture a female of this species, tether her with a thread, and use her as a decoy to lure the males within their reach.

Subfamily LIBELLULINÆ.

PALTOTHEMIS LINEATIPES Karsch.

Plate XXXIX, fig. 4.

San Bernardino County, California, May. "A. Koebele, collector." Length, 23 mm.; abdomen, 14 mm.; hind femur, 6 mm.; width of head, 6.5 mm.; of abdomen, 9 mm.

A smooth blackish species, paler ventrally, with yellowish, basal rings on femora and tibiæ. Head wider than long, with eyes not very prominent, well rounded; a very obtuse frontal ridge across the face, before which the face is vertical, behind which, sloping. The curve of the very obtuse and scurfy pubescent hind angles of the head, beginning at the eye and ending upon the straight hind margin. Labium broad, the hinge reaching posteriorly between the bases of the middle legs, median lobe prominent, spinulose on margin; lateral lobes ample, each with 7–8 large obtuse teeth on opposed lateral margins, the uppermost double, the others separated by deep notches, each armed with about four graduated spinules at tip internally; movable hook stouter, but hardly longer than setæ; lateral setæ 9; mental setæ 14–15 each side in a regular series, longest in the middle.

Legs short smooth; wing cases reaching the base of abdominal segment 7.

Abdomen broad, depressed, most narrowed posteriorly on the ninth segment, tenth segment short, half as long as the ninth, but not included in the ninth. Dorsal hooks on segments 2–6 erect diminishing in size from the front, on 6 very rudimentary, a trace on 7, wanting on 8–10; all hidden between the wing cases. Lateral spines on segments 8 and 9 short, sharp, straight, those of the ninth segment not reaching the level of the apex of the tenth segment on the ventral side. Appendages short stout, as long as the ninth segment on its ventral side; superiors and inferiors equal; laterals one-third shorter; the inferiors spinose on lateral margins; the superior thick at base with a strongly arcuate, median longitudinal, carina.

This singular nymph, so suggestive of the Cordulinæ in the form of its body and in the large teeth, higher than wide, on the opposed edges of the lateral labial lobes, was so puzzling to me I could not resist the temptation to remove the wings of one side from the solitary specimen. A moment's examination of the venation shown was enough to settle its identity.

DYTHEMIS VELOX Hagen?

Plate XLII, fig. 2.

There is a single nymph in the National Museum that I take to belong to this species. It is from Sand River, San Marcos, Texas, and was collected March 24, 1899. It is apparently not quite grown.

Length, 17 mm.; abdomen, 8 mm.; hind femur, 5 mm.; width of head, 5 mm.; of abdomen, 6.5 mm.

Body smooth, depressed, greenish, varied with brown above. Head depressed, sloping forward to the base of the antennæ, strongly narrowed behind the eyes to the nearly straight hind margin. Labium large, its hinge reaching posteriorly as far as the middle of the mesothorax; median lobe of the mentum prominent, with a fringe of slender scattered spines; mental setæ 9–10, the 5–6 outermost longer than the others. Lateral setæ 10. Hook slender, setiform; teeth almost obsolete, with the usual spinules.

Legs long and thin. Wings reaching backward as far as the middle of the seventh abdominal segment.

Abdomen broad, depressed, with thin lateral margins. Dorsal hooks on segments 3–9 in a regular and even series, thin, flat, sharp-pointed, that of the ninth segment bent downward at tip. Lateral spines on segments 8 and 9, thin, flat, sharp, strongly convergent on 9, and with spinulose-serrate external margins. Ninth segment strongly concave on dorsal apical margin; tenth annular included. Appendages slightly longer than segment 9 is on the dorsal side, short-triangular, sharp-pointed, hairy on margins, the laterals a little more than half the length of the others.

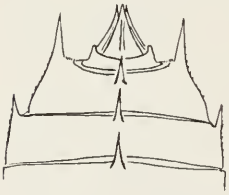


FIG. 2.—END OF ABDOMEN OF NYMPH OF DYTHEMIS FUGAX? FROM ABOVE.

DYTHEMIS FUGAX Hagen?

I have described[a] a nymph from Roswell, New Mexico, which I have supposed belongs to this species. It is very like the nymph described above, and referred to *D. velox*, except in the form of the lateral spines on the eighth and ninth abdominal segments. Fig. 2 is a drawing of the end of the abdomen of this species. A comparison of this figure with the photograph reproduced in Plate XLII, fig. 2, will serve to show the differences. I have deposited a specimen of this species in the United States National Museum.

RHYOTHEMIS PHYLLIS Sulzer?

Plate XLI, figs. 1, 2.

Three nymphs apparently well grown.

Length, 19 mm.; of abdomen, 12.5 mm.; hind femur, 6 mm.; width of head, 5 mm.; of abdomen, 7 mm.

A short and very smooth species, with broad depressed abdomen. Head pentagonal, with straight or slightly concave hind margin, obtuse hind angles, small eyes covering the lateral angles of the head at midway its length, and with obtusely prominent labrum. Antennæ pale, 7-jointed, joints nearly equal in length excepting the third, which

[a] Psyche, 1903, p. 139.

is one-third longer than the others. Labium short, the hinge scarcely reaching the mesothorax; median lobe not very prominent, its sides straight and spinulose and a pair of spinules on the obtuse median angle, end an elongate-oval, chitinous thickening on the middle of the floor of the mentum; mental setæ 10 each side, fifth, counting from the side longest; lateral setæ 5, longer than the slender, tapering, nearly straight movable hook; teeth on opposed edges low, serrate, incurved, each armed with 3–4 graduated spinules.

Legs long, thin, nearly bare, and longitudinally grooved. Wings reaching the middle of the seventh abdominal segment.

Abdomen triquetral, with sharp lateral edges, and flat sides sloping like a low roof, oval in outline, the long appendages furnishing an attenuate apical point. Lateral spines on segments 8 and 9, stout, short, triangular, those of the ninth segment as long as the tenth segment. Segments slightly increasing in length from the second to the ninth, the tenth one-third as long as the ninth on the dorsal side. Inferior appendages as long as segments 9 and 10 together, superiors scarcely shorter, laterals one-third as long. Dorsal hooks on segments 3–10, on 3 and 4 slender erect on 5 and 6 broader, declined, on 7–9 still broader, covering basally their respective segments, their thin superior margins produced posteriorly in a sharp point; the hook on segment 10 similar, much smaller, its point obtuse.

Buitenzorg, Java. D. G. Fairchild.[a]

[a] While reading the proof of this article there have come to hand a number of nymphs from Batangas, Philippine Islands, sent by my former pupil, Mr. C. F. Carstens, now of the provincial high school of that place. These nymphs are slightly larger, being fully grown (length, 22 mm.), the number of raptorial setæ upon the mentum of the labium is but 8 each side, and the third of these, counting from the side, is longest. Aside from these trivial differences, they are apparently quite identical with the ones described above.

I am able to make out in these some further venational characters that should assist in identifying the species: The ante and post cubitals are in the fore wing 12 and 8–9, respectively, and in the hind wing 8 and 10, respectively. Vein *Cu* is strongly angulate at base of triangle in the fore wing, the apex of the triangle appearing sharply retracted. There is one cross vein in the triangle, there are but three cells in the subtriangle, and the space between the latter and the hind margin is very narrow. There are three rows of cells beyond the triangle for a distance, and there is a weakly developed median supplement subtending one row of oblique cells.

In the hind wing there is a single cubito-anal cross vein before the triangle; the latter is open, and the broad anal loop consists of two rows of large cells, the distal row divided and double from "heel" to "toe;" from the proximal marginal vein of the loop about five accessory sectors are decurrent to the hind margin.

The venation is not very different from that of such species of *Neurothemis* as *N. equestris;* but the sectors of the arculus are apparently separate at base in the fore wing, as they should not be in *Neurothemis.* Specimens of the Batangas nymphs are deposited in the National Museum.

CROCOTHEMIS SERVILIA Drury?

Plate XLI, fig. 3.

Two nymphs somewhat similar to the preceding, apparently grown, smaller.

Length, 13.5 mm.; abdomen, 8.5 mm.; hind femur, 4 mm.; width of head, 4 mm.; of abdomen, 6 mm.

Head pentagonal, straight behind, sides sloping from the laterally prominent eyes, front somewhat depressed; all smooth except the hind angles inferiorly. Labium short; median lobe with front margin produced into a median obtuse middle angle, and with spinose margins. Mental setæ 11–12 each side, the seventh (counting from the side) longest; lateral setæ 6 with an additional basal axial spinule; movable hook longer and stronger than the setæ, attenuate to the slightly incurved apex; teeth on opposed edges of lateral lobes small, serrate spinulose—each with three to four graduated spinules.

Legs long, thin, nearly bare, longitudinally grooved. Wing cases reaching the middle of the seventh abdominal segment.

Abdomen sharply triquetral, widest in the middle, oval in outline. Lateral spines on segments 8 and 9, stout, those on the ninth segment about attaining the level of the apex of the tenth segment. Dorsal hooks on segments 3–9, erect and narrower in front, becoming declined and broader at base posteriorly; all sharp, longest on segment 6. Appendages longer than the last two segments on their dorsal side, sharp-edged, the superior slightly declined at tip, laterals paler, one-third as long.

The reference of these nymphs to this species is made with misgivings. It can only be said, therefore, that imagos of this species were sent by D. G. Fairchild from the same locality, Buitenzorg, Java, and that in the venation rather scantily evidenced by markings on the wing sheaths there appear to be no serious disagreements. The nymphs seem, however, rather too small. The reference is very doubtful.

ORTHEMIS FERRUGINEA Fabricius.

This species, which is common through most parts of tropical America, was bred for me by Mr. F. G. Schaupp, at Shovel Mount, Texas, in August and September, 1897, and bred specimens are in the National Museum and in my own collection. Its nymph is very similar to the nymphs of *Plathemis* and *Ladona*, and agrees with them in having the front border of the median lobe of the labium crenulate; but it differs from both in lacking dorsal hooks, and its abdominal appendages are much longer than in *Plathemis*.

Length, 22 mm.; abdomen, 13 mm.; hind femur, 5.5 mm.; width of head, 5.5 mm.; of abdomen, 7 mm.

Body lanceolate-cylindric, little depressed. Head somewhat cubical,

with small eyes capping the antero-lateral angles, scarcely narrowed on the sides before the obtuse hind angles; hind margin a little concave; frons very hairy. Labium (fig. 3) short, hinge reaching between the bases of the fore legs. Median lobe of the mentum moderately prominent, with a strongly crenulate front border, the crenulations increasing in size on either side up to the base of the prominent median tooth. Mental setæ about 10 each side, the innermost indistinct, the fourth (counting from the side) longest, the fifth and succeeding ones suddenly shorter. Lateral lobes moderate, lateral setæ 8, hook moderate, teeth serrate, each armed with three or four graduated spinules.

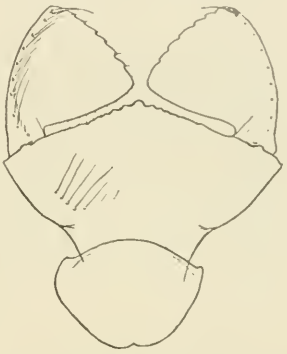


FIG. 3.—LABIUM OF NYMPH OF ORTHEMIS FERRUGINEA, FROM WITHIN.

Prothorax with high and well-exposed spiracles. Legs rather short and very hairy; held close to the body in locomotion. Wing cases reaching posteriorly as far as the sixth abdominal segment.

Abdomen somewhat triquetral, widest in the middle and tapering gradually to the apex, without dorsal hooks but with dorsal tufts of long hair replacing hooks on segments 4–7. Lateral spines on segments 8 and 9, of nearly equal size and in length equaling about one fourth the length of their respective segments. Segments 8 and 9 concave on their dorsal apical margins and 10 annular. Appendages as long as segments 8–10 on the dorsal side (about as long as 9 and 10 on the ventral side), spinous margined, slender and sharp, the laterals less than half as long as the others.

There are traces of single black bands on the sides of the thorax and near the apex of the abdomen, ending upon the base of the lateral appendages. Base of the superior appendage black.

ORTHETRUM LEPTURUM Burmeister?

Plate XLI, figs. 4, 5.

Twenty-nine specimens, some in very bad condition. Buitenzorg, Java, D. G. Fairchild; also a number of imagos from the same locality.

Nymph (apparently nearly grown). Length, 17 mm.; width of head, 4 mm.; of abdomen, 5.5 mm.

Body slender, not depressed, with sides nearly parallel, and sharply pointed abdomen. Head cubical, concave in front between the high, prominent eyes. Face and hind angles hairy; eyes situated before the middle of the length of the head, the sides behind them nearly straight and parallel as far as the rounded hind angles, hind margin scarcely concave. Labium moderate, hinge reaching posteriorly to the mesothorax, median lobe prominent, with a brownish middle tooth, and

the margin on either side of the tooth distinctly serrulate, with spinules arising singly between the serrulations. Mental setæ 3 each side, with an irregular transverse band of smaller ones across the middle. Lateral setæ 8. Hook rather short, stout at base, rapidly tapering to a slender incurved point. Teeth on opposed margins of lateral lobes small, becoming obsolete at the inner angle, slightly hooked, each armed with one or two short spinules.

Thorax slightly compressed, high. Legs slender, hairy. Wing cases reaching the base of the seventh abdominal segment.

Abdomen triquetral, the sides nearly apparallel as far as the eighth segment. Lateral spines on segments 8 and 9, straight, sharp, spinose on external margin. Dorsal hooks on segments 4–7, long, straight, sharp, slightly declined at apex, decreasing in size anteriorly where hidden between the wings, with spinose superior margins. Appendages very long and slender, as long as the last three segments of the abdomen together; laterals two-fifths as long as the others, all thinly fringed with tawny hairs. Segment 10 exserted, more than twice as long on the ventral side as on the dorsal.

LIBELLULID gen.? sp.?

Plate XLI, figs. 11, 12.

Two small nymphs, apparently half grown. Length, 11 mm.

Stocky, rather smooth of body, with short legs.

Head of the type of Libellula, concave in front between the high, narrow, very prominent eyes, which are directed forward and are situated before the middle of the head. Sides of the head scarcely narrowed before the broadly rounded hind angles. Rear marked with longitudinal scars. Antennæ pale with basal segments blackish. Labium ample, median lobe prominent, with a wide obtuse middle tooth, on either side of which the edge is strongly serrulate; stout spinules arise singly between the serrulations; eleven mental setæ each side, the seven outermost in a stronger series; nine lateral setæ; movable hook long, slender, straight to the incurved apex; teeth on opposed margins about ten, strongly serrate, each armed with about three or four graduated spinules.

Legs pale, scantily hairy; femora with two dark bands.

Abdomen blackish with paler margins, smooth, depressed, possessing the merest rudiments of dorsal hooks on segments 4 and 5, where hidden between the wings. There are very short bare lateral spines on segments 8 and 9, one-fifth the length of their respective segments. Segment 9 very strongly concave on its apical dorsal margin, less than half as long on middorsal as on midventral line. Tenth segment annular, included in the apex of the ninth. Appendages short, hardly longer than the ninth segment on its ventral side, triangular, yellowish, with black bases; laterals one-third as long as the others. Seg-

ment 10 one-half as wide as 9, which, with the abbreviated appendages, gives the abdomen a truncate appearance.

I am wholly unable to locate these nymphs generically. There is no venation to guide, and they are immature. They will be found to belong, however, to some genus allied to *Orthetrum*, with which they agree in all points except the structures of the apical abdominal segments, the brevity of the abdominal appendages, etc.

LIBELLULA SATURATA Uhler.

Plate XLII, fig. 1.

Prof. V. L. Kellogg has kindly sent me a bred specimen of this species from Stanford University collection (lot 143, sub. 20), and I have a number of nymphs kindly collected for me by Dr. John M. Stowell at San Jose, California, in February. These latter, dated April, 1897, are "from water cress in running water."

This species is distinguished among its congeners by its hairiness, its lack of dorsal hooks, and especially by the unusual brevity of the lateral spines of the ninth abdominal segment.

Length, 26 mm.; abdomen, 16 mm.; hind femur, 6.5 mm.; width of head, 6.5 mm.; of abdomen, 8 mm.

Body stout, depressed cylindric, with squarish head and tapering abdomen. Head of the usual form, very hairy on the hind angles. Antennæ with basal segments very hairy, the ratio of length of segments from the base outward being as 1:1.1:2:1.2:1.6:2:2. There is a transverse blackish band between the eyes, inclosing a paler spot on the frontal tubercle. The labium is large, with its hinge reaching posteriorly as far as the metathorax. The median lobe of the mentum is rather less prominent than usual, with smooth border and no middle tooth bearing regularly placed spinules. Lateral setæ 11–12, the six outermost in a longer series. Lateral lobes broad, concave, each with 9–10 lateral setæ and about ten low, crenate teeth with eroded summits on the opposed borders, each armed with 3–4 graduated spinules.

Thorax blackish on the dorsum, darker around the spiracles, and before the bases of the wings. Legs yellowish, hairy. Wings reaching the seventh abdominal segment.

Abdomen with a single middorsal and a pair of obscure lateral longitudinal lines; the dorsum of the tenth segment and the sides of the appendages blackish. Dorsal hooks wanting. Lateral spines on segments 8 and 9 about one-eighth as long as their respective segments, that of 9 a very little shorter than that of 8. Segment 9 concave on its dorsal apical margin; 10 annular, and almost included in the apex of 9. Appendages as long as segments 9 and 10 together, the superiors and inferiors equal, spinous margined; the laterals about half as long.

A later sending of a few alcoholic nymphs, received by the National Museum from the United States Fish Commission, includes several

specimens of this species from White's Warm Springs, Saw Tooth, Idaho. There are in the collection of the Illinois State Laboratory of Natural History a number of specimens collected by Prof. S. A. Forbes in the Yellowstone National Park, labeled "Firehole, Jul. 19th, 1890." There is in the collection of Dr. O. S. Westcott, of Chicago, Illinois, a single imago collected by him in the Yellowstone Park. It will be observed that these specimens, representing the northernmost limit of the known range of the species, come from warm water. Possibly this species, which appears to be common in ordinary waters far to the southward, is able to extend its range through the agency of these warm streams, which furnish the proper temperature conditions for the development of its nymph. Possibly this is equally the case with *Mesothemis collocata*, and with other species also.

LIBELLULA FORENSIS Hagen.

I have of this species a single female specimen that was bred by Mr. S. Bethel, at Olympia, Washington, on May 2, 1898, and a number of younger nymphs taken earlier in the season by the same collector. The imago was placed in alcohol before transformation was complete, and is in a very bad condition, and hardly determinable. It appears to be the species named above, and the structural characters of the nymph point to the same species.

Length, 24 mm.; abdomen, 15 mm.; hind femur, 6.5 mm.; width of head, 6.5 mm.; of abdomen, 7 mm.

Body lanceolate, very hairy. Head compact, half as long as wide, with small eyes capping the high anterolateral angles, little contracted behind the eyes, where sides are nearly parallel to the broadly rounded and scurfy pubescent hind angles. Antennæ about as long as the head, the relative length of segments from base outward: 1:1:1.8:1:1.2:2:1.5. Hinge of labium reaching backward as far as the mesothorax. Median lobe of mentum moderate, a toothlike prolongation in the middle of its front border, which is bordered with spinules rather regularly placed, but not crenate. Mental setæ about 8 each side in a short and sharp curve, all weak and fragile. Lateral setæ 6. Teeth about 10, low, subtruncate, subserrate, each armed with three or four graduated spinules.

Legs slender, very hairy. Wing cases reaching backward as far as the base of the sixth abdominal segment.

Abdomen lanceolate, widest on segment 6, and gradually tapering thereafter to a long point. Dorsal hooks on segments 3–7, poorly developed, except on middle segments, and hidden under thick tufts of coarse hairs. Lateral spines on segments 8 and 9, short, sharp, straight, about a fifth as long as their respective segments. Appendages longer than the long ninth and tenth segments together, slender, sharp, fringed with tawny hairs; laterals less than half as long as the others.

Since the above was written I have seen another specimen in the Museum of Comparative Zoology, from Cache Valley, Utah (No. 659), collected by C. Thomas.

SYMPETRUM MADIDUM Hagen?

A single fully grown specimen was collected for the United States Fish Commission by Mr. Chauncey Juday in Lake Creek at Twin Lakes, Colorado, on August 12, 1902. It is more strongly chitinized than usual for nymphs of the genus, and differs from all others known to me in the extreme reduction of the dorsal hook on the eighth abdominal segment and in the relatively greater length of the lateral abdominal appendages. Its reference to *madidum* is more or less doubtful. *S. decisum* and *S. atripes* both belong to the Colorado fauna.

Length (fully grown), 14.5 mm.; abdomen, 9 mm.; hind femur, 4.5 mm.; width of head, 4.5 mm.; of abdomen, 5 mm.

Body short and rather stout, smooth. Head widest across the anterior portion, where the eyes are rather prominent and are set well forward. The top of the head is smooth and the obtuse hind angles are strongly hairy, while the hind margin is nearly straight—perhaps slightly concave. Antennæ slender and hardly longer than the head, the length of the segments from the head outward being in the following ratio: 1:2:3:2:2.5:3:2.5. Labium of the proportions usual for the genus, with about 12 mental setæ each side, the fifth or sixth (counting from the side) longest. Lateral setæ 12, diminishing in size toward the base, the hook setiform, about as long as the seta behind it. Teeth subobsolete, with the usual groups of spinules.

Legs slender, smooth. Wing cases reach the middle of the sixth abdominal segment. Abdomen moderately depressed, and with rather sharp lateral margins. Lateral spines on segments 8 and 9, straight, on 9 about as long as the segment and twice as long as on 8. Dorsal hooks represented on segments 5–8, well developed on 6 and 7, smaller and erect on 5, and on 8 rudimentary and very inconspicuous. Segment 8 of abdomen slightly and segment 9 strongly concave on hind dorsal margin; 10, annular, included in the apex of 9. Appendages very unequal, the superior about three-fourths as long as the inferiors, its tip attaining the level of the tips of the lateral spines of the ninth segment. Laterals three-fourths as long as the superior. Superior and inferiors with spinous margins, stout triangular pyramidal bases and acuminate points set at an angle with the bases and directed posteriorly, while the bases are directed upward. Laterals pale yellowish.

TRITHEMIS AURORA Burmeister?

Plate XLI, figs. 6, 7.

More than eighty specimens, some in very bad condition; many apparently well grown: Buitenzorg, Java, D. G. Fairchild.

Length, 16 mm.; abdomen, 10 mm.; hind femur, 4.5 mm.; width of head, 5.5 mm.; of abdomen, 6 mm.

A short, stocky nymph, with flat head and abruptly pointed abdomen. Head strongly flattened anteriorly and strongly sloping to the front, with hind margin nearly straight, sides sloping outward to the eyes, which are rather large and directed antero-laterally. Antennæ seven-jointed pale beyond the second segment. Labium broad, its hinge reaching the middle of the mesothorax; median lobe prominent, obtuse at apex, its sides straight, thinly spinulose; mental setæ about 14, weak, in an indistinct series, the fifth to seventh each side longest; lateral setæ 10, in length equaling the very slender hook; teeth on opposed edges obsolete of lateral lobes, but single spinules remain to mark their position.

Legs rather short, hind tibiæ showing a series of fine spinules. Wing cases reaching the middle of the seventh abdominal segment.

Abdomen stout, little depressed, rounded dorsally, without dorsal hooks. Lateral spines on segments 8 and 9, short, stout, one-third as long as their respective segments, spinulose on their external margins. Tenth segment less than half as long on the middorsal as on the midventral line, more or less included in the apex of the ninth segment. Appendages as long as the ninth segment on its ventral side; laterals one-half as long as the others, divaricately curved at tips. Some nymphs show paler markings on ocellar tubercle, and on apical and lateral margins of abdominal segments. Legs pale, with indistinct darker bands on femora.

This is certainly a *Trithemis*, and one of the more typical group of species; if not the one named above, then, at least, some closely allied species.

DIPLACODES TRIVIALIS Rambur.

Plate XLI, figs. 8, 9.

More than a hundred specimens, many in bad condition, and some possibly not the same species, but not sufficiently distinct in their present state for separation. Some apparently grown. Also a number of imagos, collected at the same time and place: Buitenzorg, Java, D. G. Fairchild.

Length, 11.5 mm.; abdomen, 6 mm.; hind femur, 3.5 mm.; width of head, 4 mm.; of abdomen, 4.5 mm.

Similar to the preceding species, but much smaller, with head less flattened in front and eyes more prominent laterally. Median lobe

with very short spinules at regular intervals along its straight sides. Mental setæ 13, the second to sixth longest. Lateral setæ 10–11, teeth on opposed margins of lateral lobes serrate, small, uni-spinulose.

Abdomen similar to that of *T. aurora*, without dorsal hooks, with minute lateral spines on segments 8 and 9, sometimes aparently wanting on 8, on 9 perhaps one-fifth as long as that segment; segment 10 annular, included in the apex of the ninth; appendages as long as 9 on the ventral side, superiors a little shorter than inferiors, suddenly contracted to a slightly declined tip, laterals a little shorter, three-fourths as long as inferiors.

On Plate XLI, figs. 6–10, I bring together figures of the nymphs of the typical *Trithemis aurora* and of two aberrant species that are sometimes referred to the same genus, *T. trivialis* and *T. minuscula*, and on Plate XLIV I bring together the wings of the same species. To *Diplacodes* belongs, I think, *trivialis*, for reasons well indicated by Doctor Krüger.[a] The single crossvein under the stigma with a long vacant space before it, combined with the cubital branches of the hind wing separated at their departure from the triangle are very characteristic.

As to *T. minuscula*, with its more elongate nymph, its reduced venation, short anal loop and single row of cells between the radial sector and its supplement, I agree with Doctor Ris.[b] that it, together with its nearest tropical American allies, will eventually have to be separated from *Trithemis* as a new genus.

TRITHEMIS MINUSCULA Rambur.

Plate XLI, fig. 10.

Full-grown nymphs collected at Gotha, Orange County, Florida, in January, 1897. While the species was not bred, its identification is positive, because the venation of the imago is fully indicated in the wings of the well-preserved nymphs, and is unmistakable among the species that belong to Florida. Imagos were sent from the same locality a little later in the season.

The nymph measures in total length 12 mm., abdomen 7 mm., hind femur 3.5 mm.; width of head 3.5 mm., of abdomen 4 mm.

Body stout, nearly smooth. Head somewhat depressed, especially across the front, which is flush with the very prominent and large eyes, narrowed behind the eyes to the nearly straight hind margin. Antennæ slender, shorter than the head; ratio of length of segments from the base outward: 1 : 1.2 : 2.2 : 1.2 : 1.2 : 2 : 2. Labium with hinge reaching backward to the mesothorax; median lobe very prominent, its front border not crenulate, but with a row of rather regularly arranged spinules along the margin on either side and a pair close together at the tip of the median tooth-like prolongation.

[a] Stett. Ent. Zeit., 1902, p. 127.

[b] Ent. News, XIV, p. 219.

Mental setæ about 12 each side, the fifth (counting from the side) longest. Lateral lobes large, broadly concave. Lateral setæ 8; hook slender, setiform; teeth minute, almost obsolete, unispinulose.

Legs rather thinly clad with hairs. The basal segment of the tarsus is longer than half the length of the second or third segments. The wing cases reach posteriorly as far as the apex of the sixth abdominal segment.

Abdomen triquetral, sharp edged; in outline, oval. Dorsal hooks wanting. Lateral spines on segments 8 and 9, terminating very strongly spinulose; lateral margins on these segments about a fourth as long as the segments that bear them, straight and sharp. Segment 9 slightly concave above on the apical margin; 10 one-half shorter dorsally, one-third shorter ventrally, than 9. Appendages as long as the last two segments are on the dorsal side; superior and inferiors stout, with thin, divaricate tips and spinous margins; laterals one-fourth shorter than the others.

Color greenish, suffused with brownish dorsally, the brown divided on thorax and abdomen by a narrow middorsal pale line that is most sharply marked behind. There is a row of dots either side of the dorsum of the abdomen extending from the hind wing to the base of the lateral appendage, a pair of dots to each segment. There is a divided brownish spot on the dorsum of the prothorax and another on the mesothorax, and there are the usual bare scars on the rear of the head.

MICRATHYRIA PALLIDA, new species.

Length, male, 29 mm., abdomen 20 mm., hind wing 22 mm.; female, length 25 mm., abdomen 17 mm., hind wing 21 mm.

Color pale, fulvous; face greenish yellow, top of frons and vertical tubercle washed with chalybeous. Thorax nearly uniform fulvous, without stripes, with black dots sprinkled over the dorsum and narrow black lines on some of the corinæ about the wing roots. Legs yellowish fulvous, apical part of femora externally and all of tibiæ internally, and the tarsi blackish. Wings hyaline, slightly flavescent at extreme base; veins fuscous; stigma pale, fulvous. Abdomen brownish fulvous, darker toward apex by reason of confluence of fuscous tracts along the dorsal and lateral carinæ. Appendages yellow. Sides of abdomen little narrower beyond basal segments, regularly approximating posteriorly. Appendages as shown in figs. 5 and 6.

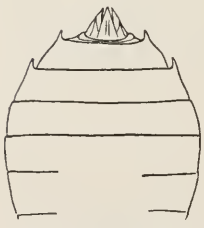


FIG. 4.—END OF ABDOMEN OF NYMPH OF MICRATHYRIA PALLIDA FROM ABOVE.

Venation of wings very similar in the two sexes. Ante- and postnodals in fore wing 11 and 7 respectively, in hind wing 8 and 8 respectively. There are 2 crossveins behind the stigma. There are 3 cells in the subtriangle of the fore wing; there is one crossvein

traversing the triangle, and there are 2 or 3 cells immediately thereafter with 2 rows following for a considerable space, increasing to 3 and to 4 at wing margin. In the hind wing the triangle is open, there is but a single cubito-anal crossvein before it, vein Cu_1 arises from its outer side, distinctly apart from Cu_2, the anal loop is rather short, with a single row of cells along either side its bisecting vein except at the "heel" where there is a single additional cell interpolated.

FIG. 5.—TERMINAL ABDOMINAL APPENDAGES OF THE MALE OF MICRATHYRIA PALLIDA.

The hind lobe of the prothorax is produced in a moderate quadrangular undivided posterior lobe fringed with tawny hairs.

The vulvar lamina of the female is elongate triangular, rounded on the tip, which nearly attains the level of the apex of the slightly produced sternum of the ninth segment.

This species was bred at São Paulo, Brazil, by Mr. Adolph Hempel, on October 8, 1897, and a number of adult specimens were captured at large at the same time and place.

Nymph: Length 12 mm., abdomen 7 mm. hind femur 3.5 mm.; width of head 3.5 mm., of abdomen 4.5 mm.

Body thick set; head highest in the rear, sloping forward, the large, bulging eyes capping the antero-lateral angles, broadly rounded behind the eyes to the nearly straight hind margin. Labium moderate, the hinge reaching posteriorly beyond the bases of the fore legs. Mentum wide, median lobe very prominent, its border not crenate, but armed with spinules rather regularly placed and with a pair of spinules close together at the tip, which is not produced forward to form a distinct tooth; mental setæ 9 each side, the fifth (counting from the side) longest. Lateral setæ 6. Teeth minute, serrate, unispinulose.

FIG. 6.—GENITAL HAMULE AND LOBE OF MALE OF MICRATHYRIA PALLIDA.

Thorax somewhat compressed, high; spiracles very prominent, highest at their projecting inner angle. Legs thin, sparsely spinulose externally. Wing cases reaching posteriorly as far as the middle of the sixth abdominal segment. Tarsal claws increasing markedly in length posteriorly, those of the hind tarsi being twice as long as those of the fore tarsi.

Abdomen (fig. 4) triquetral, ovate, widest on segment 6, tapering gradually to the ninth, which is suddenly narrower. Tenth segment short, annular, almost included in the apex of the ninth. Dorsal hooks wanting. Lateral spines on segments 8 and 9 about a third as long as the segments. Appendages as long as segments 9 and 10 together, superior and inferiors of equal length, laterals a little more than half as long.

This species clearly belongs to *Micrathyria*, but I am not sure it may not have been described already under some of the older names.

some of which, relating to the South American fauna, I have no knowledge of. I therefore present herewith a figure of the abdominal appendages (fig. 5) and of the accessory genitalia of the second abdominal segment (fig. 6) of the male, and trust that these will render certain the identity of this species later when Brazilian *Micrathyrias* shall come to be studied.

TRAMEA EURYALE Selys?

Plate XL, fig. 4.

In the Fairchild collection from Java are a number of nymphs belonging to a species of *Tramea*, here doubtfully referred to *eurvale;* two other species of *Tramea*, *T. burmeisteri* and *T. chinensis*, are known from the East Indies.

The apparently full grown nymph measures in total length 22 mm., abdomen 15 mm., hind femur 7 mm., width of head 7 mm., of abdomen 8.5 mm.

Body and head of the usual form (Plate XL, fig. 4). Antenna longer than the head; the relative length of the segments from the base outward in the ratio: 1 : 1.1 : 2.5 : 2 : 2.3 : 2.4 : 2.6. Labium ample, with about eleven mental setæ each side, the seven outermost in a close set series of which the fourth or fifth is longest; lateral setæ 10, the basal one smaller than the others. Teeth about 11 in number, low, serrate, each armed with four or five spinules at tip.

Lateral spines on abdominal segments 8 and 9 incurvate, exteriorly spinulose, slightly longer on 9, almost reaching the level of the tips of the inferior appendages. Superior appendage three-fourths as long as the inferiors, and slightly longer than the laterals. The inferiors strongly spinous on their margins.

PANTALA FLAVESCENS Fabricius.

Plate XL, fig. 5.

Side by side with the nymph of *Tramea* just described I place the nymph of the cosmopolitan *Pantala flavescens*, for the sake of showing clearly the differences between the two genera they represent. In *Pantala* the teeth on the opposed edges of the lateral lobes of the labium are separated by much deeper incisions of the margin and the mid-dorsal terminal appendage is much longer than in *Tramea*.

Subfamily LESTINÆ.

ARCHILESTES GRANDIS Rambur.

Plate XLII, fig. 3.

Folsom, California, July, 1885, and Hot Springs, Arizona, June 26, 1901; also Bright Angel, Arizona, July 12, Colorado Canyon, 3,500 feet. Nymphs apparently grown.

Length 40, including gills 12 mm., abdomen 20 mm., hind femur 7 mm., antennæ 9 mm.; width of head 5 mm., of abdomen 4 mm.

Body elongate, cylindric. Head scarcely wider than the thorax, with large, well-rounded, laterally prominent eyes, low obtuse hind angles, and a wide notch between the latter on the hind margin. Antennæ long and very slender beyond the two basal segments. Ratio of length of segments in order from the base 1 : 1.5 : 3 : 2.5 : 2 : 1.5 : 1. Labium very long and slender; hinge reaching posteriorly beyond the bases of hind legs; mentum narrow, with sides parallel, suddenly widened in its distal fourth; median lobe produced, rounded—almost truncate—in front, with a shallow, hardly closed median cleft; mental setæ 7 each side, decreasing in length internally; lateral setæ 3–4, of which but one is on the body of the median lobe, the others being upon the long, strong arcuate movable hook; lateral lobe (Plate XLIII, fig. 7) trifid at its distal end, the divisions each forming simple arcuate hooks, of which the innermost—the end hook—is longest and strongest.

Thorax stout, short. Legs long, slender, smooth. Wing cases almost reaching the apex of the fourth abdominal segment.

Abdomen cylindric, very slightly tapering on the last two segments, with stout lateral spines on segments 5–9, lesser ones on segments 3 and 4, and with serrulate lateral margins for the entire length. Segment 10 somewhat compressed, with a sharply compressed dorsal ridge, which ends in a high triangular fold whose posterior margins are strongly spinose. Gills broad, oblong, with parallel sides, obtuse apices, and distinctly segmented axes; color brown, with transverse median and basal (this one interrupted on the axis) pale bands. The better preserved specimens show the color to have been pale yellowish or greenish brown, with a transverse row of arcuate marks on the rear of the head, indistinct vertical bands on the sides of the thorax, narrow longitudinal lines on the femora, a double row of brownish clouds each side of the abdomen, and two little transverse marks on the dorsum of 3–7.

This species was bred for me by my friend and former pupil, Mr. Frank C. Willard, in the Huachuca Mountains, near Tombstone, Arizona, in July, 1897. It was found at an altitude of from 5,500 to 7,500 feet. The following interesting observations as to its haunts and habits are quoted from one of Mr. Willard's letters:

> The water was a swift little mountain stream that kept appearing and disappearing as it flowed down; also a deep reservoir, formed by damming a similar stream in another canyon. The water was very cold. The nymphs [of *Archilestes*] were very numerous. They were observed transforming about 10 o'clock in the morning, ascending the stems of cat-tails and horsetails about a foot above the surface of the water. The imagos were very pale and flabby for some time after emergence, and even when fully developed they are very sluggish, staying among the thick grass and keeping their wings horizontal, instead of holding them up, as other damsel flies do.

Subfamily AGRIONINÆ.

ARGIA FUMIPENNIS (Burmeister).

Several young specimens, collected at Gotha, Florida, on January 1, 1897, by Mr. Adolph Hempel. Numerous imagos of this species were collected at the same place and time, and no other species of *Argia*. These circumstances, as well as the structural characters of the nymphs themselves, render the supposition very probable.

Length (very immature) 10 mm., gills 4 mm. additional, abdomen 6.5 mm.

Body thickset and rather short. Head depressed, with moderate eyes, behind which the large hind angles are rather squarely truncated behind and rounded and scurfy hairy at the sides. The antennæ are slightly longer than the head. The labium (Plate XLIII, fig. 9) is moderate, with the hinge extending posteriorly as far as the mesothorax. Mental setæ wanting as in other members of the genus. Lateral setæ 2 and a rudimentary third. Lateral lobe (Plate XLIII, fig. 10) lacking the usual notch that separates the inner margin from the end hook.

Legs short. Wings reaching only the base of the second abdominal segment.

Abdomen rather short, cylindric, with the segments decreasing slightly in length apically as far as the ninth, the tenth being slightly longer than the ninth. Gills oboval, dark colored, the laterals, carinate for a distance from the base, the carinæ being low and spinulose and extending outward three-fourths of their length. Color dark, with a transverse blackish band near the apex.

ARGIA sp.?

Plate XLII, fig. 4.

This species differs from other known species of the genus in the possession of strongly triquetral gills, the lateral lamellæ possessing a high, sinuate lateral carina extending to the apex. The species appears to belong to tepid or mineralized waters in the Rocky Mountains. Full-grown specimens are from Bright Angel, Arizona, collected by Messrs. Barber and Schwarz on July 13, and from White Sulphur Springs, shore of Great Salt Lake, Utah, collected by Messrs. Hubbard and Schwarz. There are younger specimens in the Illinois State Laboratory collection, obtained by Professor Forbes in the Yellowstone Park, and Professor Cockerell has taken immature specimens of it in the tepid brooklets that flow outward from the Las Vegas Hot Springs in New Mexico.[a]

Length, 12 mm.; gills, 4 mm. additional; abdomen, 7 mm.; width of head, 4 mm.; of abdomen, 2.5 mm.

[a] These are the nymphs referred to in Psyche, X, p. 136.

Body short and stout, frequently incrusted and showing little color pattern, little hairy. Head depressed, subquadrangular, with well-rounded eyes capping the antero lateral angles, and with the hind angles rather prominent and very obtuse, and hairy externally, a deep notch in the hind margin between the hind angles. Antennæ about as long as the head, the relative length of the segments for the base outward being as follows: 1: 1.2: 2.5: 2: 1.2: 1: 1. Labium moderate, the hinge reaching posteriorly as far as the mesothorax. Median lobe prominent, its border finely spinulose. Lateral setæ 3, preceded by one or more small spinules. Hook stout, arcuate. I have already published a figure of the labium of this species.[a]

Thorax stout, not at all depressed. Legs short. Wings reaching posteriorly well over the fifth abdominal segment.

Abdomen short, slightly tapering, the segments beyond the second decreasing successively a little in both length and diameter as far as the ninth; the tenth distinctly longer than the ninth, and emarginate on its apical margin on the dorsal side. Gills oblong, their margins parallel almost to the tip, there tapering suddenly; laterals triquetral and concave internally, with a high sinuate external carina extending to the apex; dorsal gill with two less developed carinæ on its sides; all blackish mottled, with a more or less distinct subapical transverse paler bald, and white tips.

HYPONEURA LUGENS Hagen.

Plate XLII, fig. 5.

I have already described this species,[b] but without figures. I give some figures herewith to aid in comparing with the foregoing nearly allied species of Argia. In Plate XLII, fig. 5, is shown the nymph and also a lateral view of a detached gill lamella. In Plate XLIII, fig. 8, is shown the labium as viewed from within. This form is one of the most generalized of the *Agrionina* (*s. str.*).

TELAGRION DÆCKII Calvert?

A single full-grown female nymph, collected at Gotha, Florida, on January 1, 1897, by Mr. Adolph Hempel. Its slight form, long abdomen, and moderately long and slender legs seem to foreshadow the proportions these parts have in the adult of the species to which they are here referred, and there is hardly any other species inhabiting Florida to which they could be supposed to belong. The wings are unfortunately crumpled within their sheaths, and do not admit of an examination of the venation.

Length, 18 mm.; gills, 5.5 mm. additional; abdomen, 13 mm.; width of head, 3 mm.; of abdomen, 1.5 mm.

[a] Bull. 68, N. Y. State Museum, pl. XIV, figs. *e* and *f*.

[b] Psyche, X, pp. 135, 136.

Body very slender, with long cylindric abdomen. Head depressed, with eyes very large and laterally very prominent, the sides of the head sloping behind the eyes to the obtuse and scurfy pubescent hind angles between which is a deep notch on the hind margin. The three basal segments of the antenna (which only are preserved) are in relative length from the base outward as 1: 1.5: 3. The labium (Plate XLIII, fig. 13) is long and slender, with the hinge reaching posteriorly as far as the mesothorax. The median lobe is rather obtusely prominent; there are three mental setæ each side, decreasing in length toward the median line. There are six strong lateral setæ, and the end hook is rather short and stout. The inner margin of the lateral lobe is rather strongly convex and terminates in a stout and arcuate end hook, above which on the end is a row of four teeth in a straight row, diminishing in size externally, the outer angle being nearly a right angle.

FIG. 7.—CAUDAL GILL LAMELLÆ OF NYMPH OF TELAGRION DÆCKII, FROM THE SIDE.

The legs are slender and not very long; each femur shows a faint subapical brown ring. Wings reaching the base of the fourth abdominal segment. Thorax rather small.

Abdomen long, slender, cylindric; segments 2–8 of equal length, the ninth a little shorter, and the tenth half as long as the eighth. Gills (fig. 7) almost half as long as the abdomen, narrowly oblong, widest just beyond the middle and abruptly narrowed to submucronate tips, the basal half of both margins of each gill thickened and spinous, but not jointed where the thinner margin begins.

TELEBASIS SALVA Hagen.

Bred specimens from Mr. F. G. Schaupp collected at Shovel Mount, Texas.

Length, 14 mm., including gills, 3.3 mm.; abdomen, 6 mm.; width of head, 3.5 mm.

Head depressed, much wider than succeeding parts of the body, with large laterally prominent eyes, low hind angles, a sharp notch between them on the hind margin. Antennæ much shorter than the head is wide. Labium short, hinge hardly reaching the mesothorax.

FIG. 8.—MIDDLE GILL LAMELLA OF NYMPH OF TELEBASIS SALVA.

Legs moderate, scantily spinulose. Wing cases reaching the middle of the fourth abdominal segment. Abdominal segments of about equal length, cylindric; the tenth a little shorter than the others, especially on the dorsal side. Gills (fig. 8) oblanceolate, widest at three-fourths their length, and suddenly narrowed to an obtusely rounded apex, their margins smooth, marked with a few distant faint brown spots, and tracheæ more or less pigmented.

ACANTHAGRION CHELIFERUM Selys.

This species was reared at São Paulo, Brazil, September 20, 1897, by Mr. Adolph Hempel. The following description is drawn from a single cast skin, lacking gills and otherwise somewhat mutilated; the skin was accompanied by the teneral male imago that had emerged from it, and in the same sending were other maturer specimens of the same species, serving to render certain the identification of it by direct comparison. No nymphs of the genus being known, it is thought worth while to describe those characters that are shown by the present specimens, more especially because the most important of these are in the labium, which is well preserved.

The nymph measures in total length of body (gills wanting) about 13 mm.; abdomen, 7.5 mm.; hind femur, 3 mm.

Body and head of the same form and proportions as in *Enallagma* and *Ischnura*. Antennæ longer than the head, the ratio of length of segments from the base outward being: 1 : 1.5 : 2.2 : 2.2 : 2 : 1.7 : 1. Labium (Plate XLIII, fig. 11) moderate, mentum regularly widened to the base of the lateral lobes, just before each of which is a row oblique of minute spinules near the lateral margin; one mental seta each side. Lateral setæ 7, strong; movable and end hooks both well developed, the end of the lateral lobe (Plate XLIII, fig. 12) between these hooks, thin and rather evenly denticulæ on its revolute margin, the outer angle well rounded.

Legs slender, scantily armed with minute spinules. Wing cases reaching posteriorly as far as the apex of the third abdominal segment.

HESPERAGRION HETERODOXUM Selys.

This exquisite damsel fly was bred for me by Mr. Frank C. Willard in the Huachuca Mountains near Tombstone, Arizona, in the latter part of July, 1897. The altitude was near 7,500 feet. The situation was a deep reservoir of cold water, formed by damming a stream that flowed through a narrow canyon. The imagos of the species "spent most of their time among the joint-grass that grew in the edge of the water."

FIG. 9.—LABIUM OF NYMPH OF HESPERAGRION HETERODOXUM. THE LATERAL LOBE OF THE SAME, MORE ENLARGED.

The nymph measures 15 mm.; gills, 4.5 mm. additional; hind femur, 2.5 mm.; width of head, 2.5 mm.; of abdomen, 2 mm.

Body elongate, slender, gradually tapering posteriorly. Head wide, with eyes laterally very prominent, and the sides broadly rounded behind the eyes to the

excavate hind margin. Antennæ longer than the head, six, possibly seven, jointed, the last suture being indistinct, the ratio of the segments from the base outward being as 1 : 1.4 : 1.8 : 1.3 : 1.1 : 1 : .3? The labium (fig. 9) is of moderate size. The mentum is regularly widened to the base of the lateral lobes. The median lobe is moderately prominent, smooth on the edge and with straight sides. Mental setæ four (in one case on one side three) each side. Lateral lobe with six setæ, a stout movable hook, three distinct teeth on the end above the end hook, and the outer angle angulate with unusual sharpness, its margins scarcely edenticulate.

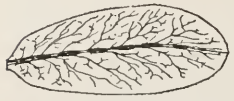


FIG. 10.—MIDDLE GILL LAMELLA OF NYMPH OF HESPERAGRION HETERODOXUM.

The legs are rather short. The wing cases reach posteriorly as far as the middle of the fourth abdominal segment.

The abdomen is cylindric, with segments of nearly equal length, slightly diminishing in diameter toward the end, the tenth segment somewhat emarginate on its superior apical margin. Gills (fig. 10) oblong-oval, widest just beyond the middle, broadly rounded at the ends, and with somewhat darker pigmentation along the axis.

LEPTOBASIS sp.?

Four nymphs, not fully grown, collected by Mr. August Busch at Cataña, Porto Rico, in January, 1899.

Length, 13 mm.; gills, 4 mm. additional; width of head, 3 mm.; of abdomen, 2 mm.

Slender, pale, short-legged nymphs, with broad, depressed head, large, laterally prominent eyes, behind which the sides slope abruptly to the obtusely prominent hind angles, between which on the rear of the head is a deep and well-rounded excavation. Antennæ longer than the head; ratio of segments 1 : 1.2 : 1.5 : 1.4 : .6 : .4. Labium moderate, its hinge reaching backward as far as the mesothorax, its median lobe very prominent, with serrulate margins, the serrulations directed laterally, and, therefore, in opposite directions on the two concave sides. One mental seta only each side. Lateral setæ, 3. End of the lateral lobe above the end hook with a series of 4–5 minute recurved denticles, diminishing in size to the outer angle.

FIG. 11.—MIDDLE GILL LAMELLA OF NYMPH OF LEPTOBASIS SP.? FROM PORTO RICO.

Legs short and rather slender. Wings reaching as far back as the apex of the fourth abdominal segment.

Abdomen cylindric, the segments of about equal length, or the two hindmost slightly shorter than the others and narrower. Gills (fig. 11) oblong, obtuse at apex, with a broad longitudinal diffuse pigmented axial tract, and pale margins. Each gill is divided transversely across

the middle by a suture into two parts, of which the basal is thicker and more strongly chitinized and has spinulose edges. On the dorsal side the brown of the skin is divided by a pale, narrow, longitudinal line, close beside which is a pair of blackish dots upon the apex of each segment.

EXPLANATIONS OF PLATES.

PLATE XXXVIII.

Fig. 1. Nymph of *Gomphoides stigmatus* from Texas.
2. Nymph of *Phyllogomphus æthiops?* from the Congo.
3. Labium of the same.
4. Nymph of *Ophiogomphus bison* from Lake Tahoe.
5. Part of labium of same.
6. Cast skin of nymph of *Gomphus minutus* from Florida.

PLATE XXXIX.

Fig. 1. Nymph of *Staurophlebia reticulata* from Nicaragua.
2. Labium of same.
3. Nymph of *Cordulegaster dorsalis?*, with labium partly opened.
4. Nymph of *Paltothemis lineatipes* from California.

PLATE XL.

Fig. 1. Cast skin of nymph of *Anax longipes?* from Jamaica.
2. Nymph of *Anax guttatus?* from Java.
3. Nymph of *Æschna galapagoensis* from Chatham Island.
4. Nymph of *Tramea euryale?* from Java.
5. Nymph of *Pantala flavescens* from Java.

PLATE XLI.

Fig. 1. Nymph of *Rhyothemis phyllis?* from Java.
2. Lateral view of the same.
3. Nymph of *Crocothemis servilia?* from Java.
4. Nymph of *Orthetrum lepturum?* from Java.
5. Lateral view of the same.
6. Nymph of *Trithemis aurora?* from Java.
7. Lateral view of the same.
8. Nymph of *Diplacodes trivialis* from Java.
9. Lateral view of the same.
10. Nymph of *Trithemis minuscula* from Florida.
11. Lateral view of unidentified *Libellulid* nymph from Java.
12. Dorsal view of head of same.

PLATE XLII.

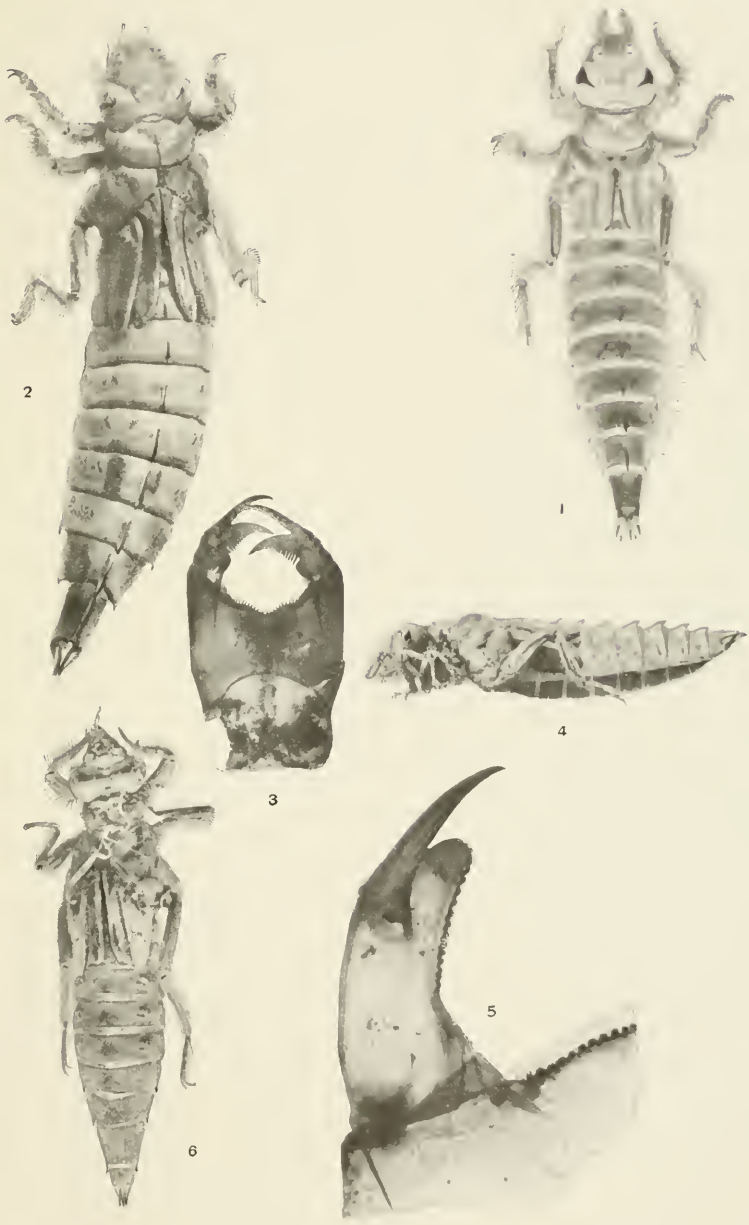
Fig. 1. Nymph of *Libellula saturata* from California.
2. Nymph of *Dythemis velox?* from Texas.
3. Nymph of *Archilestes grandis* from Arizona.
4. Nymph of *Argia sp.?* from Rocky Mountains (hot springs).
5. Nymph of *Hyponeura lugens* from New Mexico (gill detached).

PLATE XLIII.

Fig. 1. Labium of nymph of *Gomphoides stigmatus*.
2. Labium of nymph of *Gomphus minutus*.
3. Labium of nymph of *Gomphus confraternus?*
4. Labium of nymph of *Gomphus sobrinus?*
5. Labium of nymph of *Drogomphus spoliatus*.
6. Labium of nymph of *Æschna galapagoensis*.
7. Lateral lobe of labium of nymph of *Archilestes grandis*.
8. Labium of nymph of *Hyponeura lugens*.
9. Labium of nymph of *Argia fumipennis*.
10. Inner view of lateral lobe of the same.
11. Labium of nymph of *Acanthagrion cheliferum*.
12. Inner view of lateral lobe of the same.
13. Labium of *Telagrion dæckii?*

PLATE XLIV.

Fig. 1. The wings of *Trithemis aurora?*.
2. The wings of *Trithemis minuscula*.
3. The wings of *Diplacodes trivialis*.



DRAGON-FLY NYMPHS.

FOR EXPLANATION OF PLATE SEE PAGE 719.

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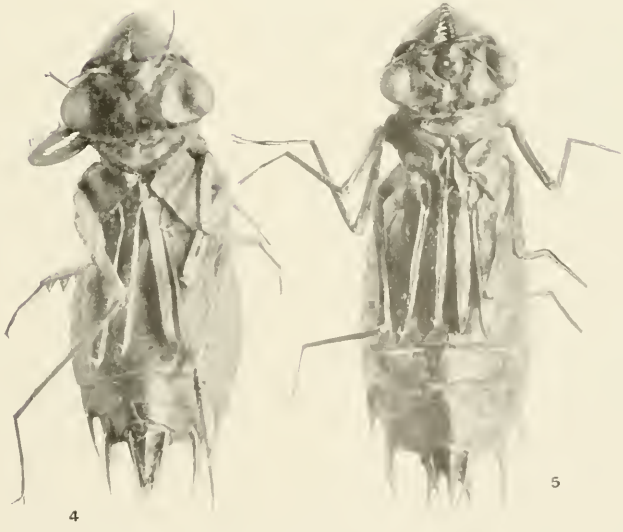
DRAGON-FLY NYMPHS.

FOR EXPLANATION OF PLATE SEE PAGE 719.



DRAGON-FLY NYMPHS.

FOR EXPLANATION OF PLATE SEE PAGE 719.

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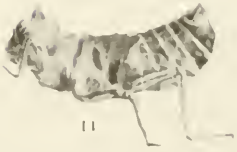

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DRAGON-FLY NYMPHS.

FOR EXPLANATION OF PLATE SEE PAGE 719.

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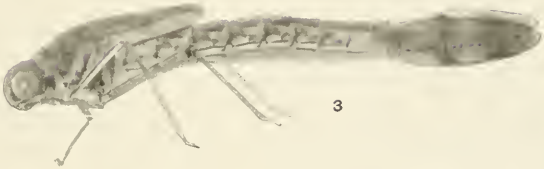

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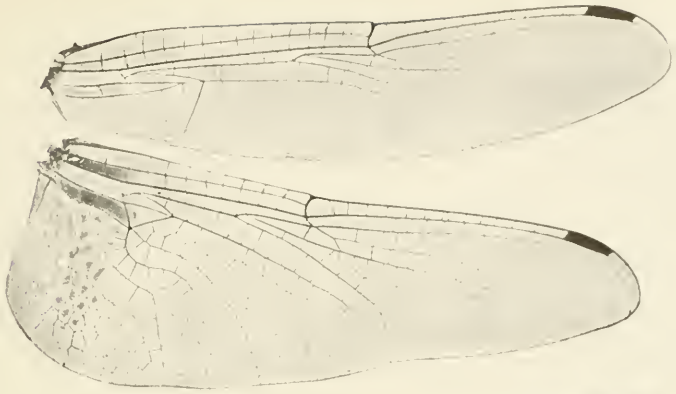
DRAGON-FLY NYMPHS.

FOR EXPLANATION OF PLATE SEE PAGE 719.

LABIAL CHARACTERS OF DRAGON-FLY NYMPHS.

FOR EXPLANATION OF PLATE SEE PAGE 720.



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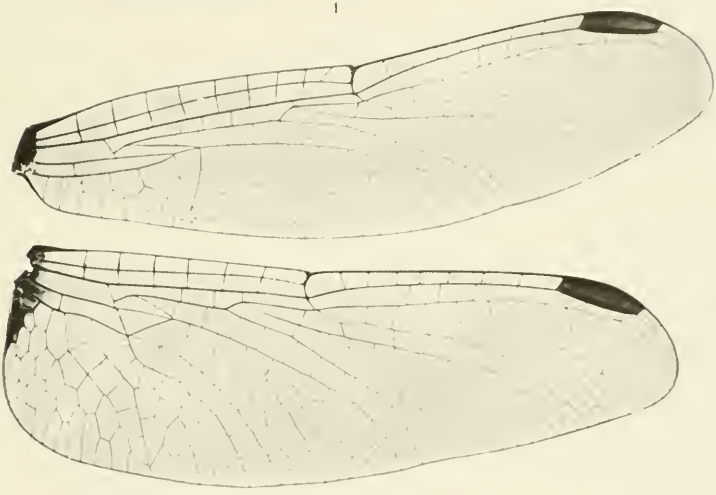

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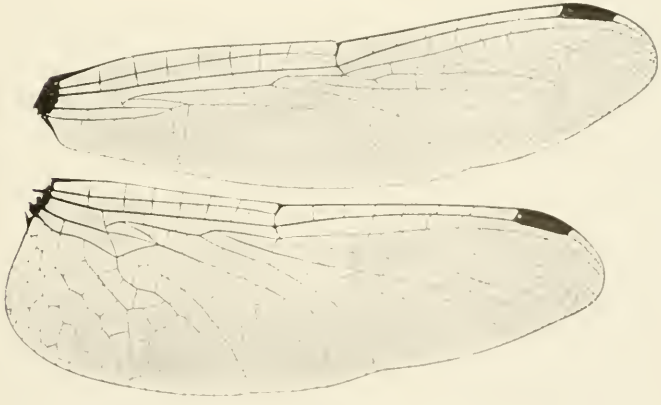

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DRAGON-FLY WING VENATION.

FOR EXPLANATION OF PLATE SEE PAGE 720.

NEW MOLLUSCAN GENERA FROM THE CARBONIFEROUS.[a]

By George H. Girty,
Custodian of Carboniferous Invertebrate Fossils.

Among the Carboniferous faunas examined in the course of investigations connected with official work, I have been led to recognize a large number of undescribed species and some genera, which in most cases it did not seem appropriate to make known in connection with the studies that brought them into notice. Many of these types were laid aside for discussion with one or another of a number of subjects the investigation of which is projected. There remains, however, a collection very miscellaneous in character and not germane to any of the papers now in view. A few of the generic types it is here proposed to describe and name.

In order to secure brevity in the title of this paper, the term molluscan is employed in a somewhat broader sense than present usage generally sanctions, though not inconsistently with that of the last generation by which brachiopoda were grouped with the true mollusca.

The fossils upon which the observations recorded in this paper were made form part of the collections of the U. S. National Museum.

LIMIPECTEN,[b] new genus.

It is rare that one is able directly to observe structural characters in Carboniferous Pectinoids. Usually either the shell is embedded in hard rock, from which it is hopeless to clear it, or else, and this is the best that happens, the test has been dissolved away and the structures are seen in reverse as casts. A few examples from Young County, Texas, however, which have recently come under my observation, though more or less fragmentary, retain their original shell substance completely and show characters which indicate that they are distinct from any of the genera thus far defined. I will first describe this form, which seems to belong to a new species as well as to an unknown genus, in detail, and then consider the characters by which it is distinct from related genera.

Genotype.—*Limipecten texanus.*

[a] Published by permission of the Director of the U. S. Geological Survey.

[b] From *Lima* and *Pecten*, two Pelecypod genera.

LIMIPECTEN TEXANUS, new species.

Plate XLV, figs. 1, 2, 3; Plate XLVI, fig. 4 (?); Plate XLVII, figs. 1, 2, 3.

Shell large; length nearly equal to or slightly in excess of the width. The largest example observed must have been over 65 mm. long when complete. The hinge line is long, though somewhat shorter than the greatest width. The obliquity is slight but appears to be forward as in *Lima*.

The convexity of the left valve is moderate or strong in different individuals. The umbo is large, well defined, and incurved. The wings are broad and the outline is not strongly withdrawn beneath them. They are of nearly equal size, the anterior one being possibly a trifle larger than the posterior. It is also much more strongly defined, for while the posterior wing is depressed and slightly upturned, and therefore bounded by an ill-defined groove, the descent to the anterior wing is abrupt and angular. This wing is flattened and somewhat oblique. The surface is crossed by rather coarse and radiating ribs, which are more or less regularly unequal in size. Frequently three gradations can be distinguished, every fourth rib being large, those half way between somewhat smaller, while others alternating with these two systems are still smaller. The ribs do not extend onto the wings, though sometimes traces of slender ones appear. The surface is also crossed by delicate concentric lamellæ, rather distant and irregular, which are much stronger and more crowded on and near the wings. They cross the shell in scalloped lines with pointed extensions in the striæ between the ribs.

The right valve is much flatter than the left and its surface ornamentation, though of the same general character, is so different that one would hardly think of the two belonging together, if found separately. The posterior wing is flat, and not marked off from the rest of the shell. The anterior wing is, on the other hand, sharply defined, and the outline is strongly retracted beneath so as to make a deep byssal sinus. While the umbo of the left valve is prominent and well defined, the right valve practically lacks this feature altogether. The surface is marked by somewhat depressed ribs, which are much finer and more numerous than those of the opposite valve. They are, as a rule, obsolete over and near the wings, but a few faint and slender ones can sometimes be seen. The concentric lamellæ are in like manner finer and fainter than those of the left valve. They are obscure over most of the shell, and only distinct upon and near the wings.

There is a broad and massive hinge plate marked by structural lines parallel to the straight lower border, and just beneath the beaks a large distinct fossette for the resilium which is very oblique and directed backward. Both valves seem to have this structure of the same character and force. Near the center, under the hinge plate, are

several small depressions arranged in a row, and some distance apart, which may mark the position of the pedal muscle.

The shell is thick and massive, especially in the upper and older portion. It is conspicuously constructed of two layers, an outer one which is relatively thin and which carries all the more delicate surface ornamentation, and an inner which is much thicker and receives only the strong plications. The inner layer consists of laminæ approximately parallel to the surface. Because of the distinct demarcation of the outer layer I suspected that it might have a prismatic structure. Though in one or two instances fine parallel lines were thought to be observed running across this layer on broken surfaces, no prismatic structure is shown by thin sections. These indicate, however, that the outer layer had a distinct composition of its own, for it is defined by a sharp line from the massive inner portion, and is, furthermore, nearly transparent, while the other transmits light but imperfectly. The fact that in its present condition the outer layer is transparent and structureless inspires and leaves room for conjecture as to what may have been its original arrangement.

This species, while presenting some resemblance to *Aviculipecten providensis* Cox, is distinct both from it and from every other American form known to me. The shape of the Texan species is somewhat different from that described by Cox, being broader at the hinge line. Furthermore, his description, as well as his figure, indicates that the main ribs are subdivided by longitudinal striæ into riblets. Nothing of this sort occurs in *Limipecten texanus*, the concentric lamellæ of which, on the other hand, are not mentioned as occurring in *Aviculipecten providensis*.

Cat. No. 27102, U.S.N.M.

Locality and horizon.—Pennsylvanian (Cisco), Graham, Young County, Texas.

LIMIPECTEN TEXANUS var. GRANDICOSTATUS, new variety.

Plate XLVI, figs. 1, 2, 3.

It is necessary also to distinguish a variety of the species above described, which differs in having larger and less numerous ribs upon the left valve. Otherwise in all its structure and ornamentation the coarsely plicated shell resembles *Limipecten texanus*.

Cat. No. 27103, U.S.N.M.

Locality and horizon.—Pennsylvanian (Cisco), Graham, Young County, Texas.

Before considering the characters which seem to distinguish this species generically, a better judgement will be formed by taking a survey of certain other forms probably congeneric with it.

The structure of the hinge plate, so well shown by the Texan form, seems to be a more important character than minor differences in con-

figuration, and relying especially upon it some three other species can probably be referred to *Limipecten*, though I suspect that a larger number of those now grouped with *Aviculipecten* really belong there. Prominent among the species assigned to *Limipecten* is *Aviculipecten occidentalis* Shumard, the commonest Pennsylvanian Pectinoid of the Mississippi Valley region. The structure of the hinge plate in this species was known and described by Meek as long ago as 1866, but he did not see fit to separate it from *Aviculipecten*, though, if the latter really has the structures universally ascribed to it, I do not see how these shells can be consistently grouped together. Meek's remarks upon this point are as follows:[a]

> In good casts of the area of this species, we have observed unmistakable evidences of a very shallow, flattened, trigonal cartilage pit. It is unlike that of Pecten, however, being quite broad, distinctly triangular and very oblique, more as we see in *Meleagrina*. It is traversed by the same fine striæ that mark other parts of the area. One of the most important distinctions between this genus, as generally understood, and all of the modern type of the *Pectinidæ*, is the presence of a distinct, well-defined cartilage pit in the hinge of the latter. The species under consideration, however, shows that there was, sometimes at least, a slight tendency to form a similar cartilage depression in the area of *Aviculopecten*, thus furnishing another evidence of the imperceptible gradations by which all groups will propably be found linked together when we can have an opportunity to compare very large numbers of the living and extinct types.

My own observations upon this species were independently made upon some external and internal casts from Saline County, Illinois. The specimens were sent by A. H. Worthen, and identified by him as *Aviculipecten clearelandicus*. It was possibly upon fossils from this lot that the recorded observations of Meek were made. It will be remembered that *A. clearelandicus* was placed by Meek in the synonymy of *L. occidentalis*, and the specimens from Illinois appear to be the form currently identified with Shumard's species. The hinge plate and cartilage pit in these specimens are the same as in *Limipecten texanus*, and I feel little doubt that they belong to the same genus. Thin sections of a shell from Afton, Union County, Iowa, supposed to belong to *L. occidentalis* show tubular structure very clearly, the tubules being remarkably large and scattered. This section seems to show only a single layer, which I would take to be the outer one if two were actually present. To harmonize this observation with that made upon *Limipecten texanus* it will be necessary to note that in the case of *Limipecten occidentalis* the section was taken near the ventral margin of a young or small example, while in the case of *Limipecten texanus* the section was taken near the hinge margin of a large old specimen. It is a probable hypothesis that the lamellose (nacreous?) inner layer of *Limipecten texanus* would be very thin, or even absent, near the margin of the shell, so that what appears to be a single homogeneous layer in

[a] Geol. Survey Illinois, Report, II, 1866, p. 331.

Limipecten occidentalis represents the thin external layer whose structure in the slides of *L. texanus* had been obliterated. If these observations are correctly correlated, the presence in these shells of an inner lamellose, probably nacreous layer, and of an outer tubulous layer, is important in ascertaining their relationship with other genera.

Another form in which the hinge structure characteristic of *Limipecten* has been observed seems to be as yet undescribed. It was found near Topeka, Kansas, and is allied to *L. occidentalis*, from which it is distinguished chiefly by its large flat ribs. No new facts are added by observations made upon this species.

The third and last form, supposed to show the hinge structure of *Limipecten*, is a species identified by De Koninck with *Aviculipecten calatus* McCoy. His figure represents a hinge plate with a ligamental pit similar to that of *Limipecten*, and his description indicates a similar median structure, although the interpretation is certainly different.

All these shells are more or less nearly erect; but because imperfections in outline are frequent, and sometimes very misleading, it is seldom possible to tell confidently whether the axis is directed forward or backward. Both conditions seem to occur; and while in some cases this character may serve to discriminate species, I doubt if it can be applied to generic groups. In practice its utility for any rank of discrimination will of necessity be much limited. In my figures *Limipecten texanus* is represented as having a forward inclination, but I am not altogether satisfied as to the fact. The growth lines seem to indicate this shape, but the circumstance that the cartilage pit has a strong backward inclination may not be without significance.

Aside from the structure of the hinge plate, several features in the configuration and ornamentation of *Limipecten* are more or less striking. The inequivalve character of the shell is one of these. The right valve throughout the forms referred to *Limipecten* is not only very much flatter than the left, but has somewhat different and much fainter surface ornamentation. The wings are not always conspicuously unequal. If anything, the posterior one is larger than the anterior; this fact being determined by the distance from the point of the umbo to the extremity of the wing. In the typical species the anterior wing is strongly defined, and the posterior undefined, but while it seems to be a general truth that the demarcation of the anterior wing is more abrupt than that of the posterior, individual specimens can be found, as, for instance, in *L. occidentalis*, in which there is little if any difference, both wings being strongly outlined. In *L. texanus* the plications, faint over most of the shell, are practically obsolete on the wings, though traces of them were noticed in individual specimens. In *L. occidentalis*, a strongly radiate species, the ribs are distinct upon the wings, being stronger upon the anterior wing (in the right valve) than upon the posterior. The relative size, demarcation, and ornamen-

tation of the wings seems to be of no value in discriminating groups as a whole, varying much in different species.

The shells having the structures above described are obviously closely related to McCoy's *Aviculipecten*, and they resemble it in so many particulars that the possibility is entertained that the only strong differences which seem to exist may be the result of imperfect observation on McCoy's part. He distinctly says that *Aviculipecten* has no median cartilage pit, and though, as I have elsewhere shown,[a] two apparently distinct types of cardinal structure are ascribed to that genus by different authors, all agree in repeating this character. I do not feel justified, therefore, in referring to *Aviculipecten* shells having a large and obvious excavation for the resilium, though the name *Limipecten* is only proposed conditionally on *Aviculipecten* having the characters which on every hand it is said to have. As previously remarked, the strong resemblance otherwise shown between the two genera leads me to believe that *Aviculipecten* really does possess a cartilage pit, a belief which finds support in the fact that De Koninck apparently describes and figures this structure in one of McCoy's species all along supposed to belong to *Aviculipecten*. The fact that Meek observed this fossette in *A. accidentalis* without considering it of sufficient importance to warrant removing the species from *Aviculipecten*, is of some interest; but if it should prove that a persistent group of species possesses the cartilage pit, while another is persistently without it, it may well be doubted whether he would still have included both types under *Aviculipecten*.

The presence of a cartilage pit is the most important character that distinguishes *Limipecten* from *Aviculipecten* as defined by McCoy, which the new genus much more closely resembles than it does the description of the hinge plate given by Woodward and copied by many succeeding writers. It will be observed that McCoy figures the hinge plate of *Aviculipecten* as broadly triangular in shape, with its longest side uppermost. The upper margin of *Pecten* also is straight, indicating in both cases, I would judge, that this was the true hinge line, and that the resilium and cartilage are internal. In *Limipecten*, however, the triangular hinge plate has its base downward, the striations due to growth being rectilinear and parallel to the lower margin, which seems to indicate that the real hinge line was along the base of the hinge plate, and that the cardinal structures are external. This is also shown by the conspicuous gaping of the valves above when they are closed, their line of contact being the lower margin of the hinge plate.

It appears to me that the name *Aviculipecten* is a misnomer so far as it indicates that these shells are at all closely connected with the Aviculidæ (Pteriidæ), and this is especially the case if *Limipecten*

[a] American Geologist, XXXIII, May, 1904.

proves to be the same as *Aviculipecten*. That the real affinities of *Aviculipecten* are with the Pectinidæ seems now to be generally accepted, and the position of *Limipecten* is clearly in the same group. Meek has suggested the propriety of discriminating *Aviculipecten* and its allies from the Pectinidæ as a separate family or subfamily, and it certainly seems that such a course would give greater unity to both groups.

Although Woodward appears to have questioned the validity of *Aviculipecten*, its distinctness from *Pecten* is now generally recognized. *Limipecten*, though presenting one additional and striking point in common with *Pecten*, is also certainly distinct. It has a large hinge plate, with an external, instead of an internal, resilium and cartilage, and the shell structure is probably different. *Limipecten* is, in fact, in many respects more closely related to *Lima* than to *Pecten*, as it has the cardinal structure of *Lima*, with the general expression of *Pecten*. The strongly inequivalve shell in *Limipecten*, its broad wings, and its composite shell structure, if, as is surmised, it has an inner nacreous as well as an outer tubuli-fibrous layer, prevent the reference of these shells directly to *Lima*. If anything, it seems to me that *Aviculipecten* and *Limipecten* belong rather to the Limidæ than to the Pectinidæ, though they do in a measure combine the characters of both families. Meek's suggestion of separating this group as a distinct family or subfamily seems, therefore, to be a good one, and is also enforced by the shell structure of *Limipecten*.

In a recent paper[a] I have proposed the name *Acanthopecten* for the peculiar and well-known species *Aviculipecten carboniferus* Stevens. I am now able to add a few facts regarding this form which go still further to validate its separation from *Aviculipecten*. Meek has called attention to the fact that the shell in this species is thin, that it seems to consist of a single layer, and that it appears to have a prismatic structure. Basing my observations apparently upon the same material from Nebraska which formed the subject of those of Meek, all of these facts are indicated, though I hesitate regarding the prismatic structure of the shell. This is, to be sure, suggested by its appearance under the microscope; but I doubt if this structure was really present. The shell substance seems to be minutely granulate, instead of prismatic, and possibly is not the original material at all, but a crystalline infiltration. The film preserved is so thin that it is difficult to determine whether the appearance is due to granules or prisms, but from their great variety in size and shape, their very minute dimensions, and their general appearance, I believe that they are grains or crystals of calcite.

Along the hinge line the shell is rather strongly elevated into a narrow cardinal ridge, which appears on the inside as a groove. In this

[a] U. S. Geol. Surv., Prof. Paper, No. 16, 1904, p. 417.

doubtless the ligament was accommodated. This groove narrows to a line at the beaks, and I doubt if there was any excavation at that point for the resilium. As the posterior ear is considerably larger than the anterior, the ligamental groove is much more distinct than on the anterior ear. Mention may also be made of a fact, not before recorded so far as I am aware, the presence of a row of small, erect spines along the cardinal line. As yet these have been observed only upon the anterior ear, but they may possibly have existed upon the other also. In the apparent absence of a median pit this form suggests *Aviculipecten*, but there is no hinge plate, and the ligamental furrow, in contrast to the hinge plate of either *Aviculipecten* or *Limipecten*, narrows toward the umbones and widens toward the extremities of the wings. The cardinal and superficial characters of this form, and the shell structure, if it has but one layer, and especially if it is prismatic, as Meek believed, satisfactorily discriminate the genus *Acanthopecten*.

PLEUROPHORELLA, new genus.[a]

This term is proposed primarily for a new species of pelecypod shell from the Pennsylvanian rocks of Texas, but to the same group probably belong several species already in the literature. While the genotype, though possessing many characters in common with King's genus *Allerisma*, has several striking peculiarities, the other allied forms to a certain extent bridge over these differences. The specific description of *Pleurophorella papillosa*, and the discussion following it, will give the characters of these shells in more detail, but it seems proper to indicate at this place the most important features of the genus, which are external, those of the interior being unknown. The shape is transversely elongate, subrectangular; the hinge line long; the valves probably in contact throughout. The lunule and escutcheon are sharply defined, the former more or less strongly concave. The shell is thin, the superior-posterior portion with a few radial costæ, the remainder marked by concentric plications, which die out more or less completely at the umbonal ridge. The surface is granulose or papillose, the granules tending to an arrangement in radial lines, and sometimes connected into liræ. The chief difference between these shells and those grouped under *Allerisma* which can be at present pointed out are the more sharply defined and more strongly depressed lunule and the presence of costæ, the development of which results in a truncation of the posterior outline.

Genotype.—*Pleurophorella papillosa.*

[a] From *Pleurophorus*, a Pelecypod genus.

PLEUROPHORELLA PAPILLOSA, new species.

Plate XLV, figs. 4, 5, 6; Plate XLVI, fig. 5.

In general appearance this form much resembles species of the genus *Pleurophorus*. The size is somewhat above the average, the shape transversely elongate, with the width about twice the height. The point of the umbo is situated but a short distance posterior to the front end of the shell. The upper and lower margins are subparallel. The hinge line is straight and occupies about two-thirds the entire width. The lower margin is gently convex, turning upward rather strongly at the anterior end, the outline of which is truncated for about half the height. The posterior end is also truncated by an oblique line, making an obtuse angle with the upper and an acute angle with the lower margin. In perfect specimens the posterior truncation is itself more or less complex or interrupted by the development of ribs upon the shell. The posterior outline is not normally strongly oblique, but in old specimens, through being worn or broken, it merges more or less with the cardinal outline and extends strongly backward, making the inferior-posterior angle sharply rounded. The convexity is considerable, and is the same in both valves. It is greatest toward the front, diminishing markedly toward the posterior end. The anterior end is strongly concave, forming what may be termed an introverted lunule. The junction of the retreating and advancing portions of the shell is acutely angular. The introversion of the anterior end produces a more or less distinct truncation of the outline. Extending diagonally from the beak to the inferior-posterior angle is a well-marked ridge or angulation, and a second fainter ridge runs midway between it and the hinge line. Here again the shell is inflexed, forming a sharply defined elongate area upon both valves. These areas in the two valves are nearly horizontal, making together an obtuse angle, which opens outward, and, doubtless, accommodated a large external ligament.

The surface is marked by fine concentric striæ and large low plications, the whole being minutely and elegantly papillose. The concentric markings, especially the more prominent ones, become more or less suddenly and completely obsolete at the umbonal ridge. The shell is thin, but nevertheless seems to consist of two layers. The outer, which carries the papillose surface ornamentation, sometimes exfoliates or wears off, leaving the underlying portion smooth but for the concentric striæ and wrinkles.

The dentition and pallial and muscular markings are unknown. One specimen, it is true, seems to show a single dental socket under the beak of the left valve, but I am not quite satisfied as to the origin and function of this depression.

Cat. No. 27140, U.S.N.M.

Locality and horizon.—Pennsylvanian (Cisco), Graham, Young County, Texas.

Aside from the typical species, whose characters have been detailed above, there can probably be referred to *Pleurophorella* several forms resting at present with different generic groups. One, a species possessing many of the essential characters of *Pleurophorella*, was described as *Allerisma? gilberti* White. This author neglects to mention the presence in this species of a depressed lunule and of a strongly marked ligamental area. The surface, furthermore, is marked by granules arranged in radial lines and having the appearance of delicate liræ. While the lunule in this species is depressed, it is not nearly so deeply concave as in *Pleurophorella papillosa*. Another species, less perfectly known than *Allerisma gilberti* but without much doubt belonging to the same generic group, is *Allerisma geinitzi* Meek. On account of the preservation of the type of this species many of the parts shown in *Allerisma gilberti* are concealed. *Allerisma reflexum*, which appears from Meek's figures to be very closely related to *Allerisma gilberti*, probably does not belong here, the type specimen being very imperfect and Meek's figure possibly misleading. *Allerisma costatum* of Meek and Worthen, which is so similar to *Pleurophorella papillosa* that one species might possibly be mistaken for the other, belongs, it is very probable, to the same group, and *Allerisma lanceolatum* Swallow also is a possible representative of *Pleurophorella*, although the description, which is unaccompanied by figures, permits no more than a surmise upon this point.

The incongruity of some of the forms referred by American authors to *Allerisma* has been remarked even by Europeans, and I find that Wheelton Hind has rejected several American species originally referred to King's genus. Among these is *Allerisma hannibalensis* Shumard, long since transferred to *Grammysia*. By an oversight it would seem he accepts the original description of *Allerisma costatum* Meek and Worthen as a true member of the genus, and rejects the republication in 1873 and also a later identification from Ohio. As the later descriptions were accompanied by figures, which were lacking to the original one, the rejection of this species probably represents his best founded opinion. He also rejects *Allerisma pleuropistha* Meek, *Allerisma winchelli* Meek, and *Allerisma ventricosum* Meek. *Allerisma illinoisense* Worthen is likewise thrown out, and either *Allerisma andrewsi* or *Allerisma maxillense*—of the two without much doubt *Allerisma andrewsi*.

Hind's rejection of *Allerisma costatum* is of importance to me because of the similarity of that species to the type of *Pleurophorella*; and in connection with the relationship of *Pleurophorella* to *Allerisma*. He neither excludes nor includes the other species which at present seem to be appropriately assigned with *Allerisma costatum* to the genus *Pleurophorella*. Relieved of these forms and those mentioned by Hind, one of which, however, can possibly be retained in

Allerisma, the American group of Allerismata regains somewhat greater homogeneity. Some species can with safety be retained in the genus, as, for example, *Allerisma terminale*, *Allerisma subcuneatum* (= *Allerisma terminale*), *Allerisma capax*, *Allerisma elongatum*, *Allerisma andrewsi*, *Allerisma claratum*, *Allerisma maxillense*, and *Allerisma sinuatum*. Several forms aside from those withdrawn under *Pleurophorella*, can be almost certainly rejected, e. g., *Allerisma cooperi*, *Allerisma granosum*, *Allerisma curtum*, *Allerisma latum*, *Allerisma pleuropistha*, *Allerisma ventricosum*, and *Allerisma winchelli*. The position of the remaining forms seems to me more or less doubtful. A few will probably remain with *Allerisma*, but the major portion will probably bring up elsewhere. The figures in many instances are suggestive of *Sphenotus*.

The type species of *Pleurophorella* is so unlike a typical *Allerisma* such as *Allerisma subcuneatum* (=*Allerisma terminale*) that the possibility of their belonging to the same genus seems at first very remote. It was in fact some time before I recognized the affinity which almost certainly exists between *Pleurophorella* and *Allerisma*. I am at present not sure that the former should hold the position of more than a subgenus. Both are transversely elongate in form, both have a shell marked with papillæ and by concentric folds, both have lunule and escutcheon fairly strongly marked. The lunule in *Pleurophorella papillosa* is not only sharply defined but retreats inward to such an extent that in a full-grown specimen the anterior end is concave by as much as 6 mm. The lunule is strongly marked and depressed in *Pleurophella gilberti*, but to no such marked degree. It is a distinct feature of *Allerisma subcuneatum*, but is not very sharply defined and is not concave. The surface of *Pleurophella papillosa* is finely papillose, with some tendency toward arrangement in radiating lines. In *Allerisma subcuneatum*, and I believe in *Allerisma* generally, the granules are coarser, much more scattering, and more linear in arrangement. One character which seems to be constant in *Pleurophorella* but is never found in *Allerisma* so far as I am aware, is the presence of one or more costæ on the upper posterior portion of the shell, a feature which gives much individuality of expression to the former genus. It is to be regretted that the interior structures of *Pleurophorella* are up to the present unknown, but those of an external character are sufficiently marked to make me look rather confidently for corresponding differences upon the inside of the shell. The costate condition and general expression of *Pleurophorella* are very suggestive of another altogether different group, and *Pleurophorella papillosa* in particular much resembles *Pleurophorus tropidophorus*, or even *Pleurophorus occidentalis* and *Pleurophorus angulatus* but the resemblance is only superficial. *Pleurophorus* has neither the papillose surface nor the impressed lunule of *Pleurophorella*, while if the latter is, as I feel little doubt, related to *Allerisma* the internal structures are distinctly different.

Among the species described as *Allerisma* which probably belong with *Pleurophorella papillosa*, none is nearer than *Allerisma costatum*. I have no specimens of that species with which to make direct comparison, but Meek's description shows the following differences, though the resemblance is so marked that but few can be pointed out. The concentric folds in *Pleurophorella papillosa* are not so strong or so regular, and the lunule is apparently more deeply concave, for Meek only mentions this feature casually in *Allerisma costatum*, while it could not but be the subject of more particular comment if it were anywhere near as deeply indented as in the Texan form. The latter is likewise not so elongate transversely nor does the anterior end project so strongly.

CLAVULITES[a], new genus.

In the Burlingame shale at Howard, Kansas, occurs an interesting little shell whose resemblance to the Dentaliidæ is rather striking, and yet some of whose characters are so peculiar as to warrant its consideration as a genus distinct from any at present referred to the family. But a single species is known.

Clavulites is founded upon a small, curved Dentalioid shell resembling the *Plagioglypta* section rather than *Dentalium* in the strict sense. The surface is marked by fine, flexuous, obliquely transverse liræ, as in *Plagioglypta;* but the character of especial importance is the presence on the concave (dorsal) side of a linear ridge or callosity over which the liræ pass with a strong anterior deflection. It is difficult where, as here, but a single species is known to distinguish between the strictly generic and specific characters, but it is probable that the annulated surface and the dorsal callosity will remain the distinctive generic characters of *Clavulites*.

Genotype.—*Clavulites howardensis*.

CLAVULITES HOWARDENSIS, new species.

Plate XLVII, figs. 4, 5, 6, 7, 8, 9, 10, 11.

Shell small, rapidly tapering, often strongly curved. Cross section circular. Along the dorsal or concave side the shell is thickened into a linear welt or ridge, which varies in prominence in different individuals, but is always present and always dorsal. The callosity is not altogether due to a thickening of the shell, however, because it can sometimes be detected upon internal casts.

This structure was doubtless produced by a lobe of the peristome quite different from anything known in *Dentalium*, and represents differences in organization sufficiently marked to show that *Clavulites* should be considered a distinct genus, and possibly the representative of a distinct family. The surface of *Clavulites howardensis* is crossed by regular, subequal, flexuous, obliquely transverse liræ. Upon the

[a] From *clavulus*, a little nail or tack.

ventral side of the shell these markings appear almost directly transverse, or are slightly bowed, with the convexity toward the smaller end. At the sides they assume a strong forward direction, and are still further flexed in passing over the dorsal callosity. In one or two specimens I have noticed a very slight serial sinuosity, repeated by each lira, as it passed from the ventral side of the shell, but I am not sure that this is more than an individual characteristic. The liræ are, moreover, faintly crenulated or serrated, so that the repetition of these minute projections sometimes lends to this specimen or to that the appearance of having fine, indistinct longitudinal lines.

The question might pertinently be raised whether *Clavulites* is a true Scaphopod, and whether it is not, like several other reputed Dentalia, a worm tube or other exuviæ. As the shelly matter of these specimens has been replaced by pyrite, they are unfavorable for sectioning to determine by means of the microscope their minute structure. This class of evidence can not, therefore, be considered. Some of the Serpulidæ grow singly, as is well known, and have one or more longitudinal ribs similar to *Clavulites*, but the uniformity of size, shape, and curvature in *Clavulites*, and the unvaried location of the callosity upon the dorsal side, is strong evidence against any affinity with the worms. Professor Pilsbry, whose opinion has been consulted regarding *Clavulites*, has suggested as a possibility that this genus may be related to *Hyolithes* or to the Conulariidæ. These suggestions are worthy of consideration, but against this relationship may be urged the facts that *Hyolithes* is rarely circular in section and *Conularia* never curved. *Clavulites* presents more characters comparable with the recently described genus *Enchostoma* than with *Conularia* itself. Both the genera last mentioned are characterized by their bright, glossy, phosphatic shells, which strongly resist solution, and probably, also, replacement. The fact that my specimens of *Clavulites* are pyritized, therefore, may be considered as negative evidence in estimating the possibility of an affinity of that genus with either *Enchostoma* or *Conularia*. Could all three genera be secured from the same bed, where they had been subjected to the same conditions, evidence of this nature would be more conclusive than that furnished by existing conditions.

From all the facts available, however, it appears much more probable that *Clavulites* is allied to *Dentalium* than that it should be associated with any of the other genera discussed.

A singular circumstance which almost invariably attends the preservation of the specimens examined is that the larger end is embedded in a pyritiferous concretion. This condition is shown in several of the specimens figured.

Cat. No. 35134, U.S.N.M.

Locality and horizon.—Pennsylvanian (Burlingame shale), Howard, Kansas.

SCHUCHERTELLA,[a] new name.

This term is proposed for shells having the type of structure for which the name *Orthothetes* is at present in use. That generic name, which there is no authority for spelling otherwise than *Orthotetes*, was introduced by Fischer-de-Waldheim early in the last century, but the term was not generally taken up and was but little used, save on several occasions by its author, until Waagen revived it in 1884. That author, changing for some reason the spelling to *Orthothetes*, subsumed under the name, as is well known, a group of Streptorhynchoid shells which was without a septum or extended dental plates in the ventral valve, and in which the socket walls were not produced so as partially to surround the muscle scars in the dorsal. A careful study of Fischer-de-Waldheim's early descriptions and figures must convince anyone that the type of structure with which the name *Orthotetes* must be associated is that for which Waagen introduced the name *Derbya*. Thus *Derbya* becomes a synonym for *Orthotetes*, and the latter name becomes dissociated from the structural type for which it is now in use and transferred to a different but related one. For the shells now left without a generic name by the removal of *Orthotetes*, the term *Schuchertella* is proposed. As here used this name is primarily employed for a group of shells which attains its climactic development in late Devonian and early Mississippian time. The genotype selected is *Streptorhynchus lens* White, from the Louisiana limestone, a form which is abundant and well preserved, and of which excellent figures, both of external and internal features, have been published by Hall and Clarke.[b] In a report now under preparation, on the Guadalupian fauna, this subject is discussed in detail in connection with a full quotation of Fischer-de-Waldheim's different descriptions and figures. As it is uncertain when this work will receive publication, owing to the difficulty of securing necessary illustrations, it seemed better to introduce the name *Schuchertella* in the present place, along with a condensed discussion of its standing, rather than to perpetuate for several years an incorrect usage.

Genotype.—*Schuchertella lens*.

[a] This name not only is an expression of friendly regard but commemorates the services of an excellent paleontologist in a group of which he is a master. It is superfluous to say that it is proposed in honor of my friend Mr. Charles Schuchert.

[b] Geol. Surv. N. Y., Pal., VIII, Pt. 1, pl. xia, figs. 16–22.

EXPLANATION OF PLATES.

Plate XLV.

Limipecten texanus, p. 722.

The type specimen in which both valves are retained in position.

Fig. 1. Left valve showing the shape and surface characters.
The squamose concentric lines are perhaps a trifle more numerous and closely arranged than shown by the figure.

2. Right valve. Though imperfect, this valve shows how different the surface characters are from those of the left. By a breaking away of the upper portion the hinge plate and cartilage-pit of the other valve are brought to view.

3. Side view of same showing the unequal convexity of the two valves.

Pleurophorella papillosa, p. 729.

The type specimen, a full-grown individual which has suffered to some extent from erosion.

Fig. 4. View of the anterior end. The degree to which the introverted lunule extends into the cavity of the shell is hardly strongly enough shown, while the sharp angular outline of the lunular area is by no means exaggerated.

5. Side view showing right valve. Probably owing to erosion or breakage the posterior-inferior angle in this specimen is more acutely angular than normal. The diagonal ridge between the main angulation and the hinge is quite indistinct in the specimen, and in the figure is represented as too near the latter; its real position is intermediate.

6. Specimen seen from above. The escutcheon and the intermediate ridges are shown in this view, and the cavity at the anterior end caused by the depressed lunule.

Plate XLVI.

Limipecten texanus var. grandicostatus, p. 723.

A specimen retaining both valves in conjunction.

Fig. 1. Right valve, showing the fine ribs characterizing this valve.

2. Left valve, showing the large loose folds and lamellose concentric lines.

3. Side view, showing relative convexity of the two valves.

Limipecten texanus (?), p. 722.

Fragment of the upper portion of a large massive left valve.

Fig. 4. View of the hinge plate, showing cartilage pit. The broken edge to the left of the figure is just beyond the edge of the cartilage pit, which is therefore represented in its entire dimensions.

Pleurophorella papillosa, p. 729.

A young specimen, somewhat more perfect than the type, and, like it, retaining both valves in place.

Fig. 5. Side view of left valve. This specimen shows the manner in which the angular concentric ridges which mark the rest of the surface become suddenly obsolete at the umbonal ridge.

PLATE XLVII.

Limipecten texanus, p. 722.

A specimen somewhat larger than the type, retaining both valves in conjunction.

Fig. 1. Left valve. The anterior ear is better preserved than in fig. 1 of Plate XLV, and the figure shows how abruptly it is depressed below the rest of the shell. The finer surface ornamentation has been lost by weathering or abrasion.

2. Right valve. The difference in surface ornamentation is well shown.

3. Side view of both valves. The convexity of the left valve has been somewhat exaggerated by fracture, but it is evidently much greater than that of the right. The depression of the anterior ear in this valve (left) and its sharp demarcation from the rest of the shell are clearly represented.

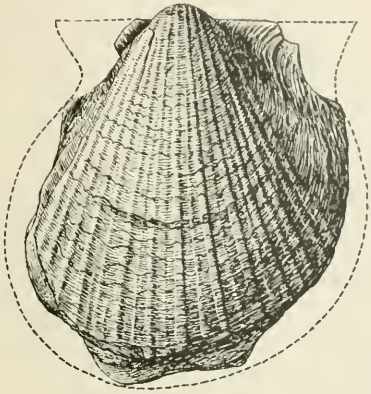
Clavulites howardensis, p. 732.

Fig. 4. Enlargement of an imperfect specimen to show the surface. The ventral side is represented. It did not prove to be practicable to show upon the concentric ridges the crenulations which, by reason of their linear succession, give well preserved surfaces the appearance of being marked by delicate, discontinuous longitudinal lirae.

5. View of the dorsal side of a specimen in which the callosity is strongly marked.

6, 7, 8. Ventral, dorsal, and side views of a strongly curved specimen in which the callosity is faint.

9, 10, 11. Dorsal, ventral, and side views of a more nearly straight specimen in which the callosity is again prominent.



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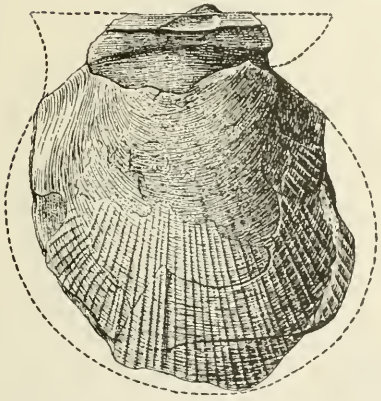

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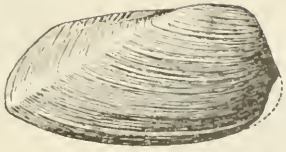

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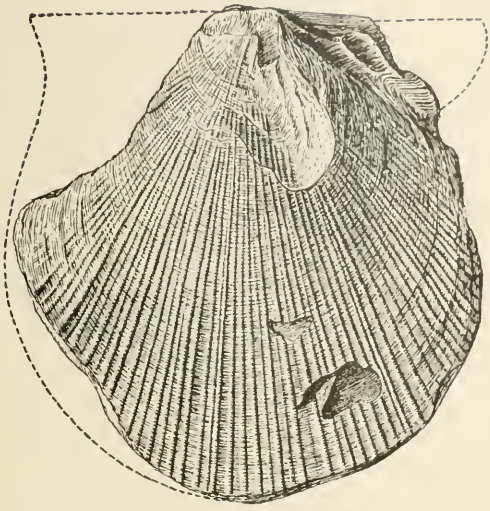
LIMIPECTEN TEXANUS AND PLEUROPHORELLA PAPILLOSA.

FOR EXPLANATION OF PLATE SEE PAGE 735.



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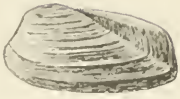

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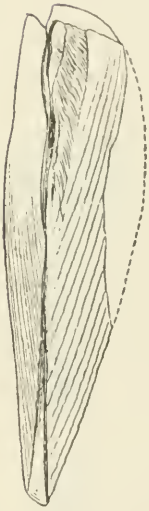

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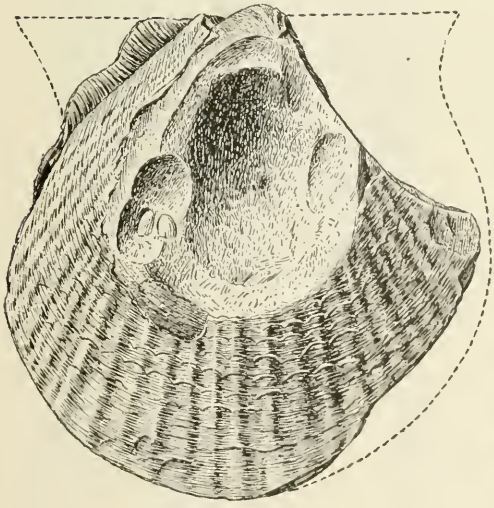

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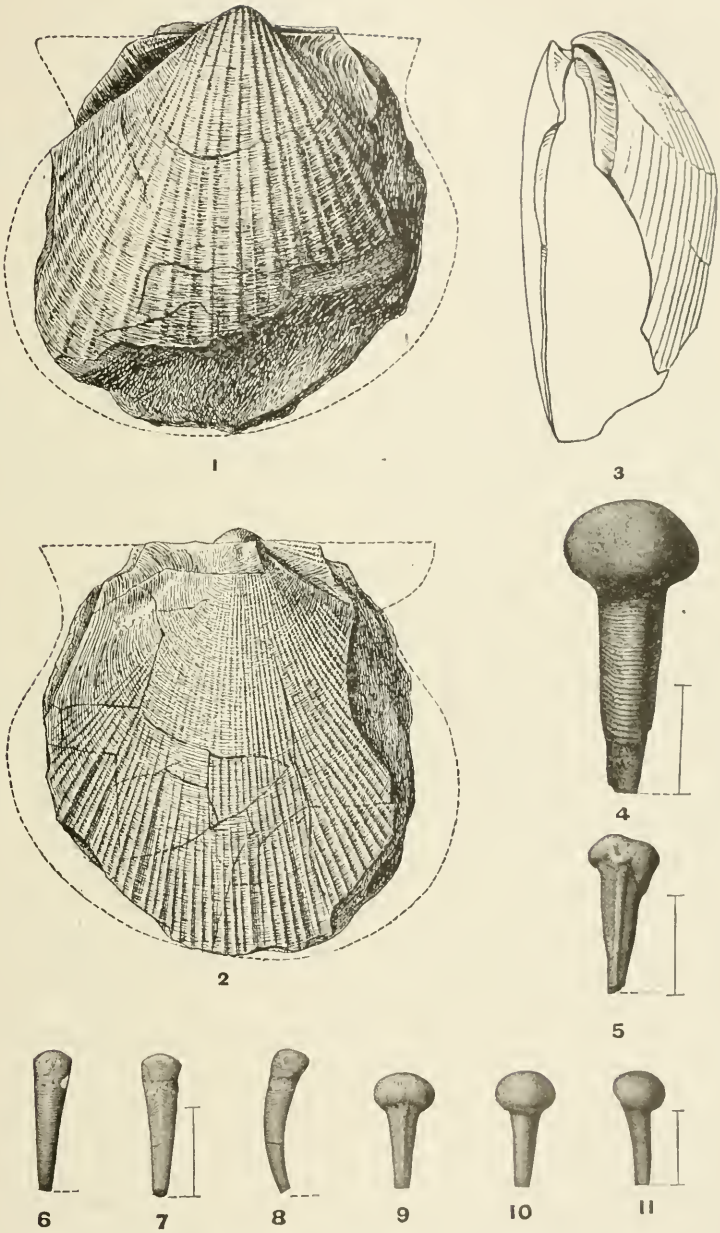
LIMPECTEN TEXANUS AND PLEUROPHORELLA PAPILLOSA.

FOR EXPLANATION OF PLATE SEE PAGE 735.



LIMPECTEN TEXANUS AND CLAVULITES HOWARDENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 736.

DESCRIPTION OF TWO NEW BIRDS FROM SOMALI LAND.

By Harry C. Oberholser,

Assistant Ornithologist, Department of Agriculture.

The two birds described below were included with a collection of African birds some time since presented to the United States National Museum by Dr. A. Donaldson Smith. Their apparent distinctness from hitherto recognized forms was recently detected, and they are accordingly herewith brought properly to the notice of ornithologists.

MEROPS SUPERCILIOSUS DONALDSONI,[a] new subspecies.

Chars. subsp.—Resembling *Merops superciliosus superciliosus*, but upper parts paler, the contrast between the color of the head and that of the back less pronounced; brown of head more golden; green of remaining upper suface more yellowish; lower parts lighter, more yellowish green, usually with less wash of bluish.

Description.—Type, adult male, No. 177908, U.S.N.M.; Bar Madu, Ganana River, Somali Land, February 19, 1895; Dr. A. Donaldson Smith. Pileum golden olive brown with a wash of greenish, shading imperceptibly into the yellowish green of the remainder of the upper surface—all with a pronounced satiny luster; tail like the back, though rather duller, the feathers, excepting the middle pair, margined on their outer webs with dusky; wings of the same uniform yellowish green, save for dark brown tips to nearly all the quills, fuscous edgings on the distal portions of the inner vanes, a bluish wash on the innermost secondaries (tertials), and a broad area of ochraceous on the basal part of the interior webs of both primaries and secondaries; narrow frontal line greenish white; superciliary stripe pale green, somewhat mixed with whitish and bluish; lores, subocular region, and broad postocular stripe brownish black, slightly washed with green; chin white, suffused with olive buff; broad malar stripe white, washed anteriorly with olive buff, posteriorly with bluish;

[a] Named for the collector and donor, Dr. A. Donaldson Smith, of Philadelphia, Pa.

upper throat reddish hazel; rest of lower surface light yellowish green, with a satiny luster, darker and shaded with olive across the jugulum, slightly bluish on center of abdomen, least yellowish on crissum; lining of wing ochraceous; "iris red."

The type and another specimen from the same locality measure in millimeters as follows:

Sex.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe.
Male (type)	135	137	44	12	13
Male	136	143	42	12	13

Compared with numerous specimens of *Merops superciliosus* from Madagascar this new form is very different, but the probality is strong that these extremes are connected by intermediates on the continent, and a trinomial is therefore employed for *donaldsoni*. Its chief distinction lies in its pale coloration, a feature that seems to be characteristic of many Somali Land forms. The original description of *Merops superciliosus*[a] was based on the bird from Madagascar, and the *Merops vaillanti* of Bonaparte[b] came from the same region. The only remaining synonym, *Merops ruficapillus* Vieillot,[c] was founded on Levaillant and was supposedly from Africa; but, judging from the description, it is undoubtedly the same as true *Merops superciliosus* from Madagascar. The Somali Land race seems, therefore, up to the present, to have been unprovided with a name.

POLIHIERAX SEMITORQUATUS HOMOPTERUS, new subspecies.

Chars. subsp.—Similar to *Polihierax semitorquatus semitorquatus*, but upper surface paler, the lower parts more purely white.

Description.—Type, adult male, No. 177898, U.S.N.M.; Goulf (Laga), western Somali Land, Africa, November 29, 1894; Dr. A. Donaldson Smith. Above slate gray, the extreme forehead, a narrow cervical collar, and the upper tail-coverts white; tail brownish black, with broad broken bars of white, which are reduced to spots on the middle rectrices; wings sepia brown, all the coverts plain slate gray, the quills with incomplete white bars (which are more or less fused on the secondaries) on their inner webs, and corresponding spots on their outer vanes, the secondaries with white tips; sides of neck slate gray like the upper surface; sides of head and entire ventral surface, including the lining of the wings, white. "Iris brown; bill gray; legs light red; bare eyelid vermilion." Length of wing, 117; tail, 71; exposed culmen without cere, 10; tarsus, 29; middle toe, 19 mm.

[a] Linnæus, Syst. Nat., 12th ed., I, 1766, p. 183.
[b] Consp. Avium, I, 1850, p. 161.
[c] Nouv. Dict. d'Hist. Nat., XIV, 1817, p. 23.

The adult female of this new form bears out the characters exhibited by the male. As will be noticed by reference to the measurements, there is apparently no difference in size between true *P. semitorquatus* and *P. semitorquatus homopterus*. The latter is evidently a pale desert race, probably confined chiefly if not wholly to Somali Land. The type of *Polihierax semitorquatus*[a] came from near old Latakoo, South Africa, and birds from the region of Mount Kilimanjaro seem to be the same. While no specimens have been examined from nearer the type locality of Heuglin's *Hypotriorchis castanonotus*,[b] which is Gondokoro, on the White Nile, between 4° and 6° north latitude, it is reasonably certain that this name belongs as a synonym under *Polihierax semitorquatus semitorquatus*.

[a] *Falco simitorquata* (err. typ.) Smith, Rep. Exped. Explor. Cent. Afr., 1836, p. 44.
[b] Ibis, 1860, p. 407.

TWO NEW FERNS OF THE GENUS POLYPODIUM, FROM JAMAICA.

By William R. Maxon,
Aid in Cryptogamic Botany, Division of Plants.

The two species of Polypodium here described as new were gathered in the Blue Mountains of Jamaica by Prof. L. M. Underwood and the writer in the spring of 1903. Both were fairly well characterized by Jenman in his synoptical list of the ferns and fern allies of Jamaica, but were, however, associated wrongly by him, in the one case with an extralimital species, in the other with South American plants doubtfully the same and, at any rate, under an untenable name. The writer is indebted to Professor Underwood for the privilege of examining the material of the Jenman herbarium now preserved in the collections of the New York Botanical Garden.

Polypodium rigens sp. nov.

Plant 15–28 cm. high, with 10–15 slender rigid fronds: rhizome about 4 mm. thick, elongate, short-creeping or ascending, the grayish inconspicuous chaff noticeably iridescent under a lens, narrow, long-acuminate: stipes 2–4.5 cm. long, rigid, for the most part closely set, dark brownish, thickly covered with long spreading bright-brown hairs: laminæ 13–23.5 cm. long, 1–2 cm. broad, linear or linear-lanceolate, tapering from near the middle to both apex and base, erect but usually arcuate toward the apex, dark-green above, conspicuously lighter on the under surface, coriaceous, opaque, cut to the blackish rachis into 45–60 pairs of alternate approximate pinnæ; pinnæ exactly oblong, regularly rounded at the apices, the largest (near the middle of the lamina) 10 mm. by 3.5 mm., decreasing in size very gradually above to give rise to a terminal cauda, which is crenate and finally entire, decreasing rather more abruptly below, the lowermost pinnæ minute (2 mm.), slightly more distant, more or less subopposite and dilated upon the upper side; the upper two-thirds of the lamina soriferous,

the sori borne midway to the margins (4–6 pairs to each pinna) on the obscure free simple veins, the sporangia mixed with a few bright-brown hairs, similar hairs borne rather abundantly on both sides of the rachis but sparingly along the midveins and sterile veins on the under surface; the sori at length nearly or quite confluent, covering the surface of the pinna from base nearly to apex and against the revolute margins.

Type in the United States National Herbarium, no. 427566; collected from trees on the heavily wooded upper slopes of John Crow Peak, Jamaica, altitude 1,650–1,800 meters, by William R. Maxon, *no. 1346*, April 18, 1903. The type sheet comprises two plants and several detached fronds, all of which are perfectly characteristic of the species as represented by the following specimens, all from Jamaica:

Highest slopes of John Crow Peak, altitude 1,650–1,800 meters, *Underwood nos. 806, 2456, 2456a; Maxon no. 1294.*

Base of John Crow Peak, altitude 1,500–1,650 meters, *Underwood no. 2387; Maxon no. 1260.*

New Haven Gap, altitude 1,650 meters, *Underwood nos. 973, 1083, 1084; Clute no. 111.*

Morces Gap, altitude 1,500 meters, *Underwood nos. 509, 643; W. Harris no. 7127.*

Blue Mountain Peak, *W. Harris, no. 7487.*

Cinchona, altitude 1,500 meters, *Underwood no. 2626.*

Specimens of this plant were referred by Jenman[a] to *Polypodium rigescens* Bory[b] described from the island of Bourbon. From that species, however, *P. rigens* differs markedly in several characters upon which Willdenow laid stress in his original description of the latter species, and which were further brought out by Hooker and Greville upon the occasion of their figuring an authentic specimen.[c] It is distinguished by the hispid-pilose covering of its vascular parts (*P. rigescens* is described and figured as glabrous throughout), by its greater size and relatively greater breadth, and by the oblong rather than ovate-oblong shape of the pinnæ. In these differences the Jamaican plants are perfectly constant.

The species is apparently not rare in Jamaica. Jenman's remarks upon its habitat and distribution are of interest: "Frequent on the branches of trees above 5,000 feet altitude; among the most rigid of all this miscellaneous group of species; uniformly found growing on the branches of trees of the high ridges to which the distribution is confined, not on the trunks as most of the other similar species do."

[a] Bull. Bot. Dept. Jamaica **4**:117. 1897.

[b] *Polypodium rigescens* Bory; Willdenow, Sp. Pl. **5**:183. 1810.

[c] Hooker and Greville, Icon. Fil. **2**: *pl. 216*. 1831.

Polypodium aromaticum sp. nov.

Plant rigid, 15–20 cm. high: rhizome stout, suberect, considerably elongate, with abundant dark-brown lanceolate attenuate chaff, and bearing numerous closely set fronds imbricated much after the manner of *Elaphoglossum huacsaro:* stipes averaging 3 cm. long, dull-brownish, hispid by scattering short spinescent hairs which from their fragility early impart a tuberculate appearance: laminæ pinnate, about 13–17 cm. long, at most 4 cm. broad, erect, coriaceous, opaque, narrowly oblanceolate, giving rise rather abruptly to a terminal caudate segment 2–3 cm. long, which is subentire except at the coarsely serrate base; rachis hispid on both surfaces throughout similarly to the stipe; pinnæ about 35 pairs, distinctly alternate, linear, strongly revolute, 2–2.5 mm. broad, nearly or quite their width apart, entire, falcate, fully adnate to the blackish rachis, dilated at the upper side, the apices acute; the lower pinnæ gradually reduced, the lowermost not minute, 5–7 mm. long, extremely brittle; venation free, the distinctly black midveins bearing 8–13 pairs of obscure simple oblique veins which approach the margin; sori 6–12 pairs to the pinna, borne at half the distance to the margin.

Type in the herbarium of the New York Botanical Garden; collected on Blue Mountain Peak, Jamaica, at an altitude of 1950–2225 meters by L. M. Underwood, *no. 1449*, February 11–12, 1903. There is a fragment of the type specimen in the U. S. National Herbarium, no. 428420. Other specimens to be referred to this species are: *Underwood no. 1469* and *Underwood no. 2490*, both from the summit of Blue Mountain Peak, and *Maxon no. 1346a* from the highest slopes of John Crow Peak, altitude 1650–1800 meters. There is additionally a single sheet in the Jenman herbarium.

Jamaican specimens of this species were referred by Jenman[a] to *Polypodium firmum* Klotzsch,[b] founded upon material from Chile and Guiana. They accord only indifferently with Klotzsch's description; and in any event the earlier *Polypodium firmum* of Kaulfuss,[c] applied to a very different plant from Australia, precludes use of the name.

There is a specimen in the U. S. National Herbarium, no. 200650, collected at Songo, Bolivia, November, 1890, by Miguel Bang, no. 901 (distributed as *P. plumula*), which is identical with the Jamaican plants here described as *P. aromaticum;* and it has, moreover, after a lapse of more than ten years the peculiar aromatic odor noted in these. It may indicate a general distribution of *P. aromaticum* in South America; but whether or not it represents the *P. firmum* of Klotzsch

[a] Bull. Bot. Dept. Jamaica 4: 123. 1897.

[b] *Polypodium firmum* Klotzsch, Linnæa 27: 378. 1847.

[c] Kaulfuss, Wesen der Farrenkr. 100. 1827.

is difficult to say. The name *Polypodium aromaticum* is founded upon Jamaican specimens and is not intended as a substitute for *P. firmum* Klotzsch. If the plants described by Klotzsch under the latter name shall prove distinct from *P. aromaticum*, they must necessarily receive a new name.

Polypodium aromaticum may be distinguished easily from *P. rigens* by its broader laminæ, by its fewer pinnæ (these linear and acute-pointed), by the absence of bristly hairs among the sporangia, and in recent specimens at least by the remarkable spicy odor of the fronds. The type specimen bears about 20 fronds. According to Jenman the species is "infrequent on the branches of trees above reach from the ground at 6,000–7,000 feet altitude in forests."

TINEID MOTHS FROM BRITISH COLUMBIA, WITH DESCRIPTIONS OF NEW SPECIES.

By August Busck,
U. S. Department of Agriculture.

The present paper is based mainly on a large collection made in British Columbia during 1903 by Dr. Harrison G. Dyar, assisted by Messrs. A. N. Caudell and R. P. Currie. It has been found expedient to include descriptions of such other material as is contained in U. S. National Museum from the Northwest, especially the collections received at various times from Prof. T. Kincaid, Seattle, Washington, and from Prof. A. B. Cordley, Corvallis, Oregon; also a large collection from Washington and Idaho recently received from Mr. C. V. Piper, as well as several smaller contributions from different sources.

In addition to these, I have examined the collections of Mr. J. W. Cockle, Kaslo, British Columbia, and of Prof. O. B. Johnson, Seattle, Washington, with permission to retain new forms, and also a smaller collection from Mr. Theodore Bryant, Wellington, British Columbia.

With the exception of the comparatively few species collected by Lord Walsingham in northern California and Oregon in 1872 and described by him in the Proceedings of the Zoological Society of London in 1880 and 1881, very little is known of the Tineina from that region, and as was to be expected many new forms were found, which I hope may be recognized from the following descriptions.

I regret that other duties prevent me at present from doing full justice to the collections; so that I have been obliged to postpone the study of very many of the more obscure forms contained in Doctor Dyar's material.

Family YPONOMEUTIDÆ.

ALLONONYMA, new name. (ORCHEMIA Fernald.)

As pointed out by Lord Walsingham,[a] the name *Orchemia* Guenée can not be employed for the genus represented by *diana* Hübner and justly separated from *Hemerophila* Hübner (*Simathis* Leach) by

[a] Ent. Mo. Mag., XIV, 1903, p. 258.

Prof. C. H. Fernald.[a] Lord Walsingham did not supply another term for this genus, which is in consequence at present without a name; an applicable name may lie dormant, which eventually can be resurrected, but I fail to find any which can be used in the literature at my command, and the genus may therefore, provisionally at least, be known under the name *Allononyma*.

ALLONONYMA DIANA, var. BETULIPERDA Dyar.

Orchemia diana, var. betuliperda Dyar, Proc. U. S. Nat. Mus., XXV, 1902, p. 403; List N. A. Lepidoptera No. 5537*a*, 1902.

One specimen, bred August 4, from alder, Kaslo, British Columbia, which can not be distinguished from the type series bred from *Betula* by Doctor Dyar in Colorado.

HEMEROPHILA Hübner.

HEMEROPHILA ALPINELLA, new species.

Labial palpi whitish ochreous, tip of both joints darker, brown. Tongue well developed, whitish. Antennæ dark brown with silvery white annulations. Face whitish; head and thorax golden olive brown, dotted with white. Forewings golden or bronzy olive brown, irregularly sprinkled with white scales; at basal third is a transverse band of brown without the white sprinkling and at apical third is another similar brown fascia outwardly angulated in the middle and followed by a nearly pure white narrow edge, which is strongly emphasized at the costal margin as a pure white dash. This white transverse angulated line is faintly continued across the hindwings.

The apical part of the forewings is more strongly bronzy metallic than the rest of the wing, the extreme apex and apical part of the costal edge especially so. Hindwings dark fuscous with strong golden reflexion, especially in the apical part outside the above-mentioned narrow white transverse line. Under side of all wings light golden ochreous with the costal white dash at apical third of the forewings plainly indicated. Legs whitish, sprinkled with golden brown; tip of last tarsal joint on posterior legs black; posterior tibiæ not, as is usual in the family, entirely smooth, but with a few longer stiff hairs on upper side of anterior half. Expanse, 14 mm.

Type.—Cat. No. 7808 U. S. National Museum.

Habitat.—Bear Lake Mountain, British Columbia, July 21 (Caudell and Currie), Kaslo, British Columbia (Cockle).

One of the type specimens of which I made a slide of the wings on the right side exhibits a rather unusual aberration in the venation, the hindwing having 7 veins emitted from the cell; besides the usual 8 veins normally found in the hindwing, there is one developed

[a] Can. Ent., XXXII, 1900, p. 237.

between veins 6 and 7, coming out from the cell close below 7; this vein is in every respect as distinct and perfect, tubular as the other veins. The left wings of the same specimen and those of the other specimens examined have normal venation.

Only once before have I come across a similar irregularity in the venation of micros among the more than two thousand wings of which I have made a denuded slidemount. That is in one of Chambers's own specimens of *Euplocamus fuscofasciella*, in which the left forewing has 13 distinct tubular veins. These two cases must be regarded as monstrosities. The venation in the microlepidoptera is generally remarkably constant within the species with a few striking exceptions as in some species of *Monopis*, which exhibit considerable variation within the species, and sometimes in the same specimen.

Another species unstable in venation is *Semioscopis steinkellneriana* Schiffermüller, which according to Meyrick[a] has veins 2 and 3 in forewing stalked. These veins are sometimes stalked, sometimes connate, and sometimes separate. In one European specimen in the U. S. National Museum they are stalked in the one wing and separate in the other.

HEMEROPHILA KINCAIDIELLA, new species.

Antennæ dark fuscous, without any color annulations. Labial palpi dark shining fuscous; base of terminal joint and inner side of both joints whitish. Head and thorax mouse-gray, face slightly lighter. Fore wings dirty bluish white, with dark bluish brown and black markings and with a metallic violet sheen; base of costa blackish; outside of this basal dark patch is a nearly immaculate white costal space, followed a little before the middle of the wing by a brown costal spot, sometimes dissolved into two or three smaller spots and downwardly continued into a broad, outwardly oblique dark brown transverse streak reaching to the fold. At apical third is a large, dark brown, cloudy costal spot, connected more or less distinctly with the dark transverse streak. Just below the first dark costal spot in the middle of the cell is a small, round, prominent black dot, and below this on the fold is a similar black dot. Another of the same color and form is found at the end of the cell. The apical and dorsal part of the wing is irregularly sprinkled with small brown spots. Hind wings, light fuscous; abdomen, yellowish; legs, silvery white. Expanse, 17–20 mm.

Type.—Cat. No. 7809, U. S. National Museum.

Habitat.—Seattle, Washington, March (Kincaid). I have also seen two specimens from Wellington, British Columbia (Bryant).

[a] Handbook British Lepidoptera, 1895, p. 617.

CHOREUTIS Hübner.

CHOREUTIS INFLATELLA Clemens.

Brenthia inflatella Clemens, Proc. Ent. Soc. Phil., II, 1863, p. 5; Tin. N. Am., 1872, p. 209.—Dyar, List N. A. Lepidoptera, No. 5519, 1902.—Busck, Proc. Wash. Ent. Soc., V, 1903, p. 210.

Choreutis inflatella Dyar, Can. Ent., XXXII, 1900, p. 85.—Fernald, Can. Ent., XXXII, 1900, p. 242.—Kearfott, Journ. N. Y. Ent. Soc., IX, 1902, p. 110.

A large series from Pullman, Washington, May (Piper).

CHOREUTIS ONUSTANA Walker.

Simæthis onustana Walker, Cat. Brit. Mus., XXX, 1864, p. 996.—Dyar, List N. A. Lepidoptera, No. 5521, 1902.

Choreutis ohioensis Zeller, Verh. k. k. zool.-bot. Gesell., Wien, XXV, 1875, p. 320.

Choreutis onustana, Riley, Smith's List Lep. Bor. Am., No. 5636, 1891.—Dyar, Can. Ent., XXXII, 1902, p. 385.—Fernald, Can. Ent., XXXII, 1902, p. 242.—Kearfott, Journ. N. Y. Ent. Soc., IX, 1902, p. 112.

Kaslo, British Columbia, June (Dyar and Cockle); Bear Lake Mountain, British Columbia, July (Caudell and Currie); Collins, Idaho, July (Piper).

CHOREUTIS BALSAMORRHIZELLA, new species.

Antennæ black, with silvery white annulations. Second joint of labial palpi golden brown, with well-developed tuft of brown, black, and white hairs; the end of the joint is white, with a deep black annulation just before the tip; terminal joint white, sprinkled with brown and black scales. Face and head covered with blackish scales, the tips of which are golden brown. Thorax golden brown, the patagia with a bluish metallic longitudinal streak. Base of fore wing golden brown, with a costal and a central longitudinal streak, metallic blue. Outside of this basal patch, which extends farther out along the costa than on the dorsal edge, the wing is thickly covered with cream-colored scales, which form a broad oblique whitish fascia; on the middle of the outer irregular edge of this fascia is a small, dark-edged spot of bright metallic scales. The middle portion of the wing is golden greenish, sprinkled with whitish and golden scales, and the end of the wing is again heavily overlaid with cream-colored scales. At the end of the cell is a large, black edged metallic spot, followed by a short transverse oblique orange streak, which again is followed by black and metallic scales. At apical third is an oblique unmottled cream-colored costal streak, preceded by a few metallic scales, and a few such scales are also found on the tip of the wing just before apex. Cilia dark brown.

Hind wings dark gray, the underside with three irregular transverse white bands, of which the outer is shown through on the upper surface of the wing.

Abdomen dark fuscous, each joint tipped with white scales. Legs greenish fuscous, annulated with white. Expanse, 17–18 mm.

Food plant.—*Balsamorrhiza sagittata.*

Habitat.—Pullman, Washington, June.

Type.—Cat. No. 7810, U. S. National Museum.

Described from a large series bred in June by Mr. C. V. Piper.

The species is very close to *Choreutis silphiella* Grote, and may ultimately prove to be merely a variety of that species. In view of the different food plants and locality and of the slight but apparently constant differences in ornamentation, I believe it safer to separate it from that species. In this connection I may offer a dissenting opinion from the recently adopted view that *Chalcela gemmalis* Hulst[a] is a synonym of *Choreutis silphiella* Grote.[b] The descriptions certainly do not read alike, and while they ultimately may be found to apply to varieties of the same species, the assertion of Mr. W. D. Kearfott,[c] who admits that he knows the species merely from description, that the two are "manifestly" synonyms, is not in agreement with the opinion of the two recognized authorities, who had the specimens before them and both declared the Sierra Nevada form an allied but distinct species. Until more ample proof is forthcoming it is safer to admit that we do not know. *Choreutis balsamorrhizella* may be the same as the Sierra Nevada species, though Hulst's description does not agree fully with the specimens before me. More authentic material from the different localities, together with a careful examination of the types, is necessary to settle the matter.

CHOREUTIS PIPERELLA, new species.

Antennæ black with silvery white annulations. Labial palpi ochreous speckled with black and white; tuft black and white; terminal joint, whitish sprinkled with darker scales. Face and head golden orange, speckled with black and white. Thorax and basal fourth of forewings light golden orange; a longitudinal streak on the patagia and a subcostal and a central longitudinal on the base of the wing bluish metallic.

The ground color of the rest of the wing is golden green, heavily overlaid with cream-colored scales. There are three conspicuous velvety black spots with metallic bronzy center, one large one at the end of the cell, a smaller one before it in the cell and one at tornus. Above these spots are several scattered golden metallic scales. Cilia brown.

Hind wings dark fuscous with a single white dash and a whitish submarginal line around the wing. Underside with irregular white

[a] Trans. Am. Ent. Soc., XIII, 1886, p. 148.

[b] Papilio, I, 1881, p. 40.

[c] Journ. N. Y. Ent. Soc., X, 1902, p. 115.

blotches and bands. Underside of body silvery white; upper side of abdomen brown. Legs fuscous with silvery white annulations. Expanse 12–13 mm.

Habitat.—Pullman, Washington, June (Piper).

Type.—Cat. No. 7811, U. S. National Museum.

I take pleasure in naming this beautiful species in honor of the collector. It is nearest to *Choreutis silphiella*, but smaller and easily distinguished by the different wing ornamentation.

CHOREUTIS LEUCOBASIS Fernald.

Choreutis leucobasis FERNALD, Can. Ent., XXXII, 1900 p. 242.—KEARFOTT, Journ. N. Y. Ent. Soc., IX, 1902, p. 124.—DYAR, List N. A. Lep., No. 5529, 1902.

Bred from *Anaphalis margaritacea* by Doctor Dyar, Kaslo, British Columbia (July); also a specimen from Wellington, British Columbia (Bryant).

GLYPHIPTERYX Hübner.

GLYPHIPTERYX IMPIGRITELLA Clemens.

Glyphipteryx impigritella CLEMENS, Proc. Ent. Soc. Phila., II, 1862, p. 9; Tin. N. Am., 1872, p. 214.—DYAR, Can. Ent., XXXII, 1900, p. 84.—FERNALD, Can. Ent., XXXII, 1900, p. 242.—DYAR, List N. A. Lep., No. 5513, 1902.—BUSCK, Proc. Wash. Ent. Soc., V, 1903, p. 211.

One specimen from Kaslo, British Columbia, May (Cockle).

EUCALANTICA, new genus.

Antennæ $\frac{3}{5}$ of forewing, thick, simple. Second joint of labial palpi long, porrected, somewhat thickened above toward apex, with rough scales; terminal joint shorter, deflexed, blunt. Maxilary palpi well developed, folded. Face smooth, head rough. Forewing broad, widening toward tornus, pointed; termen oblique; 12 veins; 7 to termen; 9 and 10 stalked; 1*b* with subobsolete fork at base. Hind wings as broad as forewings, ovate, costa straight; 8 veins, all separate; vein 2 from before middle of cell; 3 from much before end of cell; 4, 5, 6, and 7 equidistant, nearly parallel; posterior tibia smooth.

Type.—*Calantica polita* Walsingham.

While the type of this genus has a certain superficial resemblance to the true genus *Calantica* Zeller, it is in reality not very close to this genus, as supposed by Lord Walsingham,[a] differing both in the oral characters and in the very distinct venation.

EUCALANTICA POLITA Walsingham.

Calantica polita WALSINGHAM, Proc. Zool. Soc. Lond., 1881, p. 302.—DYAR, Can. Ent., XXXII, 1900, p. 38; List N. A. Lep., No. 5493, 1902.

Several specimens from Seattle, Washington, May (Kincaid). Authentic specimens, determined by Lord Walsingham are in the U. S. National Museum.

[a] Proc. Zool. Soc., London, 1881, p. 302.

EUCERATIA Walsingham.

EUCERATIA CASTELLA Walsingham.

Euceratia castella WALSINGHAM, Proc. Zool. Soc. Lond., 1881, p. 311.—DYAR, Can. Ent., XXXII, 1900, p. 37; List N. A. Lep., No. 5485, 1902.

Several specimens from Pullman, Washington, and from Moscow Mountains, Idaho, July (Piper).

CEROSTOMA Latreille.

CEROSTOMA RADIATELLA Donovan.

Phalœna radiatella DONOVAN, Nat. Hist. Brit. Ins., III, 1794, p. 14.
Cerostoma radiatella WALSINGHAM, Proc. Zool. Soc., Lond., 1881, p. 303; Insect Life, I, 1889, p. 287.—DYAR, List N. A. Lep., No. 5500, 1902.—BUSCK, Journ. N. Y. Ent. Soc., XI, 1903, p. 50.
Plateloptera ochrella CHAMBERS, Journ. Cin. Soc. Nat. Hist., II, 1880, p. 181.

Two specimens from Kaslo, British Columbia (Cockle). Doctor Dyar says that there are no oaks in that locality. As oak is the food plant of *radiatella* this would suggest a misidentification, but I am not able to find any differences from certain varieties of the European species. The explanation of the matter probably is that the specimens were not taken in the immediate vicinity of Kaslo. They bear no exact locality label.

TRACHOMA Wallengren.

TRACHOMA FALCIFERELLA Walsingham.

Cerostoma falciferella WALSINGHAM, Proc. Zool. Soc. Lond., 1881, p. 307.
Trachoma falciferella RILEY, Smith, List Lep. Bor. Am., No. 5201, 1891.—DYAR, List N. A. Lep., No. 5491, 1902.—BUSCK, Journ. N. Y. Ent. Soc., XI, 1903, p. 57.

Specimens from Pullman, Washington (Piper), and from Kaslo, British Columbia (Dyar and Cockle).

HARPIPTERYX Hübner.

HARPYPTERYX DENTIFERELLA Walsingham.

Cerostoma dentiferella WALSINGHAM, Proc. Zool. Soc. Lond., 1881, p. 308.
Periclymenobius dentiferella RILEY, Smith, List Lep. Bor. Am., No. 5205, 1891.—DYAR, List N. A. Lep., No. 5489, 1902.
Harpypteryx dentiferella BUSCK, Journ. N. Y. Ent. Soc., XI, 1903, p. 56.

Kaslo, British Columbia, August (Dyar), and Collins, Idaho, July (Piper). These specimens are intermediate between the three forms named by Lord Walsingham *dentiferella*, *canariella*, and *frustrella*, and they exhibit considerable variation. From the material which I have examined it is my opinion that the three names represent merely extreme varieties of the same species. Until the species is bred, and this opinion is confirmed, it will, however, be proper to retain all three names.

PLUTELLA Schrank.

PLUTELLA MACULIPENNIS Curtis.

Cerostoma malculipennis Curtis, Brit. Ent., 1832, pl. ccccxx (expl. p. 2).
Plutella maculipennis Walsingham, Ent. Mo. Mag., XXXIII, 1897, p. 173.—Dyar, List N. A. Lep., No. 5503, 1903.—Busck, Proc. Wash. Ent. Soc., V, 1903, p. 194.
Plutella cruciferarum Zeller, Stett. Ent. Ztg., IV, 1843, p. 281.—Chambers, Bull. U. S. Geol. Surv., IV, 1878, p. 161.—Riley, Smith List Lep. Bor. Am., No. 5187, 1891.
Cerostoma brassicella Fitch, Rep. Nox. Ins. N. Y., I, 1856, p. 170.
Plutella limbipennella Clemens, Proc. Ac. Nat. Sc. Phila., XII, 1860, p. 6.
Plutella mollipedella Clemens, Proc. Ac. Nat. Sc. Phila., XII, 1860, p. 6.
Plutella xylostella Packard, Rep. Inj. Ins. Mass., II, 1872, p. 11.
Cerostoma dubiosella Beutenmüller, Can. Ent., XXI, 1889, p. 27.

Many specimens from Kaslo, British Columbia (Dyar and Cockle), and from Pullman, Washington (Piper).

PLUTELLA PORRECTELLA Linnæus.

Tinea porrectella Linnæus, Syst. Nat., 1758, p. 540.
Plutella vigilaciella Clemens, Proc. Ac. Nat. Sc. Phila., 1860, p. 5; Tin. N. Am., 1872, p. 90.
Plutella porrectella Chambers, Bull. U. S. Geol. Surv., IV, 1878, p. 161.—Walsingham, Proc. Zool. Soc. Lond., 1881, p. 305.—Riley, Smith List Lep. Bor. Am., No. 5188, 1891.—Dyar, List N. A. Lep., 1903, No. 5504.—Busck, Proc. Wash. Ent. Soc., V, 1903, p. 194.

Received from Wellington, British Columbia (Bryant).

PLUTELLA INTERRUPTA Walsingham.

Plutella interrupta Walsingham, Proc. Zool. Soc. Lond., 1881, p. 304.—Dyar, List N. A. Lep. No. 5508, 1902.

Kaslo, British Columbia, June (Cockle). Wellington, British Columbia (Bryant).

PLUTELLA NOTABILIS, new species.

Antennæ black with silvery white annulations. Tuft on second joint of labial palpi black on the outer side, whitish in front; terminal joint white with black tip. Face white; head golden straw colored; thorax white with central black line and black patagia. Fore wings white, strikingly marked with black, as follows: On the fold from base to basal third of the wing is a heavy black streak; another longitudinal black streak in the middle of the cell is attenuated toward base and bends at the end of the cell downward in a sharp angle, reaching the dorsal edge. Following this streak is a nearly circular black spot, and around the apical edge is a series of marginal black spots, four on the costal and seven or eight on the dorsal edge. Cilia white with a

basal black line. Hind wings light fuscous. Venation typical. Abdomen light fuscous. Legs white sprinkled with fuscous. Expanse, 19 mm.

Habitat.—Mount Rainier, Washington, 10,000 feet alt., August (Piper).

Type.—Cat. No. 7812, U. S. National Museum.

A very striking species, unlike any described American *Plutella*.

PLUTELLA POULELLA, new species.

Antennæ light fuscous. Labial palpi dark brown exteriorly, ochreous white on the inner side; tuft not large. Face whitish in the middle, brown along the sides. Top of head with loose, erect scales, whitish. Thorax and forewings light ochreous fuscous; costal edge and apical part with strong, golden reflexions; below the fold the wing is whitish fuscous, lighter than above. Along the fold from the base of the wing is a dark brown, irregular streak with two short, pointed projections into the light colored field below. The entire wing is sparsely sprinkled with dark fuscous scales which form small and ill-defined dark spots on the outer costal edge and at apex. Hindwings whitish fuscous, nearly transparent and with a bluish tinge. Abdomen ochreous fuscous. Genitalia light ochreous. Legs ochreous, mottled with brown on the outer surfaces. Venation typical. Alar expanse, 24 mm.

Habitat.—Kaslo, British Columbia (Cockle).

Type.—Cat. No. 7883, U. S. National Museum.

Very similar in ornamentation to *P. maculipennis* Curtis, but nearly twice as large.

ZELLERIA Stainton.

ZELLERIA GRACILARIELLA, new species.

Both joints of labial palpi whitish, strongly mottled with black on the outer side. Antennæ light gray with narrow black annulations. Face reddish brown; tuft on head dirty yellow. Thorax and forewings brown, with strong violet reflexions; the fold more ochreous. Sparsely and irregularly scattered over the wing are dark metallic blue scales, which congregate to form a faint and much interrupted longitudinal streak under and parallel with the fold. Cilia bluish cinerous. Hind wings dark, shining bluish fuscous. Cilia strongly bluish. Abdomen above and the inner side of the legs silvery fuscous; underside of abdomen and the exposed parts of the legs reddish. Expanse, 18 mm.

Habitat.—Kaslo, British Columbia.

Foodplant: *Ribes lacustre* (Dyar).

Type.—Cat. No. 7813, U. S. National Museum.

The coloration of this species is strikingly similar to that of *Gracilaria elongella* Linnæus, var. *alnicolella* Chambers.[a] The fore wings of this and the following species have veins 6 and 7 stalked, one branch going to each side of apex; in those European species of *Zelleria*, which I have been able to examine, these two veins are separate though approximate at base; such is also the case with an American species[b] on *Celastrus*, which I have determined for Mr. William Kearfott; but as all the other characters are typical I do not think this difference of generic value. Meyrick places this genus and *Argyresthia* in the Tineidæ, but in spite of the tufted head they seem to me more nearly related to the *Yponomeutidæ*, as placed by Staudinger and Rebel.[c] The old family, *Argyresthiidæ*, should probably be adopted.

ZELLERIA RIBESELLA, new species.

Labial palpi yellow, strongly mottled with black especially on the outer and under surface. Antennæ blackish. Face whitish. Tuft on head light greenish yellow. Thorax and fore wings light greenish yellow with sparse black scales irregularly scattered over the wing and congregating more densely into a longitudinal interrupted streak, under and parallel with the fold and into another longitudinal streak before apex; basal half of costal edge is also black. The black is really the ground color of the wing, but it is so closely overlaid with the light scales as to make the wing decidedly light colored. Cilia dark fuscous. Hind wings dark fuscous. Abdomen blackish, sprinkled on the underside with yellow. Legs dark fuscous, sprinkled on the outer surfaces with yellow.

Alar expanse: 19 mm.

Habitat.—Kaslo, British Columbia.

Foodplant: *Ribes lacustre.*

Type.—Cat. No. 7814, U. S. National Museum.

Bred by Doctor Dyar at the same time and from the same foodplant as the foregoing species without differences in larvæ being noted. This would suggest that this species might be only a variety of the foregoing and such may ultimately be proven, but in the absence of actual observation, the very different coloration does not permit such assumption.

This species has a noteworthy superficial resemblance to *Gracilaria elongella* Linnæus, var. *shastaella* Beutenmüller.[d]

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[a] See p. 770.

[b] Since described as *Zelleria celastrusella* Kearfott. (Journ. N. Y. Ent. Soc., XI, 1903, p. 150.)

[c] Cat. Lep. Eur., II, 1901, p. 134.

[d] See p. 771.

ARGYRESTHIA Hübner.

ARGYRESTHIA GŒDARTELLA Linnæus.

Large series from Wellington, British Columbia, September (Dyar), and from Cornwall, Idaho, August (Piper).

ARGYRESTHIA PYGMÆELLA Hübner.

Many specimens from Kaslo, August (Dyar and Cockle), and from Bear Lake Mountain, British Columbia, July (Caudell and Currie); also specimens from Seattle, Washington, bred by Professor Kincaid from willow. This is the first record of the breeding of the species in this country, and it verifies the determination of this European species, the food plant of which has long been known in Europe.

Family GELECHIIDÆ.

ARISTOTELIA Hübner.

ARISTOTELIA ROSEOSUFFUSELLA Clemens.

Gelechia roseosuffusella Clemens, Proc. Acad. Nat. Sci. Phila., XII, 1860, pp. 162, 434; Proc. Ent. Soc. Phila., II, 1863, p. 121; III, 1864, p. 508; Tin. N. Am., 1872, pp. 40, 113, 225, 262.—Chambers, Can. Ent., IV, 1872, pp. 69, 148, 169, 193; Bull. U. S. Geol. Surv., III, 1877, pp. 125, 141; Can. Ent., IX, 1877, p. 14; Bull. U. S. Geol. Surv., IV, 1878, pp. 110, 146; Journ. Cinn. Soc. Nat. Hist., II, 1880, p. 183.—Murtfeldt, Can. Ent., VI, 1874, p. 222; Bull. U. S. Dept. Agr., Div. Ent., 1891, pp. 23, 53.—Riley, Smith's List Lep. Bor. Am., No. 5470, 1891.

Gelechia rosasuffusella Chambers, Cinn. Quart. Jour. Sci., II, 1875, p. 290.

Gelechia (Ergatis) roseosuffusella Zeller, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1872, p. 272.—Walsingham, Trans. Am. Ent. Soc., X, 1882, p. 180.

Gelechia bellela Walker, Cat. Lep. Ins. Brit. Mus., XXIX, 1864, p. 595.

Aristotelia roseosuffusella Walsingham, Proc. Zool. Soc. Lond., 1897, p. 66.—Dietz, Smith's List N. Jers. Ins., 1900, p. 470.—Busck, Proc. U. S. Nat. Mus., XXIII, 1900, p. 226; Dyar's List N. A. Lep., No. 5575, 1902; Proc. U. S. Nat. Mus., XXV, 1903, p. 796; Proc. Wash. Ent. Soc., V, 1903, p. 199.

Several specimens from Kaslo, British Columbia, July (Dyar).

ARISTOTELIA FUNGIVORELLA Clemens.

Gelechia fungivorella Clemens, Proc. Ent. Soc. Phila., III, 1864, p. 507; N. Am. Tin., 1872, p. 261.—Walsh, Proc. Ent. Soc. Phila., VI, 1866, p. 273.—Packard, Guide, 1870, p. 350.—Chambers, Bull. U. S. Geol. Surv., IV, 1878, pp. 112, 143.—Riley, Smith's List Lep. Bor. Am., 1891, No. 5367.

Aristotelia fungivorella Busck, Dyar's List N. A. Lep., No. 5579, 1903; Proc. U. S. Nat. Mus., XXV, 1903, pp. 798, 933; Proc. Wash. Ent. Soc., V, 1903, p. 219.

Several specimens from Kaslo, British Columbia, August (Dyar and Cockle), and from Pullman, Washington, August (Piper).

ARISTOTELIA RUBIDELLA Clemens.

Gelechia rubidella Clemens, Proc. Acad. Nat. Sci. Phila., XII, 1860, pp. 163, 434; Proc. Ent. Soc. Phila., II, 1863, p. 121; Tin. N. Am., 1872, pp. 40, 115, 225.—Chambers, Bull. U. S. Geol. Surv., IV, 1878, p. 147.—Riley, Smith's List Lep. Bor. Am., No. 5471, 1891.

Gelechia rubensella Chambers, Can. Ent., IV, 1872, p. 193; Bull. U. S. Geol. Surv., IV, 1878, pp. 89, 147.—Murtfeldt, Can. Ent., VI, 1874, p. 222; Bull. U. S. Dept. Agr., Div. Ent., No. 23, 1891, p. 54.

Gelechia pudibundella Chambers, Can. Ent., IX, 1877, p. 23.

Gelechia (*Ergatis*) *rubidella* Walsingham, Trans. Am. Ent. Soc., X, 1882, p. 180.

Eucatoptus rubidella Walsingham, Proc. Zool. Soc. Lond., 1897, p. 70.

Aristotelia rubidella Dietz, Smith's List N. Jers., 1900, p. 475.—Busck, Dyar's List N. A. Lep., No. 5578, 1903; Proc. U. S. Nat. Mus., XXV, 1903, p. 798; Proc. Wash. Ent. Soc., V, 1903, p. 199.

Many specimens from Kaslo, British Columbia, July (Dyar and Cockle).

ARISTOTELIA NATALELLA, new species.

Antennæ light ocherous, with dark brown annulations. Labial palpi light yellow; terminal joint not more than half as long as the second joint, pointed. Face, head, and thorax light yellow; patagia darker. Fore wings rich saffron yellow, lightest at base, gradually deeper saffron toward apex. At apical third is a hardly perceptible light ocherous costal streak, and similar light, inconspicuous dashes are found along the costal and dorsal edge on the apical third of the wing. Around the extreme apical edge is a prominent narrow black line before the cilia. Cilia yellowish. Hind wings dark fuscous. Legs yellow; tarsi slightly shaded with fuscous. Venation typical. Expanse, 15–16 mm.

Habitat.—Kaslo, British Columbia, July (Dyar and Cockle); Seattle, Washington, July (Kincaid).

Type.—Cat. No. 7854, U. S. National Museum.

Described from a large series; quite close to the following species and to *Aristotelia gilvolineella* Clemens, but the color is much deeper than in any of these species, and *A. natalella* is at once distinguished from both these species by the total absence of dark discal spots.

ARISTOTELIA HARRISONELLA, new species.

Antennæ yellowish fuscous, with indistinct darker annulations. Second joint of labial palpi ocherous, mottled with black; terminal joint very light yellow, nearly white, with the extreme tip dark. Face whitish. Head and thorax light yellowish. Fore wings dirty whitish, overlaid with light ocherous. On the middle of the fold is a prominent short black streak, and at the end of the cell is a deep black round spot. Around the apical edge is a not very conspicuous dark line

before the cilia. Abdomen and legs ocherous; anterior legs shaded with black. Hind wings light yellowish fuscous. Venation typical. Expanse, 16 mm.

Habitat.—Kaslo, British Columbia, July (Dyar and Cockle); Seattle, Washington (Kincaid).

Type.—Cat. No. 7855, U. S. National Museum.

Described from a large series; intermediate between the foregoing species and *Aristotelia disconotella* Chambers, but with more slender and more pointed fore wings than either. Easily distinguished from the foregoing species by the dark spots, and from *A. disconotella* by its much lighter color.

GNORIMOSCHEMA Busck.

GNORIMOSCHEMA GALLÆSOLIDAGINIS Riley.

Gelechia gallæsolidaginis Riley, Mo. Rep. Nox. Ins., I, 1869, p. 173; II, 1870, pp. 20, 132, 134; Smith's List Lep. Bor. Am., No. 5377, 1891.—Chambers, Can. Ent., VIII, 1876, p. 19; IX, 1877, p. 14; Cinn. Quart. Journ. Sci., II, 1875, p. 289; Bull. U. S. Geol. Surv., III, 1877, pp. 128, 141; IV, 1878, pp. 115, 143.—Kellicot, Can. Ent., X, 1878, p. 201.—Dietz, Smith's List Ins. N. Jers., 1900, p. 474.

Gnorimoschema gallæsolidaginis Busck, Proc. U. S. Nat. Mus., XXIII, 1900, p. 227; Dyar's List N. A. Lep. No. 5620, 1902; Proc. U. S. Nat. Mus., XXV, 1903, p. 824.

A bred series from Pullman, Washington, August (Piper).

GNORIMOSCHEMA WASHINGTONIELLA, new species.

Antennæ white, with brown annulations. Labial palpi white, terminal joint mottled with light brown. Face white. Head and thorax light ocherous; thorax with a central white patch. Fore wings ocherous white, finely mottled with black, each scale being slightly tipped with black; at base is an unmottled fawn-colored spot, followed by a nearly pure white narrow oblique line, which is again followed by an obliquely placed large unmottled fawn-colored spot in the middle of the wing, which nearly reaches the costal edge at basal third, and which gradually shades into the ground color toward the costal edge farther out; at apical third is a large triangular ill-defined fawn-colored costal spot, and the tip of the wing is freely suffused with the same color. Cilia white, strongly daubed with black scales. Hind wings light fuscous. Legs whitish, barred on the outside with black; tarsi yellowish. Oral parts and venation typical. Expanse, 19 mm.

Habitat.—Pullman, Washington, August (Piper).

Type.—Cat. No. 7856, U. S. National Museum.

Of the same general pattern as *Gnorimoschema gallæasterella* Kellicott, but much smaller and more slender; easily recognized by its very light coloration.

GNORIMOSCHEMA RADIATELLA, new species.

Antennæ curiously marked; uniformly dark shining fuscous above, reddish white and black checkered below. Second joint of labial palpi reddish white, strongly barred with black on the outside; terminal joint with base and an annulus around the middle black. Face irridescent, reddish white; top of head flecked with reddish fuscous. Thorax reddish fuscous. Fore wings with a nearly continuous, narrow black longitudinal central line from base to apex; costal part of the wing above this line light whitish red, shaded with fuscous; dorsal part below the central black line darker than costal half, reddish, more profusely overlaid with dark fuscous and black scales. At base is an ill-defined, small, unmottled brick-red patch. Cilia and hind-wings light fuscous; abdomen, dark fuscous above, under side ocherons. Legs blackish, mottled with light red and white scales; tarsi black with tip of each joint reddish white. Expanse, 16 mm.

Habitat.—Pullman, Washington, August (Piper).

Type.—Cat. No. 7857, U. S. National Museum.

Nearest in pattern and general appearance to *Gnorimoschema pedmontiella* Chambers, but not really like any described species of that genus. It reminds in coloration of certain varieties of *Cerostoma radiatella* Donovan.

GNORIMOSCHEMA SPLENDORIFERELLA, new species.

Antennæ dark fuscous, faintly annulated with white. Labial palpi light yellow; second joint slightly mottled with red on the outside; terminal joint with a blackish annulation at base and another before the tip. Face light yellow; head darker reddish yellow. Thorax deep bluish black. Forewings shining, intense purplish red; a narrow costal margin and the apical part of the wing mottled with white and bluish black scales; a basal subcostal longitudinal streak, and an ill-defined dorsal and a costal spot at the beginning of the cilia yellow. Cilia white, dotted with black. Abdomen dark fuscous with the ends of the joints silvery white. Legs dark fuscous, barred with white. Expanse, 16 mm.

Habitat.—Pullman, Washington, July (Piper).

Type.—Cat. No. 7858, U. S. National Museum.

This beautiful species can only be compared with the quite closely allied *Gnorimoschema saphirinella* Chambers, which has the same intense red color. The present species, however, is larger, and lacks the black longitudinal streaks found in *saphirinella;* the dark thorax and the lack of brown spots on and near the fold also separate it from this species.

GELECHIA Hübner.

GELECHIA MANDELLA, new species.

Antennæ purplish black checkered with roseate white. Second joint of labial palpi dark purplish brown on the exterior side, whitish on the interior side; brush well developed; terminal joint purplish black. Face white. Head and thorax dark purplish brown. Fore wings dark purplish fuscous sprinkled with black and white scales. There are two indistinct black discal spots, one shortly before and the other at the end of the cell. A very faint, thin, outwardly sharply angulated white fascia crosses the wing at apical third, and there are a few white scales before the apex. In some specimens the fascia is hardly perceptible. The entire edge of the wing, but more especially the apical part, is suffused with light rose-colored scales. Cilia roseate fuscous. Hind wings broader than the fore wings, dark fuscous. Abdomen dark fuscous above; roseate silvery on the under side. Legs dark fuscous, sprinkled with roseate and silvery scales except on the tarsi which are dark. Expanse, 17–18 mm.

Habitat.—Kaslo, British Columbia, August (Dyar).

Type.—Cat. No. 7859, U. S. National Museum.

Nearest to *Gelechia ribesella* Chambers, and much like this species in size, form, and general coloration, with the same roseate tinge on the fore wings, but without the striking white markings of that species.

GELECHIA MEDIOFUSCELLA Clemens.

Gelechia mediofuscella Clemens, Proc. Ent. Soc. Phil., II, 1863, pp. 11, 121; Tin. N. Am., 1872, pp. 218, 224.—Chambers, Bull. U. S. Geol. Surv., IV, 1878, p. 144.—Busck, Dyar's List N. A. Lep., No. 5764, 1902; Proc. U. S. Nat. Mus., XXV, 1903, p. 885.

Gelechia ragella Walker, Cat. Lep. Het. Brit. Mus., XXIX, 1864, p. 596.—Walsingham, Trans. Am. Ent. Soc. Phila., X, 1882, p. 178.—Riley, Smith's List. Lep. Bor. Am., No. 5506, 1891.

Depressaria fuscoochrella Chambers, Can. Ent., IV, 1872, pp. 106, 129, 147, 148.

Gelechia fuscoochrella Chambers, Bull. U. S. Geol. Surv., IV, 1878, p. 143.

Gelechia [*Lita*] *liturosella* Zeller, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 265.—Chambers, Bull. U. S. Geol. Surv., IV, 1878, p. 144.

Specimens from Seattle, Washington (Kincaid).

GELECHIA MONELLA, new species.

Antennæ dark fuscous checkered with white. Tuft on second joint of labial palpi large, projecting, approaching the genus *Ypsolophus* in form; basal half deep black, outer half white; terminal joint blackish. Face and head whitish, mottled with fuscous. Thorax and fore wings light fuscous irregularly mottled with black, white, and gray scales; costal edge somewhat lighter than the rest of the wing. In the center of the wing is a row of three more or less pronounced longitudinal

blackish streaks, one beginning at the base of the wing, the next on the outer part of the cell, and the third at the end of and outside the cell. These dark streaks are, however, not very constant, and in some specimens only the middle one is at all prominent. Around the apical edge is a row of ill-defined dark spots, with the intervals bluish white, and the entire insect has a faint violet or roseate tinge. Fore wings narrow elongate, pointed, termen very oblique. Hind wings somewhat broader than the fore wings, light fuscous. Venation typical. Legs and underside of the body bluish white, strongly overlaid with dark fuscous. Expanse, 18 mm.

Habitat.—Kaslo, British Columbia, August (Dyar).

Type.—Cat. No. 7860, U. S. National Museum.

This species resembles in a general way, and especially in the form of the palpi, *Gelechia anarsiella* Chambers, but the coloration of the palpi and the more varied wing pattern separates it easily from that species; in coloration it comes near *Gelechia dyariella* Busck.

GELECHIA CEANOTHIELLA, new species.

Antennæ dark fuscous. Labial palpi dark blackish brown, the terminal joint and the interior side of the second joint sparsely mottled with yellowish white; underside of brush yellowish. Face yellowish. Head, thorax, and anterior wings dark purplish brown; on the middle of the fold is a small yellow streak, followed by blackish scales; obliquely above this in the cell is a blackish dot partly surrounded by yellow scales and at the end of the cell is another similar spot. At apical third is a small yellow costal streak and around apical edge is a more or less complete series of small yellow dots. Cilia dark fuscous. Hind wings dark fuscous. Abdomen yellowish fuscous above, especially on basal joints; dark fuscous below, on the underside. Legs yellowish, shaded with fuscous. Alar expanse, 19 mm. Foodplant, *Ceanothus.*

Habitat.—Kaslo, British Columbia (Dyar).

Type.—Cat. No. 7873, U. S. National Museum.

Very close to *Gelechia trialbamaculella* Chambers, with the same ground color and wing pattern; the dark labial palpi, however, are an easy mark of distinction.

ANACAMPSIS Curtis.

ANACAMPSIS FRAGARIELLA, new species.

Antennæ light brown, barred with black. Basal part of second joint of labial palpi light brown; apical part whitish; terminal joint much longer than second joint, whitish, with a narrow brown longitudinal line in front from base to tip. Face fawn colored; head and thorax brown. Fore wings light whitish brown, the color somewhat deeper toward the tip than at the base; at apical third is a broad, ill-defined,

darker, mahogany-brown fascia. Cilia brown, hind wings and cilia dark fuscous. Body and legs brown. Generic characters typical. Expanse, 16 mm.

Food plant: Strawberry (*Fragaria*).

Habitat.—Pullman, Washington, July (Piper).

Type.—Cat. No. 7861, U. S. National Museum.

The coloration does not admit the confounding of this species with any described American species; in this it is very close (though lighter brown) to the European species *Anacampsis subsequella* Hübner, the larva of which, however, feeds on *Prunus spinosus* [Heinemann], and from which it is at once distinguished by the total absence of white at the apical third of the fore wing.

ANACAMPSIS NIVEOPULVELLA Chambers.

Gelechia niveopulvella Chambers, Can. Ent., VII, 1875, p. 210; Bull. U. S. Geol. Surv., IV, 1878, p. 145.

Anacampsis niveopulvella Busck, Dyar's List. N. A. Lep., No. 5704, 1902; Proc. U. S. Nat. Mus., XXV, 1903, p. 847.

Three specimens, bred by Doctor Dyar, at Kaslo, British Columbia, from *willow*. Food plant not hitherto known. In my Revision of American Gelechiidæ,[a] I suggested that this species might prove an extreme variety of *Anacampsis innocuella* Zeller, corresponding to similar variations of the European *Anacampsis populella* Clerck. Since then I have seen several additional specimens, all from the Northwest, and the constancy of the marking, together with the knowledge of the different food plants, has convinced me that the species is certainly distinct.

TRICHOTAPHE Clemens.

TRICHOTAPHE SIMPLICIELLA, new species.

Antennæ dark fuscous. Labial palpi light ocherous. Face light ocherous. Head and thorax fuscous; patagia light ocherous. Fore wings divided in two nearly equal longitudinal parts, the costal part light ocherous and the dorsal somewhat larger part, dark fuscous; the dividing line is sharp and nearly straight from base of wing to apex, but the fuscous part is slightly overlaid with ocherous in the apical third, except along termen, where the dark color is rather emphasized before the cilia. At the end of the cell is a very light ocherous round dot. Cilia whitish fuscous. Hind wings light fuscous. Abdomen dark fuscous. Legs yellow, tarsi suffused with black except at the tips of the joints. Oral parts and venation typical of the genus. Expanse, 18 mm.

Habitat.—Pullman, Washington, August (Piper).

Type.—Cat. No. 7863, U. S. National Museum.

[a] Proc. U. S. Nat. Mus., XXV, 1903, p. 847.

Nearest *Trichotaphe serrativitella* Zeller, but larger and not nearly so dark in the dorsal part of the wing; at once distinguished from that species by the light discal spot at the end of the cell, and by the straight—not serrate—dividing line between the dorsal and the costal part.

TRICHOTAPHE LEUCONOTELLA, new species.

Antennæ dark fuscous. Labial palpi lacking in the type before me, but will undoubtedly be found to be ocherous, as in the allied species. Face whitish. Head and thorax dark purplish brown. Fore wings dark purplish brown, nearly black, shining. At the end of the cell is a conspicuous canary yellow, somewhat elongated, spot, and at apical third is a hardly appreciable triangular light-brown costal spot. Cilia dark fuscous. Hind-wings dark fuscous. Venation typical. Expanse, 17 mm.

Habitat.—Pullman, Washington (Piper).

Type.—Cat. No. 7864, U. S. National Museum.

Very close to *Trichotaphe juncidella* Clemens, but hardly as dark, and with the second discal spot pronounced, pure yellow, not ocellate and obscure as in *juncidella*.

I have in former years determined this species for several correspondents as "near or equal" *T. juncidella* Clemens, but have no doubt now that it is a distinct species.

TRICHOTAPHE TRIMACULELLA Chambers.

Gelechia trimaculella Chambers, Can. Ent., III, 1874, p. 238; Bull. U. S. Geol. Surv., IV, 1878, p. 147.

Trichotaphe trimaculella Busck, Dyar's List N. A. Lep., No. 5669, 1902; Proc. U. S. Nat. Mus., XXV, 1903, p. 914.

Specimens from Kaslo, British Columbia (Dyar), and from Pullman, Washington, August (Piper).

GLYPHIDOCERA Walsingham.

GLYPHIDOCERA SEPTENTRIONELLA, new species.

Antennæ yellowish fuscous; in the male not quite as specialized as in the other described species of this genus, the notch being simple, not roundly excavated. Labial palpi normal for the genus, long, recurved, compressed, sharp edged; terminal joint pointed; yellowish fuscous, sparsely sprinkled with black scales. Face and head yellowish. Thorax and fore wings yellowish fuscous, evenly sprinkled with black scales. A very faint blackish round spot on the basal part of the cell; a similar one somewhat more pronounced on the middle of the cell, and a double one at the end of the cell. In flown specimens all of these spots are difficult to detect. Cilia yellowish. Hind wings yellowish fuscous. Venation typical. Abdomen yellowish

fuscous; anal appendages yellow. Male genitalia large, but not so specialized as in *Glyphidocera æquepulvella*, Chambers. Legs yellowish, sprinkled with fuscous. Expanse, 18–19 mm.

Habitat.—Kaslo, British Columbia, July (Dyar).

Type.—Cat. No. 7865, U. S. National Museum.

Very close to *Glyphidocera æquepulvella* Chambers, but fore wings are more slender and more mottled with black. The less specialized male antenna separates it at once. The identical peculiar venation of the two species as well as the same general habitus shows that this difference in antennæ is not of generic value.

Family OECOPHORIDÆ.

DEPRESSARIA Haworth.

DEPRESSARIA UMBRATICOSTELLA Walsingham.

Depressaria umbraticostella Walsingham, Proc. Zool. Soc. Lond., 1881, p. 318.—Busck, Proc. U. S. Nat. Mus., XXIV, 1902, p. 736.—Dyar, List N. A. Lep., No. 5855, 1902.

Specimens from Pullman, Washington, March (Piper).

DEPRESSARIA ARGILLACEA Walsingham.

Depressaria argillacea Walsingham, Proc. Zool. Soc. Lond., 1881, p. 313.—Busck, Proc. U. S. Nat. Mus., XXIV, 1902, p. 738.—Dyar, List N. A. Lep., No. 5860, 1902.

Kaslo, British Columbia (Dyar and Cockle); Revelstoke, British Columbia (Dyar).

DEPRESSARIA KLAMATHIANA Walsingham.

Depressaria klamathiana Walsingham, Proc. Zool. Soc. Lond., 1881, p. 314.—Busck, Proc. U. S. Nat. Mus., XXIV, 1902, p. 740.—Dyar, List N. A. Lep., No. 5868, 1902.

Several specimens from Kaslo, British Columbia (Dyar and Cockle).

DEPRESSARIA ROSACILIELLA, new species.

Depressaria ciliella Walsingham, Proc. Zool. Soc., Lond., 1881, p. 316.—Busck, Proc. U. S. Nat. Mus., XXIV, 1902, p. 739.—Dyar, List N. A. Lep., No. 5863, 1902.

Not *Depressaria ciliella* Stainton, Cat. Brit. Ins. Tin., 1849, p. 17.—Staudinger and Rebel, Cat. Lep. Eur., II, No. 3234, 1901.

Labial palpi red, mottled with black, terminal joint with base and an annulus before the tip black. Antennæ reddish fuscous with narrow black annulations; face whitish; head and thorax ocherous, spotted with red. Ground color of fore wings ocherous; base unmottled, rest of wing heavily suffused with red; three discal spots in one line black with white center, a fourth obliquely above and before the first of these black with a few white scales posteriorly. Black mottling

along the costal edge, and a row of short, black lines around apical edge before the cilia; cilia reddish. Hind wings light fuscous with reddish cilia. Expanse 24 mm.

Type.—Cat. No. 7815, U. S. National Museum.

This is the species collected by Lord Walsingham in Oregon in 1872 and identified by him as the European *Depressaria ciliella* Stainton. One of his original specimens is now before me. With the additional and fresher material on hand it is very plain that it is distinct from the European species, as I had suspected before; *rosaciliella* is more narrow-winged and has a conspicuous row of black lines around the apical edge, wanting in *ciliella*; the red color is also more dull than in the European species, and the discal spots not nearly as white as in that species, the black part predominating. Besides the specimen from Camp Watsia, Oregon, April, 1872, from Lord Walsingham, I have before me specimens from Kaslo, British Columbia (Dyar and Cockle), and from Pullman, Washington (Piper).

DEPRESSARIA NUBIFERELLA Walsingham.

Depressaria nubiferella Walsingham, Proc. Zool. Soc. Lond., 1881, p. 316.—Busck, Proc. U. S. Nat. Mus., XXIV, 1900, p. 745.—Dyar, List N. A. Lep., No. 5881, 1902.

Two specimens from Pullman, Washington, July (Piper).

DEPRESSARIA CANELLA, new species.

Labial palpi white, mottled with light brown. Antennæ uniformly dark fuscous. Face white. Head light brown. Thorax pure white. Fore wings white, with black, brown, and fuscous markings; basal third nearly unmottled, with only a small dark-brown spot at base of costa and a few fuscous scales forming an inconspicuous streak perpendicular on the dorsal edge near the base. This basal white part extends farther out on the dorsal than on the costal edge. The rest of the wing is suffused with darker scales. The darkest region is found on the costal half of the middle part of the wing, next to the white basal area, and from this dark center the wing gradually becomes lighter toward the apex and dorsal edge. In the middle of the cell is a small black spot, and another still smaller is found obliquely above and before it. They are followed exteriorly by a few scattered brown scales. The outer costal edge is spotted with black and brown scales, and around the apical edge is a series of black scales before the cilia; cilia gray. Hind wings light fuscous; cilia whitish. Legs white, strongly mottled with dark fuscous. Expanse, 20 mm.

Habitat.—Pullman, Washington, September (Piper).

Type.—Cat. No. 7817, U. S. National Museum.

This species can not be confounded with any described American species of *Depressaria* and is at once recognized by the pure white

thorax and anterior part of fore wings. It is nearest the European and Siberian *Depressaria alstroemeriana* Clerck, but the dark head, mottled palpi, and shaded apical part of fore wings easily separates it from this species.

DEPRESSARIA PALLIDELLA, new species.

Antennæ dark fuscous. Labial palpi light yellow; second joint externally mottled with black; terminal joint with a narrow annulation near base and one above the middle black. Face light yellow. Head and thorax yellow slightly sprinkled with black. Fore wings light straw yellow, a shade darker at base than toward apex; beyond the unmottled basal patch is a narrow transverse area mottled with black, which is perpendicular on the dorsal edge and does not reach the costal edge. Extreme base of costa black. First discal spot small oblong black; obliquely above and before it is another small black spot; second discal spot at the end of the cell also black and small, though somewhat larger than the first. Between and above these spots is a slightly dark-shaded area. Along the costal and apical edge is a series of short black lines reaching to tornus. Cilia light yellow. Veins 2 and 3 stalked.

Hind wings light yellowish; cilia whitish; along the apical edge is a series of short black lines. Abdomen yellowish fuscous. Legs yellowish. Expanse 19 mm.

Habitat.—Kaslo, British Columbia (Dyar and Cockle).

Type.—Cat. No. 7818, U. S. National Museum.

Nearest to *Depressaria senecionella* Busck, but more narrow winged and much lighter in color.

DEPRESSARIA ALIENELLA, new species.

Depressaria emeritella Walsingham, Proc. Zool. Soc. Lond., 1881, p. 381.—Riley, Smith's List Lep. Bor. Am., No. 5261, 1891.—Busck, Proc. U. S. Nat. Mus., XXIV, 1902, p. 746.—Dyar, List N. A. Lep., No. 5884, 1902.

Not *Depressaria emeritella* Stainton, Staudinger and Rebel, Cat. Lep. Eur., II, No. 3283, 1901.

This is the species determined by Lord Walsingham as the European *Depressaria emeritella*. While revising the American species of *Depressaria*,[a] I expressed in a letter to Lord Walsingham, my suspicion that some of the American species identified by him as European species were in reality distinct, and his lordship kindly sent me one of his original specimens from Rogue River, Oregon. I have now before me additional material, and there is no doubt but that the American form is distinct, though very close to *emeritella* Stainton. It belongs to the same group, with veins 2 and 3 in fore wing separate, but it is smaller, more dull brown, and at once separated from *emeritella* by the

[a] Proc. U. S. Nat. Mus., XXIV, 1902, pp. 731–749.

total absence of the angulated, whitish fascia, found in the European species. Expanse, 18 mm.

Type.—Cat. No. 7816, U. S. National Museum.

The species was taken at Kaslo, British Columbia, by Doctor Dyar.

In this connection I would say that the American species identified by Lord Walsingham as the European *Depressaria applana* Fabricius is not this species, and should be known under the original American name *clemensella* Chambers.

ETHMIA Hübner.

ETHMIA MONTICOLA Walsingham.

Psecadia monticola Walsingham, Proc. Zool. Soc. Lond., 1880, p. 87.
Ethmia monticola Dyar, Journ. N. Y. Ent. Soc., X, 1902, p. 203; List N. A. Lep., No. 5905, 1902.

One perfect specimen of this species, which I have not before known except from description and figure, was collected at Pullman, Washington, by Mr. C. V. Piper.

BORKHAUSENIA Hübner.

BORKHAUSENIA PSEUDOSPRETELLA Stainton.

Oecophora pseudospretella Stainton, Cat. Brit. Ins. Tin., 1849, p. 14.—Walsingham, Ins. Life, I, 1888, p. 149.—Dyar, List N. A. Lep., No. 5926, 1902.
Borkhausenia pseudospretella Busck, Proc. Wash. Ent. Soc., V, 1903, p. 218.

Several specimens from Kaslo, British Columbia, August (Cockle); Victoria, British Columbia, September (Dyar); Seattle, Washington, September (Piper); Chehalis, Washington (Kincaid).

BORKHAUSENIA BORKHAUSENII Zeller.

Oecophora borkhausenii Zeller, Isis, 1839, p. 192; Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 290.—Riley, Smith's List Lep. Bor. Am., No. 5551, 1891.—Dyar, List N. A. Lep., No. 5922, 1902.
Oecophora boreasella, Chambers Can. Ent., V, 1873, p. 189; Cinn. Quart. Journ. Sci., II, 1875, pp. 114, 292; Bull. U. S. Geol. Surv., III, 1877, pp. 129, 141; IV, 1878, p. 159.—Dyar, List N. A. Lep., No. 5921, 1902.
Borkhausenia borkhausenii Busck, Proc. Wash. Ent. Soc., V, 1903, p. 218.

Two specimens from Kaslo, British Columbia, July (Dyar).

BORKHAUSENIA COLORADELLA Walsingham.

Oecophora coloradella Walsingham, Ins. Life, I, 1888, p. 148.—Riley, Smith's List Lep. Bor. Am., No. 5552, 1891.—Dyar, List N. A. Lep., No. 5923, 1902.

Three specimens from Kaslo, British Columbia, August (Cockle); also from Moscow Mountains, Idaho (Piper).

BORKHAUSENIA DIMIDIELLA Walsingham.

Oecophora dimidiella Walsingham, Ins. Life, I, 1888, p. 148.—Riley, Smith's List Lep. Bor. Am., No. 5554, 1891.—Dyar, List N. A. Lep., No. 5925, 1902.

One specimen from Kaslo, British Columbia, June (Cockle).

ENDROSIS Hübner.

ENDROSIS LACTEELLA Schiffermüller.

Endrosis lacteella Schiffermüller, Staudinger and Rebel, Cat. Lep. Eur., II, 1901, p. 163.—Dyar, List. N. A. Lep., No. 6170, 1902.

Endrosis kennicottella Clemens, Proc. Acad. Nat. Sc., Phila., 1860, p. 165; Tin. N. A., 1872, p. 119.

Endrosis fenestrella (Scopoli) Chambers, Cin. Quart. Journ. Sc., II, 1875, p. 244; Bull. U. S. Geol. Surv., IV, 1878, p. 140.

Many specimens from Kaslo, British Columbia, June (Dyar and Cockle); Corvallis, Oregon, November (Cordley); Pullman, Washington, June (Piper), and Seattle, Washington (Johnson).

Family ELACHISTIDÆ.

WALSHIA Clemens.

WALSHIA AMORPHELLA Clemens.

Walshia amorphella Clemens, Proc. Ent. Soc. Phila., II, 1864, p. 419; Tin. N. Am., 1872, p. 241.—Riley, Rep. Ins. Mo., II, 1869, p. 132; Proc. Wash. Ent. Soc., I, 1886, p. 30.—Dyar, List. N. A. Lep., No. 6179, 1902.—Busck, Proc. Wash. Ent. Soc., V, 1903, p. 203.

Laverna miscecalonella Chambers, Can. Ent., VII, 1875, p. 34.

Laverna miscecolorella Chambers, Can. Ent., VII, 1875, p. 51; Bull. U. S. Geol. Surv., III, 1877, p. 144; IV, 1878, p. 152.

Many specimens from Pullman, Washington, July and August (Piper), and from Kaslo, British Columbia, August (Dyar).

MOMPHA Hübner.

MOMPHA GRANDISELLA Chambers.

Laverna grandisella Chambers, Cinn. Quart. Journ. Sci., II, 1875, p. 296; Bull. U. S. Geol Surv., III, 1877, p. 144; IV, 1878, p. 152.—Riley, Smith List. Lep. Bor. Am., No. 5730, 1891.—Dyar, List. N. A. Lep., No. 6180.

Leucophryne tricristatella Chambers, Can. Ent., VII, 1875, p. 211; Bull. U. S. Geol. Surv., IV, 1878, p. 152.—Riley, Smith List Lep. Bor. Am., No. 5739, 1891.—Dyar, List N. A. Lep., No. 6171, 1902.

Kaslo, British Columbia, July (Dyar). Chambers' type of *Laverna grandisella* (erroneously labeled by himself, *Laverna magnatella*), is in the Museum of Comparative Zoology, Cambridge, Massachusetts, where I have also examined the type of *Leucophryne tricristatella;* the two are identical. The two names were published in the same year,

but it appears that the name *grandisella* has priority, and the species must be known under that name.

There is no justification for the genus *Leucophryne;* the species agrees in every character with the genus *Mompha.*

MOMPHA DECORELLA Stephens.

Mompha decorella STEPHENS, Dyar's Cat. N. A. Lep., No. 6155, 1902.

What is undoubtedly this species was bred in large numbers from galls on the stems of *Epilobium* at Kaslo, British Columbia, by Doctor Dyar.

Another large series of this species is in U. S. National Museum, bred in the Department of Agriculture from similar galls on *Epilobium* received from Mr. J. G. Barlow, Cadet, Missouri, and from Doctor Fletcher, Ottawa, Canada.

SCYTHRIS Hübner.

SCYTHRIS MAGNATELLA, new species.

Antennæ dark bronzy fuscous. Labial palpi dark bronzy fuscous; extreme base of second joint somewhat lighter. Head, thorax, and forewings dark bronzy fuscous; forewings sparsely suffused with white scales, scattered irregularly over the wing, and producing an irrorated appearance; these white scales are rather more frequent on the base of the fold and on the apical part of the wing; at the end of the cell is a small round black spot. Cilia light bronzy brown. The wings are very elongate, narrow and pointed, slightly caudate. Venation typical of the genus; 11 veins; 8 absent; 6 and 7 stalked; 7 to costa; 1 *b* simple at base. Hindwings nearly as broad as forewings, dark fuscous, cilia light brown; 8 veins; all separate. Abdomen dark fuscous; male genitalia very large, yellowish; uncus and claspers equally long. Legs dark bronzy fuscous, irrorated with white scales; tuft on posterior tibiæ yellowish. Alar expanse, 22 mm. Foodplant, *Epilobium.*

Habitat.—Kaslo, British Columbia (Dyar).

Type.—Cat. No. 7884, U. S. National Museum.

COSMOPTERYX Hübner.

COSMOPTERYX VILLELLA, new species.

Antennæ, dark purplish brown, with the seven last joints silvery white. Labial palpi silvery fuscous. Head and thorax, dark purplish brown, nearly black. Forewings, dark purplish brown, with silvery and bluish reflections; basal part of fold, golden; at the middle of the wing below costa is a bluish metallic spot of raised scales; slightly anteriorly on the fold is a similar spot of raised scales and within the

margin at tornus is a third such spot. Between these three spots and produced toward apex above the last of them is a large, irregular, golden-orange spot, not reaching either edge of the wing. Just before apex are a few bluish, metallic scales on the dorsal edge. Cilia, dark fuscous. Hindwings, dark, shining fuscous. Abdomen, bluish black. Legs, dark purplish brown, barred with silvery white. Expanse, 10.5 mm.

Habitat.—Seattle, Washington, June (Kincaid).

Type.—Cat. No. 7866, U. S. National Museum.

Unlike any described American form, with the usual transverse golden fascia replaced by the central longitudinal golden spot.

I hope shortly to be able to finish a revision of the American species of this genus which has long been in manuscript. In the meanwhile it will be well to call attention to the fact that the species described by Beutenmüller from Florida as *C. floridandella* and redescribed from there by the writer as *C. nigrapunctella* as mentioned before[a] is the same species which Lord Walsingham had already described as *Cosmopteryx fernaldella*, as the type of this species in Professor Fernald's collection proves. This species seems to occur all along the eastern States; I have taken it in the District of Columbia and have received it from Dr. William Dietz, collected at Hazleton, Pennsylvania.

COPTODISCA Walsingham.

COPTODISCA ARBUTIELLA, new species.

Antennæ dark fuscous. Labial palpi lead colored. Face silvery white. Head, thorax, and basal half of forewings dark leaden gray with a metallic luster. Apical half of forewings brilliant golden with a large triangular silvery costal spot at apical third, edged with black and a similar silvery spot slightly anteriorly on the dorsal edge; extreme apical patch velvety black, preceded by a small longitudinal silvery dash, and with a silvery spot edging it below. Cilia whitish with an apical black pencil, and with a perpendicular black streak in the costal part. Hindwings shining dark fuscous. Abdomen dark fuscous above, silvery white below. Legs dark fuscous. Expanse: 5–5.4 mm.

Foodplant: *Arbutus menziesi.*

Habitat.—Seattle, Washington, May (Kincaid and Meary).

Type.—Cat. No. 7867, U. S. National Museum.

The species was bred from the same leaves as *Marmara arbutiella*,[b] Busck, received in May, 1898, from Mr. E. S. Meary, Seattle, Washington.

[a] Journ. N. Y. Ent. Soc., X, 1902, p. 98.

[b] See p. 772.

The mine is the usual *Coptodisca* mine, a short serpentine and blotch mine, on the upper side of the leaf, ending in an oval clear blotch (3.5 by 2.5 mm.), the sides of which the larva cuts out and makes into a flat case, which falls to the ground or is fastened with silken threads to the twig. Between 30 and 40 mines were found in a single leaf, and the numerous perforations added considerably to the disfiguration of the leaves.

The species is hardly distinguishable from *Coptotriche splendoriferella* Clemens, though somewhat larger and differing slightly in wing pattern. The darker head and the pronounced black pencil in the white apical cilia are the best marks of recognition, but careful examination would have to be made in order to separate material not bred, as is the case with the other species of the genus. They may eventually all prove to be merely phytophagic varieties of one species, though I believe I can distinguish between the described species when fresh-bred material is at hand.

Family TINEIDÆ.

LITHOCOLLETIS Hübner.

LITHOCOLLETIS POPULIELLA Chambers.

Lithocolletis populiella CHAMBERS, Bull U. S. Geol. Surv., IV, 1878, p. 101.—DYAR, List N. A. Lep., No. 6331, 1902.

A large series of this species bred from small tentiform mines on the underside of the leaves of *Populus tremuloides* by Doctor Dyar at Kaslo, British Columbia.

GRACILARIA Haworth.

GRACILARIA ELONGELLA Linnæus.

The extreme variability of this species is well known and has been embarrassing to several lepidopterists before now. So eminent a specialist as Stainton described as new his *Gracilaria inconstans*,[a] giving figures of seven different wing patterns, all of which he ultimately realized belonged to *elongella*, and that though he well knew this species and immediately after[b] treats of its variability.

I have long had in manuscript a revision of the American species of *Gracilaria* of all of the described species of which I have authentic specimens, but I have delayed its publication mainly on account of the uncertainties about this species until such a time when more ample and bred material would come to hand. I confess that while revising this genus I had no thought of regarding as the same species any of the following decidedly different looking insects: the uniformly red-

[a] Trans. Ent. Soc. Lond., I, 1851, p. 125. [b] Idem., p. 127.

dish brown *alnicolella* Chambers; the blood red and yellow *sanguinella* Beutenmüller; the brick red *pulchella* Chambers; the fuscous *fuscoochrella* Beutenmüller; the brown, yellow, and black mottled *nigristrigella* Beutenmüller, with its variety *ruptostrigella* Beutenmüller; the pepper and salt-colored *alnivorella* Chambers, and the greenish-white black dotted *shastaella* Beutenmüller. In fact, I will candidly admit that I had made an elaborate table whereby to distinguish these supposed species.

Now, however, I have before me a large series bred by Doctor Dyar during two weeks of July from similarly rolled leaves on alder at Kaslo, British Columbia, and it includes specimens which can not be distinguished from the extremes of the foregoing series. There is the deep reddish brown unicolored form described as *alnicolella* which Chambers bred from alder in Colorado, and there is the light greenish form represented by Beutenmüller's type of *shastaella* in U. S. National Museum, as well as intervening varieties.

In view of this there can not be much doubt but that all of these names represent merely varieties of the same species.

GRACILARIA STIGMATELLA Fabricius.

One specimen bred from aspen by Doctor Dyar at Kaslo, British Columbia, July 26, which can not be distinguished from the common eastern form described by Chambers as *Gracilaria purpuriella*. There can hardly be any doubt about the identity of this species with the European *stigmatella* Fabricius.

GRACILARIA MURTFELDTELLA, new species.

Labial palpi saffron yellow on the inner side and toward base lighter. Maxillary palpi dark saffron yellow. Antennæ straw-yellow without any color annulations. Face saffron yellow with a central streak of light canary-yellow. Head light canary-yellow with collar of deep saffron yellow. Thorax canary-yellow with patagia darker. Forewings light canary-yellow with base of costa and costal part of apical half brilliant deep saffron yellow; a line of the dark yellow along the dorsal apical edge before the cilia. Apical cilia saffron yellow; dorsal cilia lighter yellow. Hindwings dark fuscous; cilia yellowish. Abdomen yellowish fuscous. Legs dark brown; tarsi whitish; hind tibia smooth. Expanse 20 mm.

Habitat.—Kirkwood, Missouri, June (Miss Murtfeldt); Pullman, Washington, August. (Piper.)

Type.—Cat. No. 7869, U. S. National Museum.

This is by far the largest and stoutest *Gracilaria* described from this country and I am unacquainted with any European species as large. In coloration it comes nearest *Gracilaria elongella* variety

sanguinella Beutenmüller,[a] but it is a much more robust insect and has none of the deep red color found in *sanguinella*.

I have long possessed the type of this striking species as a unique, kindly given me by Miss Mary Murtfeldt on a visit to her home, and I take pleasure in naming it in her honor. I was much pleased to see another perfect specimen from such a different locality as Washington in Mr. Piper's collection.

MARMARA Clemens.

MARMARA ARBUTIELLA, new species.

Antennæ dark shining brown. Labial palpi blackish brown, terminal joint with tip and an annulation around the middle silvery white. Maxillary palpi brown mottled with silver. Lower part of face silvery white. Head dark, blackish brown. Thorax dark brown. Forewings shining, dark blackish brown with silvery white markings, consisting of a straight-edged perpendicular silvery white fascia at basal third; another on the middle of the wing slightly oblique and attenuated centrally; a large triangular silvery white costal spot at apical third and a smaller one opposite on the dorsal edge; a small white costal spot just before apex. Apical cilia white, dorsal cilia dark brown. Hindwings dark brown. Abdomen fuscous, annulated with silvery white. Underside of body silvery white. Legs black with broad silvery white annulations. Venation typical. Expanse: 6–7 mm.

Foodplant: *Arbutus menziesi*.

Habitat.—Seattle, Washington, May (Kincaid and Meary).

Type.—Cat. No. 7868, U. S. National Museum.

This species was bred in May, 1898, from material received at U. S. Department of Agriculture from Mr. E. S. Meary, Seattle, Washington, who wrote that the ornamental arbutus trees were made unsightly by the work of this insect in the two-year-old leaves. This was very apparent from the appearance of the leaves submitted, which were crossed and recrossed by the yellow and white mine, so that more than half of the upper surface was discolored. The moth lays its egg on the underside of the leaf and the young larva eats its way through the leaf at once and makes a very long (10-20 inch) irregular, winding, serpentine mine just under the upper epidermis.

The mine is silvery white, and very narrow in its early course, which is presumably made in the autumn of the year; in its later (spring) course it widens out (2-5 mm.), and appears golden yellow when deserted. Several mines were found on each of the leaves received.

When full-grown the larva sheds its skin in the end of the mine and escapes through a curved slit in the epidermis. No observations were

[a] See p. 770.

made on the larva or the cocoon, but the cast skins found in the mine are identical with those of *Marmara salictella* Clemens, and there is no doubt whatever but that the larva while in the mine is flat, strongly segmented and legless, and that it, after casting its last skin in the mine, assumes a cylindrical form with well-developed legs and prolegs, and spins its cocoon in some convenient corner, presumably with the same strange globules for ornamentation as *M. salictella*.

The species is very close to *M. salictella* but larger, and distinguished by the dark head.

From the same leaves which contained the mines of this insect was bred *Coptodisca arbutiella* Busck (see p. 769).

Bred specimens were received also from Professor Kincaid.

LYONETIA Hübner.

LYONETIA SPECULELLA Clemens.

Lyonenita speculella Clemens, Proc. Ent. Soc. Phila., I, 1861, p. 134; Tin. N. Am., 1872, p. 184.—Dyar, List N. Am. Lep., No. 6418, 1902.—Busck, Proc. Wash. Ent. Soc., V, 1903, p. 209.

Lithocolletis nidificansella Packard, Guide, 1869, p. 354.—Dyar, List N. Am. Lep., No. 6417, 1902.

Lyonetia apicistrigella Chambers, Cinn. Quart. Journ. Sci., II, 1875, p. 105.—Dyar, List. N. Am. Lep., No. 6414, 1902.

Lyonetia gracilella Chambers, Can. Ent., VIII, 1876, p. 34.—Dyar, List N. Am. Lep., No. 6415, 1902.

A large well-preserved series bred at Kaslo, British Columbia, by Doctor Dyar from *Ceanothus*, *Prunus*, and *Betula*; also captured specimens from same locality (Cockle).

As already realized from the examination of the types and descriptions all the above names are synonymous. With the present excellent and abundant bred material (nearly 150 specimens) this contention is amply verified. The series comprises every variation from specimens with the pure silvery white ground color to specimens with this color thickly overlaid with dark scales. Similar variation is found in the European species of the genus.

LYONETIA SALICIELLA, new species.

Antennæ greenish fuscous. Labial palpi and face white, with a greenish tinge. Tuft on head dark, consisting of black, white, and fuscous scales. Eye caps and thorax light golden green. Forewings golden green with a few irregularly scattered black dots, and with a silvery-white longitudinal streak in the middle of the wing from base to apex. Apical part of the wing and cilia white, with a round black apical spot and black apical pencil, and with three costal and two dorsal black perpendicular dashes in the cilia. Underside of body silvery white. Legs silvery white, except the hind tibiæ, which are

golden green on the exterior side, and the tarsi, which are silvery fuscous with tip of each joint white. Alar expanse, 14 mm. Food-plant, *Salix*.

Habitat.—Kaslo, British Columbia (Dyar).

Type.—Cat. No. 7874, U. S. National Museum.

Very distinct from the other described species, and at once recognized by its larger size and the peculiar wing ornamentation.

LEUCOPTERA Hübner.

LEUCOPTERA PACHYSTIMELLA, new species.

Labial palpi obsolete. Antennæ dark shining fuscous, except the eyecaps, which are silvery white. Central part of the top of the head tufted. Face, head, and thorax silvery white. Forewings silvery white; at apical third is an outwardly oblique golden costal streak margined with black on both sides. A little farther out on the wing is another similar costal streak. Three costal and two dorsal apical black streaks in the white cilia converge toward the same point in the extreme tip of the wing; at tornus is a large conspicuous metallic spot of raised lead-colored scales, surrounded by black scales and preceded by a golden streak. Cilia and hindwing silvery white. Underside of wings dark fuscous. Abdomen and legs silvery white. Alar expanse, 8 mm. Food plant, *Pachystima myrsinites*.

Habitat.—Kaslo, British Columbia (Dyar).

Type.—Cat. No. 7875, U. S. National Museum.

PHYLLOCNISTIS Zeller.

PHYLLOCNISTIS POPULIELLA Chambers.

Phyllocnistis populiella Chambers, Cinn. Quart. Journ. Sci., II, 1875, pp. 106, 303.—Busck, Proc. U. S. Nat. Mus., XXIII, 1900, p. 252.—Dyar, List N. Am. Lep., No. 6420, 1902.

Two specimens bred from aspen at Kaslo, British Columbia (Dyar).

BRACKENRIDGIA Busck.

BRACKENRIDGIA ACERIFOLIELLA Fitch.

Ornix acerifoliella Fitch, Rep. Ins. N. Y., I, 1854, p. 269.

Incurvaria acerifoliella Clemens, Proc. Acad. Nat. Sci. Phila., 1860, p. 5; Tin. N. Am., 1872, p. 90.—Walsingham, Ins. Life, I, 1888, p. 147.—Riley, Smith's List Lep. Bor. Am., No. 5116, 1891.—Dyar, List. N. A. Lep., No. 6477, 1902.

Tinea iridella Chambers, Can. Ent., V, 1873, p. 86.

Incurvaria iridella Chambers, Bull. U. S. Geol. Surv., IV, 1878, p. 151.

Brackenridgia acerifoliella Busck, Proc. Wash. Ent. Soc., V, 1903, p. 192.

Several specimens from Kaslo, British Columbia, July (Dyar and Cockle).

INCURVARIA Haworth.

INCURVARIA ÆNESCENS Walsingham.

Incurvaria æneseens Walsingham, Ins. Life, I, 1888, p. 147.—Riley, Smith's List Lep. Bor. Am., No. 5117, 1891.—Dyar, List N. A. Lep., No. 6478, 1902.—Busck, Proc. Wash. Ent. Soc., V, 1903, p. 192.

Kaslo, British Columbia (Cockle), and Pullman, Washington, May (Piper).

INCURVARIA PIPERELLA, new species.

Antennæ blackish, with short white pubescence. Labial and maxillary palpi white. Face, head, and thorax dirty white. Fore wings dull white sprinkled with small black spots; the largest of these is at apical third just below costal edge; two smaller ones are found anteriorly to this spot just below the costal edge; one dot is on the middle of the cell and another at the end of the cell; one is above and between these latter; and the dorsal part of the wing contains several small black dots. Shortly below apex are three very small black dots in a perpendicular row. Cilia white. Hind wings dark fuscous. Abdomen dark fuscous. Legs white, sprinkled with fuscous. Under side of the wings dark fuscous. Expanse, 19–20 mm.

Habitat.—Pullman, Washington (Piper).

Type.—Cat. No. 7870, U. S. National Museum.

In coloration this species is very similar to *Greya punctiferella* Walsingham,[a] and it may easily be confounded with that species. The fore wings, however, are dull white, not shining as in Walsingham's species, and have all veins present.

MONOPIS Hübner.

MONOPIS BIFLAVIMACULELLA Clemens.

Tinea biflavimaculella Clemens, Proc. Acad. Nat. Sci. Phila., 1859, p. 257; Tin. N. Am., 1872, pp. 50, 237.—Zeller, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 220.—Walsingham, Trans. Am. Ent. Soc., X, 1882, p. 170.—Dyar, List. N. A. Lep., No. 6495, 1902.

Tinea insignisella Walker, Cat. Brit. Mus., XXVIII, 1863, p. 471.

Monopis biflavimaculella Busck, Proc. Wash. Ent. Soc., V, 1903, p. 184.

This seems to be the representative species of this group from this region. It was received in large series from all collectors. Kaslo, British Columbia (Dyar and Cockle); Seattle, Washington (Kincaid, Piper, and Johnson).

This species, as well as *aurosuffusella* Chambers, and *dorsistrigella* Clemens,[b] which are all placed in the genus *Tinea* in Dyar's List, should be transferred to *Monopis*. Species of this genus are easily recognized by the naked depression in the disk of the fore wings.

[a] Dyar's List N. A. Lep., No. 6483, 1902.

[b] Idem, Nos. 6493 and 6502, 1902.

TINEOLA Herrich-Schaeffer.

TINEOLA BISELLIELLA Hummel.

Tinea biselliella HUMMEL, Ess. Ent., III, 1829, p. 13.—PACKARD, Am. Nat., I, 1867, p. 423.—ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 223.—RILEY, Smith's List Lep. Bor. Am., No. 5081, 1891.

Tineola biselliella FERNALD, Can. Ent., XIV, 1882, p. 169.—DYAR, List N. A. Lep., No. 6487, 1902.

Several examples from Kaslo, British Columbia (Cockle and Dyar), and from Pullman, Washington (Piper).

These latter are labeled "in specimen of *Acridium americana*." Presumably a cabinet specimen. I have repeatedly been somewhat troubled by this habit of the insect, which must be classed among those dangerous to entomological collections.

TINEA AUROPULVELLA Chambers.

Tinea auropulvella CHAMBERS, Can. Ent., V, 1873, p. 90; VII, 1875, p. 125; VIII, 1876, p. 19; Bull. U. S. Geol. Surv., IV, 1878, p. 163.—RILEY, Smith's List Lep. Bor. Am., No. 5075 (part), 1891.—DYAR, List N. A. Lep., No. 6491 (part), 1902.

Kaslo, British Columbia, July (Dyar).

This species, which has been placed as a synonym of *Tinea acapnopennella* Clemens since the time of Riley's List, is decidedly distinct from that species, as the types in the U. S. National Museum prove.

These types I obtained some years ago from Laval University, Quebec, through the kindness of Rev. C. E. Dionne.

TINEA OREGONELLA Busck.

Tinea oregonella BUSCK, Journ. N. Y. Ent. Soc., VIII, 1900, p. 246.—DYAR, List N. A. Lep., No. 6518, 1902.

A few examples from Pullman, Washington (Piper).

TINEA LEUCOCAPITELLA, new species.

Antennæ dark purplish brown. Labial palpi with second joint dark brown and terminal joint yellow. Maxillary palpi blackish. Face and head light yellow. Thorax and fore wings dark purplish brown with a small yellow spot on the fold and one at the end of the cell, the former preceded by black scales, the latter with a round blackish spot edging it below. Anterior legs black; the other legs yellowish, sprinkled with fuscous. Venation and oral characters typical. Expanse, 28 mm.

Habitat.—Pullman, Washington, July (Piper).

Type.—Cat. No. 7871, U. S. National Museum.

This striking species has the identical color of wings and head as *Tinea croceoverticella* Chambers,[a] which, however, has not the same

[a] Dyar's list N. A. Lep., No. 6500, 1902.

wing marking. The size at once distinguishes the present species, as it has more than twice the alar expanse.

From the description of *Tinea niveocapitella* Chambers it is evident that it must be a nearly related species. I am unacquainted with it except from the description, and can not determine the present form as Chambers's species, because the description of the wing markings does not fully agree with my specimen and especially as Chambers's species has only an expanse of 7 lines = 15–16 mm.

TINEA FUSCIPUNCTELLA Haworth.

Tinea fuscipunctella Haworth, Lep. Brit., 1829, p. 562.—Walsingham, Trans. Am. Ent. Soc., 1882, p. 171.—Riley, Smith's List Lep. Bor. Am., No. 5089, 1891.—Dyar, List N. A. Lep., No. 6503, 1902.—Busck, Proc. Wash. Ent. Soc., V, 1903, p. 185.

Tinea nubilipennella Clemens, Proc. Acad. Nat. Sci. Phila., 1859, p. 257; Tin. N. Am., 1872, p. 58.

Oecophora frigidella Packard, Proc. Bost. Soc. Nat. Hist., XI, 1867, p. 61.

Tinea spretella (Stainton) Zeller Verh. k. k. zool.-bot. Gesell. Wien, 1873, p. 222.

Many specimens from Kaslo, British Columbia (Dyar and Cocke), and from Pullman, Washington (Piper).

I have examined Packard's types of *Oecophora frigidella*, now in the Museum of Comparative Zoology in Cambridge. There is no doubt about their identity with this species, as determined by Lord Walsingham with some hesitation.

TINEA PELLIONELLA Linnæus.

Tinea pellionella Linnæus, Syst. Nat., 1758, p. 536.—Walsingham, Trans. Am. Ent. Soc., X, 1882, p. 170.—Riley, Smith's List Lep. Bor. Am., No. 5105, 1891.—Fernald, Can. Ent., XIV, 1882, p. 169.—Dyar, List. N. A. Lep., No. 6520, 1902.

Tinea griseella Chambers, Can. Ent., V, 1873, p. 88.

Several examples. Kaslo, British Columbia (Dyar).

ADELA Latreille.

ADELA SEPTENTRIONELLA Walsingham.

Adela septentrionella Walsingham, Proc. Zool. Soc. Lond., 1880, p. 79.—Dyar, List. N. A. Lep., No. 6559, 1902.

Seattle, Washington, June (Kincaid).

SCARDIA Treitschke.

SCARDIA BURKERELLA, new species.

Antennæ black, each joint narrowly tipped with yellow. Labial palpi yellowish white; exterior side of the second joint and tuft and a spot at base of the terminal joint black. Maxillary palpi small, simple.

yellow. Head and thorax dirty yellowish white; patagia blackish. Fore wings showing yellowish white, with golden and bluish reflections, and marked with blackish brown. At the base of costa is a large oblique irregular blackish spot extending along the base of the fold, but not reaching the dorsal edge. On the middle of the costal edge is a large quadrangular dark brown spot; another smaller quadrangular blackish spot is found at the beginning of the costal cilia, but only touching the costal edge by a corner; between and below these two spots is a more or less diffused blackish spot connecting the lower corners of these. On the middle of the dorsal edge is a similar angulated but somewhat diffused spot, and along the entire edge of the wing are smaller blackish brown dots. Outside of these markings the wing is sparsely mottled with blackish scales. Cilia golden white. Hind wings light fuscous. Abdomen yellowish fuscous. Legs yellowish white, mottled and barred with dark brown. Expanse, 28 mm.

Habitat.—Hoquiam, Washington (Burke).

Type.—Cat. No. 7872, U. S. National Museum.

THE LEPIDOPTERA OF THE KOOTENAI DISTRICT OF BRITISH COLUMBIA.

By Harrison G. Dyar.

Custodian of Lepidoptera.

The Kootenai district of British Columbia occupies the southeastern corner of the province, immediately north of the western part of Montana, Idaho, and the eastern end of Washington. It covers the headwaters of the Columbia River, which here makes a great bend around the Purcell Range to the north, while the Kootenai River, starting at the same point, makes a similar bend to the south into Montana and Idaho and returns to join the Columbia to the west. The country thus inclosed is practically a solid mass of mountains. Several closely parallel ranges, the Rocky Mountains, Purcell Range, and Selkirks, traverse it from north to south, so that from an elevation nothing can be seen in all directions but a mass of mountain peaks. None of these are of great height, but average 6,000 to 10,000 feet. The narrow valleys are filled by long lakes, widenings or branches of the Columbia or Kootenai rivers. The surface of the country is, therefore, steep and rugged and is well forested with coniferous trees. This forest has not been impaired to a perceptible extent by civilization, though large areas are periodically burned over. The resulting waste is gradually covered with a growth of small deciduous trees and bushes. The small town of Kaslo on Kootenai Lake is in the heart of this district, and at that point the principal collections of Lepidoptera have been made. Three months were spent here in collecting during the summer of 1903. I was assisted by Mr. A. N. Caudell and Mr. R. P. Currie, as well as by the experience of Mr. J. W. Cockle, who has been long a resident in Kaslo and has made a local collection of Lepidoptera at that place for several years. I shall frequently refer to his collection in the following pages. I am especially indebted to Doctor Hartin, of Kaslo, for the loan of his excellent microscope during the summer.

The Kootenai district contains two faunal regions, conditioned indirectly rather than directly by the altitude. None of the peaks reach timber line, or at least exceed it enough to form a defined alpine zone, as in the Rockies of Colorado. Still the upper slopes of the mountains, on account of their steepness, ruggedness, and exposure to the wind are largely devoid of trees. This effect is heightened by the presence of large areas of snow in favored spots, many of these areas forming permanent fields and glaciers. These cool the neighborhood and produce a more arctic climate not conditioned by the absolute altitude. In such areas grasses and sedges occur with other northerly plants, and a subarctic insect fauna is found to correspond. This region was but little explored by us on account of the difficulty of access, and I have no descriptions of the larvæ of its moths. Breeding work was carried on in Kaslo at an altitude of 1,700 feet. From there to 7,000 or 8,000 feet the fauna is practically uniform, differing in the later appearance of the same species. Toward the upper edge of the coniferous belt, somewhat more northern forms occur, but there is no markedly different region except that of the grassy spots on the peaks. Besides Kaslo, small collections were made at Bear Lake, Sandon, Lardo, Nelson, West Robson, Nakusp, Revelstoke, Glacier, and Field, showing the general uniformity of the faunal character of the district.

The Kootenai district is, for a western locality, comparatively rich in Lepidoptera. The Noctuidæ and Geometridæ form the bulk of the species, and these are, rather unexpectedly, for the most part not inhabitants of the coniferous forest, but feed upon the deciduous plants. Therefore we found Kaslo an exceptionally good collecting ground. The region had been completely burned over some years ago and is now densely grown to deciduous plants. The comparative absence of commercial activity has tended to increase these conditions, for even in the town itself collecting conditions are established in the neglected yards of the many deserted houses, one might almost say in the very streets of the town. The season of 1903 was not a good one, for no apparent reason. Butterflies were unusually scarce, and moths likewise in the early part of the season. Later they reached about their average abundance. With my own collections and those of Mr. Cockle, approximately 25,000 specimens have been under examination, in spite of the poorness of the season.

The fauna of our area, while showing its own peculiarities, seems nearest allied to that of the Sierra Nevadas of California. Presumably a still closer affinity would be found to the Cascade Range of Oregon and Washington, but that region is little known at present. Many of the species either occur in California, or are represented by close allies there. The fauna of the coast region of British Columbia differs perceptibly, in fact, more than I had anticipated would be the case; while on the other side of the Kootenais, the main range of the Rockies,

while not explored by us, shows markedly different features, as I judge from a brief stop at Banff, Alberta.

It has seemed desirable to publish as complete a list of the species of Lepidoptera occurring in the Kootenai district as can be done at the present time. To this I have added what larval notes I could secure; 167 species of larvæ are noticed out of 653 species of adults.

In the following account of the species taken, the dates of capture are given. If these are followed by no locality in parentheses, Kaslo is to be understood. When a place is mentioned without province or State, it is supposed to be in British Columbia. The following special localities in the Kootenai district are mentioned:

Ainsworth, altitude 2,500 to 5,000 feet. A small place on Kootenai Lake about 12 miles south of Kaslo. The collecting there was done on the hills above the town, mostly comparatively high altitude species being taken.

Banff, Alberta, altitude 4,500 feet. In the main range of the Rockies on the eastern side of the divide and not in the Kootenai district. It is mentioned once or twice for comparison.

Bear Lake Mountain, altitude 7,000 feet. An unnamed mountain to the north of Bear Lake, about 20 miles west of Kaslo. This was one point where high altitude species were obtainable owing to the trail leading to the "London Hill mine," which is situated near the summit of the mountain.

Field, altitude 4,050 feet. In the main range of the Rockies on the western side of the divide but practically within the Kootenai district. High altitude forms were taken here.

Frye Creek, altitude 1,670 feet. A point on Kootenai Lake on the eastern side, about 12 miles north of Kaslo.

Glacier, altitude 4,122 feet. A station on the main line of the Canadian Pacific Railroad in the Selkirks, nearly at the summit of the range and about 100 miles north of Kaslo. A good spot for high altitude species.

Kaslo, altitude 1,670 feet. The immediate environment of the town furnished the bulk of these collections.

Kokanee Mountain, altitude 10,000 feet. A mountain in the Selkirks, southwest of Kaslo, and almost in sight from that place. The summit is covered with a large snow field and glaciers. A few high altitude forms were taken here on the grassy slopes near the summit.

Lardo, altitude 1,670 feet. A point at the north end of Kootenai Lake.

Nakusp, altitude 1,350 feet. On Arrow Lake, a widening of the Columbia River, before it is joined by the Kootenai River and almost due west of Kaslo.

Nelson, altitude 1,670 feet. At the outlet of Kootenai Lake, southwest of Kaslo, with essentially the same faunistic conditions.

Payne Mine, altitude 3,600 feet. In the Selkirks west of Kaslo, a little west of the summit of the range.

Revelstoke, altitude 1,475 feet. A station on the main line of the Canadian Pacific railroad on the Columbia River nearly due west of Glacier.

Sandon, altitude 3,600 feet. Within a few miles of Payne Mine in the same region.

South Fork Creek, altitude indefinite, over 2,500 feet. Specimens with this label were taken on the trail between Kaslo and Kokanee Mountain, mostly from horseback and at the higher altitudes of the trail. It follows the course of the South Fork of Kaslo Creek to its source in the glacier.

West Robson, altitude 1,315 feet. At the Junction of the Columbia and Kootenai Rivers.

Family PARNASSIIDÆ.

PARNASSIUS SMINTHEUS Doubleday and Hewitson.

Two specimens, July 28 (Bear Lake Mountain), 29 (Bear Lake Mountain).

Family PAPILIONIDÆ.

PAPILIO EURYMEDON Boisduval.

Five specimens, May 31, June 1, 15. About equally common with *rutulus* and occurring with it. Eggs and larvæ were found later on *Ceanothus*.

PAPILIO RUTULUS Boisduval.

One specimen, May 29. The species was not uncommon in spring, coming to flowers in the garden. The larvæ were found later feeding on birch and other plants.

PAPILIO GLAUCUS Linnæus.

No specimens; Mr. Cockle has one from the Kootenai District which he thinks referable to this species.

PAPILIO ZOLICAON Boisduval.

No specimens; Mr. Cockle has it in his collection.

Family PIERIDÆ.

NEOPHASIA MENAPIA Felder.

No specimens. The butterfly had not yet begun to fly at the time I left Kaslo. I found them commonly in September on Vancouver Island. Mr. Cockle has taken the species.

PONTIA BECKERI Edwards.

No specimens; Mr. Cockle has taken it.

PONTIA OCCIDENTALIS Reakirt.

Two specimens, July 21 (Bear Lake Mountain).

PONTIA OCCIDENTALIS, var. CALYCE Edwards.

Five specimens, July 29 (Bear Lake Mountain).

PONTIA NAPI Linnæus, var. VENOSA Scudder.

Two specimens, May 29, June 3.

PONTIA NAPI Linnæus, var. PALLIDA Scudder.

One specimen, July 23 (Frye Creek).

PONTIA RAPÆ Linnæus.

Six specimens, May 30, July 7, 8, 19. Many more could have been taken as the species was common in the streets of the town.

SYNCHLOE SARA Boisduval.

Nine specimens, May 29, 30, 31, June 4, 5, 7.

EURYMUS EURYTHEME Boisduval, var. ERIPHYLE Edwards.

One specimen, July 19.

EURYMUS INTERIOR Scudder.

Five specimens, June 15, 26, July 2.

Family NYMPHALIDÆ.

ARGYNNIS RHODOPE Edwards.

Thirteen specimens, July 10 (Ainsworth), 11 (Ainsworth), 21 (Bear Lake Mountain), 26 (Payne Mine), 29 (Bear Lake Mountain). Some of the specimens are a little smaller and darker on the upper side than Edwards's figure of specimens from the Frazer River, but others fit it very closely. The species was named *monticola* in Mr. Cockle's collection, but not correctly, I think.

ARGYNNIS BEHRENSII Edwards.

One specimen, July 10 (Ainsworth). It is a male, with only a trace of silver on the hind wings below. What there is of it is most distinct on the submarginal lunules.

ARGYNNIS ELECTA Edwards.

Four specimens, July 10 (Ainsworth), 11 (Ainsworth), 21 (Bear Lake Mountain).

ARGYNNIS EURYNOME Edwards.

Two specimens, July 21 (Bear Lake Mountain), 29 (Bear Lake Mountain).

ARGYNNIS EURYNOME, var. CLIO Edwards.

Two specimens, July 21 (Bear Lake Mountain), 29 Bear Lake Mountain).

BRENTHIS EPITHORE Boisduval.

Thirteen specimens, May 31, June 8, July 11 (Ainsworth), 21 (Bear Lake Mountain).

LEMONIAS ANICIA Doubleday and Hewitson, var. BEANI Skinner.

Seven specimens, July 16, 21 (Bear Lake Mountain), 29 (Bear Lake Mountain).

LEMONIAS PALLA Boisduval.

Three specimens, June 25, 26, July 2.

PHYCIODES THAROS Drury.

Seven specimens, June 15, 26, July 2, 21 (Bear Lake Mountain), 23 (Frye Creek), August 9 (South Fork Creek).

PHYCIODES PRATENSIS Behr.

Four specimens, July 11 (Ainsworth), 19, 21 (Bear Lake Mountain), 26 (Payne Mine).

POLYGONIA SATYRUS Edwards.

Six specimens, June 11, 25, July 8 (bred), 15. The early specimens were hibernated, the later ones bred from larvæ on nettle. Both the light form *satyrus* and the dark one *marsyas* emerged in about equal proportions from the pupæ. The larva is white all over the dorsal region and looks like the eastern *comma* Harris.

POLYGONIA FAUNUS Edwards.

Two specimens, June 6, 18, both hibernated. No larvæ were seen, but no search of the willows was made for them.

POLYGONIA ZEPHYRUS Edwards.

Twelve specimens, May 30, June 8 (Ainsworth), 15, July 7 (bred), 16 (bred), and others seen. The early specimens were hibernated, the later ones bred from larvæ. The larvæ occurred on both currant and Rhododendron, but there was no difference between them, though the variation in color is considerable.

EUGONIA J-ALBUM Boisduval and Le Conte.

No specimens; Mr. Cockle has taken it.

EUGONIA CALIFORNICA Boisduval.

Eleven specimens, July 16, 19, 21 (Bear Lake Mountain), August 9 (South Fork Creek), 11. Many others could have been taken, as the butterflies came in the daytime in some numbers to the sugar left on the stumps to attract moths at night. The species was, however, unusually rare, only a very few larvæ being seen on the *Ceanothus* bushes, where they are generally plentiful, according to Mr. Cockle's observations.

EUVANESSA ANTIOPA Linnæus.

Six specimens, bred August 2, from larvæ fed by Mr. Cockle. The species occurred occasionally all summer, but was not abundant.

AGLAIS MILBERTI Godart, var. SUBPALLIDA Cockerell.

Two specimens, June 2, July 29 (Bear Lake Mountain). Seen occasionally all summer, the larvæ and egg masses on nettle.

VANESSA ATALANTA Linnæus.

No specimens; Mr. Cockle has taken it.

VANESSA HUNTERA Fabricius.

No specimens; Mr. Cockle has found the species very rare at Kaslo.

VANESSA CARDUI Linnæus.

One specimen, July 29 (Bear Lake Mountain). The species was common all the season but no effort was made to capture any. The larvæ were frequent on thistles and several other plants.

VANESSA CARYE Hübner.

No specimens taken. The species was less common than *cardui*, yet not infrequent. The larvæ occurred on cultivated hollyhock, to which they were rather injurious.

BASILARCHIA LORQUINII Boisduval.

Six specimens June 14, 26, July 15, 21 (Bear Lake Mountain), 26 (Payne Mine). Many others seen but not pursued. The amount of orange color at the tip of the wing is somewhat reduced as compared with Californian examples. Mr. Cockle found a larva on willow.

Family AGAPETIDÆ.

CERCYONIS SYLVESTRIS Edwards, var. CHARON Edwards.

Six specimens, June 26, July 10 (Ainsworth), August 7.

Family LYMNADIDÆ.

ANOSIA PLEXIPPUS Linnæus.

No specimens; Mr. Cockle has this butterfly from Kaslo.

Family LYCÆNIDÆ.

URANOTES MELINUS Hübner.

No specimens; but Mr. Cockle has some in his collection.

THECLA CALIFORNICA Edwards.

Four specimens, July 2, 15, August 9 (South Fork Creek).

THECLA SÆPIUM Boisduval.

Eight specimens, July 15, 18, 19.

THECLA NELSONII Boisduval.

Nine specimens, May 29, 31, June 7, 10.

THECLA SPINETORUM Boisduval.

Two specimens, June 1, 4; one of them left in Mr. Cockle's collection, as this is a new record for Kaslo.

INCISALIA IROIDES Boisduval.

Six specimens, May 29, June 1, 6, 8 (Ainsworth), 9, 11. Mr. Cockle has specimens in his collection labeled *irus* and *augustus*, but I doubt whether they represent species different from *iroides*. The three species are closely allied, but *irus* and *augustus* are not known from the west.

INCISCALIA ERYPHON Boisduval.

Eight specimens, May 31, June 8 (Ainsworth).

EPIDEMIA MARIPOSA Reakirt.

Thirteen specimens, June 25, 26, 29, July 2, 21 (Bear Lake Mountain), 23 (Frye Creek), 29 (Bear Lake Mountain).

EPIDEMIA HELLOIDES Boisduval.

Nine specimens, July 15, 21 (Bear Lake Mountain), 26 (Payne Mine), 28 (Bear Lake Mountain).

EPIDEMIA DORCAS Kirby, var. FLORUS Edwards.

No specimens; Mr. Cockle has some in his collection so labeled.

CHALCERIA SNOWI Edwards.

One specimen, July 21 (Bear Lake Mountain).

CUPIDO SAEPIOLUS Boisduval.

Eight specimens, June 1, 6, 11, 27.

NOMIADES LYGDAMUS Doubleday.

One specimen, July 21 (Bear Lake Mountain).

AGRIADES PODARCE Felder.

Four specimens, July 21 (Bear Lake Mountain). An alpine form of *podarce*, the under side of hind wings very dark gray with the white spots contrasted. The female is peculiarly marked with spots of bluish scales on the upper side.

RUSTICUS ANNA Edwards.

Six specimens, July 21 (Bear Lake Mountain), 26 (Payne Mine).

CYANIRIS LADON Cramer, var. NIGRESCENS Fletcher.

Fifteen specimens, April 25 (Mr. Cockle), May 1 (Mr. Cockle), 10 (Mr. Cockle), 29, 31, June 1, 5, 6.

EVERES COMYNTAS Godart.

Three specimens, June 4, 8 (Ainsworth), 14. Mr. Cockle has this labelled *amyntula*, but they are more like my eastern *comyntas* than the Californian *amyntula*.

Mr. Cockle has in his collection specimens identified as *acmon*, *battoides*, *melissa*, *daedalus*, *fulla*, *antiacis*, and *cooperi;* but they are not before me and were not taken by us.

Family HESPERIIDÆ.

AMBLYSCIRTES VIALIS Edwards.

Six specimens, May 31, June 2, 4, 7, 16.

ERYNNIS COMMA Linnæus, var. MANITOBA Scudder.

No specimens; Mr Cockle has it.

ANTHOMASTER AGRICOLA Boisduval.

Fourteen specimens, July 7, 11, 12, 23 (Frye Creek), August 3, 5.

PAMPHILA PALÆMON Pallas.

No specimens; Mr. Cockle has taken it.

THORYBES PYLADES Scudder.

No specimens; it is in Mr. Cockle's collection.

THANAOS ICELUS Lintner.

Four specimens, May 29, June 6, 8, 10.

THANAOS LILIUS, new species.

Two specimens, May 31, June 4. This form resembles *lucilius* Lintner, but is larger, the wing more variegated with brown, which shows distinctly in a patch at the end of the cell, cut by an erect dark line on the cross vein. Otherwise it is very similar. The size is that of *martialis*, but the markings are diffused and not as contrasted as in that species. It is the western representative of *lucilius*, probably a geographical race of it, but as much entitled to specific rank as several other species of the genus. I have specimens from Easton, Washington (Koebele), and Yosemite Valley, California, June 16 and August 5 (Dyar).

Type.—Cat. No. 7333, U. S. National Museum.

HESPERIA MONTIVAGA Reakirt.

No specimens; a few were seen, but escaped capture. Mr. Cockle has the species.

HESPERIA CÆSPITALIS Boisduval.

Six specimens, May 29, June 2, 6.

Family SPHINGIDÆ.

HEMARIS DIFFINIS Boisduval, var. THETIS Grote and Robinson.

Three specimens, May 30, 31, June 15, at flowers of lilac. Others were seen, but not captured. The form has distinct red tips on the

fore wings (*rubens* Hy. Edwards). The species extends throughout temperate North America. Larvæ from the Atlantic region have been described by Grote, Coquillett, Fischer, Holland, and Smythe, feeding on snowberry. Mr. Cockle found an egg on this plant at Kaslo, and Mr. Caudell obtained a young larva.

Egg.—Elliptical, symmetrical, narrowed in dorsoventral diameter; leaf green, minutely shagreened over a fine, obscure, hexagonal reticulation, scarcely shining. Size, 1.3 by 1.15 by 1 mm.

Stage I.—Head rounded, cap-like, slightly bilobed, black on the face, but diluted on the sides almost to luteous; epistoma pale; eyes black. Body normal, horn rather long, stout, tapered, black, bearing two setæ at the tip. Color pale yellow, cervical shield large, black. Setæ furcate, T-shaped, distinct, black; i dorsad to ii, v dorsad to iv on subventral fold; no subprimaries; on the thorax ia and ib, iia and iib from single tubercles; vi of two small separate setæ; vii and viii small, black on the legless segments. Horn minutely capitately setose. Later the color is whitish, the segments finely annulate, a faint pale subdorsal line from joint 2 to the horn.

Stage II.—Head rounded, high, the apex under joint 2, smoky green, shaded with blackish over the face below, pilose with fine secondary hairs; width 1 mm. Body normal, the horn moderate, conical, tapered, black, setose. Segments finely annulate and with numerous secondary granules, tubercle i showing as a larger granule; a row of large ones on the collar. Green, shaded with smoky blackish except at the ends, a pale subdorsal line from joint 2 to the horn. Venter and feet nearly black.

Stage III.—Head rounded, higher than wide, somewhat conoidal; green with a vinous brown shade about the eyes extending upward in a diffuse band each side of the clypeus nearly to vertex; secondary granules whitish; width, 1.8 mm. Body green, annulate, with dense secondary white granules. Horn long, tapered, black except at the sides at base where it is luteous; subventral region to spiracles shaded in vinous brown, tinting the feet except the plates of the anal pair. A narrow white subdorsal line; spiracles faintly ocherous.

Stage IV.—Head as before, the dark shade faint and detached from the ocellar patch; width, 2.3 mm. Green, the dorsum whitish, sides yellowish; granules white or yellow; dorsal shade bluish green; subdorsal line pale yellow, white at the horn, which is black at tip, reddish and luteous at base. Spiracles orange, more or less surrounded by oblique brown spots. Venter purple brown, feet dark luteous, anal flap and footplates green.

Stage V.—Head green with white granules, epistoma white, antennæ brown; width, 3.3 mm. Body as in the previous stage.

LEPISESIA FLAVOFASCIATA Walker.

Six specimens, June 6, 7, 9, at flowers of lilac. Mr. Cockle has several others. The specimens vary in the width of the orange band on the hind wings from a broad band to near obsolescence. The collar may be deep black or only slightly blackish, as indicated by the varietal names *ulalume* Strecker and *rachel* Bruce. Mr. Bruce has noted the larva on *Epilobium*.[a] Eggs were obtained from captive females and the little larvæ selected this plant from a variety of plants offered them. Until the last stage the larva is green with a red anal horn; in the last stage nearly coal black with a shining button. The change is remarkable and interesting.

Egg.—Regularly elliptical, roundedly flattened above and below; smooth, shining pale green, finely shagreened. Fine reticulations are obsoletely indicated under 87 diameters. Size, 1.3 by 1.1 by 1 mm.

Stage I.—Head rounded, slightly bilobed, full, pale greenish; width, 0.6 mm. Body cylindrical, equal, anal feet with triangular plates, horn moderate, stout. All pale greenish without any marks, the terminal setæ of the horn only blackish. Segments finely annulate; not shining, opaque. Tubercles and setæ rudimentary, a minute brown button with a short bulbous seta, consisting of a sphere on a short pedicle; i dorsad to ii, v well dorsad to iv, vi not present, a long, normal seta on the leg base; on thorax ia and ib, iia and iib approximate, vi of two remote bulbs. Setæ on the head bulb-shaped except those at the mouth. No shields.

Stage II.—Head rounded, full, whitish green, ocelli black; width 1.1 mm. Body green, the segments finely 8-annulate, with secondary granular dots whitish; horn moderate, tapered, shining green, the outer part purple; joint 2 dorsally shining; an obscure white subdorsal line, not touching the horn. Anal footplates large, green.

Stage III.—Head rounded, bilobed, apex in joint 2, whitish green, opaque, not shining; width 1.8 mm. Body normal, feet small, segments 8-annulate, horn moderate, tapered. Whitish green, subpruniose, with obscure secondary white dots; subdorsal line white, rather broad, from joint 2 posteriorly to joint 13 anteriorly, bent up toward but not touching the horn. Horn black, greenish at sides at base, a little purple tinted. Feet green; spiracles whitish.

Stage IV.—Green, scarcely whitish except for the white dots; subdorsal line more contrasted. Horn with outer third black, middle light red, base greenish white with a black dorsal line and obscure black ring around the base. Spiracles yellowish white with fine black edge. Width of head, 2.6 mm.

Stage V.—Head rounded, about as high as wide, sutures scarcely depressed, sooty black; epistoma, labrum, and antennæ greenish white;

[a] Ent. News, XII, 1901, p. 19.

width, 3.7 mm. Body normal, horn replaced by an elliptical button, 2.5 mm. long, the speculum black, shining, wrinkled and raised to a boss behind, surrounded by a narrow yellow ring and a broad, velvety black one. Body cylindrical, feet moderate, anal plates large. Olivaceous black, dotted with sooty black secondary granules; leg-plates black, thoracic feet greenish white; spiracles contrasted, bright ferruginous ochraceous; claspers of abdominal feet greenish. Slight dorsal and subdorsal velvety-black checkerings; all lines absent.

The larva entered earth to pupate.

DEILEPHILA GALLII Rottemburg.

Two specimens, June 5, August 13 (Sandon; Mr. Currie). No effort was made to take this cosmopolitan species in series. A larva on *Epilobium* was prepared by Mr. Caudell.

SPHINX VANCOUVERENSIS Hy. Edwards.

No specimens. It did not occur to us either as larva or adult, though Mr. Cockle has taken it in former years. I have described the larva on snowberry.[a]

MARUMBA MODESTA Harris.

No specimens; Mr. Cockle has recorded it.

SMERINTHUS CERYSII Kirby.

Five specimens, June 1 (bred by Mr. Cockle), 24, 25, July 22. All the specimens are gray, like southern Californian ones, yet varying in markings; some seem nearest *astarte* Strecker, others more like *ophthalmicus* Boisduval. They connect these forms. Larvæ were obtained from eggs. Descriptions are already extant by Boisduval, Hy. Edwards, French, and myself.

PAONIAS EXCÆCATUS Smith and Abbot.

No specimens; it is in Mr. Cockle's collection.

PAONIAS MYOPS Smith and Abbot.

No specimens; Mr. Cockle has it.

Family SATURNIIDÆ.

SAMIA RUBRA Behr.

One specimen, June 11. The form is nearest to Californian *rubra*, but a little divergent, approaching *gloveri* in some respects. The tone of the wings is grayer, especially toward the margin, and the discal

[a] Psyche, VII, 1894, p. 177.

spots are less produced. Mr. Cockle is acquainted with the larva on *Ceanothus*, but none occurred to us. The *Ceanothus* bushes were badly defoliated as the result of the work of Tineids (*Lyonetia speculella* Clemens), which evidently deprived other species of their accustomed food and perhaps drove away the moths which would have deposited eggs.

TELEA POLYPHEMUS Cramer.

One specimen, June 29. Mr. Cockle has a good series in his collection. This species tends toward a local race in the Kootenay district. The moths are distinctly more pink and gray than any others that I have, while the peculiar manner of spinning the cocoon with an attachment to the twig, which has been noted by Grote as occasional,[a] seems here the usual method, according to Mr. Cockle.[b] Eggs and larvæ were found by Mr. Caudell, and other eggs obtained from female moths by Mr. Cockle.

PSEUDOHAZIS SHASTAENSIS Behrens.

Three specimens, two bred by Mr. Cockle from hibernating pupæ June 27, and a pair taken with the net by Mr. Caudell in July, the male of which was destroyed in capturing it. I found a brood of young larvæ June 11 on willow. They grew slowly and were not full fed in August when we lost them. It seems probable from these data that the species takes two years to reach maturity, hibernating first in the egg and second in the pupa.

Family SYNTOMIDÆ.

SCEPSIS PACKARDII Grote, var. COCKLEI, new variety.

Six specimens, June 25, 27, July 2. Mr. Cockle has others in his collection. The species exhibits a distinct local form or race. They have the size and appearance of *packardii*, but nearly the coloration of *fulvicollis* Hübner, the fore wings being largely blackish and somewhat translucent centrally, with only a little of the light-brown tint that occupies the whole wing in *packardii*. Expanse, 42 mm. I take pleasure in dedicating this form to Mr. Cockle. We endeavored to obtain the life history, but could not find more than one female moth, and that was unfortunately killed before it came into our hands.

Type.—Cat. No. 6989, U. S. National Museum.

Family LITHOSIIDÆ.

CRAMBIDIA CASTA Sanborn.

One specimen, August 22 (Revelstoke), of the normal large form with white head.

[a] Proc. Am. Philos. Soc., XLI, 1902, p. 401.
[b] Can. Ent., XXXV, 1903, p. 139.

LEXIS BICOLOR Grote.

One specimen, August 13, normal.

HYPOPREPIA MINIATA Kirby.

Twenty-three specimens, July 4, 13, 14, 23, 31; August 1, 3, 5, at light or on leaves in the daytime. Only the species *miniata* occurred. The absence of *fucosa* confirms the distinctness of these forms, which were formerly regarded as varieties of one species. The larva lives on lichens on bark of trees or stones. Eggs were readily deposited by captive females. The larva hibernates when about half grown.

Egg.—Shape of two-thirds of a sphere, with flat base, scarcely conoidal. Reticular areas flattened, their joinings not raised, yet very distinct, regularly hexagonal, making the surface polyhedral. Shining dark lead color; diameter, 0.8 mm. Laid perfectly loose, rolling about in the dish.

Stage I.—Head round, bilobed, full, brown black; the mouth pale. Body normal, Arctiiform. Tubercles conic, high; all light orange brown. The alimentary canal darker anteriorly; tubercles concolorous; setæ coarse, stiff, spinulose. Tubercle i small, pale; ii very large, thick, black; the others pale, but rather stout, single; on the thorax ia and ib contiguous, iia also approximate to them, iib separate. Shield concolorous.

Stage II.—Head bilobed, black; mouth brown; width, 0.5 mm. Body robust, light brown, with fine dark granules, immaculate. Warts small, colorless; the setæ remarkably large and coarse. Feet pale; no shields. Tubercles i and ii single haired, iii with two hairs, iv to vi single and weak; hairs of i to iii are coarse, black, and barbuled. On thorax ia + ib + iia, iib small, iii and iv approximate, v not very remote. Later the larva becomes dull brown, with a pale, waved subdorsal line.

Stage III.—Head black; width, 0.65 mm. Body brown, with a light yellowish subdorsal band, incising the dorsal area intersegmentally on its upper side. Hairs black; structure as before.

The life history was not completed.

CLEMENSIA ALBATA Packard.

Eight specimens, July 4, 15, 29, 31; August 4, 5, 6. The larvæ were obtained from eggs laid by a captive female, but the life history was not completed, as the larvæ hibernated. They fed on lichens.

Egg.—Spherical, the base scarcely flattened, smooth, neatly reticulate, the reticulations a little elongate vertically; pale yellow, surrounded by long fine hairs from the moth, which stand nearly erect; diameter, 0.8 mm. The egg is very large for the size of the moth.

Stage I.—Head round, bilobed, shining luteous, dotted with black over the vertex, but leaving an elliptical pale patch on the summit of

each lobe; eye black, mouth brown. Body moderate, a little more slender centrally, colorless transparent; no shields. Tubercles small, elevated on rounded wart areas, single, separate, no subprimaries, iv substigmatal posteriorly, ia and ib of the thorax separate, but more approximate than iia and iib. Setæ pointed, stiff. Feet normal, with long slender claspers. Male glands plainly visible in joint 9, sordid brown. Later the larva is slightly brown speckled; joints 4, 7, and 11 subdorsally, with distinct diffuse brown spots.

Stage II.—Head whitish below, brown black over the vertex, mouth large; width, 0.55 mm. Body short and robust, Arctiiform; tubercles i and ii single, separate, i dorsad, iii with two hairs rather remote, iv and v single, iv stigmatal posterior, v subventral, vi with two hairs, a short hair on the colorless leg plate. Colorless, whitish, broadly reticulate in brown, on joints 4, 7, and 11 segregated into a distinct subdorsal patch, illy defining a dorsal and subdorsal line of ground color. No distinct lines. No true warts, the base of the hair conically enlarged, concolorous. Hairs pale, weak.

The larvæ were not carried further.

Family ARCTIIDÆ.

LEPTARCTIA CALIFORNIÆ Walker.

Two larvæ, bred by Mr. Cockle from eggs that he had obtained. The species was not common. No effort was made to take specimens, as they showed no unusual characters. The larva is rather characteristic by the long bush of hairs arising on the posterior segments. This was especially conspicuous in some larvæ collected by Mr. A. W. Hanham at Victoria, but was not at all noticeable in specimens from Golden, Colorado. The Kaslo larvæ are intermediate, but nearer the coast form.

ESTIGMENE ACRÆA Drury.

No specimens; it is in Mr. Cockle's collection.

ISIA ISABELLA Smith and Abbot.

No specimens; Mr. Cockle has taken it.

DIACRISIA VIRGINICA Fabricius.

Fourteen specimens, May 29, June 1, 3, 4, 7, 11, July 4. More could have easily been obtained, but they did not differ in any respect from the species as it occurs throughout North America.

DIACRISIA KASLOA Dyar.

Thirty-four specimens, May (Mr. Cockle), May 30, June 3, 4, 5, 12, 16, August 13 (Sandon, Mr. Currie). Nearly allied to the Californian *vagans*, but distinguished by the bright red color of both sexes. Some

of the males are of a duller brown, approaching a rare Californian variety, and some specimens from Rossland (*vagans*) have a brownish tint. Somewhere between Rossland and Kaslo will be found a dividing line between these species, or they will be seen to intergrade. Larvæ were obtained from captive female moths.

Egg.—Laid in a mass with a smaller second layer on top. Low conoidal, rather rounded. Reticulations fine, linear, irregularly hexagonal, small; slight markings occasionally within the cell areas like water drops, surface not entirely smooth, slightly coarsely shagreened. Color, waxy white. Size, diameter, 0.9 mm.; height, 0.8 mm.

Stage I.—Head broad, rounded, mouth projecting, pale reddish luteous, eye black, mouth brown. Body normal, Arctiiform, whitish, the cervical shield 5-haired, pale; tubercles large blackish, setæ long, pale. Tubercle iii 2-haired, the rest single on large elongate plates. On thorax ia+ib, iib small separate, vi 2-haired.

Stage II.—Head testaceous, shining, smoky on the vertex, eye black, mouth brown; width, 0.5 mm. Body whitish, the food showing green. Tubercle i small, iv as large as any, vi small; warts black with soft long black hairs and some shorter pale ones. Cervical shield small, leg plates dusky.

Stage III.—Head round, bilobed, full, translucent orange; width, 1 mm. Body greenish, sparsely brown dotted, heaviest subdorsally, leaving a faint, pale, dorsal line. Warts black; hair black and white, rather long, sparse.

Stage IV.—Head orange luteous, ocelli black; width, 1.4 mm. Body olivaceous gray, dotted with black. Warts black dorsally, greenish laterally. Hair black and white, irregular, straight. Dorsal pale line defined only by the black dottings. Feet dark.

Stage V.—Head round, bilobed, orange, dotted obscurely with brown; width, 2.1 mm. Body gray, thickly dotted with black, without marks. Warts sordid luteous, partly black or ringed with black, large, normal. Hair stiff, uneven, pointed black and foxy red mixed with a few longer pale ones. Spiracles white.

Stage VI.—Head slightly bilobed, black in front, broadly red over the lobes behind, shining; paraclypeus, epistoma, labrum and antennæ sordid white, pinkish tinged; width, 3 mm. Body dull brown black, strigose with a paler tint. Feet pale reddish. Warts large, blackish luteous, the hair foxy red, slightly darker tipped, except some longer ones which are most noticeable posteriorly; these are black. Aspect of *D. virginica*, but darker and redder. Spiracles white, black rimmed. A red patch before tubercle iii on joint 12. There is a difference in the color of the dorsal hairs, which may be due to the sex of the larva, as Stretch states to be the case in *D. vagans*.

Cocoons spun in the ground.

HYPHORAIA PARTHENOS Harris.

No specimens. One larva found by Mr. Caudell. The species is rare, but Mr. Cockle has several in his collection and has bred one or more. The larva is large, black, with long soft black hairs and whitish warts.

PLATYPREPIA VIRGINALIS Boisduval.

No specimens; Mr. Cockle has taken it.

APANTESIS ORNATA Packard, var. ACHAIA Grote and Robinson.

One specimen, June 13, at light. Mr. Cockle has others. This form is the same as found in California and the Pacific coast. A description of the larva has been published.[a]

AMMALO TENERA Hübner.

Three specimens, June 5, 6, 23. They agree with Atlantic coast specimens rather than with the Californian form *sciurus*, though there is very little difference between these forms at best. Eggs were obtained, but proved infertile.

HALISIDOTA MACULATA Harris, var. ALNI Hy. Edwards.

Thirteen specimens, May 30, 31, June 6, 10, 16, 25. The moths are like typical *maculata* of the Atlantic coast region, and also like the variety *alni*, these forms not differing in the adult. The larvæ are *alni*, like those of the mountains of California and Colorado, red dorsal tufts when young, no dorsal tufts in the last stage. Some of the larvæ, however, had black dorsal tufts in the last stage, thus resembling the form *angulifera* Walker of the Pacific coast, but none had black tufts in the early stages as that form has. There was much variation in color, some of the young larvæ being highly variegated with red and yellow.

Family AGARISTIDÆ.

ANDROLOMA MAC-CULLOCHII Kirby.

Two specimens, July 21 (Bear Lake Mountain). The larvæ have been described by me.[b]

ALYPIA LANGTONII Couper.

Three specimens, July 13, August 13 (Sandon; Mr. Currie). Others were seen, but the species was rare. Eggs were obtained, but proved infertile. The larva has been described by me.[c]

[a] Psyche, VI, 1893, p. 379; in error as *blakei*.
[b] Proc. U. S. Nat. Mus., XXV, 1903, p. 386.
[c] Can. Ent., XXVII, 1895, p. 278.

Family NOCTUIDÆ.

APATELA DACTYLINA Grote, var. HESPERIDA Smith.

Eleven specimens, June 13, 16, 23, 25, 30, July 2. The specimens are generally darker and more smoothly colored than eastern *dactylina*, but Professor Smith's type of *hesperida* is not so, and I scarcely see why he should have separated it. Still, *hesperida* is a good racial form, representing *dactylina* in the northwest. The larva is essentially the same, though the hairs are of a decidedly brighter brown, and are less markedly keeled on the dorsal line.

Egg.—Flat, circular, low domed; ribs about 80 at the margin, smoothly waved, diminishing by alternation toward apex, which is irregularly lumpy; no reticulations. Dark green, later with little red dots, sparsely scattered. Diameter, 1.4 mm.; height, 0.4 mm. Hatched in eight days.

Stage I.—Head bilobed, cordate, white, checkered with a more sordid shade, ocelli and coarse setæ black, jaws brown. Hairs single, the dorsal ones black, long, the lateral ones white and shorter; no subprimaries. Body cylindrical, all white, tubercles large and concolorous; hair of joint 11 all pale; shields undifferentiated.

Stage II.—Head bilobed, a little higher than wide, white with black marks; triangular mark in clypeus, median suture at apex, curved band each side of clypeus and a mark on side; width, 0.8 mm. Body normal with large round warts, white, with white hairs, joints 5, 7, and 12 dorsally with a small dusky patch and a few dark hairs. Hairs soft, long and short mixed.

Stage III.—Head sharply bilobed, with stiff white setæ; shining black, a dash from vertex of lobe, clypeus and epistoma white; width, 1 mm. Body uniform, warts round, projecting, all covered by fine long fluffy white hairs; a long dorsal black pencil on joints 5, 7, and 12; sides broadly powdered with black, inclosing wart iii. Thoracic feet black, abdominal ones pale. Later an ocherous shade appears in the broad white dorsal space.

Stage IV.—Head high, oval, bilobed, clypeal sutures depressed, shining black; width, 1.8 mm. Body black, obscured by the dense secondary hairs, warts ii and iii showing white. Dorsal hairs dense in banded segmentary tuftings, creamy brown; subdorsal and lateral hair long, white, sparse, showing the black ground; erect black pencils on joints 5, 7, and 12. Feet black, except the claspers of the abdominal ones.

Stage V. Head shining black; width, 3 mm. Body black, the warts obscured, except subventrally by broad bands of dense, secondary hair, light brownish red dorsally, white laterally, mixed with longer white hairs from the lateral warts; joints 5, 7, and 12 with high black

dorsal pencil; white hairs overhand the extremities. Warts white, moderate.

Stage VI.—Head rounded, oval, high, shining black with primary white setæ; width, 5 mm. Body cylindrical, equal; segments densely banded with secondary hair, slightly keeled along the dorsal line and with large, high, erect pencils of black hair on joints 5, 7, and 9. Dorsal hair orange brown, side hair creamy white with a few long pale ones. Skin black, spiracles white, warts obsolete.

Cocoon of silk.

APATELA FELINA Grote.

Three specimens, June 13, 16, 25. Mr. Cockle has had this species in his collection as *canadensis* Smith and Dyar, but it does not agree with our type, which was from Calgary, Alberta. It is, however, like specimens before me named *felina*, by Prof. John B. Smith. The Kaslo specimens agree in color with one labeled "Wash. T.;" Californian specimens are lighter. This error in identification illustrates the resemblance of the Kootenai fauna to that of distant California, whence *felina* was described, rather than to that of the near eastern foothills of the Rocky Mountains toward Calgary.

Egg.—Low, flattened, with a flat, broad, clear base, center domed, yellow; about 20 large, coarse, smooth ribs, irregularly joined by crossbars equally large and smooth, forming a series of large, rounded pits; surface finely sparsely granular shagreened, which alone appears at the micropyle where the ribbing is absent. Diameter to margin, 2 mm.; central dome, 1.3 mm.; height, 0.6 mm. Later there appears an irregular dark red ring at the edge of the central dome. Hatched in eight days.

Stage I.—Head cordate, black, pale diluted in a little spot each side of the median suture and at vertex (tubercle i), epistoma and antennæ white, not conspicuous. Body white; joints 2, 4–5, 7–9, and 12–13 anteriorly vinous red dorsally. Thoracic feet black. Warts conical, single haired, no subprimaries, i to iii with large black setæ, the rest with smaller ones; iii to v closely grouped around the spiracle; on thorax ia+ib, iib very small. Skin with minute, rather sparse, conical granules. Leg shields blackish; cervical shield brown-black with three large and one small setæ and two detached. Tubercles conical, large but pale.

Stage II.—Head sharply bilobed, shining vinous black, epistoma pale sordid; width 0.8 mm. Body with joints 3, 6, 10, posteriorly, 11 pale, white, the rest of the dorsum deep blackish vinous, all the warts dark except ii of 11, which is white. Intersegmentary areas paler. Hairs numerous, long, all black dorsally, some white subventrally, long, curling; feet black.

Stage III.—Head bilobed, median suture sharply depressed; shining black, the coarse setæ white; width, 1.5 mm. Body normal, joint 12

slightly enlarged. Mostly purple black, dorsal line narrow, white; joint 3 on the sides, 6, 10 posteriorly, 11 largely yellowish white; wart ii of joint 3, ii of 6 and 10 partly and ii of 11 white, all the other warts black; some white along the sides. Dorsal hair long, black, erect, mixed with white on the pale segments and on joints 2 and 13; sides with long, fluffy, white hairs, which also overhang the ends. Feet black.

Stage IV.—Head sharply bilobed, shining black, clypeus brownish, epistoma white; width, 2.1 mm. Body held in J shape, a little compressed, warts distinct, rounded and also much secondary hair present. Dorsal black hair-tufts present on joints 5, 7, 8, 9, and 12, those of 8 and 9 small; other hair long, curved, fluffy, yellowish white. Skin largely black, the untufted segments with orange-yellow warts; pale yellow lateral and subventral bands. Thoracic feet black. Later the long hair becomes yellow.

Stage V.—Head high, black, epistoma white; width, 3 mm. Body ocherous, brownish on the warts, a black band dorsally and marks on the sides, all covered and partly concealed by long, curved, fluffy, yellowish white hairs. Dorsal black pencils present on joints 5, 7 to 10, and 12, those of 7 to 10 progressively smaller.

Stage VI.—Head bilobed, oval, shining black; width, 4 mm. Body olivaceous, ochraceous, shaded with black more or less, especially over the dorsum, or nearly all black, entirely covered and nearly concealed by the long, fluffy, curved, yellow-white secondary hair. Black pencils present on joints 5, 7, and 12 or on 8 and 9 also, but short, not longer and subordinated to the other hair. In the previous stage the hair was straighter and only long laterally; now it is long all over and curved like that of *vulpina*. Later the hair becomes darker yellow. Most of the larvæ have the body yellow with a dorsal and two side stripes of black, venter and feet black.

Cocoon spun on wood with pieces bitten off to reinforce it. The hair and body turn dark before spinning.

APATELA LEPORINA Linnæus, var. MOESTA Dyar.

Six specimens, June 13, July 2, 21, 27. A very distinct form of the European species. The color is dark gray, fully as dark as *canadensis* Smith and Dyar, which it much resembles; but the basal line is broken and the transverse posterior line is dentate as in eastern *leporina*. The larvæ agree in type with *leporina*, but the head is darker, often strongly marked with black. None of the American forms of *leporina* agree exactly with the European. We seem to have three races, which I would list as follows:

Apatela leporina Linnæus ..... Europe.
variety *vulpina* Grote ..... Northern Atlantic coast.
variety *cretata* Smith ..... Mountains of Colorado.
variety *moesta* Dyar ..... Eastern British Columbia.

Egg.—Circular, flat, the center dome-shaped but without a strongly flattened rim. Ribs about 75 around the margin, decreasing irregularly and at several points by alternation or confluence, coarsely waved or even circularly joined by broad, shallow pittings representing the obsolete reticulations, cross striæ low, coarse, rounded bars; vertex finely reticulate. Pale green, the center retracted, leaving a broad, colorless edge. Diameter, 1.6 mm.; height, 0.4 mm. Later there appears a narrow, dark-red ring about the middle of the side and a small vertical dot sometimes confluent by one or two bars; still later this marking retracts to a broad, red ring, scalloped on the outside. Hatched in nine days.

Stage I.—Head rounded, bilobed, shining black, mouth parts pale. Body moderate, equal; feet normal, white with dark brown dorsal patches on joints 4–5, 7–9, and 12–13 anteriorly. Cervical shield large, black. On thorax tubercle ia+ib, on abdomen i with two large equal hairs, the rest single; no subprimaries. Warts concolorous with the marks; hair all black. Skin sparsely minutely granular, not conspicuously so.

Stage II.—Head round, bilobed, more or less black shaded all over or the paraclypeal streak heavy and black; width, 0.6 mm. Body moderate, joint 11 weak; white, light brown dorsally on joints 2, 4–5, 7–9, 12–13 anteriorly except the warts, which are white; hairs black and white, long, soft; feet pale.

Stage III.—Head white, a black band bordering the paraclypeus with dottings outwardly or largely black, only clypeus above, dot on vertex and sides of lobes white; width 1.2 mm. Body white, a faint brownish lateral shade; joints 2, 4, 5, 7, 8, 9 and 12 stained with brown especially about wart i, and with black dorsal hairs, the other hairs almost entirely white, rather long. Few, if any, secondary hairs. Wart i on the dark segments black, the rest white, moderate, raised; feet pale. In some the body is all shaded with violaceous, even partly so on the pale segments, but the warts there are white. Thoracic feet black.

Stage IV.—Head shining black, clypeus, mouth, a small spot on vertex and irregular patches above eye white; hairs whitish; width 1.8 to 2.2 mm. Body moderate, equal, white, largely shaded with brown on the back and sides between the warts. Cervical shield black, with white bristly hair. Joints 5, 7–9, and 12 brown dorsally, with brown warts and long unpaired dorsal black hair pencils. Other hair long, white, rather thin, fluffy, straight, both primary and secondary about equal. On joints 3 and 4 wart i is black; other warts white.

Stage V.—Head white, with black paraclypeal bands; width 2.8 mm. Hair white, long, fluffy, concealing the body; black pencils present on joints 5, 7, 8, 9, and 12. Most of the larvæ are white, some yellow, and then markedly darker, with more black on head and dark color on

body. Some have a black tuft on joint 6, though small, and a few black hairs on joints 3 and 4.

Stage VI.—Head white, more or less marked with black; width 4.5 mm. Body greenish white, immaculate or shaded with sordid brownish, with black dorsal marks. No pencils, all the hair fluffy white or yellow, soft, curled, abundant, the secondary predominant; warts small, inconspicuous.

APATELA INNOTATA Guenée, var. GRISEOR Dyar.

Sixteen specimens, June 13, 16, 23, 25, 30, July 4, 19, 30. A western variety of *innotata*, slightly larger, the white ground color more distinctly strewn with black scales and the black marks bordering the usual lines sharper and more pronounced, especially noticeable in the transverse anterior line, which in *innotata* is almost lost; in *griseor* it is often nearly as obvious as the transverse posterior line.

Egg.—Flat, moderately arched, no rim, the edge rather steep; about 56 ribs, diminishing in the middle of the side and again toward vertex, irregularly ending about the micropylar area, which is shagreened; wavy, moderate, no reticulations. Bluish green. Diameter 1 mm., height 0.4 mm.

Stage I.—Head cordate, translucent, whitish; mouth pointed. Body white, the food showing green, tubercles not large, elevated, concolorous; hairs long, fine, white, the dorsal ones coarse, all single, no subprimaries; on thorax ia+ib, iib small.

Stage II.—Head round, bilobed, a little elongate, whitish; width 0.5 mm. Body normal, warts prominent, with one or two long and several short hairs, the latter with enlarged tips; all transparent whitish, food green, the male glands showing white; traces of a white subdorsal band beneath wart ii in spots. Hair all pale; no shields.

Stage III.—Head deeply bilobed, flattish before, green; width 1.2 mm. Body uniform, joint 11 weak, with smaller warts. All green, warts i and ii whitish. Warts round, elevated, bearing a long, dark hair and many small, short, pale ones, with enlarged tips, except subventrally, where all the hairs are simple. Wart ii large, iv small, stigmatal posteriorly; the two upper thoracic warts (ia+ib and iia) approximate. Later there is a faint brownish dorsal spot between tubercles i on joints 5, 8, 9, and 12.

Stage IV.—Head green, mottled with brown spots over the lobes in front; width 1.8 mm. Body with joint 12 slightly enlarged; warts with a few long hairs and many short truncate-tipped ones, subventral hair feathered. At first marked as before. Warts i to iii yellow, the yellow of i and ii confluent and inclosing red-brown spots on joints 5 to 12, largest on 5, 8, 9, and 12. Traces of a yellow dorsal line between. No secondary hairs dorsally, but several fine ones subventrally. Later the dorsal markings become yellow spots with red-

brown centers, absent on joints 2 and 3, small on 4, covering wart ii on 5, 8, 9, and 12, covering i only on joints 6, 7, and 10, just to wart ii on joint 11 by a branch, absent on 13.

Stage V.—No change. Width of head 2.6 mm.

Stage VI.—Head green, the upper half thickly covered with angular black spots, a small light red patch on vertex of each lobe; antennæ black ringed, setæ white; width 3.8 mm. Body moderate, equal, joint 12 a little enlarged dorsally. Warts small, reduced, consisting of a group of few tubercles. Secondary hair present on sides and subventrally, longer below. Olivaceous blackish, black granular on a dark olivaceous ground. Warts i, ii, and iv black, with pale tubercles, iii and v light green, vi dusky; slight greenish dilutions subdorsally below tubercle i on joints 5, 8, 9, and 12. Hair black and white, the secondary hair mostly white. Spiracles white, black rimmed; no defined markings.

The larvæ in this stage closely resemble the bark of birch, on which they were fed.

APATELA MINELLA Dyar.

One specimen, June 13. No female was obtained, so the life history remains unknown. I had suspected that this species was the western form of *fragilis* Guenée, but I have normally light colored *fragilis* from Wellington, British Columbia (G. W. Taylor), on the coast. A series of specimens is required to form a definite opinion.

APATELA GRISEA Walker, var. REVELLATA Smith.

Twenty specimens, June 13, 16, 18, 19, 30, July 2, 8, 15, 19, 21, 29 (Bear Lake). This form is generally larger and darker than eastern *grisea*, as usual with western forms, but not specifically distinct, I think. Some of the moths are nearly as pale as normal *grisea*. The larvæ, too, are the same.

Egg.—Nearly hemispherical, not much flattened, no rim, the sides perpendicular, domed. Ribs, about 60, waved, smooth, no reticulations, diminishing above, forming an irregular ring around the micropyle, which is shagreened. Pale bluish green. Diameter, 0.9 mm.; height, 0.45 mm. Hatched in seven days, without change of color.

Stage I.—Head, bilobed; mouth, broadly projecting; eye, black; jaw, brown. Body, uniform, joint 12 a little enlarged, white, immaculate; hair, white, spinulose; hairs i to iii, long, fine; iv and v, shorter, weak. Hairs all single, no subprimaries, ia + ib on thorax. No shields; tubercles, concolorous, all pale and transparent. Dorsal warts, conically elevated; feet, equal. Later joints 2, 5–6, 9–10, and 12 have diffuse violaceous dorsal patches. Still later purple brown spots appear, small, rounded, covering tubercle ii only, on joints 2, 4, 5 (the one on 4 smaller than that on 5), 8, 9, and 12. Warts, white, except in the dark spots.

Stage II.—Head with the apex subangular, flat before, whitish, stained with brown streaks above the clypeus; mouth, reddish; width, 0.6 mm. Body, moderate, flattish; warts, large conical, concolorous. White, an obscure white, subdorsal line edging the dorsal purple brown spots on joints 2, 4, 5, 8, 9, and 12, with a slight subdorsal spur to joint 11. The food shows green. Each wart has one long and several short hairs; in the brown spots some of the short hairs are black with enlarged tips. Skin, granular; feet, all pale.

Stage III.—Head, angularly bilobed, washed with brown all over the lobes, especially on the angles; clypeus, green; antennæ, white; width, 1 mm. Body, cylindrical, moderate; warts, prominent, with fine long and other short hairs. Hairs, sparse, the dorsal ones mostly blackish. Green, translucent, a white subdorsal band edging the patches of purple brown on joints 2, 4–5, 8–9, and 12, that of joint 2 diluted with green behind. The patch on joint 4 is smaller; that on 12 extends a subdorsal arm onto joint 11. Feet, green.

Stage IV.—Head, high, strongly bilobed, green on face, vertex, and sides, all shaded with dark brown mottled on a pale ground; width, 1.4 mm. Body with joints 5 to 7 prominent, 12 enlarged dorsally, sides perpendicular. Warts, round, prominent, concolorous with the markings. Green, joint 2 subdorsally, 4–5, 7–9, 11 subdorsally, 12 dark brown between a pair of yellow subdorsal lines, which widen at 4–5 and 8–12. Warts with several long hairs and a few short ones.

Stage V.—Head thickly washed with purple on a white ground and a little white behind, only the clypeus green, antennæ white; width, 2.2 mm. Body hunched, sides high, perpendicular, joints 5 and 12 a little enlarged dorsally. Green, a purple brown dorsal band, wide on joint 2 and green diluted, wide on 5, narrow on 6–7, very wide on 8–12, oval, including a green spot on 11–12 anteriorly, which cuts into the yellow edging on joint 10 and surrounds tubercle i on joint 11; joint 13 faintly marked. Warts concolorous with the markings; feet, green. The sides appear shaded by minute black spicules; there are brown spots at the spiracles and tubercle vi; some secondary hair subventrally.

Stage VI.—Head round, flattened, erect, vertex in joint 2, lobes purple brown, mottled with dark in front, clypeus green, sides whitish behind the eyes; width, 3.1 mm. Body robust, compressed, joints 4–7 highly arched, 12 prominent, dorsally bearing conical warts i and ii on a quadrate platform. Warts rounded, reduced, but the dorsal ones prominent; few haired, not dominant, a few secondary hairs subventrally, especially on the leg bases. Green, a dorsal purple brown stripe wide on joint 2, over tubercle i on joint 3, triangularly widened to ii on 5, to i only on 6–7, elliptically widened on 8–12, inclosing a green space on 10–11 anteriorly, reaching the anal plate; yellow edged.

Brown spots around the spiracles and above tubercle vi. A few whitish mealy dots on the sides; feet, green.

The larvæ were fed on birch.

APATELA MANSUETA Smith.

One specimen, July 21. I greatly regret that the life history of this pretty species was missed. Mr. Cockle captured a female specimen, now in his collection, but unfortunately killed it before noting its identity.

APATELA DISTANS Grote, var. DOLOROSA Dyar.

Three specimens, June 16, 19, 25. I have another from Rossland, June 3, 1899 (W. R. Johnson). The specimens are darker than eastern *distans*, both in the tone of the gray ground and the amount of black shadings. The larvæ seem to vary more in color than eastern larvæ, but this may be because I have a larger series of the western form. The red subventral shade, so conspicuous in eastern *distans*, is lacking in all my specimens.

Egg.—Flat, circular, low domed, laid singly or in groups partly overlapping. Ribs, about 60 around the margin, diminishing by alternation toward the vertex, distinct, finely waved, almost beaded; diameter, 1.1 mm.; height, 0.3 mm.

Stage I.—Head shining black, mouth brown. Body whitish, joints 2 to 10 clear vinous dorsally, 11 weak, white, 12 and 13 brown. Warts large, blackish; i many haired, ii to v single, vi absent; leg shields faintly infuscated bearing a hair; on thorax tubercles ia and ib joined at base, iib small, separate, no subprimaries. Feet pale. Hairs blackish, spinulose, cervical shield infuscated. Later only joints 5, 8, 9, and 12 are vinous red, the other segments fading to white; the red brown marks are sharply edged and there are slight angular ones on the white segments.

Stage II.—Head bilobed, angular, shining black; width 0.6 mm. Body robust, the dorsum serrate by the projecting tubercles; sordid white on the sides and on joints 10, 11, and 13. Dorsal warts broadly dark vinous, joints 5, 8–9, and 12 marked with the same color. Hairs black, rather bristly. Later a continued dark dorsal stripe and subventral mottlings; area about tubercle iii of joints 3–4, 6–7, 10–11 white. The larva tapers behind; joint 12 is prominent dorsally.

Stage III.—Head bilobed, apices sharp, median suture depressed; shining black; width 0.8 mm. Body robust, joints 5 and 12 a little elevated; warts large, black, hair thick and bristly, black with a few pale ones intermixed. The body is mostly dark, lighter between the warts on joints 6, 7, and 11. Feet all dark.

Stage IV.—Head rounded quadrate, flattened before, shining black; width 1.5 mm. Body black except subdorsally on joints 6–7 and 10–11 where it is diluted yellowish. Warts round, black, elevated; hair

black, bristly, rather even, some of it white about the dilutions and subventrally; none secondary. Feet dark. Hair of joints 5 and 12 rather denser than elsewhere. In some specimens all the central hair on joints 6 to 11 is ocherous; another had the hair all brown, tipped with black.

Stage V.—Head black; width 2.1 mm. Body and warts black, the dorsal space rather widely bare. Hairs at the ends partly or wholly black, the central ones dull foxy red, variable. The pale subdorsal patches are gone. Hair rather soft, of irregular length, some of the end ones longer.

Stage VI.—Head bilobed, rounded, shining black, epistoma and bases of antennæ white; width 3 mm. Body equal, joint 12 scarcely enlarged; velvety black throughout. Warts large, round, shining grayish by whitish rings about the hairs, i very large, remote, leaving a rather wide dorsal space. Hairs from tubercles i and ii on joints 4, 5, and 12 light foxy red, the rest bluish black, stiff, bristly, but mixed with softer spinulose ones. Other specimens have red brown hair the whole length, mixed with some blackish and a faint reddish shade along the subventral fold intersegmentally. All have wart i partly white, joint 12 subprominent dorsally. In some the hair is all black, while one had it white with red hair on joints 5 and 12.

APATELA PERDITA Grote.

Three specimens, June 13, 16. The species is a very distinct one. Mr. Cockle had not taken it till this season, though I have several from Rossland taken in June, 1899, by Mr. W. R. Johnson.

Egg.—Shape of half of a sphere, base broadly flat; about 50 waved ribs diminishing along the middle and again near the vertex, broadly triangular in section, irregularly waved; surface else minutely granular shagreened. Whitish, later all reticulate in dark red. Diameter, 1.3 mm.; height, 0.7 mm.

Stage I.—Head round bilobed, mouth large, antennæ short, black over vertex, shading to brownish below; epistoma and antennæ white. Body cylindrical, normal, whitish, a vinous shade from within except on joints 10 and 11. Warts moderate, blackish, i many haired with large and small hairs, the rest single, no subprimaries. Thorax with ia + ib, iib small, vi single haired on joints 3 and 4. Cervical shield small, blackish. Later only joints 5, 7–9 and 12 are vinous red, the other segments greenish white.

Stage II.—Head sharply bilobed, shining black, mouth and antennæ sordid white; width, 0.5 mm. Body robust, with large warts close together; joint 12 a little enlarged, 11 weak. Dark vinous brown, joints 6 and 10 pale, 11 decidedly pale. Hair black, the lateral ones paler. All the warts dark; feet black.

Stage III.—Head rounded quadrate, shining black, mouth whitish; width, 0.75 mm. Body with joint 5 prominent, 12 enlarged dorsally. Whitish, largely overlaid with purple black, joints 6, 10 and 11 are pale, the warts pale with dark color infiltrated between; other warts black. Hairs stiff, black, only a few white except on the pale segments. Hairs of tubercle i on joint 12 subpencilled, erect. Thoracic feet black ringed, abdominal ones pale.

Stage IV.—Head shining black; width 1 mm. Body cylindrical, warts moderate, joint 12 slightly enlarged. Black, marked with white, which is cut into streaks and spots on joints 3, 6, 10, 11, and 13; a white subventral stripe. Warts black; hair black except some white ones which are mostly shorter, from the pale parts. No secondary hairs.

Stage V.—Head shining black; width, 1.4 mm. Body all black, densely covered by the bristly black hairs, no open dorsal space. On joints 3, 4, 6, 10, and 11 there are also intermixed fine soft wavy white hairs, some of the bristles here also white. Subventral hairs largely white and longer. Joints 5 and 12 rather prominent.

Stage VI.—Width of head, 2.3 mm. All black, joint 12 prominent. Hairs of joints 5 and 12 dorsally deep black, of 4 and 6 mixed with feathered white, the rest mostly white but mixed with black, bristly, irregular, rather dense; some long pale hairs subventrally; spiracles white.

Stage VII.—Width of head, 3.5 mm. Black, the segmental incisures 3–4 and 4–5 exposed in the warning attitude; joints 5 and 12 prominent. No change from the previous stage; warts black; hair bristly, rather dense, black on joints 5 and 12, elsewhere black mixed with ocherous white, distinctly ocherous on joints 4 and 6, weaker on joint 11. Some long hairs at the ends. Some of the hairs are softer but hardly spinulose, most noticeable on the prominent segments. Warts i of joints 6 to 11 more or less white.

APATELA EMACULATA Smith.

One specimen, July 29 (Bear Lake). This is very close to *distans* var. *dolorosa*, and may prove to be the same. It is, however, a smoother gray, without the contrasts of light and dark shades, the transverse posterior line is less distinctly dentate, and there are other slight differences. Therefore I keep them separate until more material is at hand. My specimen agrees closely with Smith's type from Easton, Washington (Koebele).

APATELA IMPLETA Walker, var. ILLITA Smith.

Thirteen specimens, June 2, 13, 16, 18, 19, 23, 25, July 19. This form was described as a distinct species, but is better placed as a western race of *impleta*. The specimens are generally darker than the

eastern form, Smith's male type before me being much darker; but others are not so dark, some being practically as light as normal *impleta* and nearly indistinguishable therefrom. The larva, too, is close to the eastern one. It is this larva to which I referred in the description of stage v[a] of *luteicoma* (=*impleta*) as "Californian examples."

Egg.—Shape of half of a sphere, not broadly flattened; domed, laid singly or in groups, partly overlapping. About 80 vertical ribs, diminishing toward the vertex, moderate, sharp, rather high and narrow, waved, joined by narrow low cross-striæ. The ribs run practically to vertex, becoming confused. Yellowish white, later with little red dots rather thickly scattered. Diameter, 1.2 mm.; height, 0.6 mm.

Stage I.—Head cordate, black above, shading to whitish about the mouth, jaws brown. Body whitish, dorsum broadly dark vinous, except joint 11 and the anal feet. Hair long, black, curved; wart i large, many haired, the rest single with no subprimaries; iv and v with smaller hairs. On thorax tubercles ia+ib; joint 11 weak, its wart i many haired, but small. Later the larva is white, cervical shield transverse, black; joints 4 posteriorly—5, 8, 9, 12 with large dorsal spots. Warts all black, except those on joint 11. The dark patch on joint 12 is infiltrated by pale.

Stage II.—Head cordate, pale, the apices of the lobes black; width, 0.5 mm. Joints 3, 6–7, 10 posteriorly—11 greenish, the other segments and all the warts dark, vinous blackish. Hairs black dorsally, pale subventrally, straight and stiff. Feet pale. The sides below wart iii are entirely pale.

Stage III.—Head rounded, quadrate, shining black, paraclypeus whitish, labrum and antennæ narrowly pale; width, 0.9 mm. Body purplish black over dorsum, sides of joint 11 pale and showing a white, subdorsal band; subventral region and feet pale; thoracic feet blackish. Hairs black dorsally, whitish subventrally, rather dense, spinulose, joint 5 with heavy dorsal tuftings, and 6 with short pale hairs; hairs of tubercle i of joint 12 penciled, short, plumose. Hair of joint 11 short and mostly pale.

Stage IV.—Head bilobed, shining black; width, 1.5 mm. Body black dorsally, dotted on the sides, whitish subventrally and on anal feet; a pale yellow subdorsal bar on joint 11 covering wart ii. Warts round, black, distinct; no secondary hair. Black and white fan-shaped tuft on joint 5, a smaller white one on joint 6, a pair of erect subdorsal pencils on joint 12 black. White hairs over the head and subventrally. Thoracic feet black, abdominal ones pale.

Stage V.—Head bilobed, shining black, a white mark in paraclypeus, epistoma and labrum whitish; width, 2.5 mm. Body black

[a] Proc. U. S. Nat. Mus., XXI, 1898, p. 153.

dorsally, whitish subventrally and on feet, lateral warts pale. A yellow bar on wart ii of joint 11, a pale yellow stripe along wart v. Hairs whitish, mostly thin but tufted in dorsal fans, black on joint 5, white on 6 and 5 laterally and slightly on 4; a black subdorsal pencil on 12 and small white tuft below it. Joint 12 somewhat enlarged. Later the subdorsal stripe and subventral band are more or less dark red. One had the tufts on joint 5 brown, those of 4 and 6 pinkish ocherous.

Stage VI.—Head black, paraclypeus, epistoma, edges of labrum white; width 3.2 mm. Subdorsal stripe on joints 10 and 11 at tubercle ii and subventral band at tubercle v deep red shaded. Body black dorsally, dotted and streaked with white on the sides. Fan tufts on 3, 4, and 6 creamy white, that on 5 larger and pale brown; divaricate pencils of joint 12 black with white ones below. Other hair mostly white. All as before.

Stage VII.—Width of head, 4 mm. No change from the last stage. Stripes, deep crimson; body black with white markings, tufts of warts i and ii of joint 5 black or cream color, of iii on joints 5, 4, and 6 cream color, of i on joint 12 black with cream color below. Other hairs pale.

Cocoon of silk between leaves.

MEROLONCHE LUPINI Grote.

No specimens. One in Mr. Cockle's collection is labeled *spinea* Grote and seems intermediate between that and *lupini*, for the ordinary spots are distinct, and so, too, is the median shade, which is black and angulated in the middle.

PANTHEA PORTLANDIA Grote.

No specimens; one from Mr. Cockle's collection is before me.

PANTHEA GIGANTEA French.

No specimens. One from Mr. Cockle's collection, collected August 13, 1902, is a female and expands only 45 mm.

RAPHIA FRATER Grote.

No specimens; one from Mr. Cockle's collection, June 2, 1902. The form is similar to that which I have from Easton, Washington (Koebele). Like *Gluphisia septentrionalis*, discussed later, this species feeds on the aspen and cottonwood, and its range is coextensive with its food plants. As with the *Gluphisia*, *Raphia* runs to a variety of local forms, exactly paralleling the forms of *Gluphisia* and conditioned by the same differences in environment. Prof. J. B. Smith has lately conceived the idea of treating all these forms as distinct species, exactly as the late Henry Edwards did with *Gluphisia* twenty years ago. But

such a course does not properly indicate the relationships of the forms. The names *coloradensis* Putnam-Cramer, *pallula* Hy. Edwards, and *cinderella* Smith will be referred as varieties of *frater* Grote. The form from Kaslo and Easton, Washington, alluded to above, is very similar to typical *frater*, but is a little darker shaded on the basal and inner portions of the forewing.

HADENELLA TONSA Grote.

One specimen, August 8, and three from Mr. Cockle's collection, July 31, 1901, August 20, 1903, and September 6, 1902. The specimens agree with the type of *subjuncta* Smith before me. In Bulletin 52, U. S. National Museum, I referred *subjuncta* as a synonym to *minuscula* Morrison; but I learn from Doctor Smith that this is an error, and that *subjuncta* is realy synonymous with *tonsa* Grote.

PLATYPERIGEA ANOTHA Dyar.

One specimen, August 22 (Revelstoke). Mr. Cockle has another, pale and somewhat faded.

PLATYPERIGEA PRÆACUTA Smith.

No specimens. One from Mr. Cockle's collection, August 19, 1901, closely resembles the type before me, except that the transverse anterior line is heavier, the spots more distinct, and the dark shade at anal angle less distinct.

CARADRINA MERALIS Morrison.

Twenty-three specimens, August 1, 6, 11, 13, 15, 16, 17. The specimens are all dark gray, with the ordinary spots black-filled and contrasting, hind wings more or less gray shaded, even in the males. They differ from the *meralis* in the National Museum collection (Rhode Island, Colorado), in being rather darker, with the ordinary lines and terminal shade better defined. The form seems scarcely specifically distinct from *extimia* Walker.

CARADRINA EXTIMIA Walker.

Seven specimens, July 10, 24, August 15, 17, and one from Mr. Cockle's collection, July 10. The larva is darker than that of *extimia* from Colorado, but otherwise exactly like it. I have already given the life history.[a]

CARADRINA MIRANDA Grote.

One specimen, June 24, and one from Mr. Cockle's collection, June 11. The specimens are large and grayish powdery, but not specifically distinct from *miranda*, I think.

[a] Proc. U. S. Nat Mus., XXV, 1902, p. 375.

CARADRINA NITENS Dyar.

Four specimens, June 25, July 4, and one from Mr. Cockle's collection, June 7. This is a larger and blacker form than *miranda*.

PERIGEA VETERATA Smith.

No specimens, but one from Mr. Cockle's collection.

OLIGIA FESTIVOIDES Guenée.

One specimen, June 13.

HADENA CURVATA Grote.

One hundred and seventy-two specimens, June 25, July 12, 14, 19, 25, 27, 30, August 5, 6, 7, 12, 13, 17. This has been referred as a synonym of *binotata* Walker, by Mr. Grote himself. However, *binotata* was described from Vancouver Island and my specimens from there (Wellington, Rev. G. W. Taylor; Victoria, Mr. A. W. Hanham) differ in the greater size of the pale patch beyond the reniform, in which the transverse posterior line is nearly lost. Walker seems to be referring to such a character in his description when he says "reniformi magna ochraceocinerea." Grote says of Walker's type: "It is rubbed, very dark, with the pale brown reniform contrasting." *Curvata* was described from Mendocino County, California, and Grote says in reference to this marking: "ochery brown * * * always stains the approximate transverse posterior line opposite this [reniform] spot. * * *" I think this applies more nearly to the form before me, in which the pale patch is small and distinctly traversed by the transverse posterior line. I have this same form from the Sierra Nevada Mountains of California (Coll. J. B. Smith) and Placer County, California (Koebele). The latter specimens were named *adnixa*, but wrongly so, I judge, as that species is described as paler and more variegated than *curvata*, and comes from Nevada and other arid regions.

Eggs from captive females were difficult to obtain and proved sterile; but full grown larvæ occurred to us on the wild currant (*Ribes sanguineum*).

Egg.—Slightly spheroidal, nearly spherical, without basal flattening; smooth dark yellow, the surface flattened in small hexagonal areas without raised reticulations or any trace of ribs, minutely shagreened; diameter, 0.8 mm.

Larva.—Head erect, vertex in joint 2; green, faintly white dotted on the lobes, antennæ and mouth pale; width 2.6 mm. Body cylindrical, normal, joint 13 a little attenuated behind, 12 very slightly humped. Green streaked, dotted with yellow, shields concolorous, uncornified; dorsal line white, distinct from joint 2 anteriorly to 13 posteriorly, widened a little on the posterior slope of joints 12–13;

subdorsal line yellow, broken, dotted, waved upward a little on the centers of the segments, especially so on joint 12; substigmatal line yellow, narrowly linear, just touching the lower edges of the spiracles throughout, distinct and whitish on the anal foot. Feet green. The dorsal and subdorsal lines are distinct on joint 2. Spiracles white, black rimmed. The substigmatal line is edged with red above narrowly, especially on joint 12.

HADENA DIVESTA Grote.

No specimens; one from Mr. Cockle's collection was labeled *Chytonix palliatricula* Grote, to which species it bears a slight resemblance.

HADENA REMISSA Hübner.

No specimens; one in Mr. Cockle's collection, July 21, 1901.

HADENA IMPULSA Guenée.

No specimens; one in Mr. Cockle's collection, July 8, 1902.

HADENA BARNESII Smith, var. SORA Smith.

Nine specimens, June 30, July 8, 19, 25, August 5, 15, and two from Mr. Cockle's collection July 18, 1901, August 22, 1901. The specimens agree excellently with Smith's description of *sora*. I do not see in the form anything but a dark variety of *barnesii* from Colorado and Wyoming, types of which are before me.

HADENA VERSUTA Smith.

Seventeen specimens, July 2, 19, 24, 25, 27, 30, August 1, 12, 16, and one from Mr. Cockle's collection July 25, 1902. Another specimen in Mr. Cockle's collection is labeled *Hadena ducta*, and is, indeed, so much like it as to suggest that *versuta* is but a western form of that species. Still another specimen is marked *Hadena loma* Strecker, but evidently incorrectly when compared with authentic specimens of that species. Eggs were obtained from captive females.

Egg.—Laid singly. Spherical, the base broadly flattened and strongly adherent. Ribs about 48, straight, narrow, parallel, running nearly to the summit before decreasing in number, crested by vertical reticulations, but without any in the hollows, the cells rounded quadrangular, waving the ribs a little. Vertex reticulate, micropyle slightly raised. Pale, slightly greenish yellow; diameter 1 mm. Later washed with red over most of the vertex.

Stage I.—Head rounded bilobed, shining pale luteous with brown spots at the tubercles, eye black, mouth brown. Body moderate, joint 12 enlarged, feet of joints 7 and 8 much shortened. Tubercles large.

round, black, low elevated. Shields concolorous with the black tubercles; feet pale, whitish; skin minutely sparsely dark granular.

Stage II.—Head round, shining pale green; width, 0.7 mm. Body slender, rather elongate, feet of joints 7 and 8 short, joint 12 slightly enlarged. Translucent pale green, no marks, no shields, very faintly indicated dorsal and subdorsal pale lines. Tubercles minute, setæ moderate, rather stiff, black.

Stage III.—Head shining green, ocelli black; width, 1.05 mm. Body rather slender, feet of joints 7 and 8 shortened, joint 12 enlarged dorsally. Soft green, dark dorsally, pale subventrally; dorsal and subdorsal lines narrow white, the stigmatal line broader, white, edged with dark green above. Feet green; no shields; tubercles white with black hair dots.

Stage IV.—Head rounded, the apex in joint 2, shining green, luteous tinted; width 1.6 mm. Body cylindrical, joint 12 not enlarged, the feet equal. Translucent green, dotted with white, the incisures folded yellowish. Dorsal line narrow, subdorsal more distinct, broken, dotted white, edged by a space from which the white dots are absent. Stigmatal line broad, white on its dorsal edge, diffuse and fading below, covering the spiracle except on joints 2 and 12. Feet green; tubercles white with black hair dots; setæ minute.

Stage V.—Head greenish luteous, shining, faintly brown tinted above and vacuolated by the greenish ground; width 2.2 mm. Dorsum pale brown to the spiracles by thick brown and whitish dots on the green ground color; dorsal line obscure, white, dark edged, a dark spot on tubercle i; subdorsal line finely dotted, faintly dark edged; stigmatal line narrow, white, passing below the spiracle on joints 2 and 12; subventral region green with white dots. Feet pale; spiracles white with black edge; thoracic feet a little smoky; tubercles white with dark hair dots, obscure; setæ short and fine.

Stage VI.—Head rounded, wider than high, shining greenish luteous, reticulate in pale brown, the ground showing as rounded dots; width 3.1 mm. Body moderate, joint 12 slightly enlarged, feet equal, no shields. Mottled with brown and dotted with whitish on a pale green ground to the spiracles, subventral region green with white dots, the dorsum appearing greenish brown, the venter green. Dorsal line whitish, dark edged, the edges macular in the incisures, tubercles i and ii with brown spots above; stigmatal line narrow, white, vacuolar, passing below the spiracle on joints 2 and 12; feet green like the subventral region; tubercles small, whitish; setæ small.

HADENA FINITIMA Guenée, var. CERVIANA Smith.

Four specimens, June 8, 13, 23, July 8. In Bulletin 52 of the U. S. National Museum, I referred *cerviana* as a variety of the European *basilinea* Fabricius on the strength of a specimen labeled for me by

Prof. J. B. Smith. But Professor Smith maintains the distinctness of these species,[a] though he admits *cerviana* to be the northwestern representative of the eastern *finitima*, and I accordingly so refer it.

HADENA LONGULA Grote.

One specimen August 11, much worn and faded; also one from Mr. Cockle's collection September 18, 1901.

HADENA REMISSA Hübner.

Two specimens, July 19, August 5.

HADENA VULTUOSA Grote.

One specimen, July 27, and one from Mr. Cockle's collection.

HADENA LATERITIA Hübner.

Sixteen specimens, July 25, 27, 30, August 6, 16, 18.

HADENA DUBITANS Walker, var. COGITATA Smith.

Four hundred and thirty-two specimens, June 21, July 14, 24, 27, 29 (Bear Lake), 30, August 5, 6, 7, 12, 16, 17. Many of the specimens are light, nearly like Smith's type of *cogitata*, but they run darker also, the darkest fully matching the ordinary *dubitans* of the East. This is not a racial distinction, as eastern specimens are sometimes light. The name *cogitata* can be used to designate the variation.

HADENA MAIDA Dyar.

Nine specimens, July 25, 27, August 4, 6, 12, 17.

HADENA DEVASTATRIX Brace.

Eight hundred and fifty-two specimens, July 21, 27, August 3, 4, 6, 7, 11, 12, 13, 15, 16. Although this species and *dubitans* were very common, it was impossible to obtain the life history of either, though efforts were made to do so. The captive females refused to deposit eggs.

HADENA ARCTICA Boisduval.

Sixty-five specimens, July 4, 19, 27, 30, 31, August 6, 7, 16, 17, 18. This species, like the preceding, refused to deposit eggs.

HADENA PLUVIOSA Walker.

Three specimens, July 21, August 11, September 10 (Banff, Alberta). Apparently distinct from *arctica* Boisduval, but very close to it.

[a] Can. Ent., XXXV, 1903, p. 134.

HADENA RELECINA Morrison.

No specimens; one from Mr. Cockle's collection, September 19.

POLIA EPICHYSIS Grote.

Two specimens, August 16, 18, and one from Mr. Cockle's collection, September 1, 1902. I now regard this as a distinct species from *theodori* Grote.

POLIA SANSAR Strecker.

One specimen, August 6, which I refer here with some hesitation. Strecker described the markings as brown, while mine are black. My specimen is like *pulverulenta* Smith, but less powdery, a smooth bluish gray.

HYPPA XYLINOIDES Guenée.

Six specimens, June 13, 25, July 17, August 5, 7. The moths are a little darker and grayer than eastern specimens, with rather less of the brownish shading, while the larvæ are a little lighter than eastern larvæ, more yellowish; but I think there is no specific difference. The male antennæ have the pectinations as in eastern specimens.

Eggs.—Laid singly. Shape of three-fourths of a sphere; a little spheroidal; about 25 low, rounded ribs project a little above the level at the top, crossed by distinct hexagonal reticulations, clear, transparent. Vertex reticulate, micropyle with pyriform cells; pale whitish; diameter, 0.8 mm.

Stage I.—Head round, bilobed, full, shining black. Body equal, normal, joint 12 a little enlarged, joints 5 and 6 also circularly enlarged, feet of joints 7 and 8 small. Cervical shield brown, body white, alimentary canal reddish before. Tubercles small, black; setæ moderate brownish; no marks. Later green from the food, striated with reddish subdorsally and subventrally.

Stage II.—Head rounded bilobed, shining luteous, broadly smoky black over back of lobes; width, 0.6 mm. Body enlarged a little at joint 5, distinctly so at 12, feet of joints 7 and 8 rather small. Sordid green, a narrow white dorsal and subdorsal line, the subdorsal one looped up at joint 12; a broad lateral brown shade; substigmatal band broad, faintly whitish; a slight brown shading subventrally. Tubercle dots black; setæ short, pale. Feet pale, the thoracic ones smoky.

Stage III.—Head sordid luteous, shining, dotted with smoky on the tubercles and with reticulations above the eye; width, 0.85 mm. Body contracted at joints 10–11, 12 enlarged dorsally and widened; feet about equal. Yellowish brown, a red brown narrow dorsal lattice; dorsal and subdorsal lines white, narrow. Sides dark brown, especially below; stigmatal band whitish, broad, brown filled, obscure

except on joint 2 and 12–13, where it forms a bright white spot. Subventer brown marbled; feet pale.

Stage IV.—Head flattish before, shining pale luteous, heavily reticulate in dark brown with a stripe before the eye lighter edged below; width, 1.3 mm. Body narrow from joint 5 to the head, joint 12 much enlarged. Pale ocherous dorsally, a rectangular lattice of dark brown, darker in the incisures; dorsal and subdorsal lines fine, whitish, dotted. Sides dark brown, dotted and reticulate; substigmatal line obsolete except on joints 2–4 and 12–13, where it is white. Feet pale; tubercles i and ii white, a little elevated.

Stage V.—Head shining, as before, clypeus dark edged, the side stripe broad and white edged below; width, 1.8 mm. Thorax small, joints 5 and 6 a little humped, 12 angularly enlarged both dorsally and laterally. Dorsum light yellow, checkered in brown and marked by lattice work; dorsal line dotted, white; tubercles i and ii white. Sides darker, olivaceous shaded, dotted; a dark brown stigmatal line below which on joints 2–3 and 12–13 is bright white, mottled with brown. Feet equal, pale. Subventer more white dotted than the sides.

Stage VI.—Head rounded, the apex in joint 2; shining brown, faintly reticulate with a still darker shade; a lighter line behind the ocelli with pale rings about them; width, 3.3 mm. Body robust, joint 12 enlarged, joints 2 and 3 a little tapered; feet equal. Light yellow brown dorsally, with faint darker lattice darkened to form intersegmental dorsal spots. Tubercle i dark, ii whitish; sides darker, especially intersegmentally, tubercle iii dark; a dark edge to the broad, sordid whitish substigmatal band, reddish reticulate all over; subventral region smokily darkened. Thoracic feet pinkish, abdominal ones like the subventral area, anal feet brown without, with a white line. Tubercles minute, setæ pale, spiracles reddish.

HYPPA INDISTINCTA Smith.

Three specimens, July 19, 21 (Bear Lake Mountain). I am in some doubt of the determination. Smith described *indistincta* from one male from Mount Hood, Oregon, which appeared to him to be and probably was aberrant in markings. He has identified as this species a female in the National Museum from Easton, Washington (Koebele). The length of the pectinations of the male antennæ was not stated. Later I identified some specimens from Alaska (Harriman expedition) with the European *rectilinea* Esper. Recently Smith described *brunneicrista* from Calgary, Alberta, without any reference to or comparison with *rectilinea* or *indistincta*, but with the statement that the male antennal pectinations are longer than in the eastern *xylinoides*. In all that has been published there is nothing tangible to differentiate *indistincta* Smith, *rectilinea* Dyar (not Esper), and *brunneicrista*

Smith, and I provisionally regard them as representing one species. Unfortunately, in my specimens, identified as *rectilinea*, there is but one male, and that without antennæ; neither have I any male in the Kaslo catch, nor has Mr. Cockle one in his collection. Till the contrary is shown it is fair to assume that all have long pectinations, and this will differentiate them from the European *rectilinea* Esper, in which the pectinations are much shorter than in *xylinoides*. In all, the patagia are solidly blackish brown without the central lighter bar of *xylinoides*.

The larvæ are very dark in color, though marked with the same pattern as *xylinoides*.

Egg.—Shape of two-thirds of a sphere, the base flattened. Ribs about 40, diminishing by confluence, confused into coarse quadrangular reticulations on the summit, the micropylar rosette of cells raised. The ribs have sharp angular summits, the cross striæ are fine, yet distinct, forming cells twice as wide as long. Pale yellow; diameter, 0.8 mm. Laid singly.

Stage I.—Head and cervical shield brown black; thoracic feet, the small round tubercles and leg shields also black. Body whitish, later with a brown stripe between tubercles iii and iv. Setæ short, dark.

Stage II.—Head luteous, brown dotted at the vertex; width, 0.7 mm. Body moderate, joint 12 enlarged, whitish green, dorsal and subdorsal lines white, a broad lateral brown stripe. Tubercles black, moderate; no shields; feet pale.

Stage III.—Head 1.3 mm. Like stage iv of *xylinoides*, but the dorsal ground pale ocherous greenish, while the lattice marking appears rather as oblique streaks dorsally posteriorly to subdorsally anteriorly, the anterior bars of the lattice being weak. Dorsal and subdorsal lines white dotted, stigmatal band pale the whole length, but white only at the ends. Lateral region nearly solidly dark.

Stage IV.—Head shining dull sordid, the brown marks hardly legible; a light side stripe; width, 1.9 mm. Joint 12 angularly enlarged; dorsum brownish white, brown strigose with oblique shades from the posterior dorsal part of the segments, obscure, gathering more solidly forward and downward to cut the pale subdorsal line, which is finely dotted. Dorsal line white dotted, dark edged. Sides more heavily strigose, especially below; a waved brown line above the pale stigmatal space, shading to white on joints 2–3 and 12–13. All below the lateral region white dotted, the lower lateral and subventral ground purplish brown. Feet with dark plates.

Stage V.—Head, 2.2 mm. Very black, nearly all the marks obscured by dull black, all white dotted. Dorsal and subdorsal lines, narrow rows of white dots, the yellowish ground showing in oblique strigose patches in the dorsal space. The stigmatal line shows yellowish at the ends, dotted; also the color is black to the feet; claspers pale.

Stage VI.—Head, 2.9 mm. As in the previous stage.

EUPLEXIA LUCIPARA Linnæus.

Eight specimens, June 10, 16, 25, 30, July 14, 19. The life history was observed, but I have previously described the stages,[a] so will not transcribe my notes.

HELOTROPHA RENIFORMIS Grote.

One specimen August 18, and one from Mr. Cockle's collection August 24.

HOMOHADENA BADISTRIGA Grote, var. FIFIA Dyar.

One specimen July 30, and one from Mr. Cockle's collection July 25, 1902. It differs from the eastern form in being darker gray.

HOMOHADENA COCKLEI Dyar.

No specimens; one from Mr. Cockle's collection August 13, 1902 (Ainsworth).

ONCOCNEMIS CHLANDLERI Grote.

No specimens; one in Mr. Cockle's collection August 19, 1902, much rubbed.

RHYNCHAGROTIS GILVIPENNIS Grote.

Three specimens, July 27, 30, August 6.

RHYNCHAGROTIS RUFIPECTUS Morrison.

Five hundred and nineteen specimens, July 14, 19, 22, 25, 27, 30, 31, August 4, 5, 6, 12, 13, 15, 17. This large series shows considerable variation, but it does not affect the general appearance of this distinct species. Hampson refers this species to the genus *Triphæna*.

RHYNCHAGROTIS ANCHOCELIOIDES Guenée.

One specimen, July 14. It is larger than the average of *placida*, yet very doubtfully distinct therefrom, I think.

RHYNCHAGROTIS PLACIDA Grote.

One hundred and thirty-three specimens, July 2, 4, 14, 15, 19, 24, 25, 27, 30, 31, August 4, 5, 6, 7, 11, 13, 16, 17, and two from Mr. Cockle's collection, July 26, 1902, and August 22, 1901. Extremely variable, from light ocherous brown to blackish gray. Some specimens closely match *minimalis* Grote from Maine, others are like *placida* Grote from Colorado, but I can draw no line between them, and I think these names represent forms of one species. Mr. Cockle's

[a] Can. Ent., XXI, 1889, p. 137.

1902 specimen is a curious aberration of the *minimalis* form, all the marks lost and replaced by broad, heavy, black subbasal and subterminal bands. Another suffused and nearly illiterate specimen in Mr. Cockle's collection has been named *inelegans* Smith, but a careful observation shows the orbicular to be closed and the determination to have been hasty.

RHYNCHAGROTIS TRIGONA Smith.

Sixty-three specimens, July 2, 19, 25, 27, 30, 31, August 3, 4, 5, 6, 7, 13, 15, 16, 17, 18. Extremely variable, from light ocherous to dark brown. It is nearly allied to *placida*, but distinguished therefrom by the narrow constricted reniform. The specimens all run darker than Smith's Arizona type before me; only one is as light as it.

RHYNCHAGROTIS VARIATA Grote.

Two hundred and four specimens, June 16, 21, 23, July 4, 14, 15, 17, 19, 21, 22, 24, 25, 29, 30, 31, August 4, 5, 6, 13, 16, 17. This species well deserves its name, as it varies in color from dark vinous red to stone gray. The markings, however, are fairly constant. No larvæ were obtained, though repeated unsuccessful attempts were made to induce the females to deposit eggs.

RHYNCHAGROTIS SCOPEOPS Dyar.

Five specimens, August 5, 6, and one in Mr. Cockle's collection.

RHYNCHAGROTIS COSTATA Grote.

Seventy specimens, July 25, 30, 31, August 3, 4, 5, 6, 7, 11, 13, 15, 16, 17, 21 (Revelstoke). Very variable, from dark purple brown to light ocherous clay color. This species has been named *costata* Grote and *confusa* Smith in Mr. Cockle's collection, but after attempting to separate two species in my series, I am convinced that it can not be done. *Costata* has the collar broadly tipped with black and *confusa* not so, according to Prof. J. B. Smith's published articles, and these two forms are present in my material, but they insensibly intergrade. The dark specimens have the black tip to the collar, the pale ones lack it, while intermediate ones have a purple brown tip, which can be interpreted either way. The slight differences in the male genitalia, as shown by Smith,[a] are apparently not of specific value.

ADELPHAGROTIS INDETERMINATA Walker.

Three hundred and fifty-nine specimens, July 27, 30, 31, August 1, 3, 4, 5, 6, 7, 12, 13, 15, 16, 17, 21 (Revelstoke), September 1 (Vancouver Island). A very constant and easily recognizable species, most

[a] Bull. 38, U. S. National Museum, pl. XI, figs. 7 and 9.

inappropriately named. Like many others of the Agrotids, it appeared so late in the season that we made no attempt to obtain the larvæ. Hampson refers the species to the genus *Euxoa*.

ADELPHAGROTIS PRASINA Fabricius.

One hundred and twenty-eight specimens, July 2, 8, 14, 19, 21, 25, 27, 30, 31, August 1, 3, 6, 7, 13, 17, 18, 22 (Revelstoke).

Egg.—Laid in a high pile, several layers thick in the center; neatly two-thirds spherical, base flat; ribs about 50, thin, narrow and very regular, not diminishing in number till near the summit, and then very inconspicuously. They are joined by neat, distinct cross striæ, forming square cells. Above them are two rows of cells, one rounded quadrangular, the upper ones neatly trapezoidal; the micropylar crown radiately, finely but slightly raised, not showing a distinct cell structure; greenish white, later with apical, vacuolar reddish spot, no ring; diameter, 0.7 mm.

Stage I.—Head bilobed, shining black, epistoma reddish. Cervical shield trapezoidal, shining black; body moderate, semilooping; feet of joints 7 to 8 shorter than the others; all whitish, immaculate; thoracic feet faintly infuscated; abdominal ones white. Joint 12 slightly enlarged; tubercles very small and inconspicuous, black; setæ rather long, dark, pointed; skin shining.

Stage II.—Head translucent pale luteous, slightly spotted by the tubercles; width, 0.65 mm. Body rather slender, joint 12 slightly enlarged, the feet of joints 7 and 8 small; soft translucent green, the food darker; dorsal, subdorsal, and broad substigmatal lines a shade paler; tubercles small, black; feet pale; no shields.

Stage III.—Head round, slightly bilobed, the apex in joint 2, luteous, shining; the tubercle spots black; width, 0.9 mm. Body moderate, joints 5, 6, and 12 slightly enlarged, feet of joint 7 small; green, a little grayish, the segmental incisures folded, whitish. Dorsal line a series of white intersegmental dashes, subdorsal line dotted, no lateral line, but a dark olivaceous shade above the stigmatal band, which is broad, greenish white, and centrally greenish filled. Tubercles round black; feet pale; setæ fine, moderate; no shields. Joint 2 is pale in front.

Stage IV.—Head pale luteous; the tubercle spots black; width, 1.2 mm. Body moderate, joint 12 little enlarged; soft green, dorsal and subdorsal lines white, broken, edged by dark-brown dottings, forming traces of a lattice marking. Heavy dark marking above the white stigmatal line, which is partly green-filled. Tubercles in dusky spots; feet pale.

Stage V.—Head pale brown with dark reticulations, a broad shaded band on the lobe before, tubercles black; width, 1.7 mm. Body moderate, joint 12 enlarged dorsally and laterally; pale olivaceous, brown-

ish tinted, dorsal line broken into dashes, subdorsal into dots, white; black oblique shades, dotted, forming obscure, cuneiform, subdorsal patches; irregular shades in lateral space edging the substigmatal line above; this line scarcely white, a little lighter than the subventral color, a slight black marbling at its lower edge, not continuous. Tubercle i black; cervical shield black marbled, with dorsal and subdorsal pale lines.

Stage VI (head, 2.7 mm.) and *Stage VII* (head, 3 mm.).—Head rounded, bilobed, pale brown, with dark recticulations and shaded brown band, shining. Body pale olivaceous, shaded with black; dorsal line bright white, linear, broken in the incisures; subdorsal of small specks only, all heavily black marbled to the substigmatal line, which is white above, olivaceous and black filled, the subventral region less heavily black. Feet green; a transverse white line on joint 12, black before; no dorsal line on joint 13. Cervical shield more brownish, lined; cuneiform marks obsolete, lost in the general shading.

The larvæ hibernated without being fully grown, though probably in the last stage.

ADELPHAGROTIS APPOSITA Grote.

Fifty-eight specimens, July 19, 20, 25, 30, 31, August 3, 4, 5, 6, 7, 11, 12, 15, 16, 17, and one from Mr. Cockle's collection July 18. Rather variable. The dark forms have the markings picked out by rows of fine white scales, the ordinary lines nearly lost. Eggs were secured from two captive females, but they proved sterile.

Eggs.—Laid loose, rolling about. Nearly spheroidal, a slight flattening at the vertex and base. Ribs distinct, sharp, with rounded hollows between, about 36 on a side, diminishing above by confluence. Reticulations fine, obscure, forming square cells. The ribs become small at the vertex and are joined by striæ nearly equal to them, but run practically to the micropylar rosette, which is scarcely raised: pale yellow; diameter, 0.7 mm.

PLATAGROTIS PRESSA Grote.

Eleven specimens, July 15, August 5, 6, 7. Placed by Hampson in the genus *Aplectoides* Butler.

ABAGROTIS ERRATICA Smith.

Eight hundred and twenty-one specimens, July 24, 27, 30, August 1, 3, 5, 6, 7, 15, 17, 18. It varies from dark stone gray to pale clay color. Specimens of the light form have been named *ornatus* by Prof. J. B. Smith. Mr. Cockle has a cotype of this variation in his collection.

PACHNOBIA SALICARUM Walker.

No specimens; one in Mr. Cockle's collection.

SETAGROTIS VERNILIS Grote.

Twenty-eight specimens, July 2, 27, 30, August 3, 5, 6, 11, 12, 13, 17, 18. Uniform and of a darker, bluer gray than specimens from the Sierra Nevada of California or from Vancouver Island. There is no tendency to the pinkish or ocherous tints. The orbicular is oblique, elongate, sometimes very much so, and confluent with the lower angle of the reniform.

SETAGROTIS VOCALIS Grote.

Five specimens, July 10, 24, August 5, 9. Smith erected the genus *Setagrotis* on two species, *planifrons* and *congrua*, defined by having the antennæ with tufts of hairs instead of ciliate or simple. The character is a weak one, but such as it is is exhibited equally by *vocalis* Grote, placed in *Noctua* by Smith. The species *planifrons* and *congrua* are only variations of one form and both synonymous with *vocalis*. The Kaslo specimens, while too few to properly exhibit the species, show a good range of variation, the black tip to the collar and basal dash of fore wings being present or absent. The tone of the wings is very dark gray, darker than any other specimens before me. This is the general tendency in the Kaslo moths, but it may be due in part to the freshness of the specimens and may not be so noticeable after they have been in the collection a few years.

AGROTIS YPSILON Rottemburg.

Five specimens, August 1, 5, 6, 7.

PERIDROMA OCCULTA Linnæus.

Seven hundred and forty-seven specimens, July 21, 25, August 1, 3, 6, 7, 15, 16, 18, 20 (West Robson), 21 (Revelstoke). Eggs were obtained from captive moths and the larvæ all hibernated. A few were, however, forced to the last stage, so I am able to give the full life history. Six stages, the normal number, are here described, though most of the larvæ interpolated a stage between the third and fourth and between the fourth and fifth, caused by the tendency they have to remain small till the winter is passed.

Eggs.—Laid in a high pile several layers deep centrally. Two-thirds spherical, spheroidally flattened, base flat; ribs about 26, diminishing above, narrow, not markedly raised, joined by cross-striæ about as distinct as themselves which form cells twice as wide as high, rounded, the cell areas concave and indenting the ribs. Vertex finely reticulate about the micropylar rosette, which is slightly raised. Pale yellow; diameter, 0.7 mm.

Stage I.—Head bilobed, pale brown, black spots on the tubercles and small mottlings on the lobes above. Body normal, joint 12 slightly

enlarged, feet of joints 7 and 8 smaller than the others; shield, tubercles, and leg plates very weakly infuscated. Tubercles rather large; setæ black, pointed.

Stage II.—Head shining brownish luteous; width, 0.6 mm. Body rather elongate, thorax slightly tapered, joint 12 scarcely enlarged. Green, shaded with vinous brown to the middle of the subventral area. Dorsal, subdorsal, and broken lateral lines whitish; substigmatal line broad, pure white. Tubercles minute, dark, setæ small.

Stage III.—Head bilobed, pale brownish, tubercles and vertical line blackish; width, 0.8 mm. Body rather flattened, moderate, dorsum luteous, dorsal and subdorsal lines white, dark edged, lateral area dark, vinous tinted, a shadow in place of the lateral line; substigmatal band broad, pure white; subventral area like the dorsum, but retracted. Feet very pale; those of joints 7 and 8 small; no shields; tubercles black, setæ minute.

Stage IV.—Head bilobed, rounded, pale brown, reticulations and distinct vertical band dark brown; width, 1.4 mm. Body moderate, joint 12 enlarged, without shields. Dorsum broadly carneous pinkish, dorsal and subdorsal lines whitish, broken intersegmentally, the subdorsal narrower and subobsolete, darker edged; scattered dark specks in the dorsal space; a distinct, black, cuneiform subdorsal mark on joint 12 forms a transverse bar. Lateral space black, inclosing the subdorsal line, scarcely pale dotted; substigmatal line white, pale carneous filled centrally; subventer pinkish, black irrorate; feet pale, black dotted. Tubercles black, not contrasted; setæ pale, moderate.

Stage V.—Head light pinkish in ground; heavily reticulate in brown black and with broad vertical bands; width, 2.5 mm. Dorsum lilaceous with diffuse oblique shades of black linings defining the concolorous dorsal line and forming black cuneiform patches on joints 11 and 12, that on 12 large and forming a single patch. Subdorsal line nearly concolorous with ground, segmentally lightened in orange; sides wholly black penciled; substigmatal band lilaceous with a rather broad, pale yellow, bright upper edge and salmon pink below, reaching from joint 2 to the anal foot. Substigmatal band below black penciled, its lower edge free of black. Subventral region of the same color, powdery black marked; abdominal feet concolorous, thoracic ones brown.

Stage VI.—Head shining violaceous, heavily reticulate in black with broad curved vertical bands each side of the clypeus and erect streaks from and behind the eye; clypeus black shaded; antennæ long, the basal joint whitish, second black at base, third reddish; width, 3.3 mm. Body moderately robust, equal, no enlargements, joint 13 roundedly smaller. Dorsum velvety black, very slightly vacuolated with lilaceous, dorsal line obsolete; a white speck at tubercle i. Cervical shield with a distinct dorsal reddish violaceous line and broken subdorsal one,

else black. Anal flap with three similar lines. A bright white and lilaceous speckled transverse bar on joint 12. Subdorsal line lilaceous and white dotted, broken into slightly oblique segmentary bars, shaded. Sides lighter than dorsum, black penciled on a whitish lilaceous ground, solidly black below. A narrow, crinkled, pale yellow stigmatal line representing the upper edge of the substigmatal band, the space below like the lateral area, black on lilaceous. Thoracic feet reddish, abdominal ones heavily black marked, the anal pair yellow lined before. Tubercles small, obscure; setæ moderate, pale, straight.

PERIDROMA ASTRICTA Morrison, var. SUBJUGATA Dyar.

Sixty-one specimens, July 19, 25, 27, 29 (Bear Lake), 30, 31, August 3, 5, 6, 11, 13, 16, 17. This is obviously a local form of the eastern *astricta*, yet it comes remarkably near to *nigra* Smith in appearance. It retains always some of the violaceous ground color of *astricta*, which, in *nigra*, is transformed into an ochraceous powdering.

Eggs.—Laid in a high pile three or four layers deep centrally. Two-thirds spherical, the base more or less flattened, somewhat irregular. Ribs about 40 around the margin, diminishing by confluence, running almost to the raised micropylar rosette. Cross-striæ fine, slight, forming cells about twice as wide as high. Light yellow, later with a dark red ring and spot; diameter 1 mm.

Stage I.—Head rounded bilobed, brown, clypeal sutures and tubercular spots blackish. Body normal, whitish, joints 5–6 and 12 enlarged; cervical shield bisected, blackish at the edges and tubercles. Tubercles round, black, distinct; thoracic feet blackish ringed; leg shields dusky; setæ black, pointed. Later green from the food, a whitish stigmatal stripe edged with dark above and a little brown also subdorsally and subventrally.

Stage II.—Head bilobed, shining greenish brown with obscure spots on the tubercles; width 0.6 mm. Body moderate, joint 12 scarcely enlarged; greenish, shaded in brown, dorsal line opaque dull white, divided in the incisures and a little constricted centrally on the segments; subdorsal line narrow; lateral line a row of dull white spots. Below it a heavy dark vinous shade. Substigmatal band pure white; subventral region greenish, like the dorsum. Tubercles small, round, black; feet pale; cervical shield concolorous, but defined by a dark line.

Stage III.—Head brown, slightly reticulated; width 0.8 mm. Body moderate, joint 12 enlarged; light fleshy brown dorsally with dorsal and subdorsal white lines, slightly dark brown edged, forming traces of a lattice marking with lighter areas about tubercle i. Sides dark brown; lateral line obsolete; substigmatal band pure white; subventral region pale brown, fading to the venter. Feet brownish; no shields; tubercles small, round, black; setæ minute.

Stage IV.—Head rounded bilobed, shining light brown with darker

reticulations and nearly straight vertical bands; width, 1.1 mm. Body moderate, without shields, joint 12 well enlarged. Dorsum of joints 3 to 13 violaceous pink, the white dorsal and subdorsal lines black edged and with faint oblique black shades forming cuneiform dashes on joints 11 and 12, especially on 12. Joints 2, 13, and the sides heavily mottled in black; substigmatal band pure white, narrowly pinkish filled. Feet pale with smoky shades; tubercles black, indistinct; setæ obscure. Anal flap diluted paler.

Stage V.—Head shining whitish luteous with distinct reticulations and broad vertical bands of smoky brown; width 2.2 mm. Joints 2, 13 and anal feet mouse brown with three white lines. Body moderate, joint 12 well enlarged. Dorsum carneous violaceous with black cuneiform subdorsal marks on joints 3 to 12, largest on joint 12, squarely cut behind. Dorsal and subdorsal lines white, yellow tinted, black edged intersegmentally; tubercles i and ii white. Sides above violaceous, heavily black mottled, below solidly black. Substigmatal band yellow, white at the borders, violaceous carneous filled. Feet pale carneous.

Stage VI.—Head rounded, shining pinkish brown, clypeus unspotted, vertical bands each side of it curved, broad, black, the sides reticulate and with a slight narrow band from ocelli; width, 3.4 mm. Body moderate, joint 12 scarcely enlarged; cervical shield and anal plate large, bright red brown, contrasted, the cervical shield darker shaded before and with three faint yellowish lines, anal plate with subdorsal line. Body dark lilaceous brown, nearly uniformly black penciled, forming a series of oblique subcuneiform subdorsal bars, faint on the thorax, ending at joint 12 with a transverse white line. A stigmatal black line, broken segmentarily. Dorsal line narrow, white, obsolete centrally on the segments, faintly dark edged; subdorsal line broader, yellow, distinct, interrupted intersegmentally and tending to follow the oblique subdorsal black bars, faint on the thorax, ending on joint 12. Substigmatal band with yellow and white upper edge, dark pink filled below; subventral space dull lilaceous. Feet pale, thoracic ones brown. Tubercles and setæ obscure.

PERIDROMA NIGRA Smith.

Thirteen specimens, July 30, August 5, 6, 7, 11, 12, 15, 17.

PERIDROMA MARGARITOSA Haworth.

Fifteen specimens, June 2, 4, 11, 13, 16, 25, 30, July 8, August 7, 11, 17. The species was rare, but Mr. Cockle says it was a perfect pest the year previous, and thousands of egg masses could be seen. He attributes the scarcity of the species in 1903 to the destruction of the hatching larvæ by early rains. Eggs were obtained and a brood of the larvæ raised, exhibiting the usual well-known characters.

NOCTUA BAJA Linnæus.

Six hundred and fourteen specimens, July 27, 30, August 2, 5, 6, 7, 13, 16, 17, 18. This is unquestionably the European species. It was long so recognized till in 1896 Mr. P. T. C. Snellen named the American form *smithii*, on the supposition that it had spinose fore tibiæ while the European one had not. But an examination of European specimens shows them to have several distinct spines toward the tip of the member, well hidden in the vestiture. I therefore restore the old name. The specimens before me vary from red brown to gray.

NOCTUA PLEBEIA Smith.

Twenty-eight specimens, July 19, 27, August 4, 6, 7, 11, 15. The form is not very variable, and seems to be a distinct species.

NOCTUA ROSARIA Grote.

Ninety-two specimens, May 29, June 7, 11, 23, 30, July 19, 21, 26, 27, 29, 31 (bred), August 1 (bred), 4 (bred), 7, 11, 13. I have attempted to arrange these specimens in two series corresponding to *rosaria* and *esurialis*, but they insensibly intergrade. I can not see that Professor Smith demonstrates any difference between the male genitalia[a] beyond what is accounted for in difference of drawing and natural variation. On examining several specimens I see enough variation to account for the "much narrower harpes" of *esurialis* which Professor Smith notes.

Egg.—Two-thirds spherical, base flattened; ribs about 25, raised, moderately broad at summit, the spaces concave; cross-striæ fine, not raised, micropyle reticulate; pale yellow; diameter, 0.9 mm.

Stage I.—Head broad, bilobed, black, clypeus high, width, 0.3 mm. Body short, robust, normal, joint 12 enlarged, feet of joints 7 and 8 short. Translucent whitish, unmarked, reddish from the alimentary canal, cervical shield and thoracic feet blackish. Tubercles small, blackish, with long, pale, granular bulbous-tipped setæ, iv below the center of the spiracle; no leg shields; spiracles black rimmed.

Stage II.—Head round, shining transparent colorless, sordid on vertex; width, 0.5 mm. Body normal, feet of joints 7 and 8 small; whitish smoky shaded, especially along tubercules iii, defining a straight white dorsal line and traces of a wavy subdorsal one. Shields concolorous, tubercles rather large, blackish, setæ short.

Stage III.—Head rounded, shining sordid luteous, tubercles dark, a smoky violaceous, broad, curved band each side of clypeus and suture; width, 0.8 mm. Body normal, equal, feet of joints 7 and 8 short, 12 slightly enlarged dorsally. Dorsum violaceous brown, cervical shield luteous, sides darker brown, venter again pale. Dorsal

[a] Jour. N. Y. Ent. Soc., VI, 1898, pl. VII, figs. 7, 8, and 9.

and subdorsal lines narrow, pure white, dark brown edged, segmentarily narrowly broken. Substigmatal band white, filled with the ground color except at the edges. Tubercules small, round, black; setæ short; feet all pale sordid; shields not cornified.

Stage IV.—Head rounded, broad, slightly bilobed, shining pale luteous, scarcely mottled; width, 1.3 mm. Body robust, normal, joint 12 hardly enlarged, feet equal. Dorsal line white, narrow, pulverulent, dark brown edged; subdorsal space reddish flesh color, mottled, containing white tubercles i and ii with black hair dots. Lateral space dark brown, mottled, just inclosing above the narrow, broken, white subdorsal line. Substigmatal band broad, flesh color, with light white narrow edges; subventral space flesh color, mottled in brown and white. Feet all pale.

Stage V.—Head rounded, shining, pale, a heavy brown-black band each side of clypeus, vacuolated above; a band in clypeus; sides heavily reticulate; width, 2 mm. Body robust, even, joint 12 not enlarged, 13 truncate obliquely. Dorsum broadly pale, dotted in brown, especially centrally, where a heavy shade borders the subobsolete white dorsal line. Sides below tubercle ii deep velvety brown with a string of white powdering for the subdorsal line and a narrow lateral dilution. Substigmatal band broad, white on the edges, dark red-brown filled. Thoracic feet smoky, abdominal ones pale; tubercles white with black hair dots and short setæ; shields uncornified, concolorous.

Stage VI.—Head rounded, the apex slightly in joint 2, shining, pale ground overlaid with dark brown reticulations, vertical band very broad, black, whitish edged posteriorly; width, 2.6 mm. Body normal, feet equal, joint 12 slightly enlarged. Dorsum ocherous brown, dotted, reticulate, centered by a dark brown shade cut by white linear dashes, the remains of the dorsal line. Tubercles i and ii whitish with black hair dots. Sides dark velvety brown, reticulate, darkest subdorsally and stigmatally, cut very obscurely by the remains of the subdorsal line. Substigmatal band with white edges, filled with dark brown, like that of the subventral region, reticulate, whitish dotted; a subventral dilution. Thoracic feet brown, abdominal ones pale; spiracles yellowish white, black ringed; no shields.

Eggs, June 12; larvæ pupated, July 18; first moth, July 31.

NOCTUA CYNICA Smith, var. PERUMBROSA Dyar.

One hundred and seventeen specimens, July 21, 25, 27, August 5, 6, 7, 11. This is like the Eastern *rubifera* Grote and *cynica* Smith, but darker in color. Whether there are two species mixed, differing only in genitalia, as Smith claims to be the case with the Eastern forms, I do not know, as all those examined agreed with the figure of *cynica*. Some of the specimens run close to the obscure form of *rosaria*. We did not obtain the larva on account of the lateness of appearance of the moths.

NOCTUA OBLATA Morrison.

Sixty-six specimens, June 25, July 19, 24, August 4, 5, 7, 11, 12, 13, 17. The species is apparently double brooded. I could not obtain larvæ of the first brood, and those of the second hibernated before reaching maturity, so I am able to present only a partial life history. Stage vi remains to be described.

Egg.—Laid in a large patch. Two-thirds spherical, base well flattened, a little obliquely irregular. Ribs about 25, large, coarse, deeply cut, crowned by the vertical reticulations, the cross-striæ distinct and forming rectangular cells over twice as wide as high. Vertex quadrangularly reticulate around the elevated micropylar rosette. Waxy white, no change till hatching; diameter, 0.9 mm.

Stage I.—Head bilobed, brownish luteous. Body normal, joint 12 a little enlarged, feet of joints 7 and 8 small; whitish, cervical shield sordid with black spots. Tubercles round, black, distinct; feet pale; shields blackish.

Stage II.—Head bilobed, shining light brown with a few dark dots; width 0.5 mm. Body with joints 5–6 and 12 slightly enlarged, sordid pale in ground, heavily shaded with dark brown of the color of dead leaves. Dorsal and subdorsal lines white, broken, less distinct at the ends. Below spiracles sharply paler, no defined lines. Feet sordid; tubercles rather large, black; shields concolorous.

Stage III.—Head bilobed, the apex in joint 2, shining luteous, tubercles and front irregularly marked in brown, faint reticulations on the lobes; width 0.85 mm. Body moderate, a little smaller before, joint 12 enlarged, feet nearly equal. Pale brown washed with darker, forming dorsal oblique streaks from dorsal posterior to subdorsal anterior and covering nearly all the sides. Dorsal line pale, subdorsal white dotted, stigmatal broad, pale, its narrow edges nearly white; subventral area pale. Tubercles round, black; no shields; setæ fine, obscure; feet pale.

Stage IV.—Head as before, luteous below, brown on the vertex, tubercles dark; width, 1.1 mm. Dorsum pale brown, dark marbled, with a deep brown broken lattice. Dorsal and subdorsal lines dotted white, dark edged. Sides very dark, hardly a trace of lines, the substigmatal white edged, its filling like the subventral area, pale brownish. Feet pale; tubercles black; shields absent. An interpolated stage occurred in several of the larvæ between this and the next, with width of head of 1.4 mm.

Stage V.—Head rounded bilobed, shining pale brown with dark brown bands and reticulations; width, 2.1 mm. Body pale carneous brown, cervical shield concolorous, but with black points in a V-shaped row, a dorsal white line and subdorsal spot anteriorly. Dorsal dark lattice faint and broken, showing intersegmentally as geminate

shades edging a broken white dorsal line; a narrow transverse bar on joint 12. Sides dark, enveloping the pale subdorsal line; subventral region light brown like the dorsum, the edges of the substigmatal band showing yellowish, the filling rather reddish brown. Thoracic feet brown blackish; tubercles and spiracles black, not conspicuous. The dorsal line shows white anteriorly.

Stage VI.—(Not observed.)

NOCTUA C-NIGRUM Linnæus.

Thirty-four specimens, July 21, August 1, 3, 5, 7, 11, 16, 17, 18. We did not attempt to breed this well-known species.

NOCTUA FENNICA Tauscher.

One specimen, August 7.

NOCTUA PLECTA Linnæus.

One specimen, June 20.

NOCTUA UNICOLOR Walker.

Two specimens, June 30, July 8.

NOCTUA SIERRÆ Harvey.

Three hundred and eighty-nine specimens, June 23, 25, July 8, 14, 19, 25, 29 (Bear Lake), 31, August 1, 2, 5, 7, 11, 17. This is probably not more than a local race of *haruspica* Grote. It is darker and the hind wings are a little more silky grayish. It may not be distinct from *inopinatus* Smith, which name it bears in Mr. Cockle's collection. Smith's types came from different faunal regions. The "*inopinatus*" from Corfield, Vancouver, are probably normal *sierræ*, and I would prefer to reserve the name *inopinatus* for the smaller form inhabiting the high prairies, typified by the Winnipeg, Manitoba, specimens. Eggs were obtained from captive females, but the larvæ hibernated, and only the most active ones were forced to stage v in September, so that the last stage remains to be described.

Egg.—Three-fourths spherical, rather high, the sides straightened, base flattened narrowly, vertex smooth. About 35 ribs, diminishing to 11 at the vertex, low, broad, but with linear crests and fine distinct cross-striæ, forming rectangular cells wider than high. Vertical reticulations elongate radially. Pale greenish white, no change before hatching; diameter, 0.9 mm.

Stage I.—Head rounded bilobed, blackish brown. Body moderate, normal, joint 12 enlarged, feet of joints 7 and 8 small. Whitish colorless, tubercles large, smoky black, cervical shield and bases of the feet similar, the tips clear; no leg plates. Setæ long, brown, pointed; skin sparsely dark granular.

Stage II.—Head shining brown, darkly shaded above and in clypeal sutures; width, 0.5 mm. Cervical shield dark brown; body moderate, equal, dark green dorsally, pale subventrally; dorsal line white, divided into two round spots to each segment; subdorsal dotted, lateral a trace; stigmatal band faint, indicating the boundary between the dorsal and ventral shades of green. Tubercles large, round, black; feet pale.

Stage III.—Head dark shining brown, slightly reticulated, mouth pale; width, 0.8 mm. Body moderate, dorsum dark brown, subventer pale vinous tinted. Dorsal line white, segmentarily subbimaculate; subdorsal dotted, stigmatal narrow, white, dividing the dorsal and ventral colors. Tubercles v and vi black blotched. Thoracic feet and leg plates black. Tubercles obscure; setæ pale.

Stage IV.—Head rounded, shining brown with black reticulations and bands; width, 1.2 mm. Body with joint 12 slightly enlarged, dark brown, shaded solidly along the sides. Dorsum and subventer pinkish brown; dorsal and subdorsal lines dotted only, mixed with other white dots. Upper edge of the stigmatal band white, the rest like the subventral area. A cuneiform brown subdorsal patch on joint 12. Tubercles small, black, partly white ringed; thoracic feet brown, abdominal ones pale.

Stage V.—Head rather high, rounded, the apex in joint 2, shining light pinkish brown with broad black band from base of clypeus to apex of lobe, joined by fine black reticulations, a patch before ocelli and narrow band behind; width 2.2 mm. Body moderate, normal, joint 12 scarcely enlarged. Olivaceous gray, finely black peppered and penciled on an olivaceous lilaceous ground. Dorsal line a faint pale streak, widened into a pale yellow spot posteriorly on the segments; subdorsal line a row of small yellow dots, with one at tubercle ii and anteriorly on the segment just above it; dorsal space evenly peppered, a little darker intersegmentally on the dorsal line; the subdorsal cuneiform black spot on joint 12 forms a narrow velvety bar, constricted centrally, but not divided. Subdorsal line continuous on joints 12 and 13, pale yellow; on the anterior edge of the cervical shield carneous tinged. Sides evenly peppered, violaceous washed below; substigmatal line moderate, even, its upper edge forming a narrow pale yellow line, waved, black-edged above, its lower edge fainter but similar, filled with brownish dots like the subventral area, a little more reddish than that, and both on a violaceous ground. Thoracic feet light brown, abdominal pale; venter whitish; tubercles obscure; setæ moderate.

Stage VI.—(Not observed.)

PRONOCTUA PYROPHILOIDES Harvey.

One specimen, July 25, and one from Mr. Cockle's collection, referable to the Californian form *pyrophiloides*. A large pinkish well-marked form occurs in Colorado (*typica* Smith) and a smaller pinkish lightly marked form in southern Utah (*peabodyæ* Dyar).

CHORIZAGROTIS AUXILLARIS Grote.

One specimen, September 8 (Glacier).

CHORIZAGROTIS AGRESTIS Grote.

Two specimens, August 9 (Kokanee Mountain, Mr. W. R. Allen), 10 (Kokanee Mountain, on the Glacier). This, with the preceding, which are doubtlessly only forms of one species, would seem to be wanderers from another faunal region. The species is very common throughout the plains and in the foothills of the Rocky Mountains to the south, and it is to be noted that they were only taken in the Kootenai district at high altitudes, or trapped on snow, probably while migrating.

RHIZAGROTIS FLAVICOLLIS Smith.

Five specimens, July 18, August 1, 3, 4, 5. This species has the appearance of a *Paragrotis* of the *flavidens* group, but the antennæ of the male are bristled and ciliate only, not serrate. Smith defines *Rhizagrotis* from *Paragrotis* in that the former has the male antennæ "simple or ciliate only," the latter "pectinate or serrate and bristled." While *flavicollis* does not conform exactly with either, it is probably best referred to *Rhizagrotis*, from the absence of the serrations.

FELTIA SUBGOTHICA Haworth (JACULIFERA Guenée).

One specimen, August 13.

FELTIA HERILIS Grote.

One hundred and sixty-three specimens, July 14, 19, 25, 30, August 3, 6, 17, 18, 20 (West Robson). They vary but little. After seeing this excellent series I am convinced that this is a distinct species, not a variety, as given in Bulletin No. 52, U. S. National Museum. The nomenclature there adopted may be amended so as to recognize three species.[a] In Bulletin No. 38, U. S. National Museum there is an error in the synoptic table on page 111. It should be *herilis* which has the short branches to male antennæ, not *tricosa* (*jaculifera* of the table) as there given. The life history was observed.

[a] See also Grote, Can. Ent., XXXV, 1903, p. 258, and Hampson, Cat. Lep. Phal. Brit. Mus., IV, 1903, pp. 343–346.

FELTIA VANCOUVERENSIS Grote.

Seventy-five specimens, May 31, June 5, 13, 16, 25, July 2, 28 (Bear Lake Mountain). Somewhat variable in color and the distinctness of the markings. Eggs were freely laid by captive females.

Egg.—Laid singly, adherent, pressed under objects in the jar. Nearly spherical, the basal half spheroidally flattened. Ribs about 40, low, not short, diminishing toward vertex. Reticulations all over surface, forming crests to the ribs and cross-striæ between, moderate, not sharp; all granular shagreened; area about the micropyle reticular, the micropyle itself a raised cone with circle of pyriform cells. Pale yellow, later with a broken red ring and spot; diameter 0.9 mm.

Stage I.—Head rounded bilobed, wider than high, clypeus high; black, epistoma and antennæ whitish. Body colorless whitish, green from the food, shields and tubercles blackish. Cervical shield moderate with two detached setæ; tubercles not large, setæ pale with bulbous tips, iv above the center of spiracle. Thoracic feet blackish.

Stage II.—Head rounded bilobed, shining black; width, 0.4 mm. Body robust, cylindrical, joint 12 not preceptibly enlarged. Sordid greenish white with faint marks of brown, washed longitudinally. Cervical shield and plates shining black; feet of joints 7 and 8 small. Tubercles round, black; setæ short, distinct. Thoracic feet dusky.

Stage III.—Head rounded quadrate, shining black, sutures pale; width 0.6 mm. Body sordid brown, the green showing a little, dorsal, subdorsal, and lateral lines fine, whitish, obscure; substigmatal line broad, pale; subventer more greenish. Cervical shield large, semicircular; tubercles moderate; anal plate and leg shields shining black. Feet of joints 7 and 8 still small.

Stage IV.—Head rounded, broad, brown below, the vertex black, black dots on face and a patch on eye; width 0.8 mm. Body dark sordid brown, the ordinary lines showing a shade paler, dark edged. Tubercles rather large, brown black; shields smoky; setæ short, pale, slightly enlarged at the tips.

Stage V.—Head round, solidly brown black over lobes, clypeus and area about eyes pale, sordid; width 1.2 mm. Body moderate, uniform, joint 12 scarcely enlarged. Dark sordid brown, a pale subdorsal band, contracted at the incisures indicates a broad pale dorsal area, nearly filled with dark brown; dorsal line pale, obsolete. Sides dark, the stigmatal region paler, lateral line obsolete. Tubercles rather large, round, black; cervical shield large, shining brown black; setæ short.

Stage VI.—Head as before, width, 1.7 mm. Joint 12 scarcely enlarged. The pale dorsal space is now distinct with central diamond-shaped marks. Sides dark, lateral line indicated. No other distinct

markings. Cervical shield large, dark with pale bisecting line. The spiracle and tubercle iv together show as a black spot.

Stage VII.—Head 2.8 mm. Cervical shield shining black with pale dorsal and subdorsal lines. Dorsal space pale with faint diamond-shaped marks. Sides nearly black, lighter streaked above and on subventral fold. Tubercles large, black, shining. Head brown, reticulate in black with the usual vertical bands.

FELTIA VOLUBILIS Grote.

One specimen, June 19. This seems to me only an extreme form of *vancouverensis*.

FELTIA ÆNEIPENNIS Grote.

Three specimens, June 16, 23, July 2, which I refer with some doubt to this species. They are not of the faded brown which is usual, but the colors are darker and more contrasted. On the other hand they are smoother than *vancouverensis* and less contrastingly marked.

Egg.—Spheroidal, the base narrowly flat. Ribs about 40, diminishing by alternation at upper third, crowned and separated by the vertical reticulations, which with the cross-striæ form nearly square cells, rather faint, not raised. The ribs bend at the edge of vertex and become smaller, but run right to the micropyler elevation with its circle of pyriform cells. Pale yellow; diameter, 0.8 mm.

Stage I.—Head round, bilobed, shining black; cervical shield black. Body robust, short, joint 12 not enlarged, feet of joints 7 and 8 short. Tubercles round, black, normal, elevated, setæ long, pale at tips, with enlarged glandular ends. Body sordid whitish, unmarked.

Stage II.—Head bilobed, the lobes blackish, sutures and clypeus pale; width, 0.45 mm. Cervical shield semicircular, black, as also the anal plate, tubercles, and thoracic feet. Body robust, short, joint 12 not enlarged, pale green, no marks; abdominal feet pale. The larva is sluggish and fat, a little narrowed at the ends.

Stage III.—Head full, sordid whitish, the apices of the lobes smoky; tubercles dark; width, 0.6 mm. Body short, robust, a little flattened, pale, shaded with brown, leaving dorsal subdorsal, lateral, and broad stigmatal bands of the ground color, brown edged. Cervical shield smoky, trilineate in pale. Tubercles rather large, blackish, slightly elevated; setæ pale, minutely bulbous tipped; feet of joints 7 and 8 still short.

Stage IV.—Head rounded, the apex in joint 2, pale brown, a large, dark brown mark on the face of each lobe; width, 1.1 mm. Body robust, quadrangularly flattened, joint 12 gently enlarged. Sordid brown; dorsum broadly pale to tubercle ii, with faint indications of lattice marking. Sides dark, inclosing very narrow, scarcely percep-

tible, whitish subdorsal and lateral lines. Subventral area sharply paler, but sordid, not greatly contrasted. Tubercles large, black, shining; cervical shield black, a dorsal pale line and diffuse subdorsal one; leg plates pale; setæ fine.

Stage V.—Head half retracted in joint 2, dark brown, clypeus pale; width, 1.8 mm. Body moderate, joint 12 slightly enlarged; dorsal space broadly pale, with dorsal geminate darker lines, scarcely any indication of the lattice, brown dotted. Sides dark, with obsolete subdorsal and lateral pale lines; subventral area pale, feet still paler. Cervical shield large, shining black, with faint paler dorsal and subdorsal lines. Tubercles round, black; setæ short, pale.

Stage VI.—Head rounded, the apex well within joint 2, light brown, with dark reticulations and vertical bands; width, 2.5 mm. Cervical shield shining brown, diluted in spots and with three pale lines; width, 2.5 mm. Body equal, joint 12 scarcely enlarged. Dorsum broadly pale flesh color, dotted; dorsal line pale with diffuse dark edging, sides dark dotted, subventer and venter pale; feet also pale. Tubercles large, black, round, radially grooved; setæ moderate, dusky.

POROSAGROTIS CATENULA Grote.

Eight hundred and sixty-six specimens, July 16, 25, 27, 31, August 4, 6, 7, 13, 15, 17. They run much darker than the form from Colorado and southern California, but a few are almost as light, and I think a racial name not necessary. The color is stone gray in the majority. The transverse-posterior line is continuous, finely and strongly scalloped, with white points on the veins. The variation is thus all away from *retusta* Walker (=*murænula* Grote and Robinson), and I do not think it a form of that species.

POROSAGROTIS THANATOLOGIA, new species.

No specimens; one in Mr. Cockle's collection is a female without abdomen. The specimen is labeled *Paragrotis reuda* Strecker, but does not agree at all with Hampson's figure or Strecker's description. Moreover, the spines on the fore tibiæ are so stout that the species seems referable to *Porosagrotis* rather than to *Paragrotis* (*Euxoa* of Hampson and Smith).

Head, collar, and thorax uniformly dark mouse gray. Fore wings elongated, much as in *Chorizagrotis*, light gray basally and terminally, the whole median space blackish, discolorous. Basal half line geminate, black, broken; a black basal dash, dislocated and widened beyond basal line, reaches nearly to transverse-anterior line. Lines geminate, crenulate, not strongly defined, the pale filling forming a costal spot for each. Transverse anterior nearly straight, transverse posterior moderately arched over reniform. Orbicular circular, reniform upright, well concave without, pale and narrowly black ringed, the

orbicular dusky filled, the reniform with concentric dusky line; claviform black outlined, dark filled. Subterminal line pale, dentate moderately, with black cuneiform dashes preceding it, especially at interspaces 2–4 and 5–7; a dusky subapical shade. Terminal space blackish like the median space; fringe brownish. Hind wings brownish with white fringe. Expanse, 40 mm.

Type.—Cat. No. 7882, U. S. National Museum.

PARAGROTIS MAIMES Smith.

One specimen, September 9 (Field). The species much resembles *Rhizagrotis flaricollis* Smith, but differs in the color of the thorax and in the generic character of having the male antennæ shortly serrate. My single specimen from Field agrees with one kindly sent me by Mr. F. H. Wolley Dod, from "Head of Pine Creek," near Calgary, Alberta. It should be noted that Mr. Dod's collection about Calgary may cover two faunal regions. Calgary itself is in the prairie, and shows such a fauna as would be expected, while the locality "Head of Pine Creek" must be in the foothills of the Rocky Mountains, judging by the species sent out with this label.

PARAGROTIS BROCHA Morrison.

Thirty-seven specimens. July 30, August 3, 4, 5, 6, 11, 12, 13, 15, 16, 17.

PARAGROTIS PUNCTIGERA Walker.

Eight hundred and eighty-eight specimens. July 19, 21, 25, 27, August 5, 6, 7, 12, 13, 17, and three from Mr. Cockle's collection, July 25, 1901, July 25, 1902, August 1, 1902. The mass of the specimens fall between *pastoralis* Grote and *finis* Smith. These are the extreme forms. The series, when once sorted out, looks homogeneous and uniform, though varying greatly in the amount of yellow powdering on the lines and spots. The black line on the collar comes out more or less distinctly, destroying the value of this character in separating species. The hind wings are dark brown in both sexes. I think *loya* Smith is a variation of this type and perhaps some others that now stand as good species. Mr. Cockle's specimens before me are undersized and with very little of the characteristic powdering, and, without this series, I should never think of referring them to *punctigera*. They come extremely near to the brown form of *focinus* mentioned below. A well-marked specimen in Mr. Cockle's collection has been named *compressipennis* Smith, but it does not appear to me to agree with the type of that form which is before me. A brownish specimen, also in Mr. Cockle's collection, has been named *friabilis* Grote [*focinus* Smith, was meant, probably], but it does not agree with Hampson's figure and description of that form, which is otherwise

unknown to me.[a] Eggs were obtained from captive females, but with difficulty, and they did not prosper. Many remain unhatched, and what larvæ appeared were weak and did not proceed far.[b]

Egg.—Spheroidal, symmetrical, base not more flattened than vertex; sculpturing obsolete. Under a lens the ribs are faintly shadowed, thick, diminishing above; but under 87 diameters' magnification they are evanescent, only faint, rounded reticulations showing over the surface. Micropylar rosette rather distinct. Pale ocherous; diameter, 0.8 mm. Laid in groups, strongly adherent.

Stage I.—Head rounded, brown, eye black. Body whitish colorless, shields and tubercles concolorous, obscure; setæ moderate, pale. Feet of joints 7 and 8 a little shortened.

Stage II.—Head round, black; width, 0.5 mm. Cervical shield blackish. Body moderate, equal, brown, the incisures lighter; dorsal, subdorsal, and lateral lines and a broad stigmatal one whitish; dorsal space reddish brown, the lines dark edged, the edging at tubercle ii giving a slight effect of subdorsal patches. Sides dark filled between the lines. Substigmatal line distinct, whitish, and succeeded by a dark subventral area. Tubercles and setæ dark, obscure.

PARAGROTIS TRIFASCIATA Smith.

One specimen, which I believe represents this species, described from a single female specimen from Mount Hood, Oregon. My specimen is a male, but agrees well with the description and a colored figure in the National Museum made by Professor Smith, except for being darker in tone.

PARAGROTIS PEREXCELLENS Grote.

No specimens; one in Mr. Cockle's collection, August 14, 1901, erroneously labeled *ridingsiana* Grote, is evidently a straggler from the coast region, where the species is common.

PARAGROTIS FOCINUS Smith.

One hundred and six specimens, July 19, 24, 25, August 5, 6, 11, 16, and two from Mr. Cockle's collection, July 1, of a uniformly brownish tone, which I refer here as extreme forms. A few of those in my series are like them. Another specimen from Mr. Cockle's collection has been named *fuscigera* Grote, but does not agree with a specimen before me determined by Grote in 1870.

[a] Cat. Lep. Phal. Brit. Mus., IV, 1903, p. 249.

[b] As this is in press (April 9, 1904) the eggs have begun to hatch.

PARAGROTIS TERRENUS Smith.

Six specimens, August 5, 6, 18, separated from the *fulda* series, agree with the type of *terrenus*. The hind wings are dark, and the differences between this and *messoria* are not clear to me. A specimen in Mr. Cockle's collection has been named *neotelis* Smith, but lacks the purplish tint of that form and is obviously wrongly identified.

PARAGROTIS FULDA Smith.

Thirty-five specimens, August 6, 12, 13 (Sandon, Mr. Currie), 16, 17, 21 (Revelstoke). Those with the markings most obsolete agree with the type of *fulda* Smith; the majority are marked distinctly like *messoria* (=*territorialis* Smith). I should refer this series to *messoria*, except that the hind wings are generally whitish where in *messoria* they are overspread with brown. A specimen in Mr. Cockle's collection is identified as *tessellata* Harris and another as *baliniti*s Grote, but neither identification is correct when compared with the specimens in the U. S. National Museum.

PARAGROTIS RUBEFACTALIS Grote.

Three specimens, July 14, 27, August 17, and one from Mr. Cockle's collection. They are not very much alike, and the females are doubtfully referred here. The male agrees with specimens that I have from Pullman, Washington, under this name.

PARAGROTIS INCALLIDA Smith.

Twenty-seven specimens, July 2, 29 (Bear Lake Mountain), 30, August 3, 4, 6, 7, 11, 12, 13 (Sandon, Mr. Currie), 15, 16, 17. Distinctly variable, running to a smooth, obscure form, with the maculation nearly lost. Before I was acquainted with the character of the Kootenai fauna I had named such an obscure specimen, which Mr. Cockle sent me, as *vulpina* Smith, thinking it probably conspecific with this apparently neighboring species (*vulpina* was described from Calgary, Alberta). However, it really belongs with *incallida*, described from the mountains of California. I do not see that *lutulenta* Smith or *quinquelinea* Smith are more than varieties of *incallida*. If this is correct, the species must be known as *quinquelinea*, as that name has priority by a page.

PARAGROTIS ALTICOLA Smith.

One specimen, August 18. It is darkly colored, the fore wings blackish brown, somewhat bronzy. The characteristic appearance of *alticola* is not shown, but I nevertheless refer the specimen here as a varietal form. It is not in perfect condition.

PARAGROTIS GAGATES Grote.

No specimens; one from Mr. Cockle's collection, less reddish in color than my Californian specimens.

PARAGROTIS DECOLOR Morrison.[a]

Three hundred and sixty-three specimens, July 24, 25, 26, 27, August 3, 5, 6, 11, 12. A very variable species. A specimen in Mr. Cockle's collection has been labeled *Chorizagrotis inconcinna* Harvey, perhaps by an accidental transposition of labels.

PARAGROTIS ALBIPENNIS Grote.

No specimens; two in Mr. Cockle's collection, September 4.

PARAGROTIS OCHROGASTER Guenée.

Seven hundred and eighteen specimens, July 4, 19, 24, 25, 27, August 1, 3, 5, 7, 12, 16, 17, 21 (Revelstoke). Very variable and running into three rather definite forms, a light clay yellow one (var. *illata* Walker), a uniform dark brown one (var. *turris* Grote) and a diversified, strongly marked one, which may be taken as the stem form. Several of the extreme forms were taken in copula, so there is no doubt of the specific identity of all. A large, brown, strongly marked female in Mr. Cockle's collection has been named *gagates* Grote, but it does not agree with the form so named in the National collection.

PARAGROTIS IDAHOENSIS Grote.

Five specimens, July 14, 25, August 3, 5, 11. One specimen has the costa and spots pale gray, as in my figure of the type. The others have this color replaced by a lightened shade of the reddish ground color, a little touched with gray.

PARAGROTIS OBELISCOIDES Guenée.

Thirty-three specimens, August 6, 11, 12, 15, 16, 17.

PARAGROTIS REDIMICULA Morrison.

One specimen, August 13.

PARAGROTIS COLATA Grote.

One specimen, August 13 (Sandon, Mr. Currie). It agrees with one that I have under this name from the Yellowstone Park, Wyoming.

[a] Hampson changes entirely the synonymy of this species, which is No. 1707 in Bulletin 52, U. S. National Museum. He refers all four of the Walker names to other species and refers the variety also elsewhere, leaving only *decolor* Morrison = *campestris* Grote as names for this form. This is in contradiction to Smith's previous determinations of Walker's types.

PARAGROTIS DIVERGENS Walker.

One hundred and twenty-nine specimens, July 21, 27, 31, August 5, 7, 16, 17. Two eggs were obtained from a captive female, but were lost on hatching. I have described the mature larva elsewhere.[a]

Egg.—Nearly spherical, base scarcely flattened. Ribs about 44 around the margin, diminishing angularly by confluence, narrow, almost linear, low, the surface flat between them, joined by weak, narrow cross striæ forming square cells. Vertex obsoletely quadrangularly reticulate, smaller at the micropylar rosette, which is not raised. Waxy white; diameter, 0.7 mm.

PARAGROTIS PINDAR Smith.

Five specimens, August 11, 13, 21 (Revelstoke), and one from Mr. Cockle's collection September 6, 1902. The tone is a little grayer than in Smith's type from Utah, making the costal edging less contrasted. The markings, however, are the same.

PARAGROTIS PLAGIGERA Morrison.

No specimens. One in Mr. Cockle's collection is so named, and I leave it here with some hesitation. It is brightly marked with ashen whitish; the orbicular is large and very oblique, and altogether it is rather unlike what I have as *plagigera*. Without a series, however, no certain conclusion can be arrived at.

ANYTUS EVELINA French.

No specimens. A female in Mr. Cockle's collection was taken September 18, 1901. This species has stood hitherto in our lists as an *Hadena*. I transfer it to *Anytus*, following Sir G. F. Hampson.

ANYTUS SCULPTUS Grote, var. PROFUNDUS Smith.

Two specimens, September 7 (Revelstoke), Sandon (G. C. Robbins), and one from Mr. Cockle's collection September 19. The specimen agrees with Smith's type of *profundus*, from Brandon, Manitoba. The form is a dark Western variation of *sculptus*, which is usually light, though I have one from Holderness, New Hampshire, nearly as dark as the Western ones. The name *obscurus* Smith does not deserve even a varietal rank, the male type before me being only a slightly rubbed and indistinctly marked specimen of the variety *profundus*. The specimens which I associate as female *profundus* are grayer than the males, with the hind wings darkly shaded.

[a] Proc. Ent. Soc. Wash., IV, 1898, p. 318.

MAMESTRA DISCALIS Grote.

Eighty-six specimens, June 23, 30, July 13, 30, August 3, 5, 6, 7, 11, 13, Sandon (G. C. Robbins). Eggs were obtained from several captive females. The larvæ did well at first, but soon showed a tendency to hibernate. Many were actually hibernating at Kaslo on August 12, and only a few were with difficulty forced to the fifth stage. The last stage therefore remains to be described.

Egg.—Two-thirds spherical, evenly rounded, base broad; laid in a large mass. Ribs about 40, low, broad, diminishing to vertex, crested by the sharp vertical reticulations which are, like the cross striæ, distinct, forming regular parallelogramic cells bending down in the hollows. Greenish white, not changing color; diameter, 1.1 mm.

Stage I.—Head bilobed, round, pale brownish, with smoky black spots at the tubercles. Body moderate, normal, joint 12 enlarged, the feet of joints 7 and 8 smaller than the rest, but not greatly so. Whitish, without marks, cervical shield very weak, partly smoky. Tubercles large, brownish black, angularly edged, only the primary ones present, iv stigmatal posterior, ia to iib of thorax separate, iib the largest, all normal. Leg shields faintly dusky.

Stage II.—Head bilobed, shining pale brown with round black spots on the tubercles; width, 0.8 mm. Body moderate, joints 5 to 7 looped up a little, 12 enlarged; whitish green, the folds whiter; dorsal and subdorsal lines faint white, straight; lateral space solidly brown filled; stigmatal band just over tubercle iv, very broad; a soft white shading over subventral area. Feet pale; tubercles round, black; feet of joints 7 and 8 small. Cervical shield concolorous, but without green tint, its tubercles black; abdominal feet dusky without.

Stage III.—Head shining reddish brown, reticulate with darker on the vertex; diameter, 1.1 mm. Body equal, joint 12 a little circularly enlarged. Sordid olivaceous green, checkered by very pale subdorsal patches intersegmentally; dorsal and subdorsal lines broken, narrow, the dorsal bimacular, the subdorsal dotted, bright white. Sides all vinous brown, olivaceous mottled. Substigmatal band with white edges, green filled; subventer and feet pale. Tubercles round, black, distinct; no shields; setæ moderate, pale; feet of joint 7 rather small.

Stage IV.—Head brown with dark brown reticulations; joined into the usual vertical bands; width, 1.7 mm. Body normal, joint 12 scarcely enlarged, feet equal. Brown gray, black dotted reticulate on a brownish ground, especially in a dorsal band of diamond-shaped marks and laterally. Dorsal line white, cut into two segmental streaks, the posterior one with a small macular enlargement; subdorsal line a row of fine dots, the space above it and between the dorsal marks lighter. Substigmatal band with white dotted edges, nearly entirely luteous filled. Subventral area luteous, white and black dotted; venter

greenish. Feet pale, with dark tubercular spots; no shields; tubercles obscure; setæ fine brownish.

Many larvæ hibernated at this point. An interpolated stage also occurred with width of head of 2.1 mm.

Stage V.—Head rounded, bilobed, the apex in joint 2; shining red brown, with dark brown reticulations and vertical bands, the bands irregularly bent inward above clypeus; width, 2.5 mm. Body moderate, joint 12 slightly enlarged. Dead leaf brown, the ground pinkish brown, finely penciled in black. A broad, diffuse lining surrounds the dorsal line which is composed of two white dots posteriorly on the segments and a fine tracing elsewhere, and throws out a faint spur at tubercle ii. The subdorsal space shows the ground color. Sides with obscure oblique lines and outlinings of the substigmatal band in black. Lines else obsolete, the substigmatal with scarcely any pale ground and only a trace of white at its edges. Thoracic feet shining brown; shields and abdominal feet concolorous with body; tubercles and setæ obscure.

Stage VI.—(Not observed.)

MAMESTRA PURPURISSATA Grote, var. CRYDINA Dyar.

Twenty-one specimens, June (Mr. Cockle), June 30, July 2, 8, 14, 18, 19, 27, 30, August 1, 5, 6, 13. This is a racial form, approaching *juncimacula* Smith in some characters. Eggs were obtained from captive females before the middle of July, and the resulting larvæ were inclined to hibernate on August 15. However, some were forced to the last stage.

Egg.—Laid in a large patch; spheroidal, the top roughened by the ribs. Ribs about 36 at the margin, diminishing to 11 at the micropyle, large, coarse, low and rounded. Surface smooth, irregularly shagreened, traces of long cross striæ between the ribs. Micropylar rosette of pyriform cells contrasted with the otherwise smooth surface; pale yellow, later with a dark-brown ring and spot; diameter, 1.1 mm.

Stage I.—Head rounded, bilobed, rather high, pale brown, spotted thickly with darker brown and a pale streak above. Body slender, moderate; joint 12 slightly enlarged, the feet of joints 7 and 8 very small. No cervical shield, but distinct blackish leg shields. Tubercles round, black; not black on the shield, which has dusky spots behind. Body white, with faint ocherous brown stripes, subdorsal (between tubercles i and ii), lateral, lower lateral (tubercle iii); substigmatal band broadly white pigmented; subventer less whitish; setæ rather long, black; thoracic feet smoky; anal feet, with white stripe outwardly.

Stage II.—Head rounded, the apex in joint 2, smoky luteous, with dark spots on the tubercles; width, 0.6 mm. Body with a green dilution in the dorsal space each side of the pale dorsal line, the rest of the ground dark vinous brown. Subdorsal line whitish, lateral fainter; substigmatal broad and bright white, venter paler. Feet pale, with

smoky plates, those of joints 7 and 8 small; tubercles minute, black; no shields.

Stage III.—Head oblique, bilobed, shining brown, faintly darker dotted; width, 1 mm. Body rather slender, joint 12 a little enlarged. Brown, dorsal, subdorsal, and lateral lines fine, white, together with the white tubercles i and ii dark edged, the edging of the dorsal line submacular intersegmentally. Substigmatal band moderately broad, bright white, with a few brown dottings centrally. Feet pale; no shields.

Stage IV.—Head oblique, the apex in joint 2, pale brown, with dark reticulations and the usual vertical bands, pale below; width, 1.4 mm. Body moderate, normal, a little flattened; joint 12 enlarged. Pinkish brown, shaded with dark and whitish dotted. Dorsal lattice faint; dark intersegmentary spots dorsally; dorsal, subdorsal, and lateral lines white, dotted, dark edged. Tubercles white; substigmatal band broad, pure white, partly luteous brownish filled. Subventer like dorsum; feet pale; setæ pale, moderate; cervical shield of a more luteous shade.

An interpolated stage occurred with width of head 1.6 mm.

Stage V.—Head as before; width, 2.2 mm. Body moderate; joint 12 slightly enlarged. Dorsum creamy brown, dorsal and subdorsal lines white dotted, a faint dark-brown lattice and edging to the dorsal line. Sides darker, brown reticulate, white dotted. Substigmatal band resolved into white spots, filled by the ground color; subventer like dorsum; venter pale. Tubercles white, not large; setæ small. Cervical shield more sordid.

Stage VI.—Head rounded, the apex in joint 2, shining brown, faintly darker reticulated and with traces of the bands above, forming a dark shade; width, 3.2 mm. Body moderate, joint 12 scarcely enlarged, all grayish brown, the markings obsolete, marbled and dotted in blackish. Dorsum faintly broadly pale carneous, the black shaded edgings of the dorsal line showing faintly intersegmentally. Substigmatal band brighter and obscurely white, the other marks scarcely traceable. Tubercles whitish with black hair dots; feet pale; spiracles black edged; cervical shield concolorous, but rather more blackish in shade.

MAMESTRA SEGREGATA Smith.

No specimens; two in Mr. Cockle's collection, May 14. This species is obviously variable and a good series is needed. Neither of Mr. Cockle's specimens are like the type before me, though I think they are the same species without doubt; *gussata* Smith seems to be only a variety of it.

MAMESTRA DETRACTA Walker.

Forty-four specimens, June 13, 17, 19, 23, 25, July 2, 8, 19. The color is dark as in *neoterica* Smith, the size large as in typical *detracta* Walker. We have here a local form, differing so slightly as not to be worthy of a separate name, yet constant. The Atlantic region *detracta* is large, the colors rather diversified and contrasted; the Western prairie form *neoterica* is small with the colors smoother and less diversified, while the Kootenai form is again large but smooth and dark like the priarie one. Eggs were obtained early, but the larvæ grew very slowly and none pupated, all hibernating at various stages of growth. All the stages were observed.

Egg.—Nearly spherical, the apex a little pointed, base scarcely flattened; whitish with streaked red ring and spot. Ribs moderate with reticulation lines running along the vertices which, with the cross striæ, form quadrangular cells; ribs about 40 at the edge; micropyle conically elevated, bearing a circle of pyriform cells surrounded by reticulations; diameter, 1 mm.

Stage I.—Head bilobed, bright brown with darker sutures; width, 0.4 mm. Body robust, normal, joint 12 a little enlarged, feet nearly equal. Whitish slate color, the hemispherical shield with the leg plates and small tubercles black. Skin rather densely dark spinulose; setæ fine, pale, moderate.

Stage II.—Head rounded, bilobed, pale brown, a smoky shade on paraclypeus, eyes black; width, 0.6 mm. Cervical shield shining black. Body robust, joint 12 anteriorly enlarged, feet nearly equal. Soft pale brown, vinous shaded, without lines. Tubercles round, blackish; anal plate large blackish but no leg plates; thoracic feet pale; setæ short, pale.

Stage III.—Head shining pale brown, a smoky upright shade and traces of reticulations; width 0.75 mm. Body robust, pinkish red; dorsal and subdorsal lines narrow, white, the dorsal macular on the posterior edges of the segments; traces of a white substigmatal band intersegmentally. Cervical shield large, black, rather broadly trilineate in white; anal plate similar; leg shields and tubercles brown black, the latter round, moderate. Setæ obscure dusky; joint 12 slightly enlarged.

Stage IV.—Head bilobed, shining pale brown with heavy reticulations and broad, vertical bands of dark brown; width, 1.2 mm. Cervical shield black with three white lines. Body robust, joints 2–4 smaller, 12 enlarged. Dead leaf brown, red-brown reticulate on a pale luteous ground; dorsal and subdorsal lines narrow, whitish, the dorsal distinct on joints 12 posteriorly to 13, and cutting the black anal plate. No substigmatal or subventral bands, the venter sordid, pale. Tubercles small, round, black; feet pale; setæ obscure.

This stage lasted 41 days.

Stage V.—Head shining, heavily black reticulate on a brown ground, rounded, the apex in joint 2; width, 1.6 mm. Body robust, joint 12 enlarged, a little narrower before. Soft red brown, finely uniformly dotted reticulate in paler. Dorsal line narrow, white, submaculate except at the ends; subdorsal similar, obsolescent anteriorly, a faint darker brown edging to the dorsal line. Substigmatal band obsolete, showing as a slightly lighter shading over the subventral fold. Cervical shield shining black, slightly elevated. Thoracic feet brown; leg shields quadrate, black.

Stage VI.—Head shining black, luteous dotted above and more so on the sides; clypeus and labrum paler, violaceous; apex in joint 2; width, 2.6 mm. Body robust, short, joint 12 scarcely enlarged, flattened ventrally. Cervical shield large, shining black with three broad distinct white lines. Anal plate similar but only the dorsal line distinct. Thoracic feet brown. Body dead leaf brown, reddish brown, broadly mottled on a pale carneous ground, which contrasts under a lens. Dorsal lines carneous white, broken dotted, subdorsal similar but nearly continuous, subconfluent with the pale ground above; below it a nearly solid brown space; then the sides more mottled with the pale ground color which is more whitish subventrally, but all other trace of the lower lines is lost. Tubercles brown, corrugated, rather large, not elevated. Feet with shining brown shields. Tubercle iv above the center of the spiracle on joints 9 and 10.

MAMESTRA SENATORIA Smith.

No specimens; one in Mr. Cockle's collection, August 20, agrees very nicely with this Arizonian species. The distribution is unexpected.

MAMESTRA LIQUIDA Grote.

Three specimens, June 3, 30. Two males brightly colored, one female with the colors subdued and diffused, but the same species, I think.

Egg.—Two-thirds spherical, spheroidally flattened, base flat, the ribs forming lumps at the vertex. Ribs about 35, diminishing above, capped and separated by the vertical reticulations with which the equally distinct cross striæ form nearly square cells, clear, the angular joinings suggesting as mass of soap bubbles. Vertex reticulate for two rows of cells with a small circle of pyriform ones at the micropyle. Slightly yellowish white; diameter, 0.9 mm.

MAMESTRA RADIX Walker.

Three specimens, June 23, 25. In spite of so few specimens being taken, five separate broods of the larvæ were raised. Two of the captured specimens were females and readily laid eggs; two egg masses

were found in the field on separate occasions and matured into the same larva, while Mr. Cockle bred it again from a third collected egg cluster under his number 20.

Egg.—Laid in a high pile, three or four layers deep, irregularly plastered on. Flatly spheroidal, the base well flattened. Ribs about 60, diminishing irregularly by confluence or alternation toward vertex. Reticulations all over alike, the vertical ones only on the summits of the ribs, not in the bases of the hollows, with the cross lines forming rounded hexagonal cells. Above the ends of the ribs are elongate reticulations, getting very small at the micropyle. Pale yellow; diameter, 0.9 mm.

Stage I.—Head rounded bilobed, pale brown, blackish mottled and with black posterior rim and ocelli. Body normal, uniform, joint 12 enlarged, the feet of joints 7 and 8 short, semilooping; whitish, the food green; tubercles round black, leg plates distinct and black; cervical shield blackish at the edges. Thoracic feet pale; skin minutely sparsely black spinulose; setæ rather long, black, pointed.

Stage II.—Head bilobed, pale luteous, freckled with large gray spots, mouth brown; width, 0.6 mm. Body normal, joint 12 a little enlarged, the feet of joints 7 and 8 very short. Pale green, the food dark; pale dorsal and subdorsal lines indicated. Tubercles small, black; shields concolorous, cervical shield a little shining; feet pale, the abdominal ones with black dots.

Stage III.—Head pale luteous, blackish spotted in irregular bands; width, 0.9 mm. Body moderate, joint 12 humped dorsally a little, feet of joint 7 smaller. Green, dark olivaceous dorsally, pale subventrally. Dorsal and subdorsal lines whitish, dark edged; a shadow of a lateral line; substigmatal white, broad, dark edged above; feet pale; tubercles whitish with black hair dots; setæ small.

Stage IV.—Head rounded, shining, heavily reticulate with smoky brown on a pale luteous ground; vertical bands broad; width, 1.2 mm. Body moderate, joint 12 enlarged a little; green, white dotted, the dorsum with segmentary smoky black diamond-shaped marks, cut by a white broken dorsal line. Subdorsal line fainter, lateral still fainter, smoky edged, the sides shaded nearly to black. Substigmatal band broad, white, slightly reddish centered; subventer only slightly black dotted. Feet pale; tubercles obscure, concolorous.

Stage V.—Head pale brown, shining, very heavily reticulate with dark blackish, forming a vertical band on the lobe and one above eye; width, 1.8 mm. Body normal, equal; joint 12 slightly enlarged. Greenish gray, dotted reticulate in black, edging narrow broken white dorsal, subdorsal and lateral lines, and forming oblique dorsal shades from the incisure forward and downward to the subdorsal line. Sides heavily shaded; substigmatal band broad, white, luteous and reddish filled; subventer pale, sparsely black dotted; no oblique line on thorax; feet pale; a bar on joint 12 at tubercle ii.

Stage VI.—Head pale whitish luteous, crinkly reticulate with smoky brown, joining in curved vertical band each side of clypeus and suture, and a narrow one from the eye; width, 2.5 mm. Body brown, light brown with white dots and black strigose mottlings. Dorsal and subdorsal lines white dotted; black oblique lines from dorsal posterior to subdorsal line, where they form a broken border, met by lines from dorsal anterior to the black-marked tubercle i, forming a broken lattice; a transverse bar on joint 12; sides black streaked; substigmatal band broadly pale, of the ground color, or pinkish, and shading to the subventer, only slightly strigose, showing by its white-dotted edges. Feet pale; spiracles white; tubercles black marked, obsolete.

MAMESTRA NEVADÆ Grote.

Six specimens, July 1, 4, 19, 21, August 11. The specimens agree with some from Wisconsin which Professor Smith has picked out from the U. S. National Museum series as representing his *canadensis*. I think, however, that I really have *nevadæ* Grote, described from the Sierra Nevada of California, or, as is more probable, *canadensis* is a synonym of *nevadæ*. Mr. F. H. Wolley Dod has sent me specimens from Calgary, Alberta, labelled *nevadæ*, which seem conspecific with the Kaslo ones.

Egg.—Laid in a high pile, four layers deep in part, irregularly heaped up. Flatly spheroidal, base well flattened, often irregularly so. Ribs about 50 at the margin, diminishing variously toward the vertex, fine, close, the reticulations at the summits with the cross striæ forming cells higher than wide, slightly hollowed, the ribs looking beaded under a low power, really waved by the cell areas; vertex reticulate about the micropylar rosette, which is not raised. Pale pearly bluish green; diameter, 0.7 mm.; height, 0.4 mm.

Stage I.—Head pale brown with large black spots on the tubercles and small brown freckles over vertex; body moderately slender, semilooping, the feet of joints 7 and 8 small, joint 12 slightly enlarged. Shield pale brown, blackish on the edges and tubercles; tubercles very large, angularly rounded, black, normal; setæ black, pointed; leg plates black; skin sparsely dark spicular.

Stage II.—Head luteous, with brown tubercular spots; width, 0.55 mm. Body rather slender, contracted somewhat subventrally, narrowed at joint 11, joint 12 enlarged a little. Translucent green; dorsal, subdorsal, lateral, and broad substignatal lines a little more whitish than the ground color. Feet pale; tubercles round, black; cervical shield a little smoky.

Stage III.—Head bilobed, shining brownish luteous, dark spots on the tubercles and small freckles over vertex; width, 1 mm. Body moderate, narrowed at joints 10 and 11, 12 enlarged dorsally, feet of joints 7 and 8 small. Dark green dorsally; dorsal, subdorsal, and

faint lateral lines white, dark green edged; space between lateral and substigmatal lines all dark green. Substigmatal band broad, white; subventer green, shaded with dark; feet paler. Tubercles all black, round, not large, pale ringed minutely.

Stage IV.—Head pale brown, freckled over the vertex and most of the surface, except the clypeus, with fine strigæ; tubercles in black spots; a pair of little dots at apex of paraclypeus; width, 1.8 mm. Body moderate, joint 12 enlarged. Green, strongly shaded with blackish green, edging the broken white dorsal, subdorsal, and lateral lines and forming traces of a dorsal lattice; solid on the sides about the broad, white substigmatal band. Subventer likewise dark, but the feet pale. Tubercles white, with black hair dots; setæ fine; no shields; the lines reach the ends; thoracic feet smoky ringed.

An interpolated stage occurred with width of head 1.7 mm.

Stage V.—Like the next stage; width of head, 2.2 mm.

Stage VI.—Head rounded, the apex in joint 2, luteous, heavily circularly mottled with dull brown, with the usual vertical bands; width, 2.8 mm. Body moderate, joint 12 gently enlarged, feet equal. Ground color creamy brown, heavily mottled in black and nearly obscured. Dorsal and subdorsal lines white, dotted, the subdorsal the heaviest. Oblique black shades in the dorsal space; tubercle ii large, white. Sides like the dorsum, but pale by the absence of the oblique shades, sparsely white dotted. Substigmatal band white dotted, filled by the ground color; subventer like the sides. Thoracic feet red brown, the abdominal ones pale, whitish. Tubercles and setæ obscure.

MAMESTRA SUBJUNCTA Grote and Robinson.

Nine specimens, June 13, 16, 25, July 2, August 11 (bred), 15 (bred), 16 (bred). Through some error Mr. Cockle has this species named *canadensis* in his collection.

Egg.—Laid in a large patch, in part in two layers. Flatly spheroidal, almost disk-like; 50 vertical ribs, low, slight, close together, their summits bearing the longitudinal reticulations, the cross-striæ of which form quadrangular cells. Reticulations equally distinct, alike, neat, narrow, sharply raised. Summit broadly elongate-hexagonally reticulate, the micropyle with a circle of pyriform cells. Pure white, later faintly purplish gray; diameter, 0.7 mm.

Stage I.—Head round, bilobed, shining translucent pale brownish luteous, faintly blackish freckled, eye black, mouth brown. Body slender, normal, semilooping, joint 12 enlarged, the feet of joint 7 and 8 very short. Whitish, shields concolorous, tubercles moderate, black; alimentary canal reddish in anterior half of body. When fed the larvæ are green; setæ long, black.

Stage II.—Head rounded, translucent pale luteous, ocelli black; width, 0.5 mm. Body moderate, semilooping, feet of joints 7 and 8

small; joint 12 enlarged dorsally. Pale green, shaded with olivaceous blackish, leaving narrow dorsal, subdorsal, and lateral pale straight lines. Stigmatal band whitish, illy defined below from the pale subventer. Tubercles small, black; feet pale.

Stage III.—Head round, the apex slightly in joint 2; green, ocelli black; width, 1 mm. Body normal, joint 12 slightly enlarged, feet nearly equal, those of joint 7 only a little reduced. Green, dorsal and subdorsal lines narrow, white, blackish green edged, this color mottling the ground a little. Substigmatal band broad, white above, shading to the subventral color below, edged above with blackish green, leaving a lateral defined line of the ground color. Subventral region slightly dark-marbled; hair dots black in a pale rim; feet pale. Other larvæ were faintly brown shaded.

Stage IV.—Head rounded, the apex in joint 2; whitish luteous, reticulate with smoky brown over the lobes; width, 1.5 mm. Body sordid green, dotted and reticulate with olivaceous green, edging the lines and forming an obscure lattice in the dorsal space. Dorsal, subdorsal and lateral lines white, narrow, broken; stigmatal band broad, white, covering the spiracle except on joints 2 and 12, dark-edged above, greenish-filled below; a few white dots scattered over the surface. Feet all pale; spiracles black-rimmed; joint 12 slightly enlarged; feet nearly equal.

Stage V.—Head whitish luteous, the reticulations forming a band on the lobe and a small one from the eye; width, 2.1 mm. Body normal, joint 12 scarcely enlarged; pale brown without green tint; dorsal, subdorsal, and lateral lines broken and lost in the ground color, dotted reticulate with white and dark brown, forming irregular narrow oblique dark lines on the segments posteriorly forward and downward, obscurely joining a dark band stigmatally, forming a transverse subdorsal bar on joint 12. Stigmatal band lost in the ground color, a red line filling it above, whiter than the subventral area, which is dotted like the dorsum, but with more white and less brown. Feet pale; tubercles small, white, obscure.

Stage VI.—Head rounded, the apex in joint 2, pale brown, shining, dark brown reticulate, with broad indistinct vertical bands and a band from the eye; width, 3 mm. Body normal, joint 12 very little enlarged. Pale brown, tessellated with blackish, dotted and reticulate. The blackish color forms subdorsal bars and dorsal spots, smoky and diffuse, transverse and squarish on joint 12; a broad lateral line indicated in pale. Substigmatal band pale, reddish mottled and all dark reticulate like the body; subventer dotted and reticulate. Feet and venter pale; tubercles whitish, obscure.

MAMESTRA GRANDIS Boisduval.

Four specimens, June 7, 13, 23, July 14, and one from Mr. Cockle's collection June 14. Mr. Cockle has the species labeled *nevadæ*, but it does not agree with Grote's description of that form. Prof. J. B. Smith is the authority for the name, but not improbably some confusion in the labels has occurred. The specimens agree closely with Eastern *grandis*, and, though a trifle smaller, there is scarcely enough difference to define even a local race.

Egg.—Laid in a large patch. Flatly spheroidal, base flattened but little; 30 vertical ribs, diminishing by alternation, broad, rounded, crested by the longitudinal reticulations, but weakly so, the cross striæ likewise weak, shagreened wrinkly over all. Pale yellow, later with a purple ring and spot; diameter, 0.6 mm.

Stage I.—Head strongly bilobed, shining sordid luteous, eye black. Body semilooping, feet of joints 7 and 8 short, cylindrical; joint 12 enlarged. Transparent whitish, alimentary canal red; tubercles large, setæ short, black, stiff. Cervical shield faintly luteous with black spots at the tubercles, two detached setæ; leg shields smoky. Tubercles normal, large, black, no subprimaries; ia to iib on thorax separate, ia and ib small.

Stage II.—Head bilobed, whitish, smoky shaded, shining, eye black; width, 0.6 mm. Body equal, normal, feet of joints 7 and 8 small, joint 12 not enlarged. Whitish, green from the food, with olivaceous shading, leaving pale dorsal, subdorsal and lateral lines, the space below the lateral line darker. Below tracheal line to venter sharply paler. No shields; feet pale; tubercles moderate, black, in pale rings; setæ fine, short.

Stage III.—Head bilobed, held flatly, shining pale brown, thickly mottled with blackish over the apices of the lobes; width, 1.1 mm. Body normal, depressed anteriorly, joint 12 a little enlarged dorsally. Dorsum blackish green, subventer light green; dorsal, subdorsal and lateral lines narrow, white, dark edged; space between lateral and stigmatal lines black; substigmatal band broad, white, greenish filled. No shields, the lines continuous; feet pale, the pair on joint 7 small, those of 8 nearly equal to the ones on 9 and 10. Tubercles minute, black; setæ moderate, brown.

Stage IV.—Head round, low bilobed, broad, shining translucent white, brown reticulate, showing faintly brown vertical bands on the lobes and upward from the eye; width, 1.7 mm. Body normal, joint 12 enlarged a little, feet equal. Dorsum dark slaty olivaceous, black crinkled lines thickly on an ochraceous ground, edging the faint narrow pale dorsal and subdorsal lines. A dark vinous band between the obsolete lateral white line and the substigmatal one. The latter broad, white, pale vinous filled; subventral space white, translucent, waxy,

lightly blackish reticulate. Feet pale; tubercles whitish with black hair dots; setæ moderate, dusky.

Stage V.—Head shining pale brown with dark brown bands and reticulations; width, 2.8 mm. Body smoky olivaceous dorsally, reticulate in dark brown and speckled with white, shading to vinous laterally. Dorsal and subdorsal lines obsolete, linear, pulverulent, white; blackish patches at the tubercles. Stigmatal line linear, white, being the upper edge of the substigmatal band, its lower edge lost in the waxy white subventral area. A little vinous centers the subventer with some white and black specks. Feet pale; tubercles and setæ minute.

Stage VI.—Head sordid luteous, reticulate in brown, vertical bands and one from eye moderately distinct, the round, shining apex slightly retracted in joint 2; width, 3.6 mm. Body robust, equal, joint 12 scarcely enlarged, feet equal. Dull sordid purplish, shading to whitish below the spiracles. Feet pale, no distinct marks. The dorsum is dotted in white and strigose reticulate in black on a lilaceous ground; traces of the white dorsal line and the upper and lower edges of the substigmatal band show by an alignment of dots only. Cervical shield slightly sooty shaded. Tubercles minute, setæ fine, obscure; spiracles white, black rimmed.

MAMESTRA INVALIDA Smith.

Three specimens, July 2, 25, August 11, and one from Mr. Cockle's collection June 24. A captive female deposited eggs. The larvæ passed but five stages according to my notes.

Egg.—Laid in a large patch, not touching. Two-thirds spherical, the base roundedly flattened; ribs about 40, finely angularly waved, decreasing irregularly toward vertex: no vertical reticulations in the hollows; cross striæ fine, nearly obsolete; vertex weakly reticulate from the ends of the ribs to the slightly raised micropyle, which bears a circle of pyriform cells. Pale yellow, later washed with reddish all over the upper part; diameter, 0.85 mm.

Stage I.—Head rounded bilobed, pale brown with slight brown spots on the tubercles; antennæ rather short. Body moderate, normal, joint 12 a little enlarged, shields uncornified. Whitish, the tubercles moderate, brown, normal. Feet of joints 7 and 8 small; skin minutely dotted spicular, subcutaneous layer rounded vacuolar: setæ black, pointed.

Stage II.—Head round, bilobed, greenish, thickly brown dotted except a streak on lobe above and clypeus; width, 0.8 mm. Body moderate, green, olivaceous shaded, leaving dorsal, subdorsal, lateral, and broad stigmatal lines pale. Shields concolorous; tubercles small, round, black. Feet pale, those of joints 7 and 8 smaller; joint 12 a little enlarged.

Stage III.—Head green, the paraclypeal tubercles blackish; width, 1.1 mm. Body dark olivaceous green; dorsal and subdorsal lines narrow, dark edged, lateral wavy, obscure, stigmatal broad, pale; subventer olivaceous; feet pale; tubercles and setæ obscure.

Stage IV. (Green form)—Head green, faintly darker reticulate; width, 1.9 to 2.1 mm. Body uniform, rather slender; joint 12 enlarged dorsally in a low hump which appears brighter by its markings. Green, dorsal, subdorsal, and broad stigmatal lines white, dark-green edged, throwing a series of broken green obliques from subdorsal anterior to dorsal posterior, forming a bar on joint 12. Sides dark marbled, subventer less so; stigmatal line straight, touching spiracle except on joints 2 and 12. Feet green; tubercles white obscure. (Brown form)—Head pale brown, heavily recticulate in dark brown, forming an erect stripe on face edging clypeus and median suture. Body brown, reticulate in dark brown, marked as in the other form, but the oblique and bounding shades heavier, the light lines nearly completely light brown filled. Tubercles white, but no other white dots. No shields; feet equal.

Stage V.—Head brown, reticulate in darker and with distinct vertical bands; width, 3.3 mm. Large, robust, equal; joint 12 a little enlarged. Light ocherous brown, with subdorsal blackish shaded oblique bands, squarely terminated on joint 12, fainter on the thorax. Dorsal line rather broad, pale; subdorsal indicated by dark edging lines; sides black recticulate, light, not shaded; substigmatal band yellowish, with a narrow dark edge above; subventer brown recticulate. Setæ small, brown; feet pale; cervical shield darkened, trilineate.

MAMESTRA TRIFOLII Rottemburg.

One specimen, much worn, taken August 1 by Mr. Cockle.

MAMESTRA OREGONICA Grote.

No specimens; one in Mr. Cockle's collection, July 12, 1902. I am inclined to regard this form as distinct from *trifolii*.

MAMESTRA ASSIMILIS Morrison.

Seven specimens, July 6, 8, 25, 30, August 5. The specimens have grayer, more diversified wings than the Atlantic region form, which is a smooth black. This is probably a local race, which I leave to be named by some enterprising student. The larva is remarkably pretty. The Kaslo ones were black, but this color is not constant, as I took one on brake (*Pteris*) at Shawnigan Lake, on Vancouver Island, in which the ground color was green. The larvæ had but five stages.

Egg.—Spheroidal with flattened base; ribs fine, about 40 around the margin, diminishing by confluence above. Reticulations distinct, both

vertical and transverse, the latter forming cross-striæ with nearly square cells; no vertical lines in the hollows. Vertex reticulate between the ends of the ribs and the micropylar rosette. Pale yellow; diameter, 0.8 mm.

Stage I.—Head round, bilobed, pale whitish luteous; tubercles blackish; mouth brown. Body moderate, joint 12 slightly enlarged, feet of joints 7 and 8 smaller. Whitish, cervical shield pale brown with black tubercles, the other tubercles very large, black, round, i and ii nearly in line, ia and ib of thorax small. Leg plates black; skin sparsely dark spicular.

Stage II.—Head shining luteous with smoky blackish spots on the tubercles; width, 0.6 mm. Body moderate, joint 12 slightly enlarged; some look very slender, others more robust. Shield greenish luteous, nearly concolorous; body light green, the ordinary lines of the ground color broad, about equal to the intervening spaces, which are olivaceous dark green, and may be described as addorsal, upper and lower lateral. Feet pale; those of joints 7 and 8 short. Tubercles minute, blackish, with the setæ inconspicuous. Later the ordinary lines show pale, the dorsal obscure, the subdorsal yellowish white, the lateral obscure, the substigmatal line like the subdorsal. The colors fade very markedly during the stage.

Stage III.—Head green, dotted with brown over the upper part; width, 1.1 mm. Body moderate; joint 12 scarcely enlarged, darkly and contrastingly colored. Black above, dorsal and lateral lines obsolete, dotted; subdorsal and substigmatal alike, broad, greenish white. Subventral region and feet pale greenish, black mottled. Shields concolorous; tubercles black, minute.

Stage IV.—Head with the apex in joint 2, the median sutures depressed, shining luteous, with a few brown spots above; width, 2 mm. Body uniform, velvety olivaceous black; broad, equal, subdorsal and substigmatal bands of pale yellow, even, reaching the ends, no shield, the substigmatal only narrowly black below; subventral region and feet pale greenish, but retracted. Traces of a narrow dorsal line; tubercles and setæ obscure.

Some of the larvæ had heads 1.5, 1.6 mm., etc., while one had a 2.4 mm. head, probably representing the missing stage v that was not observed in the larva specially under observation. The colors were the same.

Stage VI.—Head slightly bilobed, the vertex in joint 2, light red, finely mottled; width, 3 mm. Body velvety black; broad subdorsal and substigmatal bands light yellow, narrowly white at the edges. Lower subventral region and feet outwardly light red; anal flap brown-black. Thoracic feet pale luteous; venter pale whitish; tubercles obsolete; setæ fine, black; spiracles white.

MAMESTRA INGRAVIS Smith.

One specimen, July 25, and one from Mr. Cockle's collection, May 2. The species varies in the width and distinctness of the submarginal pale lilac shading.

MAMESTRA ADJUNCTA Boisduval.

Two specimens, June 25, July 16.

Egg.—Laid in a large irregular patch. Two-thirds spherical, the base flattened; ribs about 56 around the margin, diminishing by confluence, pitted-waved; cross-striæ nearly obsolete; vertex above the ribs reticulate; micropyle raised. Pale yellow; diameter, 0.6 mm.

MAMESTRA TACOMA Strecker.

Two specimens, June 3, July 22. This species was determined for Mr. Cockle by Professor Smith and seems to be correctly so, as the specimens agree with Strecker's description. The form was previously unknown to me.

Egg.—Laid in a large mass, adherent. Spheroidal, the base well rounded, the top roughened by the ends of the ribs; ribs about 25, broad, narrow at the tip, decreasing toward the vertex which is reticulate; cross-striæ distinct, about as high as the ribs, forming nearly quadrangular cells. Pale yellow, later with brownish dotted ring and spot; width, 0.8 mm, height, 0.6 mm.

Stage I.—Head rounded, bilobed, long, pale brown, slightly streaked, the sutures darker. Body slender, cylindrical, normal, joint 12 a little enlarged, semilooping, the feet of joints 7 and 8 smaller. Translucent yellowish, the food green; tubercles small, neatly black; shields of the abdominal feet blackish. Cervical shield reduced, luteous; no marks.

Stage II.—Head luteous, faintly brownish reticulate and with curved lines each side of the clypeus; eye black, mouth brown; width, 0.6 mm. Body normal, uniform, joint 12 enlarged, the feet of joints 7 and 8 short. Pale green, striped with olivaceous blackish; a broad dorsal line, two narrower lateral ones and broad subventral one, leaving a subdorsal, lateral and broad stigmatal pale green lines. Feet pale; tubercle dots black in pale areas; setæ short, dark; no shields.

Stage III.—Head shining pale green, vertex a little smoky, eyes black; width, 1 mm. Body pale green with broad, straight stripes of velvety green, subdorsal, lateral, suprastigmatal, subventral, the subdorsal broad and darker at its edges. Shields concolorous, lined, but the green is more olivaceous on them. Tubercles pale; hair dots and setæ black; small.

Stage IV.—Head shining green, the vertex more whitish and faintly dusky reticulate, ocelli black; width, 1.7 mm. Markings as before,

but the subventral band is dotted and obsolete, the substigmatal space forming a broad greenish white band. Suprastigmatal band paler than the subdorsal and lateral; subdorsal broadly geminate, blackish-green dotted filled.

Stage V.—Head, 2.1 mm. Lateral and suprastigmatal dark bands more vacuolated dotted and obscurely geminate by their edges. Otherwise no change; spiracles white.

Stage VI.—Head erect, bilobed, the apex in joint 2; green, a little yellowish over the lobes and faintly darker green reticulate; width, 3.1 mm. Body all much as before but still paler. Soft velvety yellow green, faintly dotted and reticulate in darker. Subdorsal band defined only by its edges, giving a smoky dorsal geminate line, the space between subdorsal and lateral forming dark bands, giving a pale subdorsal line blackish-green edged; an obscure white stigmatal line. Skin folds yellowish; tubercles small, dark; iv below the center of the spiracle. The larva is almost unmarked, especially as the colors pale with growth.

This is a tree-feeding Noctuid, as is very evident from the coloration. The food plant is probably the thimbleberry (*Rubus nutkanus*).

MAMESTRA STRICTA Walker.

Seven specimens, August 20 (West Robson), 25 (Victoria), 31 (Shawnigan Lake), September 1 (Shawnigan Lake), 2 (Wellington), 5 (Shawnigan Lake).

MAMESTRA OLIVACEA Morrison, var. PETITA Smith.

Eight hundred and forty-three specimens, June 25, July 21, 22, 25, 27, 31, August 5, 6, 7, 12, 15, 21 (Revelstoke). As some difference of opinion has arisen concerning the proper placing of the forms allied to *olivacea*, I will here discuss the matter. In Bulletin No. 52 of the U. S. National Museum, I referred *comis* Grote as a variety of *olivacea* with *davena* Smith, *lucina* Smith, *altua* Smith, *megarena* Smith, and *petita* Smith as synonyms; *rectilinea* Smith as a second variety with *circumcincta* Smith and *obnigra* Smith as synonyms. To this conclusion Professor Smith expresses dissent,[a] and states his adherence to the views expressed in a previous paper.[b] After studying the 1,500 specimens from Kaslo, the material in the National Museum and Professor Smith's slides, I am disposed to admit two distinct species, though they run very closely. I have separated the Kaslo catch into two series, which typify *olivacea* and *comis* and, though there may be doubt about a few specimens, I can broadly separate them. *Olivacea* is smaller, without tendency to green, and the discolorous spot at anal

[a] Jour. N. Y. Ent. Soc., XI, 1903, p. 14.

[b] Trans. Am. Ent. Soc., XXVII, 1901, p. 230.

angle is diffuse; *comis* is larger, with a certain tendency to green, the spot at anal angle of primaries smaller, concrete, especially marked in the females. The male genitalia offer no sharp contrast. I will now refer to the names proposed by Professor Smith.

1. *circumcincta* Smith. This is obviously only a very dark form of *stricta*. I was in error in referring it to *olivacea*. The Kootenai form of *stricta* is not dark, judging from the single specimen I obtained as I was leaving the place, though it might pass for *cinnabarina* Grote. Professor Smith's form is from the Sierra Nevada of California.

2. *rectilinea* Smith. The female types before me are from Sierra Nevada, California. They are normal females of *comis*.

3. *lucina* Smith, *altua* Smith, *megarena* Smith. These are admitted by the author to be but races of *olivacea*. They should not have been listed as species. *Altua* and *megarena* are from the same faunal region and should be made synonymous.

4. *davena* Smith. I have the male type. I can not match it exactly in the same sex from the Kaslo catch, though the faunal region is the same. It is a somewhat aberrant specimen. A male *comis* from Wellington, Vancouver Island, is nearly its exact mate and a female from Kaslo represents the same form. Smith's slide of the male genitalia shows some differences. The piece is narrower at the end, less spinose. The single specimen, however, is not convincing and I am inclined to view it as varietal.

5. *obnigra* Smith. The female type before me is only *comis* Grote.

6. *petita* Smith. This was described from one male and three females. I believe the male was *comis*, the females *olivacea*. The latter I can match from Wellington and the males accompanying them resemble *altua* and do not show the peculiar character attributed to the genital structures in Smith's figure. This slide is before me and is only, I think, a distorted specimen. The spine that stands up so strangely has been misplaced from its normal position by pressure, while its apparent slenderness is due to its being seen edgeways. If replaced, I think nothing different from the usual *comis* form would be seen.

Besides these, Smith has described *vau-media* and *incurva*, which he refers in this neighborhood. They are not before me, but I have little doubt that *vau-media* is *olivacea* and will replace the name *altua*, while *incurva* is compared with *anguina* and therefore is probably not referable to this group.

Allowing now every possible latitude for geographical forms, I place the names thus:

OLIVACEA Morrison ..... Atlantic region.
obscurior Smith.
race *lucina* Smith ..... Western prairies.
race *altua* Smith (=? *vau-media* Smith) ..... Rocky Mountains.
megarena Smith.
race *petita* Smith ..... Pacific coast and mountains.

COMIS Grote.....Pacific coast and mountains adjoining.
obnigra Smith.
rectilinea Smith.
male *petita* Smith.
davena Smith.

This arrangement leaves the name *petita* Smith for the Kootenai form, about which there seems some confusion. Perhaps a separate name is not needed, as the form runs so near typical *oliracea*. The name *petita*, however, may properly be restricted to the female types, as the male is a synonym of another species and was characterized from a distorted structure, and this name will apply to the northwestern race of *oliracea* if a separate name is desired.

Egg.—Three-fourths spherical, the base flat, the apex roughened by the ends of the ribs; ribs about 30, diminishing toward the vertex, neatly waved, with obsolete cross-striæ; vertex confused, the micropyle slightly raised. Pale yellow with dull red vertical ring and spot: diameter, 0.75 mm.

Stage I.—Head slightly bilobed, shining black. Body normal, joint 12 not enlarged, feet of joints 7 and 8 small; whitish, the large cervical shield, feet, tubercles and plates black. Tubercles rather large, brown-black; cervical shield shining; setæ long, bulbous-tipped; skin finely dark granular.

Stage II.—Head round, dull black; width, 0.5 mm. Body moderate, a little flattened, joint 12 slightly enlarged dorsally. Dark brown, dorsal and subdorsal lines pale, broken, darker edged, traces of a lateral line; substigmatal line broad, all pale, sordid. Tubercles round, black, elevated; setæ long, glandular tipped, dark at base, curving backward and forward; thoracic feet black.

Stage III.—Head dark brown, the sutures black, clypeus pale brown; width, 0.85 mm. Body robust, a little squarely flattened, joint 12 slightly angularly prominent, folded. Dark, the skin granular; subdorsal region pale ocherous, indicating a segmentary widening of the dark dorsal band, edged below by a straight black band. Sides nearly uniformly dark, the subventral region lighter below the fold. Tubercles small, black; setæ coarse, stiff, the tips truncate and black; shields concolorous.

Stage IV.—Head small, rounded, dull dark brown, a black V-mark over the clypeus and paler streak on vertex; width, 1.3 mm. Body robust, flattened, resembling a piece of dirty wood, stiff, sluggish, granular, the setæ stiff with enlarged tips and alternating in direction. Dorsal space wood-brown with a black dorsal diamond-shaped marking. Subdorsal line broad, whitish, with central dark line and blackish upper border, below black with a lateral waved pale line and a broad parallel dilution below it. Substigmatal band broad, waved, whitish, brown dotted; spiracles small, black; subventer obscure brown. Feet, pale; tubercles, black, slightly elevated.

Stage V.—Head, 2 and 2.05 mm. All as before, but brighter after the moult, though soon becoming as dull as before. Setæ white, stiff, thick, subcapitate. Head pale brown, dull, subpruniose, with black reticulations and bands.

The larvæ had but five stages. They are concealed ground feeders, eating any low plant, mostly by night. The pattern of coloration and habits as well are identical with those of *Mamestra laudabilis* Guenée.[a]

MAMESTRA COMIS Grote.

Six hundred and sixty-five specimens, June 16, 25, July 19, 27, 31, August 3, 5, 6, 7, 12, 16, 17. The larva greatly resembles that of *oliracea* Morrison. I did not notice any differences while they were alive, but the inflated *comis* are pinker than the *oliracea* similarly prepared, while the relative distinctness of the markings is somewhat different, giving the impression that we have to do with distinct species.

Egg.—Two-thirds spherical, base not strongly flattened, more or less irregularly compressed; vertex roughened by the ends of the ribs; ribs about 40, diminishing by alternation, angularly undulate, the sides pitted by the hollows, the reticulations indistinct. The ribs end in a circle where the surface is radially grooved; micropyle elevated, with a circle of pyriform cells. Pale yellow; diameter, 0.75 mm.

Stage I.—Whitish, the head large; cervical shield, anal plate, and large tubercles black. Setæ long, curved, bulbous tipped. Feet of joints 7 and 8 very short; the body is robust, joint 12 scarcely enlarged.

Stage II.—Head shining black; width, 0.5 mm. Body moderate, equal, a little flattened, sordid green, shaded with brown, leaving dorsal, subdorsal, lateral, and broad substigmatal pale lines. Tubercles small, black, a little elevated; setæ coarse, black, subcapitate.

Stage III.—Head, 0.85 mm. As in the next stage.

Stage IV.—Head, 1.3 mm. The description of the corresponding stage of *oliracea* may be repeated for this.

Stage V.—Head, 2.1 mm. As in the previous stage, but brighter after the moult. The dorsal shaded diamond-shaped markings are distinct. The description of *oliracea* will apply with the exceptions noted above.

MAMESTRA ILLAUDABILIS Grote.

Nine specimens, June 25, July 2, 20, 21 (Bear Lake), 29, 31, August 3, 6. This has been referred as a local variation of the Eastern *laudabilis* Guenée, but I am disposed to consider it a true species. It is constantly smaller than *laudabilis* and more darkly colored. The

[a] See Can. Ent., XXXV, 1903, p. 273.

small size would not be expected in a Western race of an Eastern species, since these are always larger.

Egg.—Spheroidal, the basal half more flattened than the upper half; about 40 vertical ribs, diminishing by alternation toward vertex, angularly undulate, the sides pitted by the hollows, the vertex with zigzag crest, but the reticulations not distinct. The ribs end in a circle where the surface is radially grooved; micropyle elevated, with circle of pyriform cells. Pale yellow; diameter, 0.9 mm.

Stage I.—Head slightly bilobed, round, convex before, clypeus high; brown-black, clypeus paler; width, 0.3 mm. Body robust, joint 12 slightly enlarged, the feet of joints 7 and 8 short. Whitish, food reddish anteriorly; cervical shield large, black. Tubercles small, blackish; setæ long, pale, swollen-tipped, curved. The cervical shield has pale spaces around the tubercles. Skin minutely dusky, granular.

Stage II.—Not observed; the description of *Mamestra laudabilis*[a] in the corresponding stage will probably suffice.

Stage III.—Head dark sordid brown with long pale setæ; width, 0.6 mm. Body moderate, sordid brown with narrow faint whitish subdorsal and lateral lines. Tubercles round, black; setæ long, fine pale, curved, with enlarged tips. Skin minutely dark granular.

Stage IV.—Head dull black, paraclypeus, mouth, small brown spots on faces of lobes and in vertical suture pale brown; width, 1 mm. Body robust, rather squarely flattened, joint 12 slightly enlarged, folded; feet equal. Skin densely pale, papillose granular; ground color dark brown, lines obsolete; subdorsal region lighter, edged below by a velvety black band which is widened on the segments, broken on thorax. Sides irregularly marked. Setæ thick, the tips widened. Shields concolorous; tubercle ii conspicuous by a cluster of light granules; a light subdorsal patch on joint 12 anteriorly.

Stage V.—Head rounded, the apex in joint 2 heavily reticulated in dark brown on a pale ground, almost black; width, 1.8 mm. Body robust, quadrately flattened, no shields; densely papillose granular. Black mixed with brown; tubercle ii surrounded by a ring of pale papillæ, especially prominent on joints 12 and 13. Subdorsal region of joint 12 and anal flap washed with pale. Subdorsal line pale with deep black edge below; subventral fold lighter; lines obsolete. Setæ thick, pale or dark, widened toward the tips. Papillæ concolorous with the markings.

The larvæ pupated in the earth at the end of this stage, but no moths emerged.

MAMESTRA SUTRINA Grote.

No specimens; one from Mr. Cockle's collection July 12, 1902.

[a] Can. Ent., XXXV, 1903, p. 273.

MAMESTRA MUTILATA Smith.

Two specimens, August 13 (Sandon, Mr. Currie); September 8 (Glacier). The two specimens are not closely similar. The male is *mutilata* Smith, the female *rainierii* Smith, but I can not regard them as separate.

MAMESTRA LOREA Guenée.

Thirty-eight specimens, June 13, 16, 17, 23, 24, 25, 30, July 2, 8, 22. An early species. Eggs were obtained in season, but I could not carry the larvæ beyond stage iv, they showed such a persistent tendency to hibernate. They were fed on dead leaves.

Egg.—Two-thirds spherical, base round, not flat, easily detached and rolling. Ribs about 40, rather sharply narrow and straight, diminishing at summit where they become low and less distinct. Reticulations scarcely indicated, cross-striæ obsolete; vertex broadly smooth, obsoletely reticulate; micropyle slightly raised with crown of small pyriform cells. Pale yellow, later dark red all over the vertex; diameter, 0.7 mm.

Stage I.—Head rounded, pale brown, eye black. Body robust, normal, joint 12 slightly enlarged. Cervical shield pale luteous; body whitish, finely dusky, spicular granular. Tubercles small, brownish; setæ long, pale, with enlarged tips.

Stage II.—Head bilobed, erect, pale brown, the vertex darker; width 0.45 mm. Body robust, joint 12 scarcely enlarged; whitish sordid, dark from the alimentary canal, the incisures folded. Dorsal and subdorsal lines barely indicated; tubercles round, black; setæ moderate, capitate; feet pale, those of joint 7 a little smaller.

Stage III.—Head round, dull dark brown, darker shaded centrally; width 0.7 mm. Body robust, flattened, equal; ocherous subdorsally, a series of wide dorsal diamond-shaped marks, lighter centrally and cut by a very obscure, pale dorsal line. Sides mottled in brown black like the dorsum. Shields concolorous; tubercles small, black; setæ stiff, pale, subcapitate, alternating forward and backward; feet pale, the pair on joint 7 smaller.

Stage IV.—Head round, pale brown, with obscure darker reticulations and bands; width 1 mm. Body robust, flattened, equal, sluggish. Color as before.

The concluding stages remain to be described.

MAMESTRA LARISSA Smith.

One specimen, June 13, and two from Mr. Cockle's collection June 2 and 25, 1902, which he has kindly allowed me to keep. Mr. Cockle says the species was not rare in 1902, but it certainly was so in 1903. It is very close to *pensilis* Grote in appearance.

MAMESTRA PENSILIS Grote.

One hundred and forty-three specimens, July 25, 27, August 3, 4, 5, 6, 7, 13, 15, 17. The species is very near *vicina* Grote. I do not agree with the manner in which Prof. J. B. Smith has separated these forms in the U. S. National Museum collection. I would refer the New York, Texas, Colorado, and Arizona specimens to *vicina*, the Vancouver Island and California ones to *pensilis*.

Eggs were obtained, but not very early, and the larvæ refused to proceed beyond stage ii before hibernating. They were fed on dead leaves.

Egg.—Laid in a mass under a piece of paper in the jar, which was glued to the glass by them. Two-thirds spherical, conoidally narrowed above, base flattened, somewhat irregular. Ribs about 48, not diminishing till the edge of the large vertex, where is a mass of irregular crumpled ridges. Sides of ribs waved, crossed by faint striæ, which meet at an angle in the depressions, these being without flat bottom. Micropylar rosette raised. Pale yellow, with a red ring and spot: diameter, 0.6 mm.

Stage I.—Head rounded, wide, with the cervical shield, plates, and tubercles brown black. Body white, densely dark granular; tubercles large, angular; setæ with clear bulbous tips, rather long. Body robust, joint 12 enlarged, the feet of joints 7 and 8 smaller.

Stage II.—Head rounded, shining black, mouth brown; width 0.4 mm. Cervical shield, anal plate, leg plates, and round tubercles black. Body robust, equal, sordid, dark brown, with very faint whitish dorsal, subdorsal, and broad substigmatal lines with illy defined edges. Setæ coarse, black, with enlarged tips, alternating forward and backward; feet of joints 7 and 8 a little smaller.

The concluding stages remain to be described.

ADMETOVIS OXYMORUS Grote.

No specimens; one from Mr. Cockle's collection, June 28, 1902 (Sandon). It is a male and has brown hind wings.

BARATHRA CURIALIS Smith.

One specimen, June 10. It has less yellow shading than a bred specimen from Randolph, Vermont, before me, but is the same species, I judge. Eggs were obtained from this single specimen, but proved sterile.

Egg.—Laid in a small patch. Flattened spheroidal, base moderately flattened; ribs about 48, rather narrow, moderate, diminishing rapidly by alternation near vertex, ending on the summit, the vertex in a broad, circular, radiate area; micropyle with a circle of pyriform cells; cross-striæ very obscure, forming nearly quadrangular cells. Waxy yellow; diameter, 0.6 mm.; height, 0.5 mm.

DARGIDA PROCINCTA Grote.

Twenty-five specimens, May 31, June 13, 21, 23, 25, 27, July 14, August 6, 7, 13, September 8 (Glacier).

Egg.—Two-thirds spherical, the base flat; ribs about 40, diminishing irregularly at vertex, coarsely projected at apex, covered by reticulations, the longitudinal lines in the hollows and on the apices of the ribs forming rounded hexagonal cells which indent the sides of the ribs. An irregularly sculptured area about the raised micropyle, which has a circle of pyriform cells. Pale yellow; diameter, 0.6 mm.

Stage I.—Head bilobed, clypeus high, brown-black, shining. Body stout, joint 12 slightly enlarged, feet of joints 7 and 8 short; cervical shield large, brownish. All sordid gray, whitish, with skin finely dark granular; alimentary canal reddish. Tubercles rather large, smoky; setæ black with swollen tips, normal, ia to iib of thorax separate, no subprimaries, iv above the center of the spiracle on the posterior segments; four stout sharp setæ at anus, two above and two below.

Stage II.—Head rounded, bilobed, shining sordid luteous, thickly dotted reticulate with blackish, except on median suture and line on each lobe; width, 0.55 mm. Body moderate, tapered behind, joint 12 not enlarged; feet practically equal, the thoracic ones small. Blackish olivaceous green; dorsal, subdorsal, and lateral narrow pale lines, substigmatal line broader and white. Feet sordid, shields concolorous; tubercles and setæ obsolete. With growth, pale green, the lines obscure.

Stage III.—Head rounded, green, thickly marked with angular gray spots; width 1 mm. Body normal, smaller behind, joint 12 scarcely enlarged. Velvety dark olivaceous with narrow pale-green lines; dorsal line isolated, subdorsal and three lateral lines closely approximated, the middle one diffuse; substigmatal band broader, greenish white. Feet pale; spiracles white; no shield, the lines reaching the ends; tubercles and setæ invisible.

Stage IV.—Head rounded, the apex in joint 2, greenish luteous, thickly brown dotted, lost in a sordid vertical shade; width 1.9 mm. Dorsum olivaceous velvety black; sides lighter, obscurely traversed by four still lighter lines, the upper and lower of these the brightest; a dark area above the stigmatal band which is olivaceous, yellow dotted, diffuse below; subventer dark olivaceous, venter lighter; feet dotted.

Stage V.—Head heavily reticulated in leaden blackish and overspread with leaden; width 2.6 mm. Body varies from light to dark. Ground color velvety olivaceous black; subdorsal and lateral bands lighter, straight, rather broad, light-edged and darker filled; substigmatal band about the same, a shade lighter Subventer pulverulently black above, greenish below. Feet pale, the thoracic ones smoky;

spiracles white; venter green; no shields. The light forms show only the dorsal space and suprastigmatal band dark, the rest all greenish.

Stage VI.—Head 3.5 mm. I have described this stage previously from Californian larvæ.[a] It is essentially like stage v.

XYLOMIGES PERLUBENS Grote.

Four specimens, April 26 (Mr. Cockle), May 30, June 4, 6.

XYLOMIGES RUBRICA Harvey.

No specimens; one from Mr. Cockle's collection, May 8.

XYLOMIGES HIEMALIS Grote.

Two specimens, April 23 (Mr. Cockle), 26 (Mr. Cockle), and one from Mr. Cockle's collection April 17.

XYLOMIGES SIMPLEX Walker.

Two specimens, May 30.

XYLOMIGES DOLOSA Grote.

No specimens; one in Mr. Cockle's collection.

SCOTOGRAMMA DENSA Smith

No specimens. I refer with hesitation to this species, a single female from Mr. Cockle's collection, taken July 31. It is of a dark gray, produced by white powdering on a bluish black ground and patches of ocherous yellowish, most distinct in a line at base of fringe. It has a very different look to the types of *densa* and is doubtless worthy of a new name; but from the single specimen I do not care to characterize it.

SCOTOGRAMMA UNIFORMIS Smith.

Two specimens, July 29 (Bear Lake Mountain) and one in Mr. Cockle's collection, August 8, 1902 (McGuigan). Mr. Cockle's specimen is a female, more distinctly marked than the males, and approaches *infuscata* Smith, which is probably not specifically distinct from this.

SCOTOGRAMMA SEDILIS Smith.

Five specimens, June 26, July 24, 29 (Bear Lake Mountain), August 13 (Sandon, Mr. Currie). A female agrees well with the type of *sedilis* Smith; the rest, a male and three females are not different from what I have as *perplexa* Smith. I have not the type of the latter, so do not make this synonymy at present. A specimen in Mr. Cockle's collec-

[a] Proc. Ent. Soc. Wash., IV, 1899, p. 322.

tion is named *inconcinna* Smith, but it does not agree with the type before me. Professor Smith has made this same erroneous determination for the U. S. National Museum, and I suppose that he has conceived a wrong idea of his own species, not having the type before him.

ANARTA MELANOPA Thunberg.

Eight specimens, July 29 (Bear Lake Mountain). The hind wings are largely black at base, reducing the size of the white space, while the forewings are dark. I judge the form is not so extreme as *laerta* Smith, but probably connects it with *melanopa*. *Kelloggi* Hy. Edwards seems to be the same as or very close to the Kaslo specimens.

ANARTA LAPPONICA Thunberg.

One specimen, August 10 (Kokanee Mountain).

ANARTA ZETTERSTEDTI Staudinger.

One specimen, August 10 (Kokanee Mountain). It has the forewings very dark, the markings nearly lost; hind wings with the white space much reduced and powdered with black.

TAPINOSTOLA ORIENTALIS Grote.

No specimen; one in Mr. Cockle's collection.

HELIOPHILA OXYGALE Grote.

One hundred and seventy-two specimens, June 25, July 14, 21, 30, 31, August 5, 6, 7, 11, 12. The form occurring at Kaslo is marked like *oxygale* from California, but runs smaller, about the size of *minorata* Smith. Most of the specimens are lightly marked, some few run to heavy dark shadings (var. *minorata* Smith). I am satisfied, from a couple of slides made of the male genitalia, that there is easily enough variation to account for the slight differences between Smith's figures of *oxygale* and *minorata*,[a] and therefore the name *minorata* expresses only a varietal form of *oxygale*, not a racial one. The species is the western form of the eastern *luteopallens* Smith, and both are only geographical expressions of the European *pallens* Linnæus, scarcely worthy of more than racial distinction. Eggs were obtained, but the larvæ persisted in hibernating and could not be carried to maturity.

Egg.—Elliptical, higher than wide, rounded barrel shaped; smooth, shining, pale yellow, with no trace of ribs; reticulations linear, irregularly quadrangular, the vertical lines mostly straight, faint, scarcely raised, smaller, and rounded on the vertex to the micropylar rosette. Diameter, 0.6 mm.; height, 0.7 mm.

[a] Proc. U. S. Nat. Mus., XXV, pl. v, figs. 4 and 5.

Stage I.—Head slightly bilobed, rounded, brown; cervical shield brown. Body moderate, feet of joints 7 and 8 a little smaller, joint 12 scarcely enlarged. White, the skin dark, spicular; tubercles small, brown; setæ pointed; feet and leg plates smoky; chin gland clear, conical.

Stage II.—Head bilobed, oblique, brown, smoky shaded, eye black; width, 0.5 mm. Body with joints 5–6 and 12 slightly enlarged, feet nearly equal. Pale whitish with faint brown shadings, not defined; tubercles minute, dusky; setæ pale.

Stage III.—Head bilobed, brown, dark dotted by the tubercles; width, 0.8 mm. Body rather slender and tapering a little to the ends, subequal. Translucent yellowish sordid green from the food; dorsal, subdorsal, lateral, and broad substigmatal lines whitish, sharply edged, but obscure, a slight brown shading between them; tubercles small, black.

Stage IV.—Head pale luteous, darkly reticulate, tubercles black, a black shade before vertex of lobe within; width, 1.2 mm. Body moderate, equal, of a translucent reddish brown; dorsal line narrow, whitish, a broad smoky area around tubercle i; subdorsal and lateral lines whitish, not edged, the space between lateral and substigmatal lines smoky blackish on the edges, brown centrally. Substigmatal band whitish, not contrasted; subventer faintly brown tinged. Tubercles small, black, contrasted; cervical shield shining, concolorous with the markings before, but luteous behind; feet pale.

At this point the larvæ became persistent in their efforts to hibernate, but a stage was obtained with head of 1.4 mm. on September 18, and another of 1.7 mm. on October 7, but they did not differ in markings and are not improbably interpolated. The last stages remain to be observed.

HELIOPHILA ROSEOLA Smith.

One hundred and thirty-four specimens, June 30, July 2, 8, 19, 24, 27, 31, August 4, 5, 6. It varies in the depth of the reddish tint of the fore wings, but this is never wholly lacking. The transverse-posterior line sometimes appears as a row of five dots, but two is the usual number, and they may be wholly wanting. The species approaches *calgariana* Smith. Some of the darkest forms apparently come out as that species in Smith's synoptic table on account of the presence of a faint darker shade under the median vein; but on comparison with the types of *calgariana* the *roseola* are all far less brightly marked and can not be confused with it. It is closely allied to and perhaps only a race of *fuveta* Grote, which lacks the red tint. The larva is like *fuveta*, with the markings brighter and more contrasted. It fed on grass.

Egg.—Laid crowded in the groove of a leaf, gummed into a mass.

Nearly spherical, the base a little flattened; perfectly smooth, shining yellowish white without sculpture; diameter, 0.6 mm.

Stage I.—Head slightly bilobed, round, brownish luteous, ocelli black. Body short, robust, joint 12 and the central segments slightly enlarged. Cervical shield large, pale luteous. Body whitish, densely clear granular; tubercles minute, brown; setæ moderate, pointed, colorless. Feet of joint 7 very slightly shorter than the others. Later the food appears green.

Stage II.—Head pale luteous, vertex narrowly blackish; width 0.55 mm. Body thickened at joints 5–6, joint 12 enlarged. Yellowish, green from the food, especially in joints 5 and 6. Dorsal, subdorsal, traces of lateral and broad stigmatal bands faint, white. Cervical shield a little blackish, but not cornified. Tubercles and setæ obscure.

Stage III.—Head pale luteous with traces of brown vertical lines; a dark shade behind vertex; width, 1.05 mm. Body moderate, joints 5–6 and 12 a trace enlarged. Olive green, lines white, straight; dorsal, trace of upper subdorsal, lower subdorsal, lateral, a line between lateral and substigmatal, brown shaded; trace of suprastigmatal; substigmatal broad, yellowish tinted, folded. Feet brownish marked; no shields; tubercles and setæ obscure.

Stage IV.—Head rounded, full, whitish with rather open brown reticulations and vertical bands; width, 1.5 mm. Body moderate, equal, feet nearly equal. Straw-yellow; dorsal, upper and lower subdorsal and lateral lines whitish, even, brownish edged, obscure; space below lateral line gray brown, divided by a dilution. Substigmatal line white, straw-yellow filled. Feet pale with dusky tubercles; tubercles small, black; setæ short, obscure.

Stage V.—Head round, whitish luteous, reticulations open, faint with faint vertical bands, shining; width, 2.3 mm. Body equal; straw-yellow; dorsal, upper and lower subdorsal and lateral lines straight, whitish, distinct, edged by light brown; three lines alternating with them narrow and waved; lateral space dark brown, filled with a narrow central pale line; a white line at the top of the black spiracles; substigmatal band broadly straw-yellow filled, its lower edge also white; subventer dully marbled. Tubercles small black. Feet dark shaded; setæ minute; no shields.

Stage VI.—Head large, rounded, shining pale luteous with smoky-brown reticulations and vertical bands; width, 3.2 mm. Body moderate, equal, no shields, uniformly colored. Light straw yellow; dorsal space blackish reticular, defining a white dorsal line and addorsal dilution; a black, distinct, even subdorsal band, lightened centrally by a double straw-brown line; suprastigmatal space heavily and distinctly black reticulate on a whitish ground, forming a black band like the subdorsal one, diluted centrally. Substigmatal band white edged, straw-brown filled. Feet nearly white, those of joints 7 to 10, with

curved black bars outwardly, the others entirely pale, the anal pair with gray reticulations. Tubercles small, i showing blackish; setæ fine, obscure.

HELIOPHILA COMMOIDES Guenée.

Two specimens, July 2.

HELIOPHILA HETERODOXA Smith.

Five specimens, May 29, June 1, 4, 11. The basal streak on fore wings may be faint (*heterodoxa* Smith) or distinct (*megadia* Smith). There is obviously no specific difference between these forms. The species is close to *insueta* Guenée and apparently only a geographical expression of it; yet, being lighter and slighter than its eastern ally, it violates the usual rule for western races, and I would not, therefore, unite these forms specifically.

Eggs were obtained from captive females in good season; the larvæ were fed on grass.

Egg.—Laid crowded into crevices of the leaf and glued together. Two-thirds spherical, the base well flattened, smooth, no trace of ribs; surface neatly reticulate in linear, mostly quadrangular lines, slightly elongate vertically. Pale yellow; diameter, 0.7 mm.

Stage I.—Head rounded, testaceous, the edges, sutures, and mouth brown; width, 0.4 mm. Body robust, normal, joint 12 a little enlarged, feet all present, the anterior abdominal ones a little smaller. Whitish, unmarked; cervical shield small, brown. Tubercles minute, black, iv above the spiracular line; foot plates and anal plate dusky; setæ moderate, long. Later the food appears dark green in spots; faint brown subdorsal and lateral lines.

Stage II.—Head round, shining whitish, broadly shaded with brown; ocelli black; width, 0.5 mm. Body enlarged at joints 4–6, slender behind, 12 a little enlarged. Whitish, green shaded; dorsal, subdorsal, and lateral lines white, straight, obscure. Substigmatal line broad, white, the space between it and lateral line filled in with brown shading; a subventral brown shaded band. Tubercles small, black; setæ short, pale; feet, smoky shaded; no shields.

Stage III.—Head very pale brown with dark reticulations on the back part; eyes black; width, 0.8 mm. Body moderate, largest before, tapering behind, joint 12 slightly enlarged dorsally. Very pale fleshy whitish; dorsal, subdorsal, and lateral lines whitish, narrow, straight, obscurely dark-edged; substigmatal band broad, white, edged above and below by a broad dark-brown band, the upper one the most distinct mark on the body. Feet nearly equal, all pale; tubercles and setæ obsolete.

Stage IV.—Head round, full, about spherical, free, oblique, shining pale luteous, faintly reticulate, most strongly so on the vertices and

sides of the lobes, ocelli black; width, 1.2 mm. Body slender, tapering a little, joint 12 slightly enlarged dorsally. Smooth translucent green, the color mostly from the food; dorsal, upper and lower subdorsal and lateral lines white, about as broad as the spaces; stigmatal band white. Between it and the lateral line, all dark purplish brown; subventer irregularly shaded in brown. Folded bases of the feet whitish; feet colorless; tubercles minute, black; setæ short, pale.

Stage V.—Head round, slightly bilobed, full, large, shining waxy white, faintly reticulate in brown; width, 1.8 mm. Body moderate, equal; feet equal. Pale brown, mottled with dark brown; dorsal line narrow, white, subdorsal broad, eroded geminate above; lateral straight, a trace of a line below it; lower lateral straight; between this and the stigmatal line a broad dark-brown area obscurely geminate by a dilution. Stigmatal band white, below the spiracles on joints 2 and 12; subventer slightly brown mottled. Feet whitish; tubercles dark, but obscure; no shields.

Stage VI.—Head luteous white, reticulate with brown and with vertical bands beside the clypeus and a narrow one from eye; width, 2.5 mm. Body finely and neatly striped. Ground color pale creamy; dorsal line white, broadly dark brown edged, powdery without with a partly detached line along tubercle i. Subdorsal line white, powdery, dark brown edged above; lateral line white, straight like the others; lateral space brown filled, with a central dilution, almost forming a line. Space between lateral and stigmatal purple-brown filled, with a similar linear dilution, whitish. Substigmatal band white, geminate by a broad waved filling. Subventral area luteous, white dotted. Feet pale; tubercles i and ii with small black spots, the other tubercles concolorous; spiracles black; shields concolorous. The body is uniform, joint 12 not enlarged; feet equal; setæ short, obscure.

Stage VII.—Head luteous, reticulations and vertical bands dark brown; width, 3.5 mm. Body equal, tapered a little at the ends; luteous, white dotted, brown reticulate. Dorsal line white, dark edged; subdorsal and lateral similar, the subdorsal broadly dark above. Space between lateral line and spiracles dark; substigmatal band white; luteous filled; subventer white dotted; feet pale.

ZOSTEROPODA HIRTIPES Grote.

Forty-two specimens, June 16, 19, 23, 25, July 8, 21, 27, 30, August 11.

Egg.—Low ellipsoidal, the base flattened; ribs about 36, broad, low, indistinct, covered by reticulations, the apical ones on the ribs forming a regular zigzag; no lines in the hollows and the cross-striæ obsolete on the sides but distinct toward vertex, where there is a coarse, rounded, hexagonal reticulation, irregular and confused; micropylar circle of pyriform cells slightly raised. Pale yellow, with a reddish ring and spot; diameter, 0.8 mm.

Stage I.—Head rounded, slightly bilobed, clypeus high, whitish; three vertical rows of brown spots on each lobe; width, 0.3 mm. Body moderate, normal, joint 12 slightly enlarged, feet of joints 7 and 8 small, whitish; the tubercles small, brown, shields concolrous with the body; no marks; feet pale; setæ rather long, sharp, normal, ia to iib separate.

Stage II.—Head long, rounded before, the apex in joint 2; whitish, a brown line from the eye, one parallel to suture and edging clypeus roundedly, and a row of dots approximate to the latter, ocelli black; width, 0.55 mm. Body slender, joints 5 to 7 thicker and looped up a little, joint 12 scarcely enlarged, 10 and 11 narrower, feet of 7 and 8 smaller; whitish, green from the food; dorsal, subdorsal, faint lateral, broad substigmatal lines whitish; sides shaded in brown between the subdorsal and stigmatal lines. Tubercles small, dark; feet pale.

Stage III.—Head elongate, narrowed to the mouth, held flatly, white, with rows of purple-brown dots edging the suture on face and on angle of lobes; clypeus dark edged, jaws dark, vertex of lobes smoky behind; width, 0.8 mm. Body slender, elongate, slightly flattened, feet of joint 7 very small, those of joint 8 larger; whitish, shaded with ocherous; dorsal line white, dull olive edged, tubercle i in a large, olive spot; ii in a smaller one; subdorsal line white, straight, traces of a lateral line, the sides dark brown filled. Substigmatal line white, showing on subventral fold, partly concealed subventrally and brownish filled. Feet pale, with spots on the tubercles.

Stage IV.—Head held flatly, white with vertical dotted lines, two on the lobe parallel to suture, one on side of head, marbled and a streak from the eye, brown black; width, 1.1 mm. Body large for the head, largest at joints 5 and 6, tapering each way, joint 12 again a little enlarged. Fleshy whitish, tubercles small, black; lines on dorsum whitish, obscure, hardly traceable, defined by grayish cloudings; sides darker, with two whitish lateral lines; stigmatal band white, bisected by luteous gray; feet pale.

Stage V.—Head round, oblique, white, marked as before; width, 1.5 mm. Body slender and flattened, anal feet extended backward, clasping. Fleshy brown, dorsal space yellowish brown, marbled between the narrow, obscure dorsal and subdorsal lines. Tubercles small, black; sides dark, shaded in broad, diffuse longitudinal bandings; substigmatal band white, geminate by a brown filling; subventral area marbled in brown; feet pale with black tubercles; setæ small.

Stage VI.—Head held flat, the apex in joint 2, straw yellow, luteous brown reticulate, the vertical bands no longer separate; width, 2.1 mm. Body flattened, the sides projecting, narrowed slightly toward the ends, feet equal, no shields; straw brown, dotted with black without distinct lines. The black dots are segregated about the obsolete dorsal and subdorsal lines and over the tubercles, especially on joints 11 and 12 where a contrasted shade is produced. Sides shaded in

dark brown, obscurely triplicate, including the obsolete lateral line; substigmatal band all red-brown marbled, its edges clearer yellowish white; subventer dark brown dotted on the upper half, reddish below and on venter. Feet pale with black tubercles; dorsal tubercles white; setæ fine, rather short.

HIMELLA INFIDELIS Dyar.

Four specimens, July 2, 19, 21 (Bear Lake) and one from Mr. Cockle's collection, July 12, 1902.

GRAPHIPHORA CURTICA Smith.

Thirteen specimens, August 16, 17, 18, all very dark in color but apparently conspecific with *curtica*, described from the Sierra Nevada of California. I have others from Pullman, Washington (C. V. Piper).

GRAPHIPHORA COMMUNIS Dyar.

Three thousand four hundred and twenty-five specimens, June 13, 16, 19, 25, July 2, 24, 25, 27, 30, August 4, 5, 6, 7, 11, 12, 13, 15, 16, 17, 18. This is the species described by Smith as *Taeniocampa furfurata* Grote,[a] but it is not Grote's *furfurata*, which has scaly vestiture. I therefore proposed the name *communis* for this form. Smith's locality "New York" is erroneous, as is also the locality "Illinois." The single female before me, on which he made the latter reference, differs from *communis* in the straighter, more uniform and oblique transverse anterior line, both this line and the transverse posterior distinctly pale filled. I think it is at least a different race from *communis* and I would call it *smithii*.

Type.—Cat. No. 7334, U. S. National Museum.

The first brood of *communis* is grayer and smoother than the second which is more yellowish brown and contrasted.

Egg.—Spheroidal, the base flattened, upper half more rounded; ribs moderate, diminishing in pairs; reticulations also moderate, cresting the ribs and forming cross-striæ; apex reticulate, micropyle with circle of pyriform cells. Pale yellow; diameter, 0.7 mm. Laid singly, adherent.

Stage I.—Head bilobed, pale luteous, with dusky spots on the tubercles. Body moderate, normal, feet of joint 7 very small, of 8 larger, the others normal. Whitish, smooth, green from the food; tubercles moderate, dusky; setæ long, pale with small bulbous tibs; tubercle iv above the center of the spiracle.

Stage II.—Head rounded, pale sordid luteous, thickly fleckled with dark over the lobes and in vertex; width, 0.55 mm. Body short, robust, narrower behind, joint 12 enlarged, the feet of 7 smaller than

[a] Proc. U. S. Nat. Mus., XII, 1889, pp. 477.

the others. Fleshy, brownish; darker shaded on the sides, faintly indicating a greenish subdorsal line. Cervical shield and tubercles brownish, hair dots black; setæ moderate, dark.

Stage III.—Head pale whitish, a smoky shade at vertex, thickly dotted with black over lobes and in median suture; width, 0.8 mm. Body short, robust, dark brown shaded, with narrow yellowish broken dorsal and subdorsal lines. Cervical shield luteous, edged and spotted with blackish. Upper edge of stigmatal band indicated, below it paler. Tubercles moderate, black; setæ rather long, glandular tipped; feet nearly equal, with darker shields.

Stage IV.—Head pale brown, thickly spotted with round black dots in median suture and over lobes; width, 1.2 mm. Body robust, thorax tapering to the head, joint 12 enlarged. Pale brown, mottled and speckled with blackish; dorsal line narrow, whitish, smoky edged. Oblique whitish shades from posteriorly near dorsal line to subdorsal anteriorly on the segments, dark margined before, define obscure diamond-shaped dorsal patches, olivaceous shaded. Tubercles round, black; setæ short, pale; cervical shield pale, irregularly black powdered, leaving pale dorsal and subdorsal lines.

Stage V.—Head with the apex in joint 2, sordid luteous with thick, round black spots except on the face and a band on the lobe; width, 1.8 mm. Body robust, somewhat flattened, joint 12 slightly enlarged. Blackish gray, thickly black streaked and white dotted on a pale brown ground; shield concolorous. Oblique light subdorsal lines posterior and dorsal, forward and downward on joints 5 to 12, bar-shaped on joint 12, darker shaded behind. Substigmatal band paler, reddish reticulate, shading to the subventer, all white dotted. Traces of a pale dorsal line.

Most of the larvæ had but five stages, though one was noted with a 1.4 mm. head, which would indicate six stages in that specimen.

GRAPHIPHORA UNIFORMIS Smith.

Eight specimens, July 19, August 12.

GRAPHIPHORA ALIA Guenée.

No specimens; one from Mr. Cockle's collection, April 18.

STRETCHIA NORMALIS Grote.

No specimens; one from Mr. Cockle's collection, April 23.

STRETCHIA PLUSIIFORMIS Hy. Edwards.

No specimens; one in Mr. Cockle's collection, September 27. I have described the larva from Coloradan specimens.[a]

[a] Proc. U. S. Nat. Mus., XXV, 1902, p. 377.

STRETCHIA VARIABILIS Smith.

No specimens; one in Mr. Cockle's collection, April 28, 1902.

PERIGRAPHA ACHSHA Dyar.

No specimens; one from Mr. Cockle's collection, April 24.

CLEOCERIS RECTIFASCIA Smith.

Five specimens, July 31, August 1, 11, 13, 16. The species was described from the mountains of California. One of the specimens has the light tint in the reniform pale yellow instead of the usual brownish red.

PLEROMA OBLIQUATA Smith.

No specimens; one from Mr. Cockle's collection, April 26.

PLEROMA BONUSCULA Smith.

No specimens; one in Mr. Cockle's collection taken August 24, I refer here. It differs from the type in the blackish shadings being reduced, while the double row of black spots separated by the fragments of the white subterminal line is prominent, the spots slightly produced, suggesting dashes. The specimen is a little rubbed. A series might show a form worthy of a distinctive name.

XYLINA FAGINA Morrison.

No specimens; one in Mr. Cockle's collection, April 24.

XYLINA OREGONENSIS Harvey.

No specimens; one from Mr. Cockle's collection apparently represents a stray specimen from the coast region.

XYLINA CAPAX Grote and Robinson.

No specimens; one in Mr. Cockle's collection, September 20.

EUHARVEYA CARBONARIA Harvey.

No specimens; one from Mr. Cockle's collection, April 23.

LITHOLOMIA NAPÆA Morrison.

Four specimens, May 30, June 2.

CALOCAMPA CINERITIA Grote.

No specimens; one in Mr. Cockle's collection, May 14, 1901.

CUCULLIA OBSCURIOR Smith.

One specimen, August 4.

CUCULLIA POSTERA Guenée.

Two specimens, July 8, August 20 (Nelson).

GORTYNA MEDIALIS Smith.

No specimens; one in Mr. Cockle's collection.

PYRRHIA EXPRIMENS Walker.

No specimens; one in Mr. Cockle's collection, July 20, 1901.

XANTHIA FLAVAGO Fabricius.

Two specimens, August 15, 17.

TRIGONOPHORA PERICULOSA Guenée.

Two hundred and sixty specimens, July 14, 21, 22, 27, August 3, 4, 5, 6, 15, 17. Variable within the usual specific range. The form *v-brunneum* occurred in small proportion. Eggs were obtained, but only a few larvæ reached the last stage before winter.

Egg.—Nearly spheroidal, the top slightly conoidal, roughened by the ends of the ribs, base flattened moderately; ribs about 32 around the margin, diminishing above by alternation to 10 about the vertex, where they end in a low ring formed by a prominent cross-stria; within this a series of low radiate bars to the micropylar rosette which is elevated; cross-striæ low, rounded, yet distinct, the cell areas gently concave, twice as wide as high or more. Surface subgranular shagreened; pale yellow later with a brown ring and spot; diameter 1 mm. Laid singly.

Stage I.—Head round, bilobed, pale brown with smoky black spots on the tubercles, mouth red brown. Body moderately elongated, semilooping, feet of joints 7 and 8 small, joint 12 enlarged. Cervical shield pale brown; leg shields not infuscated, white; the tubercles large, black; setæ black, stiff, pointed.

Stage II.—Head bilobed, oblique, pale luteous with distinct black spots on the tubercles; width, 0.8 mm. Body rather slender, flattened, joint 12 enlarged laterally, feet of 7 and 8 small. Clear translucent green without shields; a broad, waved, obscurely geminate subdorsal line dividing the dorsal space into diamond-shaped green marks; a broad suprastigmatal more blackish band; subventral region more whitish. Tubercles round, black, distinct; setæ black, pointed.

Stage III.—Head bilobed, oblique, green, brownish on the vertex, the tubercles black; width, 1.1 mm. Body soft clear green, the seg-

ments submoniliform, joint 12 the most enlarged, feet of joints 7 and 8 smaller. White dorsal intersegmental spots, double on the posterior edges of the segments, single and fainter on the anterior edges; olivaceous blackish broad open shadings, inclosing traces of the white subdorsal line and extending on the dorsum and sides, forming a broad, straight band over tubercle iii to the substigmatal band, which is broad, pale green, and shading to the subventer. Tubercles round, black; setæ small; no shields.

Stage IV.—Head as before shining with pale brown reticulations and black spots on the tubercles; width, 1.5 mm. Body olivaceous green, marked as before in brown linings. The broad substigmatal band and subventer are distinctly whitish.

Stage V.—Head rounded bilobed, pale brown with dark brown reticulations and brown vertical bands; width, 2.1 mm. Body moderate, joint 12 gently enlarged, the incisures somewhat marked. Light olivaceous green, dotted and streaked in dark red brown, forming edges to the dorsal line, tubercles i and ii and long oblique streaks to the dark edge of the substigmatal line. Dorsal line resolved into two rounded spots to each segment and an anterior faint streak; tubercles i and ii whitish; substigmatal band rather narrow, white, the subventer sparingly brown marked. Feet brown marked; spiracles black; tubercle iv above the middle on the posterior segments.

Stage VI.—Head pale greenish luteous, reticulations and bands light brown; tubercles i and ii black marked; width, 2.8 mm. Body soft light olivaceous yellowish, robust, the segments enlarged, all nearly equal. It is flecked with patches of light brown, edging the dorsal line, tubercles i and ii, forming oblique side lines and edging the substigmatal band above. Dorsal line forming two dots posteriorly on the segments, rounded, white; tubercles i and ii white; spiracles black edged; substigmatal line obsolete, light, nearly without markings; subventer red marked instead of brown; thoracic feet brownish; tubercles distinct, white, setæ moderate.

One larva spun a slight cocoon of white silk October 28.

EUCIRRŒDIA PAMPINA Guenée.

Four specimens, August 18.

SCOLIOPTERYX LIBATRIX Linnæus.

Six specimens, May 29, 30, June 13, 25. The characteristic larva was found on willow.

PSEUDORTHOSIA VARIABILIS Grote.

Eighty-six specimens, August 6, 11, 13, 16, 17.

COSMIA PALEACEA Esper.

Sixteen specimens, July 7 (bred), 30, 31 (bred), August 4, 6, 7, 13, 18. Of these eight have the spot in the reniform like European *paleacea;* the others lack it (var. *discolor* Walker). The larva was found on birch and aspen.

Stage VI.—Head bilobed, free, shining pale yellow, ocelli partly brown; width, 3.5 mm. Body moderate, joint 12 scarcely enlarged. Translucent frosted whitish, food showing green. Dorsal line white, narrow, straight; subdorsal less rigid and narrower, two stigmatal lines, one above and one below the spiracle, linear, waved like the subdorsal. Feet pale, no shields, tubercles small, white, iv above the center of the spiracle posteriorly. The skin is perfectly transparent, the whitish frosted look being subcutaneous and caused largely by the branches of the tracheæ, both those running to the skin and to the stomach being separately visible. Spiracles white, brown ringed.

ORTHOSIA PURPUREA Grote.

Three specimens, September 8 (bred), 10 (bred), and four from Mr. Cockle's collection, September 18, 19, 20. Larvæ were found on hollyhock and plantain.

Stage V.—Joint 12 slightly enlarged; green, dorsal, subdorsal, and broad substigmatal bands white, the subdorsal waved; body all white dotted; tubercles small, white; spiracles white, black ringed.

Stage VI.—Head rounded, apex in joint 2, erect, very pale brown, mottled reticulate in darker gray, forming faint broad bands on the faces of lobes. Body cylindrical, normal, joint 12 scarcely enlarged. Cervical shield black with a few pale dots, cut by a whitish subdorsal line, weakly cornified. Body light brown, minutely dotted with whitish; a series of subdorsal black marks on joints 5 to 12, diamond-shaped and throwing an arm from the lateral angles anteriorly, lighter centrally, cut by the narrow, broken, powdery white dorsal line. Tubercles i and ii small, white. Traces of a pale subdorsal line, black edged; substigmatal line broad, filled by mottlings of the brown ground till only its edges show white, dotted like all the ground and especially the subventral region. Tubercles iii to vi white, not as contrasted as tubercles i and ii. Feet all pale.

ORTHOSIA BICOLORAGO Guenee, var. FERRUGINOIDES Guenee.

Eight specimens, August 12, 17, 18, and two from Mr. Cockle's collection August 24 and September 19.

ORTHOSIA EUROA Grote and Robinson.

One specimen, August 22 (Revelstoke) and one from Mr. Cockle's collection August 20.

IPIMORPHA PLEONECTUSA Grote.

Six specimens, July 3 (bred), August 7, 12, 18. Both the dark normal form and the light clay-colored one (var. *æquilinea* Smith) occurred. Larvæ were found separately in neat houses of leaves with a round hole at the lower end, on aspen.

Stage VI.—Head rounded, disk like, yellowish white, white on the face, which is edged by a semicircular heavy black band; jaws and sutures of mouth black; width, about 3 mm. Body normal, flattened ventrally, joint 12 not enlarged. Translucent, green from food and blood, a broad, dorsal pale white band on joints 3 to 13, narrowed before; cervical shield all green, not cornified; a similar but narrower and broken subdorsal line; a narrow substigmatal white line, resembling the tracheal line. Thoracic feet black tipped; abdominal ones normal. Tubercles small, pale, white with dark hair dots, iv at the lower corner of the spiracle; spiracles white, black edged; skin shagreened.

HELIOTHIS PHLOGOPHAGUS Grote and Robinson.

No specimens; one in Mr. Cockle's collection. I have described the larva from Coloradan specimens.[a]

HELIOTHIS SCUTOSUS Fabricius.

No specimens; one in Mr. Cockle's collection.

MELICLEPTRIA HONESTA Grote.

No specimens; Smith's type of *Melicleptria kasloa* is, however, before me and seems inseparable from *honesta* Grote.

MELICLEPTRIA SEPTENTRIONALIS Hy. Edwards.

No specimens; one from Mr. Cockle's collection, June 7 (Ainsworth).

HELIACA NEXILIS Morrison.

Three specimens, July 21 (Bear Lake Mountain), 29 (Bear Lake Mountain).

PLUSIA AEREOIDES Grote.

No specimens; one from Mr. Cockle's collection, August 19, 1902.

PLUSIA METALLICA Grote.

Two specimens, August 6, 11.

AUTOGRAPHA MAPPA Grote and Robinson.

Two specimens, August 13 (Sandon, Mr. Currie).

[a] Proc. U. S. Nat. Mus., XXV, 1902, p. 374.

AUTOGRAPHA FLAGELLUM Walker.

No specimens; one in Mr. Cockle's collection, August 12.

AUTOGRAPHA PSEUDOGAMMA Grote.

One specimen, July 25.

AUTOGRAPHA CALIFORNICA Speyer.

Twenty-three specimens, June 1, 6, 7, 11, 13, 16, July 1 (bred), 3 (bred), 4, 24, 31, August 2, 3, 4, 5, 6, 24 (Vancouver). Eggs were obtained from captive females and the larvæ throve well, completing in five stages. I have elsewhere described the stages,[a] and will therefore not repeat the descriptions.

AUTOGRAPHA BRASSICÆ Riley.

Three specimens, June (Mr. Cockle), August 25 (bred). No description was taken of this well-known larva.

AUTOGRAPHA RECTANGULA Kirby.

Six specimens, July 26, August 3, 4, 6, 7.

AUTOGRAPHA U-AUREUM Guenée.

Four specimens, August 18, 20 (Nelson), and one given me by Mr. Cockle.

AUTOGRAPHA VACCINII Hy. Edwards.

One specimen, August 4.

AUTOGRAPHA SELECTA Walker.

Two specimens, August 6, 15.

AUTOGRAPHA EPIGAEA Grote.

No specimens; one in Mr. Cockle's collection, August 26, 1902.

AUTOGRAPHA AMPLA Walker.

Two specimens, July 15, August 13 (Sandon, Mr. Currie).

AUTOGRAPHA DIASEMA Boisduval.

One specimen, September 8 (Glacier, dead in an electric light).

SYNGRAPHA IGNEA Grote.

One specimen, September 8 (Glacier, dead in an electric light).

[a] Ent. Amer., VI, 1890, p. 14.

MARASMALUS INFICITA Walker.

No specimens; one in Mr. Cockle's collection.

ANNAPHILA DANISTICA Grote.

No specimens; one in Mr. Cockle's collection.

EUSTROTIA ALBIDULA Guenée.

Eighteen specimens, July 11 (Fletcher's Ranch), August 23 (Mission Junction). This species did not occur at Kaslo at all. At both places where I took it there are cultivated fields.

THERASEA ANGUSTIPENNIS Grote.

One specimen, August 10 (Kokanee Mountain, on snow).

TARACHE MAJOR Smith.

No specimens; one in Mr. Cockle's collection, August 1, 1902.

TARACHE ARELI Strecker.

Two specimens, June 23, July 23. Eggs were obtained from one of the specimens and the larvæ hatched, but I could not find their food plant.

Egg.—A little higher than wide, slightly conoidal, base rounded flattened; ribs about 40 at the side, diminishing by alternation to 10 at the edge of the micropylar area, straight, sharply elevated from a flat surface; cross-striæ obsolete, except at the ends of the ribs, vertex irregularly quadrangularly reticulate with a cluster of small cells at the micropyle. Bright bluish green; diameter, 0.75 mm.

Stage I.—Head large and thick, rounded, black. Body slender, the segments moniliform, feet of joints 7 and 8 absent, the other feet large. Cervical shield and thoracic feet black; tubercles large, blackish, normal, no subprimaries; leg plates blackish. Luteous ochraceous, darkened by fine skin granules, the segments broadly, diffusely marked with dark vinous. Setæ black with small bulbous clear tips; joint 12 slightly enlarged.

HYAMIA SEXPUNCATATA Grote.

One specimen, June 8, and one from Mr. Cockle's collection, June 14. I have described this larva on dogbane from New Hampshire specimens.[a]

[a] Journ. N. Y. Ent. Soc., IV, 1896, p. 145.

MYCTEROPHORA LONGIPALPATA Hulst.

Nine specimens, July 15, 18, 19, 24, 27. The species was identified for Mr. Cockle by Prof. J. B. Smith, by comparison with Hulst's type. The genus, described as a Geometrid, is properly referable to the Noctuidæ. *Prosoparia* Grote is probably also a Noctuid genus, judging from Hulst's description of the venation. Eggs were obtained from captive females, but the little larvæ soon exhibited the inevitable tendency to hibernate, and only the first three stages were obtained. They fed on green lichens growing on damp wood.

Egg.—Ellipsoidal, base slightly flattened, top granularly roughened; ribs about 40, low, narrow, neatly waved, diminishing by confluence to 12 at the edge of the micropylar area; cross striæ distinct, rounded, the cell areas not much wider than high; the ribs run practically to the micropyle. Pale yellow, later with the top all reddish; diameter, 0.6 mm.

Stage I.—Head round, bilobed, thick, held flatly; brown, smoky tinged. Body slender, elongate, joint 12 slightly enlarged, semilooping, the feet of joints 7 and 8 entirely absent. Whitish, the alimentary canal reddish. Tubercles rather large, brown, angular, normal; setæ very long, curved, white, smooth, with small bulbous tips. Cervical shield, leg-plates and anal plate blackish.

Stage II.—Head bilobed, pale whitish, sutures dark brown, a vertical line in clypeus and obscure dottings on the tubercles; width, 0.45 mm. Body cylindrical, moderately elongate, no feet on joints 7 and 8, those of 9 and 10 approximate. Pale whitish, with longitudinal crimson lines, shadedly joined centrally on the segments, subdorsal, lateral, supra- and substigmatal and subventral, irregularly broken. Feet pale; setæ long, curved, dusky; tubercles minute, dark.

Stage III.—Head broad, rounded, dull brown gray; width, 0.6 mm. Body slender, elongate, feet of joints 7 and 8 absent. As before, but the color changed. Nearly uniform dull dark gray brown intersegmentally; on the segments with fine longitudinal streaks of yellowish white, addorsal, subdorsal, lateral, stigmatal, and subventral, rather irregular and not rigid. Venter pale between the feet. Hair soft, pale, long, curved. Tubercles slightly raised, concolorous; hair dots dark.

The subsequent stages were not obtained.

EUCLIDIA CUSPIDEA Hübner.

No specimens; one in Mr. Cockle's collection.

MELIPOTIS PALLESCENS Grote and Robinson.

No specimens; one in Mr. Cockle's collection, June 24, is a worn and faded specimen, originally darkly colored, but I think referable here.

MELIPOTIS JUCUNDA Hübner.

No specimens; one in Mr. Cockle's collection, July 12, 1902.

CIRRHOBOLINA MEXICANA Behr.

No specimens; one in Mr. Cockle's collection, August 12, 1901.

SYNEDA ALLENI Grote.

Three specimens; May 30, June 6, 26.

SYNEDA SOCIA Behr.

No specimens; one in Mr. Cockle's collection.

SYNEDA OCHRACEA Behr.

No specimens; one in Mr. Cockle's collection, July 10 (Ainsworth).

SYNEDA HUDSONICA Grote and Robinson.

Thirty-eight specimens; May 29, June 4, 6, 8 (Ainsworth), 9, 11, 18, 29, July 2, 13. The specimens vary in the color of the middle band of fore wings from uniformly pale gray to a bright chestnut brown shading on the central part. This is the form *seposita* Hy. Edwards, which is not a distinct species as hitherto listed. I endeavored many times to obtain eggs of this species, but always without success.

CATOCALA BRISEIS Edwards.

Six specimens, August 12, 13, 16, 17, 18. They agree exactly with Eastern *briseis*, although I had expected them to be the Californian *hermia* Hy. Edwards. Two of them are of the form *groteana* Bailey.

CATOCALA AUGUSTA Hy. Edwards.

Two specimens, August 12, 15. The specimens agree with others which Mr. Beutenmüller has so named for me.

CATOCALA RELICTA Walker.

No specimens; one in Mr. Cockle's collection, which he has kindly transmitted to me for examination. It was supposed to represent *elda* Behrens, but if so, then I do not regard this as distinct from *relicta*.

TOXOCAMPA VICTORIA Grote.

Forty-two specimens, June 25, July 12, 14, 15, 25, 26, August 1. Eggs were readily obtained from captive females, but I could not feed the young larvæ. I judge that they do not have a particular food plant, as the eggs were laid loose and rolling about; perhaps they hibernate in stage i.

Egg.—Perfectly spherical, rolling about in the dish like shot, very slightly adherent as laid, but not enough to stick to a leaf. About 26 vertical ribs, diminishing toward the ends, sharp, crested by the vertical reticulations, but low and with broadly concave spaces between, rather remote. Cross striæ fine, parallel, forming rectangular cells four times as wide as long. Sordid pale green; diameter, 0.9 mm.

Stage I.—Head rounded bilobed, oval, whitish, a narrow curved mottled brown band on the face of each lobe, mouth brown. Body long, slender, vibrant looping, sordid whitish without marks. Feet of joints 7 and 8 very short; shields concolorous; tubercles small, brown, setæ moderate, pointed.

HOMOPTERA CALYCANTHATA Smith and Abbot.

Seven specimens, May 13 (Mr. Cockle), June 1, 2, 16, 19, 23. The moths occurred in two forms, with and without ocherous shading. Eggs were obtained from both and the resulting larvæ proved indistinguishable.

Egg.—Two-thirds spherical, the base flattened, rounded under. About 40 ribs, narrow, moderate, waved, with faint obsolete cross striæ; apex broadly reticular, the cells as broad as two ribs, quadrangular, then smaller cells, the micropyle with a circle of pyriform cells. Bluish green; diameter, 1 mm.

Stage I.—Head rounded bilobed, held obliquely, pale brown. Body slender, rapidly vibrant looping, feet of joints 7 and 8 very short. Whitish translucent, green in the alimentary canal before eating, apparently from the green egg, which does not turn red. Tubercles moderate, black; shields concolorous, the elliptical leg plates of joints 9, 10, and 13 smoky.

Stage II.—Head elongate, the vertex full, oblique; gray whitish, shining, heavily black reticulate, forming a band on vertex of lobes from occiput to above clypeus; width, 0.6 mm. Body slender, elongate, feet of joints 7 and 8 very short and not used; slaty gray, greenish diluted dorsally, brownish laterally; geminate dorsal, subdorsal, lateral and broad substigmatal gray lines, obscure. Cervical shield concolorous, leg shields olivaceous. Tubercles small, black, setæ moderate, black; joint 12 a little enlarged dorsally; thoracic feet pale.

Stage III.—Head round, full, clypeus depressed, blackish, dotted with white in six lines on vertex and a confused area over sides, a whitish gray bar each side of clypeus, clypeus gray with three erect black marks; width, 1 mm. Body slender, anal feet long, divergent, those of joints 7 and 8 very short; joint 12 slightly humped dorsally. Blackish, diluted in sordid green on joints 5 to 7; wavy addorsal, straight subdorsal and lateral lines whitish; stigmatal and subventral lines similar, equally narrow. Feet pale, the abdominal ones gray

without, the anal pair blackish like the body. Tubercles moderate, black; setæ black, fine, rather long. The greenish, thickened part at joints 5–6 is held arched.

Stage IV.—Head bilobed, oblique, lobes full above clypeus, sutures depressed; black, dotted in white, leaving a bar on lobe above; width, 1.7 mm. Body slender, tapering behind, joints 5 and 6 enlarged, an elevation on joint 5 posteriorly and a higher one on joint 12, bearing the conical tubercle ii; feet of joints 7 and 8 not used, short. Black, green diluted on joints 5 and 6. Dorsal, subdorsal, lateral stigmatal narrow wavy broken white lines; thoracic feet pale; tubercles small, with setæ black.

Stage V.—Head round, bilobed, erect, free, violaceous white, densely reticulate in black, clypeus streaked vertically, antennæ pink; width, 2.6 mm. Body slender, looped up at joints 5–6, tubercles ii on joint 12 forming a pair of cones; anal feet long, spreading; feet of joints 7 and 8 short and pale. Incisures of joints 4–5 and 5–6 conspicuously green, else bark gray; dorsal line geminate, waved, white; subdorsal narrow white, black edged above; lateral and stigmatal lines narrow, white, similar. Thoracic feet luteous, ringed in black; abdominal ones gray-lined with luteous plates except the anal pair. Tubercles white with black hair dots, i and ii of joint 5 conspicuous; a bright dilution on the side of joint 8.

Stage VI.—Head round, prominent, higher and wider than joint 2, oblique, clypeal sutures depressed, reddish-brown bark color, freckled with little white spots which are aggregated in large groups leaving a line of the ground color from clypeus over tubercles i and ii; antennæ white, striped with pink without; labrum whitish with reddish marks; width, 3.7 mm. Body rather slender, joint 5 enlarged dorsally and humped a little, joint 12 more sharply but less enlarged with high cones bearing setæ ii; feet of joints 7 and 8 shorter than the others but alike in color. Bark brown, tubercle ii of joint 5 white in a black spot, the cones ii of joint 12 dark red. Dorsal line white, geminate, waved, filled with white reticulations; subdorsal, lateral, substigmatal and subventral lines single, waved, dotted on a greenish ground, the greenish showing as a dilution about the hump on joint 5; a large misty white shade over joint 8; sides of joint 12 and all of 13 a little lightened. No shields; tubercles white marked; feet pale, the abdominal ones dull red within with white tubercles, the anal pair black lined; setæ fine, pale.

The larvæ fed on birch. They entered the ground to pupate.

EPIZEUXIS ÆMULA Hüber.

No specimens; one from Mr. Cockle's collection, August 2, 1902, is nearest this species, but differs in several characters. It is, however, in too poor condition to be made the type of a new name.

ZANCLOGNATHA OCHREIPENNIS Grote.

No specimens; one in Mr. Cockle's collection.

BLEPTINA CARADRINALIS Guenée.

Fifty-six specimens, June 13, 16, 19, 20, 30, July 2, 4, August 5, 7. Eggs were obtained from captive females but the larvæ hibernated before reaching maturity. They fed on dead dry leaves.

Egg.—Conoidal with flattened base, perfectly smooth, scarcely even shagreened, shining pale yellow; diameter, 0.6 mm.

Stage I.—Head rounded, bilobed, black, mouth brown, antennæ colorless; width, 0.25 mm. Cervical shield bisected, with anal plate black. Feet of joints 7 and 8 short, the body normal, joint 12 a little enlarged. Colorless, translucent, tubercles large, black, angular; setæ with swollen tips, clear, the shaft subspinulose, dusky.

Stage II.—Head rounded, bilobed, whitish with a vertical blackish streak above the black ocelli; width, 0.4 mm. Body short, robust, brown, shaded on the sides with vinous, incisures paler. Cervical shield blackish, broadly bisected; an obscure dark dorsal line; tubercles concolorous, setæ short, thick, capitate, the tips pale and contrasted.

Stage III.—Head sordid, dull, a black V-mark over clypeus and dash above eyes; width, 0.75 mm. Body robust, flattened, joint 12 enlarged. Cervical shield quadrate, blackish with a central dilution. Body sordid smoky gray, marked by the white points of the capitate setæ; a darker dorsal line; sides irregularly diluted in pale in the incisures and folds. Hair dots black.

Stage IV.—Head as before; width, 1.1 mm. Body the same, very dark, the dorsal line blackish with oblique subdorsal bars from anterior addorsal to posterior lateral, indistinct. Setæ with white heads.

Stage V.—Head rounded, dull dark brown, a light band each side of clypeus; width, 1.8 mm. Body robust, flattened, blackish brown, thickly dotted with lighter, darker laterally. A pale stigmatal line of the color of the dots, broken, diffuse, obscure. Setæ short, thick, swollen capitate, pale, contrasted on the dark ground; iv at the center of the spiracle, v and vi nearly in line on the subventral fold.

The last stage, apparently, remains to be described.

PALTHIS ANGULALIS Hübner.

Two specimens, June 10, 15. An egg was obtained from one of the captured specimens, but the larva which hatched from it was accidentally lost.

Egg.—Rounded hemispherical, translucent whitish; about 40 low ribs not sharper than the hollows, covered by an uniform hexagonal

reticulation of slightly raised lines, one junction at the summit of a rib, the next in the base of a hollow. Apex confusedly reticulate. Some irregular red spottings; diameter, 0.8 mm.

Stage I.—Head rounded, bilobed, brown-black on vertex, pale below, shining. Body moderate, joint 12 a little enlarged, feet normal, equal; translucent brown, the small tubercles and shields blackish brown, including the cervical shield, leg plates, and anal plate. Setæ moderate, pointed, dark; thoracic feet black.

HYPENA HUMULI Harris.

Sixteen specimens, May 30, 31, June 2, 11 (bred), 12 (bred), 13, August 3, Sandon (G. C. Robbins) and one from Mr. Cockle's collection. Eggs were obtained and the larvæ fed on nettle.

Egg.—Flattened like one-third of a sphere, the base rounded, very flattened ellipsoidal; about 32 ribs, sharp, linear, high, fluted-waved, diminishing toward the micropyle which is marked by a cluster of elliptical cells; cross-striæ distinct but scarcely raised, arcuated downward in the deep grooves, forming rectangular cells about twice as wide as high. Color whitish, translucent, beaded by the ribs which look wide under a low power; later with irregular brown specks; diameter, 0.5 mm.; height, 0.3 mm.

Stage I.—Head large, rounded, bilobed, colorless, eye black, mouth brown; body slender, submoniliform, semilooping, feet on joints 9, 10 and 13. Colorless, transparent, unmarked, tubercles invisible, setæ pale.

Stage II.—Head high, narrowed to mouth, bilobed, free, transparent colorless, black spots on the tubercles, eye black, mouth brown. Body slender, semilooping, no feet on joint 7; transparent, food green, shields concolorous; tubercles small, black.

Stage III.—Head pale whitish with black tubercles; width 0.6 mm. No feet on joint 7, the anal pair extended backward. Body transparent green, tubercles black, a distinct white subdorsal line.

Stage IV.—Head green with black tubercles; width, 1.3 mm. Body slender, elongate, no feet on joint 7, those of joint 8 small; transparent green with distinct white subdorsal stripe; tubercles moderate, concolorous, with black hair dots; setæ black, stiff.

Stage V.—Head green with many grayish black flecks over vertex; width, 1.9 mm. Body semilooping, no feet on joint 7, those of 8 to 10 equal. Dorsum olivaceous green, subventer and venter clearer green; dorsal vessel dark, whitish edged; subdorsal line bright white, narrow. Tubercles pale, sordid, hair dots black. Hair rather long, dark; feet all green; spiracles black ringed.

Apparently finished in five stages, though it seems possible that stage iv was missed.

HYPENA CALIFORNICA Behr.

Three specimens, June 1, 3, 10, and one from Mr. Cockle's collection, October 20, 1902.

Family NYCTEOLIDÆ.

NYCTEOLA REVAYANA Scopoli.

Four specimens of this cosmopolitan species, August 3, 4, 7, 16. The larvæ were common on the balsam poplar, webbing up the young leaves in their well-known, characteristic manner.

Family PERICOPIDÆ.

GNOPHÆLA LATIPENNIS Boisduval.

One specimen, August 7, of the form found in Washington and the mountains of California with the yellow markings reduced.

Family NOTODONTIDÆ.

MELALOPHA APICALIS Walker.

No specimens; one in Mr. Cockle's collection.

MELALOPHA BRUCEI Hy. Edwards.

No specimens; Mr. Cockle has taken it.

HYPERÆSCHRA PACIFICA Behr.

No specimens; one in Mr. Cockle's collection. This form differs rather distinctly from the Atlantic region *stragula* Grote in the gray patch over cell and the straighter subterminal line.

ODONTOSIA ELEGANS Strecker.

No specimens; Mr. Cockle has taken it. I have described the larva on aspen from Coloradan specimens.[a]

NOTODONTA SIMPLARIA Graef.

No specimens; a single large female in Mr. Cockle's collection seems referable to this species.

PHEOSIA DIMIDIATA Herrich-Schaeffer.

One specimen, August 11. The moth was rare and the larvæ were not seen. The form agrees with Californian specimens and is not like the Pacific coast form *portlandia* Hy. Edwards.

[a] Proc. U. S. Nat. Mus., XXV, 1902, p. 393.

NADATA GIBBOSA Smith and Abbot.

One specimen, June 2. The form is normal, like specimens from the Atlantic coast, not like the peculiar red or pale yellow forms that occur in certain places. The yellow marking in the cell of fore wing is well contrasted.

SCHIZURA IPOMŒÆ Doubleday.

One specimen, July 4. Of the normal form without any black shadings. The species occurs throughout North America, except possibly in the Southwest. The well-known larva was not seen at Kaslo.

SCHIZURA CONCINNA Smith and Abbot.

No specimens; Mr. Cockle has taken it.

SCHIZURA UNICORNIS Smith and Abbot.

No specimens; Mr. Cockle has taken it.

SCHIZURA PERANGULATA Hy. Edwards.

No specimens; one in Mr. Cockle's collection, without date. Without a series I can not say positively that this is a local race, but such is probably the case. The specimen is nearest to one which I have from Ogden, Utah, as distinguished from others from Colorado. It has the fore wings a bright, nearly uniform gray, all the markings obliterate, except a heavy black shade at base and along basal two-thirds of inner margin. The basal dash is present and the reddish shade on inner margin faintly so. Hind wings pure white, scarcely soiled at anal angle.

HARPYIA SCOLOPENDRINA Boisduval.

No specimen; Mr. Cockle has some referable to a form of this species.

GLUPHISIA SEPTENTRIONALIS Walker.

One specimen, July 25, and one from Mr. Cockle's collection, July 2, 1901. Mr. Cockle has taken others. They are of the form *quinquelinea* Dyar, which was described from Portland, Oregon. The larva was not seen; it feeds on aspen and cottonwood. These trees occur everywhere from the cold woods of Maine to the sun-baked arroyos of Arizona, and *Gluphisia* accompanies them. Naturally the adult varies much in appearance from the dark forms of the northern woods to the pale, almost white ones of the southern deserts. The North American forms have been variously called *septentrionalis*, *clandestina*, *trilineata*, *rildenda*, *quinquelinea*, *wrightii*, *albofascia*, *rupta*, and *formosa*, all described as good species. They have been gradually

united, till but two so-called species are now listed. I think there is really but one, with a series of local races, each adapted to its special locality. I would therefore unite all the names under *septentrionalis* Walker.

GLUPHISIA LINTNERI Grote, var. SEVERA Hy. Edwards.

Two specimens, May (Mr. Cockle), May 30. The larvæ were later beaten from balsam poplar by Mr. Currie. A description has been published.[a] This form has gone under the specific name *severa* Hy. Edwards, but I am convinced, after seeing a small series, including several from Rossland, that the form varies enough to cover all the descriptions—*lintneri*, *severa*, *danbyi*, *arimacula*, and *slossonii*—and that we have but one species, not two. The western race (*severa*) is larger, broader winged and more shaggy looking, as well as generally darker in color. I would arrange the forms thus:

Smaller, narrower winged, lighter gray	*lintneri* Grote.
Median space not darker than the rest of wing.	
Yellow discal mark absent	var. *lintneri* Grote.
Yellow discal mark present	var. *arimacula* Hudson.
Median space largely black	var. *slossonii* Packard.
Larger, broader winged, darker gray	race *severa* Hy. Edwards.
Median space not darker than the rest of wing.	
Yellow discal mark absent	var. *danbyi* Neumogen.
Yellow discal mark present	var. *normalis* Dyar.
Median space largely black shaded	var. *severa* Hy. Edwards.

The name *normalis* above is new. This is the usual form in the West, but no one has happened to name it.

Type.—Cat. No. 6990, U. S. National Museum.

Family THYATIRIDÆ.

HABROSYNE SCRIPTA Gosse.

Fifteen specimens; July 14, 15, 19, 24, 25, 27, 30, August 2, 5, 6, 7. These specimens agree exactly in markings with eastern *scripta*, but the general color is in all a little darker, more grayish, less yellowish. There is not enough difference for a varietal name, I think, though the character is constant. Grote named the Pacific Coast form *chatfeldii*, but I have a specimen from Vancouver Island from Mr. Taylor and it agrees exactly with *scripta* from New York, not differing even in the tint, as the Kaslo specimens do. Therefore I would make *chatfeldii* Grote a synonym of *scripta* Gosse. Larvæ were obtained from eggs laid by a captive female. They fed on thimbleberry.

Egg.—Elliptical, rounded, one diameter less; about 16 narrow raised ribs, confused at the ends, joined by neat cross striæ, forming cells over twice as wide as long; micropyler end larger and somewhat

[a] Packard, Monog. Notodont., 1895, p. 96.

flattened. Pale yellow, turning red; size, 0.9 by 0.6 by 0.5 mm. Laid singly on the flat side on the surface of the leaf.

Stage I.—Head rounded, bilobed, black. Body moderate, feet equal, joint 12 slightly enlarged, segments annulate. Colorless, the shields concolorous; tubercles small, brown, v higher than iv, no subprimaries; on joints 11 and 12 tubercle ii is dorsad to i, though not so on joints 5 to 10; setæ pointed, pale.

Stage II.—Head bilobed, white, with rows of gray spots radiating from the clypeus and in blotches on the sides; width, 0.7 mm. Body with joints 3 and 4 slightly squarely enlarged, anal feet elevated, joint 12 enlarged. Whitish over joints 3 and 4, dorsum and sides infiltrated with luteous gray; subdorsal region, dorsum of joints 2, 3, and 12 and subventral region darker gray. Feet pale, the anal pair dark. Tubercles small, dark; setæ moderate.

Stage III.—Head bilobed, full, flat before, clypeus small; whitish, thickly dotted with black except streaks on faces of lobes and ocelli; width, 1.2 mm. Joint 3 posteriorly enlarged, also joint 12 dorsally; anal feet elevated. Gray-black, washed with white dorsally on joints 3 and 4, from there along the sides and in oblique streaks to a geminate white dorsal line. Tubercles small, dark, their bases a little elevated. Setæ pale, small; feet pale, the anal pair dark.

Stage IV.—As before, the dots on the head brown; width, 2.2 mm. Body brown, velvety, washed with white as before, a series of white spots subventrally. Feet very pale, white except the anal pair. During the stage the colors became well contrasted and pretty, velvety brown and yellowish-white.

Stage V.—The colors change entirely to brown like *Pseudothyatira*. Head large, bilobed, squarish, clypeus small; white, thickly dotted with brown except in pale streaks in front of lobes, paraclypeus smoky brown, clypeus dull olivaceous; width, 3 mm. Body moderate, joints 3 and 4 a little enlarged dorsally, joint 12 enlarged; dark brown, blackish shaded, reticulate; dorsal line narrow, black with dark oblique shades over two segments to the spiracles, a lighter area along the stigmata, illy defined but conspicuous; feet pale.

PSEUDOTHYATIRA CYMATOPHOROIDES Guenée.

Twenty-five specimens; June 13, 18, 19, 25, 27, 30, July 2, 15, 17, 21, 25, August 1, 6. They agree with specimens from the Atlantic coast and Pacific region. The larvæ were bred on thimbleberry from eggs laid in long strings on the tips of the leaves. The life history has been previously described by me.[a]

[a] Proc. Boston Soc. Nat. Hist., XXVI, 1895, p. 400; in error as *Habrosyne scripta*.

PSEUDOTHYATIRA EXPULTRIX Grote.

Six specimens; June 16, July 2, 14, 19, 25. They agree with specimens from the Atlantic States and Pacific coast. Eggs were obtained from a captive female, laid in long strings on the tips of the leaves. I provisionally regard this form as a distinct species from *cymatophoroides* Guenée. There are no intergrades in the moths. The larvæ of *expultrix* showed no white lateral spots, while those of *cymatophoroides* did in most cases. In a group where the larvæ are so much alike as they are here, this difference may be of some value. Some differences were observed between the eggs, but they may be of an individual character rather than specific. Both sets of larvæ had five stages and were indistinguishable except as noted above. I need not, therefore, transcribe my notes.

EUTHYATIRA PUDENS Guenée.

No specimens; Mr. Cockle has one so named. The food plant, *Cornus*, occurs at Kaslo, but none of the characteristic larvæ were seen on it.

Family LIPARIDÆ.

NOTOLOPHUS ANTIQUA Linnæus.

No specimens; Mr. Cockle has the species, but whether of the coast form *badia* Hy. Edwards or not, I can not say, not having seen the larva.

OLENE PLAGIATA Walker.

No specimens; one from Mr. Cockle's collection, July 18, 1902.

Family LASIOCAMPIDÆ.

MALACOSOMA PLUVIALIS Dyar.

Fifty-eight specimens, July 13, 14, 15, 16, 17, 18, 25, 30, August 3 (Sandon, Mr. Currie). The moths and larvæ agree with specimens from the Pacific coast. The larvæ are a little less orange colored, some specimens having the orange marks considerably reduced, the blue marks distinct, suggesting *fragilis* Stretch of Colorado, but they do not diverge sufficiently from *pluvialis* for even racial distinction. The species has recently been called synonymous with *californica* Packard; but there is, of course, no warrant for that. *Californica* is a very near relative of *pluvialis* and single specimens of the adult are not distinguishable, but the larva differs in the great reduction of all its markings, both blue and orange, so that it looks black. Furthermore it is an oak feeder, while *pluvialis* is addicted to other plants. This precludes considering the forms otherwise than as distinct species.

A number of nests of the larvæ were found at different times early in spring on several deciduous trees. A fresh egg mass was noted on a birch twig in August.

EPICNAPTERA AMERICANA Harris.

One example, June 2, almost typical *americana* like Atlantic coast specimens. There is a little obsolescence of the white markings, indicating the first step toward the variety *ferruginea* Packard. The larvæ were beaten from *Ceanothus* and were of the normal appearance.

Family PLATYPTERYGIDÆ.

DREPANA ARCUATA Walker, var. SICULIFER Packard.

No specimens; Mr. Cockle has a few in his collection. As I recollect, they are similar to those occurring on the coast which I have from Seattle, Washington (Kincaid), Wellington (Taylor), and Portland, Oregon (Dyar). In Bulletin No. 52 of the U. S. National Museum, I listed *siculifer* as a distinct species, but I would no longer maintain that. The race is larger only. Both spring and summer forms occur, differing as do the eastern forms *arcuata* Walker and *geniculu* Grote. A few larvæ occurred on alder with the appearance and habits of the eastern race.

FALCARIA BILINEATA Packard.

No specimens; but Mr. Cockle has six in his collection. They probably do not differ from a specimen that I have from Wellington (Taylor). It is the same as the Atlantic coast form, being scarcely larger even. Mr. Cockle has both the forms *bilineata* Packard and *levis* Hudson. His dates are: Spring form *bilineata*, June 17, July 7; summer form *levis*, July 31.

A few larvæ occurred on birch with the appearance and habits of the Atlantic coast form.

Family GEOMETRIDÆ.

NYCTOBIA NIGROANGULATA Strecker.

One specimen, June 2, in bad condition, and one from Mr. Cockle's collection, April 3. I have the species also from Seattle, Washington (T. Kincaid), Wellington (T. Bryant) and Rossland (W. R. Johnson). The Rossland specimen was seriously misidentified for me by the late Doctor Hulst, who called it *Hydriomene californiata* Packard var., so that I lost sight of the form for several years. It is, I think, only a western race of *limitata* Walker or *furcifascia* Walker, being larger and darker; but I do not wish to enter into the question of the specific distinctness of these eastern species with my present material and without knowing any larvæ. Therefore I provisionally let *nigroangulata* stand.

TALLEDEGA MONTANATA Packard, var. MAGNOLIATOIDATA, new variety.

Nine specimens, May 31, June 8 (Ainsworth), 10, July 21 (Bear Lake, Mr. Cockle), and one from Mr. Cockle's collection, June 9, labeled *Enchoria osculata* Hulst, but erroneously. It differs from the eastern *montanata* in the much darker colors, the pale lines more contrasted, the pinkish tint of the hind wings and the evident submarginal line. A specimen of this form is mentioned by Doctor Packard as from Colorado[a] and said to differ from eastern specimens. It is, I think, a good geographical race.

Type.—Cat. No. 7103, U. S. National Museum.

TEPHROCLYSTIS RAVOCOSTALIATA Packard.[b]

Two specimens, June 1, and one in Mr. Cockle's collection, May 4, 1901.

TEPHROCLYSTIS LAQUÆARIA Herrich-Schaeffer.

No specimens; one in Mr. Cockle's collection, June 1, 1902, resembles rather nearly the European *laquæaria*. The transverse-anterior shade is more blackish than brown and the costal shading just before the discal dot is blackish and pronounced, while the pale band beyond the dotted-cuneiform transverse-posterior line forms a rather distinct white blotch on the costa not noticeable in the European form.

TEPHROCLYSTIS ABSINTHIATA Clerck.

No specimens; one in Mr. Cockle's collection, May 27, 1902, resembles the European *absinthiata*, but the basal two-thirds of the wing is paler than the terminal portion, not unicolorously brownish as in the European species. The costal black dashes are well marked and one of them is bent, joining the discal spot. The form stands midway between *absinthiata* Clerck and *expallidata* Guenée. The latter has the ground color entirely pale.

TEPHROCLYSTIS SATYRATA Hübner.

Sixteen specimens, May 30, 31, June 3, 7, 11, 13, 20, 22, 25, July 4, 27, June 25, 1901 (Golden, Colorado), and six from Mr. Cockle's collection, May 13, 27, 1902, June 11 and July 7, 1901. The specimens

[a] Mon. Geom., 1876, p. 182.

[b] The following determinations in *Tephroclystis* are made at a disadvantage. The National Museum collection is unequally poor in this genus, and there exists no table for the determination of the species. Hulst's descriptions are made without any comparisons or statement of salient characters and are nearly worthless in the case of these closely allied and difficult forms. Under these circumstances it became necessary to examine the Hulst collection, now in the charge of Dr. John B. Smith at New Brunswick, New Jersey. I made repeated applications to him, but he failed to make the collection accessible to me.

are a little larger than the European form and without any brown tint. Some of my specimens from Norway are of exactly the same color. This may be *T. perfusca* Hulst. It is obviously the same as the Alaskan specimens named *perfusca* for me by Doctor Hulst, but Hulst's type from Utah before me is so poor that I can not tell what it is like. Eggs obtained from a captive female proved sterile.

Egg.—Elliptical, well flattened, rounded, truncation and depression distinct, all rounded; uniformly reticulate with waved reticulations, broad, rounded, forming cells with five lobes but not neatly, not very distinctly, and tending to run in the long diameter. Yellowish white, shining; size, 0.6 by 0.5 by 0.4 mm.

TEPHROCLYSTIS LARICATA Freyer.

No specimens; one in Mr. Cockle's collection comes near the European *laricata*. The markings are more pronounced and contrasted, the outer pale band being broader and less obscured by its centering line. The discal dots on both wings are well marked.

TEPHROCLYSTIS MULTISTRIGATA Hulst.

One specimen, April 22 (Mr. Cockle), and one in Mr. Cockle's collection, May 7, agree in general with a specimen from Calgary, Alberta, communicated to me by Mr. George W. Taylor. The agreement is not absolute, but I will not venture to separate them on the present slender material.

TEPHROCLYSTIS NIPHADOPHILATA, new species.

Twenty specimens, June 7, August 10 (Kokanee Mountain, on snow), September 8 (Glacier), 9 (Field), and two from Mr. Cockle's collection, August 22, 1901. Dark gray, the wings rather pointed; a light band followed by black on basal segments of abdomen. Lines not contrasted, both well angled subcostally, the veins marked with black dashes, especially the median vein and those before the transverse posterior band. Subterminal line faint, pale, not forming a dot above tornus. Discal spot black. Hind wings gray, subpellucid, with gray lines on the inner margin and two faint outer pale lines across the wing. Expanse, 24 mm.

Type.—Cat. No. 7823, U. S. National Museum.

TEPHROCLYSTIS COOTENAIATA, new species.

One specimen, June 16, and one in Mr. Cockle's collection, July 17, 1901. Gray, the dark band on second segment of abdomen not contrasted. Wings nearly uniform gray, the lines nearly obsolete, pale; discal spots large, black. Hind wing indistinctly lined, with small, faint, discal dot. Expanse, 26 mm.

Type.—Cat. No. 7825, U. S. National Museum.

TEPHROCLYSTIS CASLOATA, new species.

One specimen, July 15, and one in Mr. Cockle's collection, July 28, 1901. Light gray, the dark band on second segment of abdomen distinct, not deep black. Lines moderately distinct, blackish on a gray ground, crenulate on the veins, emphasized on costa. Discal spot black. Subterminal line white, crenulate, forming a spot above tornus. Hind wing rather distinctly lined, the dark submaculate mesial line following a smoky black discal spot. Expanse, 23 mm.

Type.—Cat. No. 7824, U. S. National Museum.

Eggs were obtained from my specimen and hatched, but the food plant was not discovered.

Egg.—Elliptical, narrowed toward the antemicropylar end, ends rounded, one diameter less, no flat areas. Reticulations rounded, low raised from a smooth surface, neat, rather narrow, hexagonally reticulate, waved, not strongly stellate. Shining yellowish white. Size, 0.6 by 0.5 by 0.4 mm.

Stage I.—Head slightly bilobed, pale luteous, eye black. Body moderate, not elongate, segments about 6 annulate. White, immaculate, shields and feet a shade darker. Tubercles moderate, blackish, hair dots elevated; setæ rather long, with enlarged tips.

TEPHROCLYSTIS COLUMBIATA, new species.

One specimen, May 31, and one in Mr. Cockle's collection, May 4, 1902. Wings pointed; band on abdomen black, distinct, following a whitish space. Wings gray, tinged with russet outwardly mesially; lines black, the transverse-posterior finely crenulated, the points within, scarcely excurved over cell; discal spot narrow, black. Subterminal line white, crenulated, black edged within, forming a spot above tornus; marginal black line forming cuneiform spots between the veins. Hind wings whitish, with four dark gray lines nearly crossing the wing, the first and third not distinct. Expanse, 19 mm.

Type.—Cat. No. 7821, U. S. National Museum.

TEPHROCYSTIS BIFASCIATA, new species.

One specimen, June 25, and one from Mr. Cockle's collection, June 13. Gray; abdominal band obsolete. Fore wing with narrow scales, gray, indefinitely marked; a broad, nearly white band at outer third just beyond the large, black discal spot; transverse posterior line whitish, geminate, both strongly angled subcostally, contrasted with the pale-gray ground color which is without distinct black lines. Slight black dashes subapically before and following the transverse posterior line. Subterminal line pale, linear, subobsolete. Hind wing pale, the outer two of the dark lines nearly crossing wing, the basal two abbreviated at the margin; discal dot faint. Expanse, 20 mm.

Type.—Cat. No. 7820, U. S. National Museum.

TEPHROCLYSTIS SUBFOVEATA, new species.

Three specimens, June 1, 5. Wings elongate, rounded. Hind wing of male with a large area on upper side over cell clothed with smooth appressed scales, which in certain lights are shining silky while the rest of the wing is dull. Obscure gray; costal edge dotted in black. Lines obsolete, the transverse-posterior faintly paler gray; terminal area darker; discal spot black. Hind wing with the lines blackish, dotted, those below the cell crossing the wing. Terminal black dashes on both wings. Abdominal blackish line present, following a basal light ashen space. Expanse, 18 mm.

Type.—Cat. No. 7822, U. S. National Museum.

Egg.—Elliptical, the depressed end broadened, narrowing to the truncate end; flattenings rounded. Smooth, except for slight reticulations composed of rather broad, slightly raised lines with parallel edges, irregularly hexagonal, a little elongate in the long diameter, and gently waved. Pale yellow, irridescent under 85 diameters. Size 0.6 by 0.5 by 0.4 mm.

Stage I.—Head squarish bilobed, pale testaceous, smoky shaded, eye black, mouth brown. Body moderate, flattened, translucent testaceus, faintly smoky shaded. Tubercles concolorous, obscure; feet and setæ pale, normal.

Stage III.—Head bilobed, whitish; eye black; width 0.6 mm. Body slender, waxy whitish, with narrow smoky black dorsal line. Segments finely annulate; setæ short, capitate, alternately forward and backward. Feet all brownish tipped; no marks.

Stage IV.—Head bilobed, whitish, the lobes thickly brown dotted, arranged obscurely in two vertical bands; width 1 mm. Body rather slender, not much elongate, whitish or pale green, not shining, granular shagreened. A broad dorsal smoky brown band widened between tubercles i and ii; a subdorsal series of cuneiform brown marks. Tubercles concolorous, setæ short, dark, alternately directed forward and backward. Thoracic feet brownish ringed.

The larvæ fed on flowers of *Ceanothus*. I missed the second stage.

EUCYMATOGE GRANDIS Hulst.

Three specimens, July 25, August 4, and three from Mr. Cockle's collection, July 21 (Bear Lake), October 16, 1902. Most of the specimens have the discal spot strongly tinged with bright brown and are thereby readily recognizable. One of Mr. Cockle's specimens (October 16) has a brown shade running outward from the spot nearly to the margin, resembling a very distinct form from Vancouver Island, of which I have a specimen from Mr. George W. Taylor

EUCYMATOGE LINARIATA Fabricius.

No specimens; one from Mr. Cockle's collection closely resembles the European *linariata*. The mesial dark band is more excurved over the cell and the outer mesial pale band of hind wings is likewise more bent. The specimen is a true *Eucymatoge*, having two accessory cells on the fore wings; vein 12 separate from vein 11, and two pairs of spurs on the hind tibiæ.

EUCYMATOGE INTESTINATA Guenée.

No specimens; one from Mr. Cockle's collection taken June 1.

VENUSIA CAMBRICA Curtis.

Two specimens, July 21 (Bear Lake Mountain), 25, and one from Mr. Cockle's collection July 1.

VENUSIA DUODECEMLINEATA Packard.

One specimen, June 11 (Mr. Currie), and one from Mr. Cockle's collection April 28, 1901.

EUCHŒCA ALBOVITTATA Guenée.

Six specimens, August 9 (South Fork Creek), 11 (South Fork Creek); all taken from horseback, on the trail to Kokanee Mountain, at altitudes higher than Kaslo.

EUCHŒCA CRETACEATA Packard.

Fourteen specimens, July 22, 29 (Bear Lake Mountain), 31, August 5, 9 (South Fork Creek), 10 (Kokanee Mountain), 13 (Sandon, Mr. Currie), Sandon (G. C. Robbins). A high-altitude species, occurring also at Kaslo, but less commonly.

EUCHŒCA ALBIFERA Walker.

Seven specimens, June 11 (Fletcher's Ranch), and one from Mr. Cockle's collection June 11, taken at the same place. This seems to be the eastern *albifera*, as it lacks the blackish tip to the fore wing which Vancouver Island specimens have (var. *brunneifasciata* Packard). Still, the lines are pale brown rather than ocherous, as Doctor Packard describes the eastern form. It is therefore probable that we have here a local race which could be distinguished by name, but as I have no eastern specimens before me, I can not judge of the actual amount of difference.

EPIRRITA DILUTATA Schiffermüller.

One specimen, September 8 (Glacier).

CORYPHISTA MEADII Packard, var. BADIARIA Henry Edwards.

Five specimens, June 13, July 21, 25, 31, August 1. Both forms occurred, *meadii* being the usual one. The true *badiaria* looks very distinct, and Mr. G. W. Taylor has pointed out to me that there are no intergrades, yet I think it is only a varietal form. A typical *badiaria* was bred from a larva on barberry. My description of the larva of *badiaria*[a] should be applied to *meadii*, as we took no true *badiaria* in Colorado, though one specimen is very near it. The two larvæ are, however, indistinguishable. I observed all the stages in the Kaslo specimens.

HYDRIA UNDULATA Linnæus.

One specimen, July 21 (Bear Lake Mountain, Currie and Caudell). Observations on this larva should be made. I have described the eastern form,[b] but in the West *Prunus serotina*, the food plant, does not occur, nor have the peculiar nests of the larvæ ever been noted, so far as I can discover.

EUSTROMA DESTINATA Moeschler.

Sixteen specimens, August 11 (South Fork Creek, Mr. Cockle), 20 (West Robson), September 7 (Glacier), 8 (Glacier), 9 (Field). None taken at Kaslo, though Mr. Cockle has some in his collection.

EUSTROMA POPULATA Linnæus.

Two specimens, July 21 (Bear Lake Mountain), Sandon (G. C. Robbins). They are of the variety *packardata* Lintner, agreeing exactly with a specimen from Yosemite, California (J. B. Lembert), and less closely, but still very nearly, with Lintner's type before me. There are a number of differences between this form and the European *populata*, and I suspect that *packardata* will be found to be a distinct species. I have specimens of the true *populata* from Clatsop County, Oregon (H. Ahlers), and Wellington (T. Bryant). Mr. Cockle has latterly sent me a true *populata* from his collection, taken August 10 (South Fork Creek).

EUSTROMA CERVINIFASCIA Walker.

One specimen, August 13 (Sandon, Mr. Currie) and two from Mr. Cockle's collection August 10 (South Fork Creek) and August 13, 1902, all three females. The specimens are alike and agree well with the original colored figure of Walker's type which Doctor Packard used for the figure in his monograph. They differ markedly from *populata* and

[a] Life Histories of North American Geometridæ, XXXV, Psyche, IX, 1902, p. 396.
[b] Idem, VIII, Psyche, IX, 1900, p. 9.

packardata in the ground color being gray with the broad median area bright chestnut brown. I feel sure the species is a perfectly distinct one and not a variety of *populata*.[a]

EUSTROMA NUBILATA Packard.

Sixty-five specimens, May 31, June 1, 4, 10, 11, 15, 20, 23, 24, 30, July 15, 18, 21 (Bear Lake Mountain), 23, 29 (Bear Lake Mountain), 29, 30, August 1, 4, 5, 6, 7, 9 (South Fork Creek), 10 (Kokanee Mountain), 11 (South Fork Creek), 15, 21 (Revelstoke), 22 (Revelstoke), Sandon (G. C. Robbins). Probably double brooded, the broods overlapping. The moths are rather variable, especially in the width of the pale transverse-anterior band of the forewings. One specimen is distinctly aberrant, the band being wide and pale, while the outward projection of the dark median space is represented only by two short teeth and there is a pale shade about the discal dot. The larvæ were obtained from eggs laid by a captive female and bred on *Epilobium*. The description will appear in my Life Histories of North American Geometridæ, LIII, in Psyche.

NEOLEXIA XYLINA Hulst.

Twenty-three specimens, July 27, 29, 31, August 3, 4, 5, 6, 13, 15, 18, September 8 (Glacier), 9 (Field). A constant and characteristic species. The larva was not found.

RHEUMAPTERA HASTATA Linnæus.

Twenty-seven specimens; May 29, June 2, 8 (Ainsworth), 18 (Kaslo Creek, Mr. Caudell), July 21 (Bear Lake Mountain), July (near McGuigan), 29 (Bear Lake Mountain), August 9 (South Fork Creek), 11 (South Fork Creek). Many more could have been taken, as the species was very common at high altitudes.

RHEUMAPTERA SOCIATA Borkhausen.

Seven specimens; June 18 (Kaslo Creek, Mr. Caudell), 22, 23; July 21 (Bear Lake, Mr. Cockle), 25, August 1 (South Fork Creek) and one from Mr. Cockle's collection, June 11. Agrees well with European specimens. I have the species also from Oregon (Koebele), Seattle, Washington (T. Kincaid), Vancouver (R. V. Harvey) and Wellington (T. Bryant).

RHEUMAPTERA LUCTUATA Schiffermüller.

Three specimens, August 7, 9 (South Fork Creek), 11 (South Fork Creek, Mr. Cockle), all with black hind wings (var. *obductata* Möschler). I am clearly of the opinion that there are too many varietal names recognized of this species. Hulst gives *kodiakata*, *obductata*, and *con-*

[a] See Bulletin No. 52, U. S. National Museum, 1903, p. 277.

cordata. I would make *concordata* synonymous with *obductata* and *kodiakata* with *luctuata*. In Staudinger and Rebel's catalogue the species is called *lugubrata* Staudinger, the name *luctuata* being used for a different form (*hastulata* Hübner). This depends upon the interpretation of Denis and Schiffermüller's work, Staudinger and Rebel regarding the name *lugubrata* of Schiffermüller as a *nomen nudum* and recognizing the next use of it by Hübner (1786), which was in a different sense. Hulst, in Bulletin No. 52 of the U. S. National Museum, regarded Schiffermüller's name as valid. Which is correct I am not prepared to say, as I have not Schiffermüller's work before me; but in any case *lugubrata* can not stand, as Möschler's name *obductata* has ten years priority.

RHEUMAPTERA GEORGII Hulst.

No specimens; one from Mr. Cockle's collection without date. The species flies in August and September and probably had not begun to appear at the time I left Kaslo. I took it in September at Victoria.

MESOLEUCA RUFICILIATA Guenée.

Ten specimens, May 31, June 4, 7, 8 (Ainsworth), 19, July 15, August 9 (South Fork Creek). The dates indicate two broods. Eggs were obtained from a captive female but proved infertile.

Egg.—Elliptical, rather thick, flattened above and below in a small area, depression distinct, truncation distinct but rounded. Very finely pitted shagreened, the cell areas showing by slightly raised broad, indistinct reticulations, evenly pitted all over, one cell area containing about 12 pits. Pale green; size, 0.8 by 0.6 by 0.5 mm.

MESOLEUCA GRATULATA Walker.

Three specimens, May 29, and one from Mr. Cockle's collection, April 15, 1901. I have described the larva in Life Histories of North American Geometridæ, XLIV.[a]

MESOLEUCA CÆSIATA Schiffermüller.

Twenty-eight specimens, June 13, August 6, 21 (Revelstoke), September 8 (Glacier), 9 (Field), 10 (Banff, Alberta). The dates indicate two broods. This is a high altitude species, only three specimens being taken at Kaslo.

MESOLEUCA LACUSTRATA Guenée.

Two specimens, June 10 (Mr. Cockle), 11 (Fletcher's ranch). Eggs were obtained from a captive female and hatched, but no suitable food plant could be found, the larvæ refusing everything offered them.

[a] Psyche, X, 1904, p. 191.

Egg.—Elliptical, flattened, depression and truncation well marked, rounded, normal; reticulations stellate-waved, irregular, of various sizes, moderately raised, distinct, but the cell areas very shallow. Surface finely punctate shagreened all over. Pale yellow, turning reddish; size, 0.8 by 0.6 by 0.4 mm.

Stage I.—Head rounded, bilobed, pale brown, shining, with two rows of purplish spots on each lobe, setæ rather long. Body moderate, rather slowly looping, pale whitish with longitudinal brown bands about as wide as the spaces, dorsal, subdorsal and lateral approximate, subventral and ventral. Feet pale; tubercles small, brown; setæ short, dark, glandular tipped.

MESOLEUCA TRUNCATA Hufnagel.

Thirty-four specimens, June 14, 23, July 17, 29 (Bear Lake), August 6, 7, 9 (South Fork Creek), 18, 21 (Revelstoke), 22 (Revelstoke), 8 (Glacier), 9 (Field). Sandon (G. C. Robbins). The series shows the usual amount of variation, but none of the extreme forms are present. The species much resembles *Mesoleuca hersiliata* Guenée. One specimen was bred by Mr. Cockle, but I have not his notes on the larva.

MESOLEUCA HERSILIATA Guenée.

Fifteen specimens, mostly bred from larvæ on currant, June 16, 18, 21, 29, July 4, 14, 21 (Bear Lake), 29 (Bear Lake Mountain) and one from Mr. Cockle's collection. The variation is marked. Most of the specimens are dark, though a few are very light, as light as any that I have from Placer County, California (Koebele), Victoria (Hanham). I suspect that a light specimen of this formed Hulst's type of *athela* and Mr. G. W. Taylor has recently sent me a specimen so marked. If so, that name may be used for the western race of *hersiliata* which certainly differs markedly in appearance from eastern specimens. The light red bands (which induced Walker's synonymic name *flammifera*) are never present, being replaced by rusty brown or cream color; the transverse anterior band is narrower, usually more dentate and directed obliquely outward from costa to inner margin instead of inward. All my British Columbian and nearly all the Californian specimens show these characters, but the Coloradan ones are intermediate, some showing the narrow oblique bands, others the erect broader ones, but they agree with the Pacific coast specimens in color.

Larva.—Head rounded, slightly bilobed, roughly shagreened, pale luteous green, the setæ small and white; width, 1.5 mm. Body moderately slender, the skin densely clothed with minute secondary spines and roughened by the slightly elevated, small, white tubercles; green, the dorsal vessel darker, a distinct white subdorsal line from joint 2 to 13 and trace of a lateral one; a similar but broken medio-

ventral line. Ventral tubercles white like the dorsal ones; setæ coarse, white, not long; all feet green, the abdominal ones normal on joints 10 and 13.

Cocoon a net of yellowish silk among the leaves. Pupa green with a white dorsal stripe.

Food plant, currant (*Ribes sanguineum*).

MESOLEUCA ALBOLINEATA Packard.

Five specimens, June 3, 6, 11, July 21 (Bear Lake, Mr. Cockle), August 6, and one from Mr. Cockle's collection, July 18, 1902. Eggs from a captive female proved infertile.

Egg.—Elliptical, rounded, one diameter less, scarcely any depression, truncation rounded; densely finely reticulate, the reticulations elongate in the long diameter, hexagonal, normally alternating, rather low, broad, and rounded, the surface all over slightly shagreened. Pale yellow; size, 0.8 by 0.6 by 0.5 mm.

MESOLEUCA VASALIATA Guenée.

Seven specimens, May 31, June 2, 5, 6, 7, 8. The larvæ were bred on thimbleberry. I will describe them in Life Histories of North American Geometridæ, LVIII.

MESOLEUCA SIMULATA Hübner, var. OTISI, new variety.

Eleven specimens, all females, September 8 (Glacier), 9 (Field). The specimens are stone gray throughout without any of the brown tint seen in examples from the Alps of Europe, but all the lines and markings are exactly alike. The species has not been hitherto recorded in America. The American form is named for my son, Otis P. Dyar, who assisted me in collecting the specimens. The form resembles *Hydriomene contractata* Packard, as Mr. G. W. Taylor pointed out to me, but it lacks the distinct thoracic tuft of that form and is without its warm brown tint.

Type.—Cat. No. 7105, U. S. National Museum.

HYDRIOMENE SORDIDATA Fabricius.

Two hundred and fifty-nine specimens, July 15, 21, 24, 26, 27, 31, August 11 (South Fork Creek), 12, 13, 17, September 9 (Field), Sandon (G. C. Robbins). Very variable in the markings, but constant in color, all examples being shades of brown, greenish gray, and black, none of the light forms appearing. All the specimens are rather large. The larva was not obtained. Living females were repeatedly confined in jars, but all refused to deposit eggs.

HYDRIOMENE AUTUMNALIS Stromeyer.

One specimen, July 2 and one from Mr. Cockle's collection, July 10 (Ainsworth). The specimens are distinctly smaller than *sordidata* Fabricius.

HYDRIOMENE TÆNIATA Stephens.

Five specimens, July 29 (Bear Lake), August 9 (South Fork Creek), 11 (South Fork Creek), much worn, but apparently agreeing with Walker's *basaliata*, which stands as a synonym of *tæniata* in our list. I have one specimen of European *tæniata* and I should hardly think it conspecific with my Kaslo specimens. Hence this synonymy appears doubtful to me, but I can make no positive statement with the present scanty material.

HYDRIOMENE EXCURVATA Grote.

Three hundred and fifteen specimens, June 26, July 2, 4, 11, 19, 24, 30, 31, August 3, 4, 5, 6, 11 (South Fork Creek), 12, 13, 15, 17. This was the commonest species of Geometridæ in Kaslo. It is the *Cratodalia gueneata* of Packard's monograph. The larvæ hibernate at various stages and produce a single brood of moths. I have described them in Life Histories of North American Geometridæ, XLVII.[a]

HYDRIOMENE MULTIFERATA Walker.

Six specimens, May 31, June 4, 7, 8. The larva has been described by me in Life Histories of North American Geometridæ, XLVI.[b]

HYDRIOMENE MAGNOLIATA Guenée.

Thirty-five specimens, May 31, June 1, 3, 7, 10, 11, 16, 18 (Kaslo Creek, Mr. Caudell), 23, 25, July 13, 14, 15, 18, 29 (Bear Lake), 30, 31, August 1, 2, 4, 5, 6, 7, 11 (South Fork Creek). The dates indicate two broods. The larva has been described by me in Life Histories of North American Geometridæ, XLV,[c] where I show that the species is referable to *Hydriomene* instead of *Venocalpe* and that Hulst's *pernotata* is a synonym.

TRIPHOSA PROGRESSATA Walker.

No specimens; one in Mr. Cockle's collection, October 20. I should have probably taken the species myself if I had remained later in the season.

GYPSOCHROA DESIGNATA Hufnagel.

No specimens; one in Mr. Cockle's collection, June 4.

[a] Psyche, X, 1904, p. 194. [b] Idem, X, 1904, p. 193. [c] Idem, X, 1904, p. 191.

TRICHOCHLAMYS LACTEATA Packard.

No specimens; one in Mr. Cockle's collection, August 8 (South Fork Creek), a little smaller and more shaded with brown than specimens from Wellington, Oregon, and California.

PETROPHORA ABRASARIA Herrich-Schaeffer.

Twenty-two specimens, June 23, 25, 26, 30, July 2, 10, 11 (Ainsworth), 18, 19, 21 (Bear Lake), 23, August 4, 9 (South Fork Creek), 11 (South Fork Creek), and one from Mr. Cockle's collection, July 10 (Ainsworth). Eggs were obtained from captive females, but the larvæ could not be carried beyond the second stage on account of their propensity to hibernate.

Egg.—Elliptical, compressed, one end very strongly depressed, wedge-shaped from side view, ends rounded, the large one scarcely flattened. Cell areas depressed, flat-bottomed, the reticulations low, raised, corrugated, or wrinkled transversely, pentagonal to hexagonal. Pale yellow; size, 0.8 by 0.6 by 0.5 mm.

Stage I.—Head rounded, brown black, scarcely bilobed, darker on the sides; width, 0.3 mm. Body short and stout, the segments wrinkly annulate, feet normal, moderate. Yellowish white, with lines of fine blackish dots along the sides, indefinite yet distinct subdorsal, lateral and subventral rows. Cervical shield, anal leg shields and thoracic feet smoky. Tubercles minute; setæ short, bladder-shaped; skin minutely granular, the dots of the illy-defined dark bands underlying the granules.

Stage II.—Head rounded, dark brown, darker on the sides; width, 0.55 mm. Body moderate, somewhat flattened, dorsum pale brown, with dorsal and subdorsal darker lines. Sides dark brown; subventral region broadly pale, like the dorsum; venter also pale, with faint darker lines, subventral and medioventra Tubercles and setæ obscure; no shields.

PETROPHORA CONVALLARIA Guenée.

Twenty specimens, June 8, 9, 16, 19, 22, July 4, 30, September 5 (Victoria), Sandon (G. C. Robbins). After carefully studying Guenée's description with Mr. G. W. Taylor, I am satisfied that we have correctly identified this species. Hulst's *nemorella* from Alaska is scarcely more than a color variety of this, and both will be found to unite with the European *munitata* Hübner. I shall describe the larva in Life Histories of North American Geometridæ, LXI.

PETROPHORA DEFENSARIA Guenée.

Four specimens, June 4, August 21 (Revelstoke), 25 (Victoria), 26 (Victoria), and one from Mr. Cockle's collection, August 14, 1901. This is very closely allied to *munitata* (=*convallaria*=*nemorella*), but

distinct, I think. The larva was not obtained. Mr. Taylor has pointed out to me, and the experience of other resident collectors in British Columbia corroborates him, that in 1902 and previously *defensaria* was the common species, while *convallaria* was rare, while in 1903 the conditions were reversed. This is in agreement with my captures and appears to me to further indicate the distinctness of the two species.

PETROPHORA FERRUGATA Clerck.

Two specimens, June 24 (Mr. Cockle), August 22 (Revelstoke), and two from Mr. Cockle's collection, July 31, 1901, August 23, 1902, the latter a female apparently agreeing with Hulst's *borealis*.

COSYMBIA LUMENARIA Hübner.

Seven specimens, June 16, 18, 25, July 2. They are mostly large, and of a dark, even stone gray, the lines nearly lost. My Eastern specimens, and others from Corvallis, Oregon, and Wellington, while variable, are all much lighter, some nearly white, with distinct markings. One of the Kaslo specimens, however, is nearly normal, thus dispelling the idea of a local race. Eggs were obtained from a captive female, but I was unable to find the food plant.

Egg.—Elliptical, strongly flattened, compressed, one end smaller and depressed, both rounded; reticulations uniform, rounded and broad, elongate hexagonal, low rounded bars, the areas between nearly flat, granular shagreened. Pale yellow; size, 0.9 by 0.5 by 0.3 mm.

Stage I.—Head rounded, full, pale brown, slightly darker mottled over the sides, a dark band on the median suture, edged with lighter. Body moderate, not elongate, feet normal; pale brown, a broad dark-brown dorsal band, a similar less distinct ventral one, diluted on the posterior rims of the segments. Feet pale; segments irregularly annulate; tubercles minute, brown; setæ moderate, fine, minutely enlarged at tip.

XYSTROTA HEPATICARIA Guenée.

No specimens; one from Mr. Cockle's collection, June 1 (Ainsworth).

LEPTOMERIS QUINQUELINEARIA Packard.

Nineteen specimens, June 15, 18, 23, 24, 25, July 1, 2, 4, 6, 17, 21 (Bear Lake, Mr. Cockle) and one from Mr. Cockle's collection, June 17. The larvæ will be described by me in Life Histories of North American Geometridæ, LXII.

LEPTOMERIS SIDERARIA Guenée.

Four specimens, June 24, 29 and one from Mr. Cockle's collection. This species was placed by Doctor Hulst in *Eois*, but, as the females have four spurs on the hind tibiæ, I change the generic reference.

The eastern *inductata* Guenée is likewise wrongly placed and should go with this species. Eggs were obtained and the larvæ carried to stage iv, but here they hibernated and could not be induced to develop the last stage. By October 10 they had all died.

Egg.—Elliptical, compressed but rounded, no depression, tapering to the micropylar end, which is small, truncate. Laid on the large blunt end like butterfly eggs. Vertically ribbed, about nine ribs on the broad side, low, rounded, finely waved yet distinct; cross striæ slight, not waved, forming rectangular cells; upper end coarsely rounded reticulate; all minutely granular shagreened. Pale yellow, spotted with pale pink; size, 1 by 0.6 by 0.5 mm.

Stage I.—Head round, slightly bilobed, pale brown, ocelli black. Body very slender, elongate, the segments numerously finely annulate. Pale whitish with subdorsal and subventral parallel, rather broad dark-brown stripes, the subdorsal pair rather remote anteriorly, diluted by the luteous cervical shield, approximate behind but separated by a linear pale streak to the anal plate; subventral band more smoky and pale. Foot of joint 13 brown lined; tubercles small; setæ short with enlarged ends.

Stage II.—Head bilobed, free, pale whitish with a band of spots over the lobes, eyes and antennæ black marked; width, 0.5 mm. Body long, slender, curled in twisted S-shape, finely annulate. Dorsum broadly brown with a central geminate dorsal line; subventer pale green broadly on the fold below a broad pale olivaceous band. Feet pale; tubercles small, round, pale with black hair dots and short black truncate setæ.

Stage III.—Head round, whitish, dotted with brown over the vertex except in a central streak on the lobe; width, 0.7 mm. Body slender, finely annulate, brown dorsally, a whitish dorsal line darker edged, a darker edge above the broad, greenish-white stigmatal stripe. Subventer very dark; a ventral white stripe. Cervical shield pale like the head; abdominal feet whitish without, dark brown before.

Stage IV.—Head rounded, slightly bilobed, white below, yellowish on the vertex, thickly dotted with pale brown except a streak on each lobe; width, 1 mm. Body slender, uniform, cylindrical, finely annulate. Pale brown dorsally, subventral fold pale yellow, venter dark brown, the colors shaded. A narrow addorsal blackish dotted line, a series of dark-brown spots, two to each segment, joined by an obscure dark subdorsal shade, a lighter medioventral line. Abdominal feet light without; tubercles small; setæ short, thick, brown; no shields.

The larvæ ate alder and *Polygonum*.

EOIS ROTUNDOPENNATA Packard.

Seven specimens, June 9, 16, 25, 29, and three from Mr. Cockle's collection, June 17 and 20, 1902. The specimens agree well with Packard's description of two males from Brunswick, Maine, except

that I can detect no "pale ocherous, slightly scalloped line at the base of the fringe" and there are small blackish spots at the ends of the veins not mentioned by Packard. The lines vary much in distinctness. I shall describe the larvæ in Life Histories of North American Geometridæ, LXV.

EUCROSTIS VIRIDIPENNATA Hulst.

No specimens; one in Mr. Cockle's collection. I have described the larva in Life Histories of North American Geometridæ, XXVIII.[a]

SYNCHLORA RUBRIFRONTARIA Packard.

One specimen, July 4, and one from Mr. Cockle's collection, June 26, 1902, essentially like eastern specimens.

APLODES RUBRIFRONTARIA Packard, var. DARWINIATA, new variety.

Sixteen specimens, June 9, 16, 20, 23, 25, 30, July 4, 19, August 3, 5, 6, 7. The dates indicate two broods. I am doubtful about the standing of this form. It looks different from eastern *rubrifrontaria*, being larger, but I can not find any differential character that seems constant. Doctor Packard says:[b] "I am unable to detect any differences between the Pacific coast and Atlantic coast individuals in the markings or colors." Yet his description of the larva states it to be green, whereas the Kaslo ones are brown. I incline to the opinion that there are two species; certainly there seems enough difference to warrant racial distinction. Besides the larger size may be mentioned a tendency to have red points in the fringe at the ends of the veins and the occasional presence of red-brown discal dots on all wings. The white dorsal spots on the abdomen are narrowly circled with red, not overspread with that color even in the females. Mr. Cockle had the species named *Anaplodes pistacearia* Packard in his collection, but this is erroneous, as the male has a hair pencil on the hind tibiæ and dorsal abdominal spots. I shall describe the larvæ in Life Histories of North American Geometridæ, LVII.

Type.—Cat. No. 7104, U. S. National Museum.

ORTHOFIDONIA SEMICLARATA Walker.

Six specimens, May 29, 31, June 4, 11 (Fletcher's ranch). A few eggs were obtained from a captive female, but the little larva failed to feed.

Egg.—Elliptical, distinctly flattened above and below, the flattenings not quite reaching the edge which is rounded; ends rounded, not truncate, depression of antemicropylar end not marked. Perfectly

[a] Psyche, IX, 1901, p. 287.

[b] Mon. Geom., p. 386.

smooth (87 diameters), the cell areas just indicated by obscure flattenings. Pale yellow, later more or less spotted with red which brings out the obsolete reticulations better; size 0.6 by 0.4 by 0.3 mm.

Stage I.—Head bilobed, clypeus high, shining honey yellow, eye black, mouth brown. Body slender, rather short but looping rapidly, all honey yellow, unmarked. No shields; tubercles invisible; setæ short, capitate, dusky.

ORTHOFIDONIA EXORNATA Walker.

Five specimens, May (Mr. Cockle), May 29, June 5,

DEILINIA BEHRENSARIA Hulst.

Eleven specimens, May 31, June 2, 13, 16, 19, July 14, 19, August 4. Apparently double brooded. The specimens vary in color from gray (var. *cervinicolor*) to ocherous gray, but none are as light as Californian specimens. I have described the larva in Life Histories of North American Geometridæ, L.[a]

DEILINIA QUADRARIA Grote.

Three specimens, June 6, 15, and one from Mr. Cockle's collection June 22, 1901. I have described the larva from Colorado in Life Histories of North American Geometridæ, XXXIV.[b] Eggs were obtained from a captive female and the larvæ reared on *Ceanothus* to the fourth stage, when they were lost.

DEILINIA PULVERARIA Hulst.

Forty-six specimens, May (Mr. Cockle), May 29, 30, 31, June 1, 2, 3, 4, 5, 9, 16. The species is rather constant. I have described the larva in Life Histories of North American Geometridæ, XLIX.[c]

DEILINIA FUMOSA Hulst.

Two specimens, one Sandon (G. C. Robbins), the other bred from a larva beaten from *Ceanothus* by Mr. Cockle, emerged August 23.

Larva.—Head rounded bilobed, clypeus high; green, dotted with white, tubercles and setæ dark; width, 2.4 mm. Body normal, moderate, smooth; green, finely white streaked and dotted. Addorsal line white, faint, subdorsal more distinct, both faint on the concolorous cervical shield, absent on the anal plate; lateral line about like the subdorsal; substigmatal yellow, narrow, diffusing a yellow shade on the green about it, especially at the stigmata which are orange, brown rimmed. Tubercles round, small, neatly black; feet green; triangular plate of anal feet slightly black dotted.

[a] Psyche, X, 1904, p. 197. [b] Idem, IX, 1902, p. 383. [c] Idem, X, 1904, p. 196.

DEILINIA RECTIFASCIA Hulst.

Forty-eight specimens, May (Mr. Cockle), May 30, June 3, 4, 5, 6, 9, 10, 13, 16, 20, 21, 22, 23, July 4, 8, 15 17, 25, 26, and one from Mr. Cockle's collection labeled *Deilinia feminaria* Guenée. The color varies from nearly white to pale ocherous, with reddish shades at the outer halves of both wings. I have described the life history in Life Histories of North American Geometridæ, LII,[a] where I have made some remarks on the generic position of the species.

DEILINIA LITARIA Hulst.

Thirty-three specimens, April 15 (Mr. Cockle), May 30, June 1, 9, 25, and one specimen from Mr. Cockle's collection, June 3, 1901, labelled *Deilinia falcataria* Packard. Very variable, especially in the females, which are markedly smaller than the males. One female specimen, nearly without markings, seems to be almost the exact counterpart of Packard's *ferruginosaria*, described from a single female from California. I think the name *litaria* will ultimately fall before an older one, perhaps *ferruginosaria* Packard, or *feminaria* Guenée, or *falcataria* Packard; but as there are many species of *Deilinia* attached to *Ceanothus* in the West, all variable and closely allied (six are here listed from Kaslo), and as the *falcataria* group is not before me in large series, I will let the name stand for the present. I have described the larva in Life Histories of North American Geometridæ, LI.[b]

DEILINIA ERYTHREMARIA Guenée, var. PACIFICARIA Packard.

Fourteen specimens, May 30, June 3, 9, 13, 16, 20, July 4, 21 (Bear Lake, Mr. Cockle), August 7. This is the western form of *erythremaria*, slightly larger and more distinctly marked. I have described the larvæ in Life Histories of North American Geometridæ, XLVIII.[c]

DEILINIA VARIOLARIA Guenée.

Two specimens, June 24, July 25, and one from Mr. Cockle's collection, June 17. They are not in good condition, but appear referable to this species. Mr. G. W. Taylor has sent me a specimen agreeing with the Kaslo ones as *Cymatophora subalbaria* Hulst from New Jersey. However, in this case I prefer Mr. Cockle's determination, as I think I see a fovea on the hind wings below, which makes the species a *Deilinia*.

[a] Psyche, X, 1904, p. 200. [b] Idem, X, 1904, p. 199. [c] Idem, X, 1904, p. 195.

SCIAGRAPHIA GRANITATA Guenée.

Fifteen specimens, May 29, June 2, 3, 5, 10, 16, 24, 25, 29, July 10 (Ainsworth), 29 (Bear Lake Mountain), and three from Mr. Cockle's collection. Two of these bear labels "*punctolinearia* Packard" and "*nubiculata* Packard," but I think these determinations erroneous. The larva will be described by me in Life Histories of North American Geometridæ, LVI. It feeds on spruce and mimics the needles of the second year's growth in color.

SCIAGRAPHIA DENTICULATA Grote.

No specimens; one in Mr. Cockle's collection agrees rather nearly, though not exactly, with one from Montana so named for me by the late Doctor Hulst.

SCIAGRAPHIA NEPTATA Guenée.

Twenty specimens; May 31, June 3, 16, 23, July 7, 18 (bred), 24, 31, August 3, 4, 18, September 8 (Glacier, dead in a lamp). Rather variable in color, the lines more or less sinuous, the yellow shading in the transverse posterior line sometimes obsolete. It is very nearly allied to *irrorata* Packard. Both feed on the poplar. I shall describe the larva of *neptata* in Life Histories of North American Geometridæ, LXIII; *irrorata* was described in No. XXX.[a]

SCIAGRAPHIA CONTINUATA Walker.

No specimens; one in Mr. Cockle's collection is small and worn, but apparently referable here.

MACARIA MINORATA Packard, var. INCOLORATA, new variety.

Five specimens; May 29, June 11, 25, 26, and one from Mr. Cockle's collection August 5, 1902. The form differs from the eastern *minorata* in its slightly larger size, nearly obsolete emargination of the outer margin of fore wing, and obscure gray coloration, all the contrasts of the black and reddish marks being lost and the head and collar being gray with only a trace of the orange marking. It will not unlikely be found to represent a distinct species, but I prefer to list it for the present as a western race of *minorata*.

Type.—Cat. No. 7879, U. S. National Museum.

CYMATOPHORA LATIFERRUGATA Walker.

No specimens; one in Mr. Cockle's collection so named. In Bulletin No. 52, United States National Museum, Doctor Hulst makes this species synonymous with *pustularia* Hübner, although in 1895 he "felt

[a] Psyche, IX, 1902, p. 310.

uncertain about this."[a] The synonymy is certainly erroneous, for Hübner's excellent figure is not in the least like *latiferrugata*. I have no direct information at present about Walker's type, but Packard's type of *brunneata* is before me, and I assume them to be the same, since Walker's description does not disagree. The Kaslo specimen, though somewhat worn, agrees well with Packard's type.

CYMATOPHORA INQUINARIA Hulst.

Twenty-three specimens: July 8, 12, 18, 19, 23, 24, 25, 26 (Payne Mine), 30, 31, August 3, 5, 6, 7, and two from Mr. Cockle's collection. Distinctly variable, yet characteristic. It looks very much like *Symepherta julia* Hulst. The larva was not obtained. My other specimens are from Placer County, Cal. (Koebele), and the Mariposa Big Tree Grove, California (Dyar).

CYMATOPHORA BIACTATA Walker.

One specimen, Sandon (G. C. Robbins) and one from Mr. Cockle's collection.

CYMATOPHORA MATILDA, new species.

Twenty specimens, June 3, 9, 10, 13, 17, 20, 21, 24, July 14, 27, and one from Mr. Cockle's collection labeled *Eois anticaria* Walker; but the species has vein 5 of the hind wings absent and is therefore not even an *Eois*.

Male antennæ with short, clavate, hairy pectinations decreasing to the tip, of female simple. Yellowish white, front with a narrow line of dark scales at its summit, vertex and collar faintly yellowish, wings with minute dark atoms forming a line on the base of the costal edge. Two faint, dark, nearly straight lines on fore wing, one on hind wing, the outer line placed unusually near the margin on both wings, being at the outer fourth. Inner line of fore wing may be absent and both are always faint. In some a faint discal dot on hind wing. Below unmarked or with discal dot on both wings. Fore wing square at the apex but not falcate, hind wing rounded. Expanse, 24–27 mm.

Type.—Cat. No. 7880, U. S. National Museum.

I have a specimen from Colorado. Concerning *Eois anticaria* Walker (=*subalbaria* Packard), Packard states that the antennæ are pectinated, which shows that it is not an *Eois*, but probably referable to *Xystrota*. It is certainly not my species even if it should prove to be a *Cymatophora*, for mine does not agree in markings with Packard's figure and description.

SYMPHERTA TRIPUNCTARIA Packard.

One specimen, July 23 (Frye Creek) and one from Mr. Cockle's collection without label.

[a] Ent. News, VI, p. 106.

ENEMERA JUTURNARIA Guenée.

Thirty-two specimens, June (Mr. Cockle), June 23, 30, July 4, 13, 14, 15, 17, 18, 19, 23, 25, 26 (Payne Mine), August 4, 11, Sandon (G. C. Robbins). Many more could have been obtained as the moth is easily started up in the daytime. The species is single brooded with hibernation in the egg state. I have described the egg [a] and larva.[b]

CARIPETA ÆQUALIARIA Grote.

No specimens; one in Mr. Cockle's collection, July 7, 1901. The specimen differs from *æqualiaria* that I have from Victoria; Easton, Washington; Portland, Oregon; California and Williams, Arizona, in being darker, the pinkish tint obscured by brown, the marginal pale dashes absent, and the marginal orange rays on the hind wings reduced. Beneath it does not differ from normal specimens. This probably represents a distinct local race, but without more material I can not feel certain.

CARIPETA DIVISATA Walker.

One specimen, July 11 (Ainsworth, Currie and Caudell). It differs in some respects from eastern specimens, but without a series I cannot judge whether these differences are constant enough to define a local race.

PHENGOMMATÆA EDWARDSIATA Hulst.

No specimens; one from Mr. Cockle's collection, August 23, 1902.

ENYPIA PERANGULATA Hulst.

Sixty-one specimens, July 29, 30, August 1, 2, 6, 7, 8, 10 (on snow, Kokanee Mountain), 13 (Sandon, Mr. Currie), 16, 17, 18, 20 (Nelson), 20 (West Robson), 21 (Revelstoke), 22 (Revelstoke), and one from Mr. Cockle's collection August 9, 1901, as well as Sandon specimens collected by Mr. G. C. Robbins. Very constant and darker than the Pacific coast form *venata* Grote, of which it may nevertheless be a local race. It appears smaller and narrower winged than *venata*, and the latter is remarkably variable. I hold it, therefore, provisionally as a distinct species. The range is down the Rocky Mountains. I have specimens from Taos Mountain, New Mexico, and Silverton, Colorado. Eggs from females taken at Nelson, where the species was commonest hatched but were not raised, as I was leaving the district and could not attend to them.

Egg.—Elliptical, thick and regular, sides strongly concavely flattened, ends rounded and nearly alike, scarcely any truncation or

[a] Proc. U. S. Nat. Mus., XXV, 1903, p. 392 [b] Ent. News., V, 1895, p. 63.

depression; smooth. Pale yellowish greenish, scarcely any color, shining, turning bark brown; size, 1.3 by 1 by 0.7 mm. Laid singly, adherent, all covered with gray scales from the moth, so that they appear like woolly balls.

Stage I.—Head large, round, slightly bilobed, pale red brown. Body moderate, rather short, slate gray, cervical shield and spots at tubercles i and ii pale luteous, subventral fold, feet and anal plates pale.

PHILEDIA PUNCTOMACULARIA Hulst.

No specimens, but Mr. Cockle has taken it. The species flies late in summer, and none had emerged by August 18, when I left Kaslo. I took it later on Vancouver Island. In Bulletin No. 52, U. S. National Museum (p. 320), I note the spruce defoliating geometrid, reported by Dr. A. D. Hopkins, as being this species. This is probably an error, since Mr. Theodore Bryant informs me that he has bred *punctomacularia* from larvæ on the common brake (*Pteris*).

NEPYTIA UMBROSARIA Packard.

Two specimens, one from Mr. Cockle, one August 20 (Nelson) and one from Mr. Cockle's collection, August 12, 1901. Very rare, perhaps a little out of its range. I have it from Portland and Mount Angel, Oregon, and Santa Cruz Mountains, California.

ALCIS SULPHURARIA Packard.

Thirty-one specimens, June 23, 26, 30, July 3, 4, 19, 23, 24, 25, 27, 29, 30, 31, August 11, 12. Very variable, the markings tending to reduction or nearly complete obsolescence (var. *unicoloraria* Hulst). Eggs were obtained from captive females, but they hibernated without hatching.

Egg.—Elliptical, well flattened, but without flat areas, rounded; ends much alike, without marked truncation or depression. Ribbed, about 10 on the flat side in the center, diminishing to both ends irregularly; waved and cut nearly through at each obsolete cell, the resulting elevations crested each by two pores not in line with the rib; crests of pores white. Obsolete cross striæ show as low, rounded bars, principally on the flanks of the ribs. Surface minutely granular shagreened. Micropylar end without ribs centrally. Orange ochraceous; later all red; size, 1 by 0.6 by 0.4 mm.

PARAPHIA SUBATOMARIA Wood.

No specimens; one from Mr. Cockle's collection, July 17, 1901.

SPODOLEPIS SUBSTRIARIA Hulst.

Four specimens, May 13 (Mr. Cockle), June 2, 3, the later ones much worn; also one from Mr. Cockle's collection, April 23.

GABRIOLA DYARI Taylor.

No specimens; one in Mr. Cockle's collection.

SELIDOSEMA HUMARIUM Guenée, var. EMASCULATUM, new variety.

Five specimens, June 30, July 16, 18, and one from Mr. Cockle's collection, much darker than the others. In markings this form agrees closely with eastern *humarium*. It is, however, much slighter in build and the secondary sexual characters of the male are less developed. The hind tibiæ are swollen, but not nearly as strongly as in *humarium*. There is a groove on the inner side, but I do not detect a hair pencil in it.

Type.—Cat. No. 7881, U. S. National Museum.

CLEORA PAMPINARIA Guenée.

Five specimens, June 7, 10, 13, and one from Mr. Cockle's collection, June 1, 1901. I have the species from Wellington, and Seattle, Washington.

CLEORA UMBROSARIA Hübner.

No specimens; one from Mr. Cockle's collection. The specimen agrees with two in the National Museum bearing Dr. Packard's original labels "*Boarmia indicataria*, comp. Walker's type" and "*Boarmia umbrosaria* Hbn., *B. gnophosaria* Gn.," the specimens originally coming from the Meske and Riley collections. They are males and show a hair pencil on the hind tibiæ, so I transfer *umbrosaria* to *Cleora*, following Hulst's separation of *Cleora* and *Selidosema*.

MELANOLOPHIA CANADARIA Guenée, var. SUBGENERICATA, new variety.

Five specimens, May 29, 30, June 3, 4, and one from Mr. Cockle's collection. The specimens are generally larger and darker than the Eastern form and differ decidedly in the reduction of the secondary sexual characters. I shall describe the larvæ in Life Histories of North American Geometridæ, LX. They feed on spruce, mimicking the young needles in color. In the male moths the lateral abdominal tufts are very small, in some hardly perceptible, and the hind tibiæ are less swollen than in Eastern specimens and are more slender, though bearing a distinct hair pencil. I have the form also from Mount Angel, Oregon (F. Epper). Push, Oregon (H. Ahlers), Seattle,

Washington (T. Kincaid), and Rossland (W. R. Johnson). The Rossland specimen was named "*Meis sp.*" by Doctor Hulst, apparently on the supposition that the male had a fovea on the fore wings below; but I am unable to see it.

Type.—Cat. No. 7106, U. S. National Museum.

ÆTHALOPTERA INTEXTATA Walker.

Twenty-five specimens, April 18 (Mr. Cockle), 25 (Mr. Cockle), May 31, June 2, 9, and two from Mr. Cockle's collection, May 15.

ECTROPIS CREPUSCULARIA Schiffermüller.

Three specimens, June 1. In collecting, this species was confounded with *Melanolophia canadaria*, so that the usual efforts to obtain eggs were not made in this case, much to my present regret.

LYCIA COGNATARIA Guenée.

One specimen, August 1. I have described the larva in Life Histories of North American Geometridæ, XL.[a]

ERANNIS VANCOUVERENSIS Hulst.

No specimens; one from Mr. Cockle's collection, October 14. I have it also from Pullman, Washington (C. V. Piper). Hulst calls this form *E. defoliaria* variety *vancouverensis;* but I see no more reason for regarding it as a variety of the European *defoliaria* than of the Eastern *tiliaria* Harris. The fact is that all the American forms of *Erannis* are but slightly divergent geographical expressions of the European one and will doubtless be finally so listed. Yet, pending the examination of a larger series of all the forms, I will temporarily regard the Northwestern form as specific.

DYSCIA ORCIFERATA Walker.

No specimens; one in Mr. Cockle's collection, July 6, 1901.

SICYA MACULARIA Harris.

Five specimens, July 14, 25, 31, September 9 (Field).

THERINA LUGUBROSA Hulst.

No specimens; one from Mr. Cockle's collection labeled *T. sommiaria* Hulst. However, it agrees well with Hulst's type of *lugubrosa* before me from Rossland. From *sommiaria* the form differs in being much more densely strewn with the gray strigæ, which are confluent and dominate the coloration. *T. sommiaria* has been shown to feed on the oak in the larval state, a plant which does not grow at Kaslo. Therefore, I judge that *lugubrosa* is really a distinct species.

[a] Psyche, X, 1903, p. 78.

METROCAMPA PRÆGRANDARIA Guenée.

Twenty-four specimens, June 28, July 2, 4, 7, 14, 15, 19, 21, 25. The peculiar larvæ with an additional pair of feet on the fifth adominal segment and with subventral fringe were fed on birch, the bark of which they closely mimicked. I have described them in Life Histories of North American Geometridæ, XLIII.[a]

ENNOMOS MAGNARIUS Guenée.

One specimen, sent me by Mr. Cockle and one from his collection.

PLAGODIS APPROXIMARIA Dyar.

No specimens; one in Mr. Cockle's collection, June 3 (Ainsworth). I have the species also from Rossland and Portland, Oregon.

HYPERITIS TRIANGULIFERATA Packard.

Thirty-two specimens, May 29, 30, 31, June 2, 3, 4, 5, 7, 8 (Ainsworth), 10, 12, 13, 16, 18, 23, July 4, 24. Some have the brown mark above anal angle (var. *notataria* Hulst), others lack it entirely and there are all intergrades in the obsolescence of the marking. The basal costal spot is likewise evanescent. The form *notataria* is not specifically distinct as listed by Hulst. The larvæ occurred on currant. I shall describe them in Life Histories of North American Geometridæ, LIV. Prof. G. H. French has previously described them.[b]

HYPERITIS AMICARIA Herrich-Schaeffer.

Seven specimens, May 31, June 1, 8 (Ainsworth), 9, 11, 25. The larvæ were raised on wild cherry. I shall describe them in Life Histories of North American Geometridæ, LV, and give some notes on the form of imago occurring at Kaslo.

ANIA LIMBARIA Haworth.

One specimen sent me by Mr. Cockle and one from his collection, July 24.

GONODONTIS DUARIA Guenée.

No specimens; one from Mr. Cockle's collection.

EUCHLÆNA PECTINARIA Schiffermüller.

One specimen, June 25, and one from Mr. Cockle's collection labeled *E. sirenaria* Strecker. It does, indeed, agree with Strecker's description of *sirenaria*, but the form is that usually identified as *pectinaria*, and I do not see that Strecker has done more than make a synonym.

[a] Psyche, X, 1904, p. 190.

[b] Can. Ent., XVIII, 1886, p. 105.

My specimen was a female and deposited eggs which hatched and were carried to stage v when they were all lost by a fungoid disease. I have described the larva in Life Histories of North American Geometridæ, XXXII.[a]

EUCHLÆNA ASTYLUSARIA Walker.

Nine specimens, June 9, 19, 24, 25, 27, July 2. They agree with Coloradan examples. As compared with eastern specimens they are more yellowish, the strigæ fewer and less defined, the dark shade beyond the transverse posterior line lighter and either partially or wholly wanting. This may be Hulst's *manubriata*, which I do not know. I will describe the larvæ in Life Histories of North American Geometridæ, LIX.

EUTRAPELA ALCIPHERARIA Walker.

One specimen, May 30. The specimen was a female, but the eggs were infertile. I have the larvæ from Mr. Theodore Bryant, Wellington, who points out to me that the two broods of the species are different, the spring brood being large and heavily marked, the summer brood small and lightly marked. I have described the larvæ in Life Histories of North American Geometridæ, III.[b]

METANEMA TEXTRINARIA Grote and Robinson.

Two specimens, June 8 (Ainsworth), 11, and one from Mr. Cockle's collection.

AZELINA ANCETARIA Hübner, var. OCCIDENTALIS Hulst.

Twenty-six specimens, July 15, 26, 29, 30, August 4, 5, 6, 7, 12, 21 (Revelstoke). This is, I think, Hulst's *Marmarea occidentalis*. Only two of my specimens are males. In describing *occidentalis*, Doctor Hulst calls it a "Darwinian species"—that is to say, in this case, a geographical race—and he erects the new genus for it on the slight difference in the male antennæ. In the Kaslo specimens this is certainly extremely slight. Neither is it greater in specimens from California and Arizona before me. The Kaslo specimens are all decidedly larger than eastern *ancetaria*, agreeing with Doctor Hulst's specific diagnosis of *occidentalis*. So while there is a possibility that I have not the true *occidentalis*, I do not think this is the case. I am of the opinion that when a character is admittedly not of specific value it can not be used to define a genus, even if it be "structural." Therefore I place Hulst's genus *Marmarea* as a synonym of *Azelina* and his species *occidentalis* as a variety of *ancetaria*. The life history was started, but I failed to complete it.

[a] Psyche, IX, 1902, p. 344. [b] Idem, VIII, 1899, p. 395

Egg.—Eliptical, smoothly and evenly rounded, no perceptible flattening nor truncation; surface smooth, shagreened. Shining sordid olivaceous, under a lens minutely black speckled; size, 0.9 by 0.7 by 0.65 mm.

Stage I.—Head rounded, bilobed, pale brown, erect, sutures depressed. Body moderately elongate, normal, whitish, marked with irregular green rings from the alimentary canal before eating; a very faint, narrow, brown subdorsal line. Segments annulate; cervical shield small, black; tubercles black, a slight blackening around the hair dots only; setæ stiff, minutely flared at the tip.

Stage II.—Face below and epistoma broadly bluish white, edged above with a straight black shade; vertex yellowish, with brown black spots in alternating oblique rows; width, 0.75 mm. Body moderately slender, normal, dark gray, many fine irregular brown lines on a greenish gray ground; venter darker than dorsum, which is irregularly diluted greenish. Feet concolorous; tubercles round, black; setæ pointed, dark.

The larvæ began to hibernate at this point and finally died.

SABULODES CATENULATA Grote.

One specimen, June 25, and one from Mr. Cockle's collection, August 1, 1902.

BREPHOS INFANS Möschler.

No specimens; one from Mr. Cockle's collection, June 24 (Ainsworth).

Family NOLIDÆ.

CELAMA MINNA Butler.

One specimen, May 31. It differs somewhat from *minna* from California and Vancouver Island, but without a series it is not possible to define the racial characters, if such exist. In the specimen the subcostal mark on the transverse-anterior line is much reduced, while the transverse-posterior line is an obviously geminate row of dots, filled by a little darker shade. Larvæ of this, as I suppose, occurred on *Ceanothus*. They are not yet bred.

Larva.—Head bilobed, pale yellow, densely checkered with brown, leaving the paraclypeal pieces yellow; epistoma white. Body flattened, no feet on joint 7; warts normal, formed with tubercles i+ii and iv+v. Cervical shield small, bisected. Body checkered yellow and brown, joints 5, 7, and 11 broadly brown dorsally; a narrow brown dorsal line, straight; subdorsal, lateral, and subventral waved broad brown bands, broken in the incisures, dark and subconfluent on the dark segments, avoiding the warts. Warts ocherous, ringed with

brown. Hair bristly, black tipped, some long ones laterally. Feet pale. Wart iv+v is lighter than the others. The dorsal band is widened on joints 3–4 and 12 and shows distinctly in dark specimens. Very variable in the intensity of coloring.

Cocoon boat-shaped, made of bits of bark on a stem in the well-known manner.

Family PSYCHIDÆ.

PSYCHE FRAGMENTELLA Henry Edwards.

No specimens. A single immature larva was found in its characteristic case but it failed to mature.

Family COCHLIDIIDÆ.

TORTRICIDIA TESTACEA Packard.

Three specimens, June 13. They agree with specimens from Manitoba and Colorado, and are probably referable to the form *crypta* Dyar. A single larva was found on birch, but it was parasitized, and died before the characteristic markings had appeared. This is the westernmost record (except in the extreme Southwest) for any Cochlidian in North America. The rarity of the species prevented as complete observations as are desirable.

Family COSSIDÆ.

COSSUS POPULI Walker.

No specimens; one in Mr. Cockle's collection, July 27, 1902, is a male in good condition, expanding 60 mm. It resembles *undosus* Lintner, but the collar is grayer and the lines on the wings are less pronounced, more broken and strigose.

Family SESIIDÆ.

ALBUNA PYRAMIDALIS Walker.

Ten specimens, June 11, 18, 23, July 11 (Ainsworth), 21 (Bear Lake Mountain), 28 (Bear Lake Mountain), taken at flowers. Five are normal *pyramidalis*, three of the variety *rubescens*, and two of the variety *coloradensis*. The extremes suggest different species, and it is not surprising that they were described as such.

SESIA TIPULIFORMIS Linnæus.

No specimens; one in Mr. Cockle's collection, June 27.

Family PYRALIDÆ.

SYMPHYSA ERIPALIS Grote.

One specimen, August 20 (Nelson), in very poor condition, seems referable here.

DESMIA FUNERALIS Hübner.

No specimens; one from Mr. Cockle's collection.

EVERGESTIS FUNALIS Grote.

No specimens; one from Mr. Cockle's collection. I took the species later on Vancouver Island.

NOMOPHILA NOCTUELLA Schiffermüller.

Twenty-four specimens, May 31, June 1, 2, 3, 4, 5, 7, July 19, 23, 24, 25, August 1, 14 (Revelstoke, Mr. Currie), 21 (Revelstoke).

LOXOSTEGE COMMIXTALIS Walker.

Four specimens, June 4, and one from Mr. Cockle's collection.

PHLYCTÆNIA FERRUGALIS Hübner.

One much-worn specimen, July 28 (Bear Lake), may be of this species, and another equally bad from Mr. Cockle's collection. My specimen is of the usual size, but Mr. Cockle's is larger, like the form from the Pacific coast (*profundalis* Packard).

PHLYCTÆNIA TERREALIS Treitschke.

No specimens; one in Mr. Cockle's collection, June 22, 1902.

PHLYCTÆNIA TERTIALIS Guenée.

No specimens; one in Mr. Cockle's collection, June 7.

PHLYCTÆNIA TILLIALIS, new species.

Two specimens, August 7, September 9 (Field), and one from Mr. Cockle's collection, August 23, 1902. Light, whitish, straw yellow, irregularly shaded with reddish brown, especially toward costa and outer margin. Reniform and orbicular large, nearly solidly brown-black filled, fused to a concolorous costal stripe that reaches two-thirds to the apex. Transverse-anterior line nearly obsolete, linear, bent out on median vein; transverse-posterior punctiform, moderately arcuate, not distinct. A row of small, terminal black dots. Fringe brown, whitish checkered without. Hind wings subpellucid whitish, faintly testaceous tinged, a small fuscous, obscure discal spot and faint shadow of a dusky outer line, indefinite. Expanse, 24 mm.

Type.—Cat. No. 7829, U. S. National Museum.

PHLYCTÆNIA ITYSALIS Walker.

No specimens; one from Mr. Cockle's collection, July 1.

PYRAUSTA FUMOFERALIS Hulst.

Twelve specimens, June 1, 10, 11, 16, 23, 24, 29, July 18, 26 (Payne Mine), and one from Mr. Cockle's collection.

PYRAUSTA UNIFASCIALIS Packard.

One specimen, July 29 (Bear Lake Mountain), and one from Mr. Cockle's collection, June 11.

PYRAUSTA BOREALIS Packard.

Seven specimens, May 29, 31, June 2, and one from Mr. Cockle's collection, June 28, 1902. The specimens are rather small and much shaded with black, the hind wings especially being nearly solidly black from the inner line to the base. The eight specimens are alike, but another from Mr. Cockle's collection, without label, is of the usual larger and paler form.

PYRAUSTA OCHOSALIS Dyar.

No specimens; one from Mr. Cockle's collection, June 20, 1902.

PYRAUSTA NICALIS Grote.

No specimens; one in Mr. Cockle's collection.

PYRAUSTA INCONCINNALIS Lederer.

No specimens; one from Mr. Cockle's collection, which differs a little from my Colorado and Arizona examples in having a trace of a line on the hind wings.

PYRAUSTA FUNEBRIS Stromeyer.

Four specimens, June 11, and one from Mr. Cockle's collection, July 3, 1902.

PYRAUSTA ÆGLEALIS Walker.

No specimens; one from Mr. Cockle's collection, July 31, 1901.

CORNIFRONS SIMALIS Grote.

No specimens; one from Mr. Cockle's collection.

NOCTUELIS THALIALIS Walker.

Ten specimens, June 11, 23, 25, July 11 (Ainsworth), and one from Mr. Cockle's collection.

SCOPARIA CENTURIELLA Schiffermüller.

Twenty-six specimens, June 18, 20, 22, 23, 25, July 2, 13, 14, 16, 19, 23, 29 (Bear Lake Mountain), August 6, 7, 8, 11, 13 (Sandon, Mr. Currie), 17, Sandon (G. C. Robbins), and one from Mr. Cockle's collection.

SCOPARIA NOMINATELLA Hulst.

Twelve specimens, July 19, 24, August 1, 3, 6, 7, 17, September 1 (Shawnigan Lake, Vancouver Island), and two from Mr. Cockle's collection, August 17, 1902, and August 17, 1903.

SCOPARIA FERNALDALIS Dyar.

One hundred and eighty-seven specimens, June 24, July 7, 15, 25, 30, August 4, 5, 12, 30 (Shawnigan Lake) and two from Mr. Cockle's collection, August 30, 1902.

SCOPARIA RECTILINEA Zeller.

One hundred and seventy-six specimens, July 8, 15, 24, 27, August 5, 6, 11, 12, 13, 17, 29 (Shawnigan Lake) and one from Mr. Cockle's collection, July 20, 1901.

SCOPARIA TRICOLORALIS Dyar.

One specimen, July 10 (Ainsworth) and two from Mr. Cockle's collection, July 7 and August 3, 1902.

PYRALIS ELECTALIS Hulst.

No specimens; one from Mr. Cockle's collection, July 2.

PYRALIS FARINALIS Linnæus.

Ten specimens, June 16, 17, 24, 27, July 23, 30, August 7, 13.

CRAMBUS HAMELLUS Thunberg.

Sixty-three specimens, August 16, 17, 21 (Nakusp), 21 (Revelstoke), September 2 (Wellington). The ground color of the wings varies from the usual dark brown to gray or yellowish gray, showing that the Californian *cypridalis* Hulst, which differs only in the ground color, is not specifically distinct from *hamellus*.

CRAMBUS PASCUELLUS Linnæus.

Seven specimens, June 13, 18, July 2, 7 (Lardo), 15, 17, and one from Mr. Cockle's collection, August 3, 1902.

CRAMBUS UNISTRIATELLUS Packard.

One specimen, July 17, and one from Mr. Cockle's collection, July 20, 1901.

CRAMBUS HORTUELLUS Hübner.

Thirty-seven specimens, June 11, 15, 16, 23. The specimens vary in color from light (*toparius* Zeller) to dark (*vachellellus* Kearfott), the majority being intermediate.

CRAMBUS MYELLUS Hübner.

Eighteen specimens, July 16, 18, 24, 25, 30, August 3, 4, 5, 6, 7, 13, 19, and one from Mr. Cockle's collection, July 21, 1902.

CRAMBUS VULGIVAGELLUS Clemens.

Three specimens, August 22 (Revelstoke), 28 (Victoria), and one from Mr. Cockle's collection, September 1, 1902.

CRAMBUS PLUMBIFIMBRIELLUS, new species.

Sixteen specimens, June 14, 16, 19, 20, 29, July 3, 7 (Lardo), 23 (Frye Creek), August 4, 7, and one from Mr. Cockle's collection, July 3, 1902. Sordid whitish, palpi sprinkled with gray; fore wings whitish, tinged with ocherous, especially along terminal space and outer half of costa; all the interspaces filled with scattered gray-brown scales. These scales are grouped to occasionally indicate a median line, bent outward across cell, but faint and usually wanting. Outer line near the margin, roundly bent below apex, then straight and parallel to margin; a row of seven terminal black dots; fringe shining lead color. Hind wings sordid white, a faint dark line close to the margin, a little more remote at the anal angle. Expanse, 20 mm.

Type.—Cat. No. 7827, U. S. National Museum.

CRAMBUS OREGONICUS Grote.

Nine specimens, July 15, 21 (Bear Lake Mountain), 28 (Bear Lake Mountain), August 3, 21 (Revelstoke), September 2 (Wellington).

CRAMBUS MURELLUS, new species.

No specimens; one from Mr. Cockle's collection, without date, and two from Pullman, Washington (C. V. Piper). Fore wing light gray, dusted with darker; an illy defined pale carneous shade over lower half of wing, spreading from the median fold, fading before the tornus. Scarcely any lines; subterminal faint, finely linear, dark, minutely dentate and slightly excurved opposite the cell, not very near the margin. Terminal black dots very small; fringe not at all metallic. Hind wings dark gray, the fringe pale, almost white. Expanse, 22 to 24 mm.

Type.—Cat. No. 7826, U. S. National Museum.

CRAMBUS BONIFATELLUS Hulst.

Thirty-four specimens, June 1, 8 (Ainsworth), 13, 15, July 15, 19, 21 (Bear Lake), 24, 25, 31, August 7, 21 (Revelstoke), 22 (Revelstoke), and two from Mr. Cockle's collection, May 26, 1901, June 11. This obscurely marked species varies considerably, the white speck used as a differential character by Doctor Fernald being inconstant. There appears in many specimens a dark outer line, curved outward beyond the cell.

CRAMBUS TRISECTUS Walker.

Five specimens, August 21 (Revelstoke), September 2 (Wellington), and one from Mr. Cockle's collection, August 17, 1901.

MYELOIS CORNIELLA Ragonot.

Sixteen specimens, July 15, 24, 31, August 1, 5, 7, 17, 21 (Revelstoke), 22 (Revelstoke), and two from Mr. Cockle's collection, June 24 and July 8, 1901. The black scales of fore wing form indefinitely a line from the costal inception of the outer line to the inner margin at middle of wing. This is shown distinctly in Ragonot's figure, but it is faint in my specimens and often not determinate.

DIORYCTRIA ABIETELLA Schiffermüller.

One specimen, June 20, and one from Mr. Cockle's collection, July 2, 1901.

DASYPYGA ALTERNOSQUAMELLA Ragonot.

One specimen, August 6, of this very pretty and distinctly marked species. I have another from Williams, Arizona (Schwarz and Barber), and two from Seattle, Washington (O. B. Johnson).

AMBESA WALSINGHAMI Ragonot.

No specimens; one from Mr. Cockle's collection, August 4. This species is not represented in the National Museum collection.

NEPHOPTERYX SUBTINCTELLA Ragonot.

Two specimens, June 16, 25, and two from Mr. Cockle's collection, June 24, 1901, and June 7, 1903.

NEPHOPTERYX OVALIS Packard.

No specimen; one from Mr. Cockle's collection, June 28, 1902, is rather larger and lighter colored, but essentially similar to eastern specimens.

MEROPTERA PRAVELLA Grote.

One specimen, June 13, and two from Mr. Cockle's collection, May 27, 1902, and July 7, 1902.

SALEBRIA LÆVIGATELLA Hulst.

No specimens; one from Mr. Cockle's collection, May 29, 1901.

LAODAMIA FUSCA Haworth.

Three specimens, July 29 (Bear Lake Mountain), August 4, 31 (Shawnigan Lake), and one from Mr. Cockle's collection, July 7, 1902.

ETIELLA ZINCKENELLA Treitschke.

No specimens; one from Mr. Cockle's collection, July 3, 1902.

ZOPHODIA PACKARDELLA Ragonot.

One specimen, April 30 (Mr. Cockle), and two from Mr. Cockle's collection, April 28, 1901, and May 20, 1902.

EUZOPHERA OCHRIFRONTELLA Zeller.

Two specimens, July 23, 30.

ECCOPISA SERRATILINEELLA Ragonot.

Four specimens, August 17, September 4 (Shawnigan Lake), and one from Mr. Cockle's collection, June 24, 1902.

HULSTIA UNDULATELLA Clemens.

Twenty-eight specimens, April 27 (Mr. Cockle), June 27, 28, July 1, 3, 4, 10 (Ainsworth), 15, and one from Mr. Cockle's collection, July 8, 1902.

EPHESTIA AMARELLA, new species.

Three specimens, June 13, 23, 24. Fore wings with 9 veins, hind wings with 7; tongue long; ocelli absent, palpi erect, hind wings with veins 3 and 4 connate. By these characters it falls between *Eurythmia* and *Unadilla*, according to Hulst's tables, but is really an *Ephestia*.

Light gray; a carneous reddish shade along inner third of wing, most distinct on submedian fold in median space. Inner line obsolete, but indicated by a broad, light blackish outer edge, which forms a straight, slightly oblique band. Discal spot of two superimposed dots. Outer line obsolete, indicated by its rather narrow, blackish inner shade, inwaved opposite cell and on submedian fold. Hind wings whitish, fuscous along costa. Expanse, 18 mm.

Type.—Cat. No. 7828, U. S. National Museum.

HOMŒOSOMA MUCIDELLUM Ragonot.

One specimen, June 24, and one from Mr. Cockle's collection, June 20, 1902.

EPHESTIODES GILVESCENTELLA Ragonot.

Four specimens, June 18, July 1, August 13, and one from Mr. Cockle's collection, June 27.

EPHESTIODES BENJAMINELLA, new species.

Five specimens, June 22, July 19, 24, 25, August 3, two from Mr. Cockle's collection, July 19, 1901, August 17, and five from Pullman, Washington (C. V. Piper), July 11, 12, 1898, and August 2, 1899. Dark fuscous with a red tint. Lines more or less obscured, pale, edged with blackish toward median space; discal dots black, indistinct. Hind wings fuscous. Anal tuft of male sordid ocherous. Expanse, 13–14 mm.

The form differs from *gilvescentella* Ragonot and *nigrella* Hulst by the fuscous hind wings. It seems nearest allied to *erythrella* Ragonot, which I have not seen, but is not so red, that being described as "dark vinous red, dusted with black on costa and veins."

Type.—Cat. No. 7830, U. S. National Museum.

Respectfully dedicated to Dr. Marcus Benjamin, the efficient editor of these Proceedings.

Family PTEROPHORIDÆ.

PLATYPTILIA COSMODACTYLA Hübner.

Three specimens, July 11, 12, 19 and one from Mr. Cockle's collection, June 21, 1902. The larvæ were found in the red bracts of the high bush honeysuckle (*Lonicera involucrata*), eating holes in the young fruit through the bracts and destroying the fruit. A larva in the penultimate stage had the following characters. I have described the mature larva from a Coloradan specimen.[a]

Larva.—Head bilobed, shining black. Cervical shield quadrate, black; thoracic feet and anal plate black; tubercles brown, angularly plated, i and ii with a pale hair and very short black one separate, i dorsad to ii; tubercle iii also with multiple hairs; two secondary hairs, very short, black, below tubercle i; tubercle iiia present; iv + v with a secondary hair closely adjoining; vi single. Skin with sparse, dark, secondary granules. Dorsum broadly whitish with dorsal reddish line; sides dull reddish, stigmatal region whitish. The mature larva has numerous secondary hairs.

[a] Proc. U. S. National Museum, XXV, 1902, p. 399.

PLATYPTILIA TESSERADACTYLA Linnæus.

Two specimens, July 29 (Bear Lake Mountain), August 11 (Kokanee Mountain).

PLATYPTILIA CARDUIDACTYLA Riley.

Five specimens, June 5, 23, July 21 (Bear Lake), August 5, and one from Mr. Cockle's collection, June 24.

OXYPTILUS NINGORIS Walsingham.

Seven specimens, June 25, 27, 29, August 3. The young larvæ were found webbing the heads and deforming the leaves of a wooly herbaceous plant with milky juice, *Hieracium albiflorum*. The larvæ were very small but made a great showing as the whole head of the plant is webbed and distorted, the leaves crumpled and the flower shoot does not grow up as it normally would.

Larva.—Head small, bilobed, pale honey yellow, mouth pointed. Body robust, tapering a little at the ends, feet normal, slender, dilated at the ends as usual in the Pterophoridæ. Primary hairs simple, coarse, white, i and ii closely approximated, the tubercles black; iii single, iv and v closely approximated, vi single, the tubercles brownish ringed. Numerous small secondary hairs all over, white, short, broadly clavate tipped. Olivaceous green, the food dark; skin densely covered with minute black, flat granules; spiracles black ringed. Later there is a deep brown spot on tubercle i+ii.

Pupa.—Attached by the anal extremity, free; pale yellow, the tubercles like those of the larva, the dorsal ones colored red. The young larva is without the capitate secondary hairs.

OXYPTILUS TENUIDACTYLUS Fitch.

Two specimens, June 23 (bred). The larvæ occured on the thimbleberry (*Rubus nutkanus*) with the normal structure and coloration. I have described them from New York specimens on blackberry.[a]

PTEROPHORUS ANGUSTUS Walsingham.

Thirty-three specimens, June 9, 10, 11, 13, 20, 21, 23, 24, 25, 30, July 11 (Ainsworth), 24, 25, and one from Mr. Cockle's collection June 10, 1902. The moths were easily started up from low grass and weeds, but especially from the plant *Anaphalis margaritacea*, which I suppose is their food plant. Larvæ were found commonly in the flower heads of this plant, but unfortunately were not bred. The following is a description of them:

Larva.—Head shining brown-black, bilobed, the clypeus reaching vertex, rounded at top; mouth pointed. Body robust, flattened,

[a] Psyche, VIII, 1898, p. 249.

tapered behind, feet normal, small. Densely covered with brown-black, flat granules, forming a double patch dorsally, bisected by a pale dorsal line; ground color whitish, forming a subdorsal band; segmental incisures shagreened. Tubercles i and ii separate, i dorsally placed, with secondary hairs; iv and v separate. Later the larva is whitish, with the flat black granules; dorsal, subdorsal, and stigmatal purplish bands, the dorsal band geminately segmentarily bimaculate in blackish.

PTEROPHORUS HELIANTHI Walsingham.

No specimens; one from Mr. Cockle's collection, August 10 (South Fork Creek), may be referable to this species, although it lacks the subapical brown dash shown in Lord Walsingham's figure. The two discal dots are present, and the brown powdering around the fissure.

PTEROPHORUS BRUCEI Fernald.

Two specimens, August 12, September 4 (Shawnigan Lake, Vancouver Island), in poor condition, but seeming to agree with specimens from Colorado so named for me by Dr. C. H. Fernald.

STENOPTILIA COLORADENSIS Fernald.

One specimen, June 25, agrees well with Doctor Fernald's type before me, except that it is smaller.

Family ORNEODIDÆ.

ORNEODES HEXADACTYLA Linnæus.

One specimen, July 13 (bred), and one from Mr. Cockle's collection, April 24. The moth emerged in a jar containing leaf miners on snowberry, but I am not certain that I have correctly observed the larva.

Family TORTRICIDÆ.

OLETHREUTES CAPREANA Hübner.

One specimen, July 9, and one from Mr. Cockle's collection. Mr. W. D. Kearfott, in kindly going over my Tortricid material from Kaslo, named this form *frigidana* Packard. His determination may be perfectly correct, but, if so, *frigidana* can not be a distinct species from the European *capreana*.

OLETHREUTES CAMPESTRANA Zeller.

Sixty-three specimens, June 7, 10, 11, 13, 16, 18, 19, 20, 22, 23, 24, 25, 26, 27, 30, July 2, 3, 4, 8, 10 (Ainsworth), 11 (Ainsworth), 19, 25, August 3, 4. The larvæ of this common little species occurred on the thimbleberry (*Rubus nutkanus*).

Larva.—Head rounded, squarish, held obliquely, smooth and even in front, clypeus highly triangular; deep black, slightly shining, mouth a little paler, basal joint of antennæ pale. Cervical shield large, dull black, vinous tinted. Body slender, very active, uniformly dark vinous brown throughout; anal plate black; tubercles small, slightly raised, appearing paler than the body by reflection of light, really concolorous. Setæ moderate, brownish, longer on the anal end, iv+v; on thorax ia+ib and iia+iib.

OLETHREUTES CORUSCANA Clemens.

Thirty-seven specimens, June 11, 13, 16, 17, 18, 19, 20, 22, 23, 24, 25, 29, 30, July 1, 2, 4, 10 (Ainsworth), 13, 15, and one from Mr. Cockle's collection, June 18, 1902. The specimens are larger than eastern *coruscana*, the hind wings paler. Some examples closely approach *constellatana* Zeller.

OLETHREUTES DUPLEX Walsingham.

Five specimens, June 10, 12, 16, and one from Mr. Cockle's collection, June 27, 1901. The green larvæ were found on aspen, but spun before a description had been prepared.

EUCOSMA CIRCULANA Hübner.

No specimens; one from Mr. Cockle's collection. The specimen is large, like those I have from Manitou, Colorado, and Huachuca Mountains, Arizona, and the transverse obscure silvery bands are straight. The costal fold is closely applied and difficult to see. I can not positively observe it in the Kalso specimen, though it is fairly obvious in some of the others.

EUCOSMA CASTANEANA Walsingham.

Nineteen specimens, June 26, 27, July 10, and one from Mr. Cockle's collection, June 24. The moths were common, flying about the gooseberry bushes on which their larvæ fed.

EUCOSMA JUNCTICILIANA Walsingham.

No specimens; one from Mr. Cockle's collection resembles eastern specimens so nearly that I do not venture to separate it.

EUCOSMA AGRICOLANA Walsingham.

Two specimens, June 11, 17, and one from Mr. Cockle's collection.

EUCOSMA ATOMOSANA Walsingham.

No specimens; one from Mr. Cockle's collection, considerably worn, seems probably referable to this species on comparison with Walsingham's figure.

EUCOSMA TRANSMISSANA Walker.

One specimen, July 28 (Bear Lake Mountain) and three from Mr. Cockle's collection, May 13, June 11, are apparently very near to *transmissana* Walker, if not really that species. They may retain the identification pending the receipt of more complete collections.

EUCOSMA DORSISIGNATANA Clemens.

Two specimens, sent by Mr. Cockle, taken probably sometime in August.

EUCOSMA PULSATILLANA Dyar.

Three specimens, July 24, 25, 29 and one from Mr. Cockle's collection, July 31. The larvæ were found webbing and killing the leaves of clematis.

EUCOSMA SIMILANA Hübner.

No specimens; two from Mr. Cockle's collection, October 1, 1902.

EUCOSMA CRENANA Hübner.

Forty-four specimens, March 26 (Mr. Cockle), June 1, 29, July 1, 2, 5, 6, 8, 24, 25, 31, August 4, 5, 6, 11, 12, 13, 17, and six from Mr. Cockle's collection, March 29, April 4, June 6, September 21, October 20. This seems inseparable from the European species. Mr. Kearfott has recently described it as *Proteopteryx columbia*[a] with two varieties, but I do not think the new name necessary. It is extremely variable, but my European series of six specimens match nicely the forms *columbia* Kearfott and *albidorsana* Kearfott. It should certainly not be placed in *Proteopteryx*, which has no costal fold in the male.[b] Meyrick[c] gives the larva on willow. A number of my specimens were bred from this plant, but so mixed with other species that I can not give a description of the larva with certainty.

THIODIA APACHEANA Walsingham.

Eight specimens, June 23, 24, and one from Mr. Cockle's collection, June 11. They agree well with one from Los Angeles, California (Koebele), identified by Lord Walsingham in 1887. They are a little larger and the markings seem brighter, which is probably due to their being fresher. In going over this species with Mr. Kearfott we concluded that it was *Eucosma albangulana* Walsingham; but in this we were hasty, as the male has no costal fold. It resembles the figure of that species, however.

[a] Can. Ent., XXXVI, 1904, p. 112.

[b] As this is in press I see that Professor Fernald corrects Lord Walsingham's diagnosis of *Proteopteryx* to include the costal fold. Can. Ent., XXXVI, 1904, p. 120.

[c] Handb. Brit. Lep., 1895, p. 493.

THIODIA PSEUDOTSUGANA Kearfott.

Twenty specimens, June 24, July 9, August 4, 10 (Kokanee Mountain), 17, and three from Mr. Cockle's collection, April 10, 1902, August 10 (Kitchener Glacier). Several of the specimens were found torpid on snow. The larvæ were beaten from a spruce tree at Powder Creek.

Larva.—Head bilobed, elongate, reddish luteous, sutures and jaws dark brown, eye black, antennæ white at base, black at tip. Cervical shield large, black, shading paler before, rather broadly bisected. Later head red brown, epistoma and bases of antennæ white. Cervical shield green, except the black posterior rim. Body green without marks.

THIODIA ARCTOSTAPHYLANA Kearfott.

Seven specimens, all raised from larvæ on bearberry (*Arctostaphylos uva-ursi*). They emerged late in August. The larvæ are sordid whitish with red brown heads and spin up the ends of the shoots of the plant, eating out the terminal bud. I found the same larvæ two years previously high on the foothills back of Golden, Colorado, where the bearberry grows. These moths also emerged in August.

Larva.—Head rounded, apex in joint 2, shining brown, clypeus high. Cervical shield rather large, shining luteous, transparent, shading to black behind. Anal plate brown-black; some small shields on joint 13 anteriorly, a single dorsal and a subdorsal. Body robust, tapering at the ends, not very active; translucent greenish yellow, food opaquely green; tubercles small but distinct, blackish luteous, ia+ib, iia+iib, iv+v, i dorsad to ii. Feet normal, short, the thoracic ones black.

THIODIA ELONGANA Walsingham, var. TRANSVERSA Walsingham.

Ten specimens, June 8 (Ainsworth), and one from Mr. Cockle's collection, June 30, 1902. Three are *elongana*, seven of the form *transversa*. I can not regard these as distinct species. They were flying commonly in a dried-out swamp near Loon Lake above Ainsworth, but alighting among dead brush were very difficult to capture.

THIODIA ARTEMISIANA Walsingham, var. INFIMBRIANA, new variety.

Three specimens, June 23, August 9 (South Fork Creek), and two from Mr. Cockle's collection, August 4 and August 17, 1902. The specimens are a little smaller than the typical form, the dark bands on the wing rather less oblique and the fringe light gray like the bands, not discolorously bright brown.

Type.—Cat. No. 7659, U. S. National Museum.

EPINOTIA BIANGULANA Walsingham.

One specimen, October 13 (Mr. Cockle) and one from Mr. Cockle's collection, September 30. These nearly agree with Lord Walsingham's figure and may remain under the name, at least temporarily.

EPINOTIA LINDANA Fernald.

Five specimens, August 8, 11, and two from Mr. Cockle's collection, September 2, September 6, 1902. Mr. Cockle's specimens have the dark costal part of the fore wings red brown, while mine are dark brown. His specimens are probably discolored. The larvæ occurred on dogwood (*Cornus*), spinning up the leaves and killing them.

Larva.—Head retracted in joint 2, shining brown, blotched with black, epistoma and bases of antennæ pale. Cervical shield large, black. Abdomen slender, colorless whitish, tubercles slightly shining.

EPINOTIA MEDIOPLAGATA Walsingham.

Seven specimens, June 20, 21, 25, July 2, 21 (Bear Lake Mountain), and one from Mr. Cockle's collection, July 3, 1902. Mr. Kearfott and myself, after comparing carefully Lord Walsingham's figure and description, have concluded that we have correctly identified this form.

ANCYLIS MEDIOFASCIANA Clemens.

No specimens; two from Mr. Cockle's collection, June 11 and 27.

EUDEMIS VACCINIANA Packard.

One specimen, July 23.

ANCYLIS BIARCUANA Stephens.

One specimen, the label lost, and one from Mr. Cockle's collection, June 11.

ANCYLIS PACIFICANA Clemens.

Four specimens, May 29, 31, June 3, and one from Mr. Cockle's collection, May 9, 1902.

ENARMONIA NIGRICANA Stephens.

No specimens; three from Mr. Cockle's collection, May 28, June 10, 1901, of which I have retained one for the National Museum. The species was omitted from Bulletin No. 52 by Doctor Fernald, but is well known to occur in Canada.[a]

[a] Bull. U. S. Dept. Agr., Div. Ent., No. 33, new series, 1902, p. 96.

ENARMONIA COCKLEANA Kearfott.

Twenty-five specimens, June 15, 16, 17, July 1, 2, 4, 8, 19, 23, 25, 26, and one from Mr. Cockle's collection, July 3, 1902. Extremely near the European *cruciana* Linnæus and in all probability not specifically distinct therefrom. The European larva feeds on willow. Many of my specimens were bred from this plant. The following is a description of the larvæ, but there is a chance that it is not correct, as the cultures from the willow buds yielded a mixture of species and the description may have been taken from a *Eucosma cretana*.

Larva.—Head bilobed, pale translucent brown, irregularly smoky shaded over the lobes, apex retracted, clypeus high, eye and a dash behind black, mouth brown. Body moderately slender, not very active, translucent pale greenish yellow, the food showing opaquely green, not filling the body. Cervical shield shining translucent pale luteous, a little smoky blotched about the edges. Tubercles concolorous, minute, a little shining; setæ pale. Feet normal, pale, no plates; several short stiff spines at the end of the anal flap. Tubercles ia+ib, iia+iib, iv+v.

ENARMONIA GALLÆSALICANA Riley.

One specimen, June 25, determined by Mr. W. D. Kearfott.

HEMIMENE PLUMBANA Scopoli.

Fourteen specimens, June 4, July 28 (Bear Lake Mountain), 29 (Bear Lake Mountain).

HEMIMENE ALPINANA Treitschke.

Four specimens, June 12, 20, 25, and one from Mr. Cockle's collection June 24.

ACLERIS VARIANA Fernald.

Nine specimens, June 11, August 3, September 9 (Field), 10 (Banff, Alberta), and seven from Mr. Cockle's collection, July 8, 1902, October 16, 19, 20, 1902.

ACLERIS SCABRANA Curtis.

One specimen, June 1, which Mr. Kearfott named *trisignana* Robinson; but does not correspond with it, as I have these species separated.

ACLERIS FERRUGINIGUTTANA Fernald.

One specimen, August 30 (Shawnigan Lake, Vancouver Island), and one from Mr. Cockle's collection, April 15, 1902.

ACLERIS EFFRACTANA Froelich.

Two specimens, July 6, August 4. Much darker than the European species and possibly specifically distinct therefrom. One specimen was bred from a jar of mixed pupæ.

ACLERIS HASTIANA Linnæus, var. SIGNATANA Heyden.

Four specimens, August 6, 8, and five from Mr. Cockle's collection, showing much variation. The two specimens which I refer to the variety *signatana* were bred from larvæ webbing the heads of Azalea. The head was luteous, body greenish, grayish dorsally but transparent; male glands yellowish. One variety of the moth was small with a yellow stripe. I have one captured specimen of it and one from Mr. Cockle's collection, October 10, 1902. Another variety had a white costal shade, the specimen being from Mr. Cockle's collection, April 20.

ACLERIS SCHALLERIANA Linnæus.

One specimen, July 29, and four from Mr. Cockle's collection, June 6, 11, September 18.

ACLERIS BRITTANIA Kearfott.

Sixteen specimens, July 4, 5, 8, 21, 24, August 3, 6, 31 (Shawnigan Lake), September 5 (Shawnigan Lake), and one from Mr. Cockle's collection, August 3, 1901. The larvæ were bred on thimbleberry and rose. On the former plant they often bit off the leaves partly, living in the dead and dried portion.

Larva.—Head squarish, full in front, shining brown black, diluted about the mouth. Cervical shield luteous, blackish blotched at the borders. Body moderate, shining transparent greenish, the male glands faintly whitish. Tubercles concolorous, obscure; setæ small. Thoracic feet black.

ARCHIPS ROSACEANA Harris.

Thirteen specimens, June 25, July 19, 21, 25, 31, August 6, 7, 12, 13, 26 (Victoria), September 5 (Victoria), and one from Mr. Cockle's collection, July 1, 1901. A specimen was bred from a larva on aspen.

ARCHIPS VIRESCANA Clemens.

Eighteen specimens, June 16, July 2, 7, 8, 15, 18, 19, 23, 25, August 1, 3, 4, 5, 11, 13, 14 (Revelstoke, Mr. Currie), and one from Mr. Cockle's collection, July 20, 1901.

ARCHIPS ARGYROSPILA Walker.

Five specimens, July 19, 25, August 12, 15 (in train near Field, Mr. Currie).

ARCHIPS PERSICANA Fitch.

Seventeen specimens, June 15, 16, 23, 25, July 2, 15, 21, 23, 24, 25, August 5, 6, 11, and one from Mr. Cockle's collection July 3, 1902. A larva was found on *Ceanothus* and produced this species.

Larva.—Head green, opaquely luteous over the lobes, antennæ white at base, black at tip, epistoma white, ocelli black, a short black band on side of head behind. Body translucent green, a faint yellowish line along tubercles i and ii. Cervical shield green, faintly luteous tinged. Thoracic feet blackish; tubercles moderate, whitish, raised, conspicuous with black hair dots; anal plate luteous; tubercles iv + v. Dorsal vessel dark green; segments coarsely annulate.

PLATYNOTA SENTANA Clemens.

Thirteen specimens, June 16, 17, 23, 28, July 3, 4, 11, 15, 21, 25, August 5, 6, 7, and two from Mr. Cockle's collection June 21. The larvæ were bred on clematis mixed with *Eucosma pulsatillana* and also on birch where they had killed the leaves.

Larva.—Head vinous black, diluted with brown streaks, or brown. Cervical shield large, black, shading to luteous on the front border. Body green or purplish, the subdorsal fat body faintly whitish. Tubercles small, white, hair dots black; setæ stiff, pale; thoracic feet largely black; male glands large, dull vinous.

TORTRIX DORSALANA Dyar.

One specimen, June 30, and one from Mr. Cockle's collection, July 14, 1901.

TORTRIX ARGENTANA Clemens.

One specimen, June 15, and one from Mr. Cockle's collection.

TORTRIX OSSEANA Scopoli.

No specimens; one from Mr. Cockle's collection, August 10 (Camp Mansfield).

TORTRIX ALBICOMANA Clemens.

Three specimens, June 29, July 4, August 3.

TORTRIX BERGMANNIANA Linnæus.

Four specimens, June 25, 29, July 15, 18, and one from Mr. Cockle's collection, July 1.

EULIA MINISTRANA Linnæus.

One specimen, June 11, and one from Mr. Cockle's collection, June 11.

EULIA GLOVERANA Walsingham.

Four specimens, July 2, 15, 27, August 3; determined by Mr. Kearfott.

PHALONIA DUBITANA Hübner.

No specimens; one from Mr. Cockle's collection, May 30.

PHALONIA DEUTSCHIANA Zetterstedt.

No specimens; one from Mr. Cockle's collection, July 12, agreeing essentially with European specimens.

COMMOPHILA FUSCODORSANA Kearfott.

No specimens; one from Mr. Cockle's collection, June 7, formed Mr. Kearfott's type and has been retained in the National Museum.

CARPOSINA CRESCENTELLA Walsingham.

No specimens; one from Mr. Cockle's collection, May 12, 1902, is larger than my Eastern specimens, but not separable specifically therefrom, at least with the present small material.

Family YPONOMEUTIDÆ.

ALLONONYMA DIANA Hübner, var. BETULIPERDA Dyar.

One specimen, August 4, bred from a cocoon on alder.

HEMEROPHILA ALPINELLA Busck.

Four specimens, July 21 (Bear Lake Mountain), and one from Mr. Cockle's collection, July 9, 1901.

CHOREUTIS ONUSTANA Walker.

Four specimens, June 11, 18, 23, July 21 (Bear Lake Mountain), and one from Mr. Cockle's collection, July 3, 1902.

CHOREUTIS LEUCOBASIS Fernald.

Five specimens, May 29, July 12, 13, 14. The larva occurred on *Anaphalis margaritacea* in a soft web on the top of a leaf, solitary.

Larva.—Head long, elliptical, mouth pointed, lobes full, clypeus high; held flatly; pale luteous, ocelli black, mouth brown. Body cylindrical, tapering at the ends, slender, segments coarsely annulate, feet normal, slender. Pale green; a broad dorsal yellowish, illy defined shade; tubercles small, black, distinct; setæ pale, rather long, iv and v closely approximated, v smaller and a little ventrad; no discolorous shields; feet all pale.

Cocoon fusiform, white.

GLYPHIPTERYX IMPIGRITELLA Clemens.

No specimens; one in Mr. Cockle's collection, May 29.

CEROSTOMA RADIATELLA Donovan.

No specimens; two in Mr. Cockle's collection, March 27 and April 10, 1902.

TRACHOMA FALCIFERELLA Walsingham.

One specimen, August 7, and two from Mr. Cockle's collection, August 28 and October 20, 1902.

HARPHYPTERYX DENTIFERELLA Walsingham.

One specimen, August 7.

PLUTELLA MACULIPENNIS Curtis.

Fifteen specimens, June 1, 3, 11, 13, 14, 20, July 4, 14, 15, 24, and one from Mr. Cockle's collection, May 28. The larvæ occurred on cabbage and other cruciferous plants.

PLUTELLA POULELLA Busck.

No specimens; one from Mr. Cockle's collection, July 12, formed Mr. Busck's type and has been retained in the National Museum.

PLUTELLA INTERRUPTA Walsingham.

No specimens; one in Mr. Cockle's collection, June 24.

ZELLERIA GRACILARIELLA Busck.

Nine specimens, May 31, July 19, 22, 23, 25, 26, 29. The larvæ occurred on *Ribes lacustre*, gregariously in a large loose web among the leaves.

Larva.—Slender, head luteous, heavily spotted with black, body with a subdorsal smoky black shade. The cocoon is fusiform, white, in a cloud of delicate white silk with drops of fluid in it.

ZELLERIA RIBESIELLA Busck.

Two specimens, July 22, 25. Bred from the same lot of larvæ that gave the preceding species and it is probably a variety of that.

ARGYRESTHIA PYGMÆELLA Hübner.

Nine specimens, July 10, 16, 18, 24, August 3, 28 (Victoria).

ARGYRESTHIA GOEDARTELLA Linnæus.

Forty-three specimens, July 10, 31, August 5, September 3 (Wellington). The Wellington specimens were all collected on alder, which is evidently the food plant of the species.

Family ŒCOPHORIDÆ.

DEPRESSARIA ARGILLACEA Walsingham.

Four specimens, June 5, August 6, 21 (Revelstoke), 22 (Revelstoke), and one from Mr. Cockle's collection, April 24.

DEPRESSARIA KLAMATHIANA Walsingham.

Two specimens, August 1, 11, and three from Mr. Cockle's collection, April 1, April 30, 1902, and September 18.

DEPRESSARIA ROSACILIELLA Busck.

One specimen, June 5, and one from Mr. Cockle's collection, May 4, 1901.

DEPRESSARIA ALIENELLA Busck.

One specimen, August 6.

DEPRESSARIA PALLIDELLA Busck.

One specimen, August 6, and one from Mr. Cockle's collection, August 15, 1901.

BORKHAUSENIA PSEUDOSPRETELLA Stainton.

Four specimens, August 8, 13 (Sandon, Mr. Currie), September 5 (Victoria), and two from Mr. Cockle's collection, June 24, August 12.

BORKHAUSENIA DIMIDIELLA Walsingham.

No specimens; one in Mr. Cockle's collection, June 6.

BORKHAUSENIA BORKHAUSENII Zeller.

Two specimens, June 29, July 25.

BORKHAUSENIA COLORADELLA Walsingham.

No specimens; three in Mr. Cockle's collection, June 24, July 12, and July 1, 1901.

ENDROSIS LACTEELLA Schiffermüller.

Seven specimens, June 5, 6, 24, 25, July 9, 11 (Ainsworth), and two from Mr. Cockle's collection, June 6 and June 18, 1901. Most of the specimens were taken in the house.

Family GELECHIIDÆ.

ARISTOTELIA NOTATELLA Busck.

Fifteen specimens, June 22, 23, 29, July 1, 15, August 3, and one from Mr. Cockle's collection, July 3, 1902.

ARISTOTELIA HARRISONELLA Busck.

Seventeen specimens, June 1, 3, 8, 10, 11, 16, 20, 22, 23, 25, and four from Mr. Cockle's collection, June 6, 11, July 3, 1902.

ARISTOTELIA FUNGIVORELLA Clemens.

Fifteen specimens, July 25, August 4, 5, 6, 7, 11, 15. The larva occurred on willow, in a soft loose web, eating the parenchyma of the leaf from the upper side.

Larva.—Head rounded, greenish, whitish dotted, and washed with brown above. Body slender, whitish green, opaque, reticular dotted in brown, forming laterally a broad, heavy band; subventral fold lighter. Thoracic feet black, tubercles minute, setæ moderate, iv and v closely approximated, in line.

ARISTOTELIA RUBIDELLA Clemens.

Nine specimens, June 23, 27, 30, July 15, 23, 25, and one from Mr. Cockle's collection, July 1.

ANACAMPSIS NIVEOPULVELLA Chambers.

Two specimens, June 24, July 12. One specimen was bred from a leaf roller on willow; the other from a leaf roller and stitcher on aspen. The larva makes a neat roll of the leaf, the ends closed and covered with little stitches on the outside. It eats the inner part.

Larva.—Head slightly bilobed, black, diluted to brown in a blotch on the face; clypeus highly triangular, reaching vertex, shining. Cervical shield shining black, a brown triangular dilution posteriorly and a crooked mark in the center of each half; divided by a pale dorsal line; anterior rim of joint 2 whitish. Body tortriciform, translucent sordid grayish white; tubercles round, black, ia+ib, iia+iib, iv+v; anal plate large, brown black; setæ rather long, dusky; thoracic feet black.

GLYPHIDOCERA SEPTENTRIONELLA Busck.

Seven specimens, July 4, 15, 19, 21, 24.

GELECHIA MANDELLA Busck.

Seven specimens, July 7, August 5, 13 (Saudon, Mr. Currie), 15.

GELECHIA MONELLA Busck.

Eleven specimens, August 5, 6, 7, 12, 15, 16, 17, 18.

GELECHIA ABACTELLA Busck.

Fifty-one specimens, July 19, 24, 30, August 3, 4, 5, 6, 7, 12, 16, 17, 18. Mr. Busck is not certain that all the specimens belong to this species, as he has not critically examined each; but they appear to do so, being of the same size and color.

GELECHIA CEANOTHIELLA Busck.

Eleven specimens, June 18, 19, 20, 21, 22, July 21, August 4. The larvæ occurred on the *Ceanothus sanguineus*.

Larva.—Head elongate, oblique, scarcely bilobed, shining vinous black. Cervical shield large, black; thoracic feet also black. All of joints 2 to 4 dark vinous except two bright white incisures, 2–3 and 3–4, which are folded, white all around. Joints 5 to 13 lined in bluish white and dull vinous, the stripes about equal in width, the pale lines dorsal, subdorsal, lateral, stigmatal. Feet pale; anal plate vinous black. Tubercles small, black; setæ moderate, dusky.

Family ELACHISTIDÆ.

MOMPHA GRANDISELLA Chambers.

One specimen, June 21.

MOMPHA DECORELLA Stephens.

Twenty-eight specimens, July 14, 24, 25, 27, August 15. Bred from large galls in the stems of *Epilobium*. The gall is fusiform, or nearly spherical, situated in the main stem, usually near the summit, and contains from two to twenty larvæ. The elongate white cocoons are spun within the gall attached to the lids of the apertures of emergence.

SCYTHRIS MAGNATELLA Busck.

Three specimens, July 20, 22. The larvæ occurred on *Epilobium*, solitary, when small, folding over half of the leaf to the midrib in the central part of its length, attached with web. Later they form considerable web among the leaves, and the pupa is formed in a delicate flossy web. Three stages were seen.

Stage IV (?).—Head cordate, black, held flatly. Cervical shield blackish, bisected by a pale line. Body slender, tortriciform; dorsum broadly dull yellow shaded, sharply edged subdorsally, sides vinous tinted, venter sordid green. The dorsal mark is a dorsal and subdorsal band attached together; stigmatal band pale yellow, subventral region vinous tinted; tubercles small, blackish.

Stage V.—Head dull black, a white spot in clypeus, on epistoma and a large one each side of clypeus. Cervical shield large, black, bisected by pale; anterior rim of joint 2 pale. Body washed with yellow dorsally, subdorsal line whitish, lateral region vinous shaded, subventral band white, distinct. Feet, leg shields and rather large tubercles black.

Stage VI.—Head with the whole face white, the sides and vertex black. Cervical shield diluted brown before; anterior rim of joint 2 and bisecting line whitish. Lines all yellow, the subdorsal lost in the dorsal yellow suffusion, the sides vinous black. Tubercles pale with black dots.

Family TINEIDÆ.

GRACILARIA ELONGELLA Linnaeus.

Thirteen specimens, June 11, July 3, 4, 5, 7, 14, 15, 16, and one from Mr. Cockle's collection, May 29. The larvæ occurred on alder. They formed linear mines on the under sides of the leaves ending in a bladder-shaped enlargement. The bladder is contracted, sewn up in a line, the leaf rumpled from midrib to margin. Later the whole leaf is rolled.

Larva.—Head bilobed, narrowed behind, luteous, eye black, jaws brown. Body cylindrical, rather short and robust, whitish translucent, yellowish or greenish from the food, no marks, slightly frosted shagreened. Tubercles invisible, setæ fine, pale, shields concolorous; tubercles iv and v closely approximated on the subventral ridge in line, vi present, vii a hair on the leg base.

GRACILARIA STIGMATELLA Fabricius.

One specimen, July 25 and one from Mr. Cockle's collection, May 9. The larva occurred in a blister mine on the upper side of an aspen leaf at the tip. The linear part of the mine is short, broad, from the midrib outward, the blister large, the upper epidermis only separated, white, adhering again in spots when the green color reappears. The larva emerged, spun up the leaf on the upper side and fed at the ends of the spinning.

LITHOCOLLETIS POPULIELLA Chambers.

Nine specimens, July 29, August 16. The larvæ occurred in blotch mines on aspen and were very numerous at a point two miles up Kaslo Creek where the aspens were completely discolored by their mines, every leaf containing several of them.

LYONETIA SPECULELLA Clemens.

One hundred and forty specimens, May 30, 31, June 19, 22, 23, 26, 29 (Bear Lake). The larvæ were enormously abundant on *Ceanothus* early in the season, infesting all the leaves to such an extent that they were destroyed and the bushes defoliated. The larvæ hung from the twigs by long threads so abundantly that the bushes seemed as if covered with spider's webs on which the larvæ hung in rows. They occurred to a less extent on other plants, being found occasionally on wild cherry, apple, birch, and alder. The larva forms a long, tortuous linear mine, starting from a vein and ending suddenly in a blotch. The frass is in a line at first but is ejected from the blotch by holes. The larva has the feet all present. Cocoons hammock-shaped, slung on the back of the slightly curved leaf.

LYONETIA SALICIELLA Busck.

One specimen, July 8, bred from a mine on willow much like that of the preceding species.

LEUCOPTERA PACHYSTIMELLA Busck.

Five specimens, June 9, 29, July 11, August 4, and one from Mr. Cockle's collection, July 10. They were bred from upper-surface mines in the last year's leaves of the evergreen plant *Pachystima myrsinites*. The linear mine follows the margin of the leaf, finally forming a blotch which fills the whole leaf. The frass is crowded in a pack at the end. The larva emerges by a hole in the upper surface. It is bright yellow, without feet. The cocoon is spun beneath silken bands on the under side of another leaf.

PHYLLOCNISTIS POPULIELLA Chambers.

Two specimens, June 12, 16, bred from mines on aspen. The mine is on the back of the leaf, finally covering it entirely, but not killing it. The lower epidermis only is separated, the frass in a long brown line; no blotch. The cocoon occupies an enlargement of the mine in a corner of the leaf and is slightly contracted. Rarely the mines occurred on the upper side.

BRACKENRIDGIA ACERIFOLIELLA Fitch.

Four specimens, June 6, and one from Mr. Cockle's collection, June 6.

INCURVARIA ÆNESCENS Walsingham.

One specimen, June 4.

MONOPIS BIFLAVIMACULELLA Clemens.

Thirteen specimens, July 16, 18, August 9 (South Fork Creek), and two from Mr. Cockle's collection, July 7, 1901, and July 27, 1902.

TINEOLA BISSELLIELLA Hummel.

No specimens; one from Mr. Cockle's collection, May 27, 1902.

TINEA PELLIONELLA Linnæus.

Six specimens, June 17, 30, July 12, 29 (Bear Lake Mountain), August 10 (Kokanee Mountain).

TINEA AUROPULVELLA Chambers.

One specimen, July 23 (Frye Creek).

NOTES ON COLLECTIONS OF FISHES FROM OAHU ISLAND AND LAYSAN ISLAND, HAWAII, WITH DESCRIPTIONS OF FOUR NEW SPECIES.

By David Starr Jordan and John Otterbein Snyder.

Of Stanford University, California.

In the autumn of 1903 a collection of fishes was received by the U. S. Bureau of Fisheries from the market at Honolulu. They were selected and preserved by Mr. E. L. Berndt, inspector of fisheries of Honolulu, and acting assistant to the U. S. Bureau of Fisheries.

At about the same time a series of fishes was sent to Stanford University from Laysan Island, about 800 miles to the westward of Oahu. These were collected by Mr. Max Schlemmer, superintendent of the guano industry of Laysan.

An account of these collections is given in this paper. Plates of the new species will be published in the final report on the Hawaiian fishes.

We have also included three species obtained at Hilo by Mr. Henry W. Henshaw.

The following species are new to the fauna of the Hawaiian Islands:

Alopias vulpes (Gmelin), Oahu.
Galeocerdo tigrinus Müller and Henle, Oahu.
Brachysomophis henshawi Jordan and Snyder, Oahu.
Ariomma lurida Jordan and Snyder, Oahu.
Thalassoma ancitense (Günther), Oahu.
Lactoria schlemmeri Jordan and Snyder, Laysan.
Antennarius laysanius Jordan and Snyder, Laysan.

Family ALOPIIDÆ.

1. ALOPIAS VULPES (Gmelin).

A large specimen from the market of Honolulu.

Family CARCHARHIDÆ.

2. GALEOCERDO TIGRINUS Müller and Henle.

Galeocerdo rayneri MACDONALD and BARRON, Proc. Zool. Soc., 1868, p. 368, pl. XXXII, not *Galeus maculatus* Ranzani of the Atlantic.

One large specimen, answering well to the description and figure given by Macdonald and Barron, except that the coloration is brighter, the black spots along the base of the dorsal being bright, and the short, black, vertical bands below them conspicuous. A stuffed specimen from Nagasaki, called *Galeocerdo tigrinus* by Jordan and Fowler[a] although faded, shows the same color markings.

It seems certain that the original *Galeocerdo tigrinus* of Müller and Henle, from Pondicherry, is the same species, and that the species with spots, instead of vertical bars below the dorsal, *Galeocerdo maculatus* (Ranzani), is probably confined to the Atlantic.

Family OPHICHTHYIDÆ.

3. MICRODONOPHIS FOWLERI Jordan and Evermann.

4. BRACHYSOMOPHIS HENSHAWI Jordan and Snyder, new species.

Head measured to gill opening, 7.5 in length, 3.8 in length to vent; depth 2.5 in head; eye 1.5 in snout; snout 10 in head.

Body cylindrical, the head greatly depressed, swollen laterally in the region of the occiput, narrowing anteriorly to the pointed snout; a conspicuous transverse depression in the post-orbital region; interorbital space concave, its width equal to length of snout; a slight supra-orbital crest, ending in a prominent wart-like protuberance behind eye. Nostrils with minute tubes, the anterior located midway between tip of snout and eye, the posterior on lip between eye and anterior nostril. Mouth large, length of cleft contained 2.8 in head; lower jaw projecting beyond the upper; outer edge of lips with a row of rather coarse papillæ. Teeth of upper jaw in two rows, the outer ones small and close set, the inner ones larger; vomer with a single row of five or six widely-spaced canines, the anterior of which is about equal in length to diameter of eye, the others growing successively smaller; tip of jaw with three minute teeth separated from the lateral rows by a wide space; lower jaw with a single row of widely-spaced fang-like teeth. Teeth all sharply pointed; many of them in both jaws depressible. No tongue. Gill openings below middle of body, their length equal to width of space between them or to distance between tip of snout and posterior border of eye.

One-fourth of base of pectoral above gill opening; length of pectoral equal to distance between tip of snout and center of pupil. Dor-

[a] Proc. U. S. Nat. Mus., XXVI, 1903, p. 612.

sal inserted behind gill opening, a distance contained two times in space between gill opening and pupil; height of fin a short distance behind its origin about equal to diameter of pupil, slightly higher in region above vent; origin of anal just behind vent; height of fin equal to that of dorsal; both dorsal and anal become low on posterior part of tail, the membranes growing thick, passing into slight ridges and finally disappearing near tip of tail.

A row of large mucous tubes passing over head in the depression behind eye; six conspicuous tubes on top of head, four being on the interorbital region, two on the snout; four tubes on upper lip; anterior ends of lateral line connected by a curved row of tubes passing over occiput; about 125 tubes in lateral line, the posterior ones very small.

Color gray, with a yellowish tint; a few brownish-black spots about as large as pupil thinly scattered above the lateral line, the mucous pores on anterior part of body edged with black; dorsal brownish-black, with a broad marginal band of white, posterior part of fin without dark color; anal immaculate.

One specimen, 485 millimeters long.

Type.—No. 51399, U. S. National Museum. Honolulu. Collector, Mr. E. L. Berndt.

Named for Henry W. Henshaw, the well-known naturalist, now resident at Hilo, Hawaii, to whom we are indebted for several rare specimens.

The large Japanese eel described by Schlegel as *Ophisurus porphyreus*, has the lips fringed and should be referred to *Brachysomophis* instead of *Mystriophis*. It may stand as *Brachysomophis porphyreus*.

Family MURAENIDÆ.

5. MURAENA KAILUÆ Jordan and Evermann.

One specimen from Honolulu and one from Laysan Island.

6. ENCHELYNASSA BLEEKERI Kaup.

? *Gymnothorax vinolentus* JORDAN and EVERMANN, Bull. U. S. Fish Commission, 1903, p. 165; Honolulu.

A very large example, 124 centimeters long, apparently identical with the scantily-described *Enchelynassa bleekeri* of Kaup. *Gymnothorax vinolentus* is doubtless the young of the same species, although the number of teeth is considerably different from that shown in our specimen. The genus *Enchelynassa* is well distinguished by the large size of the posterior nostril, which in form suggests the nostril of a horse.

The head measured to gill opening is contained 7.1 in the length; snout 5.5 in head; eye 3 in snout; interorbital space, 1.5; cleft of mouth 1.75 in head. Origin of dorsal on a vertical passing midway

between angle of mouth and gill-opening; height of fin about equal to length of snout, the membrane very thick and fleshy; anal arising immediately behind vent, its height equal to one-half the length of snout; both dorsal and anal continuous with the very short caudal. Tail slightly longer than head and body. Depth 9 in the length. Anterior nostril located at a point one-third the distance between tip of snout and border of eye, the edge with a low, thickened rim and a posterior cirrus with tentacles; posterior nostrils situated on dorsal side of snout half way between anterior nostrils and eye, the opening oval, surrounded by a broad, thin membrane. Teeth lanceolate canines, the lateral notches not evident on some of the smaller ones; those of upper jaw in two rows, the inner ones larger, their length about equal to two-thirds the diameter of eye; a row of four or five long teeth on vomer, followed by a short row of small teeth; anterior vomerine teeth and those of inner series of jaw depressible; teeth of lower jaw in two series, the inner row having four or five large, depressible ones. Width of gill-opening equal to or slightly more than half the length of snout.

Color in alcohol wine-brown, with a few small, darker spots scattered over the body. We have a third specimen from Samoa.

7. GYMNOTHORAX THALASSOPTERUS Jenkins; Honolulu.
8. GYMNOTHORAX STEINDACHNERI Jordan and Evermann; Honolulu.
9. GYMNOTHORAX LAYSANUS Steindachner; Honolulu.

Family AULOSTOMIDÆ.

10. AULOSTOMUS VALENTINI (Bleeker); Honolulu; Laysan.

Family CARANGIDÆ.

11. ALECTIS CILIARIS (Bloch); Honolulu.

Family SERRANIDÆ.

12. PIKEA AURORA Jordan and Evermann; Honolulu.
13. ANTHIAS FUSCIPINNIS Jenkins; Honolulu.

Family APOGONIDÆ.

ARIOMMA Jordan and Snyder, new genus

(Type, *Ariomma lurida* Jordan and Snyder, new species).

Body not greatly compressed; caudal peduncle slender, cylindrical; head large; eyes large, with thin, adipose lids; mouth small, the maxillary short, broad, rounded posteriorly; jaws with teeth, none on vomer and palatines. Pseudobranchiæ present. Preopercle smooth. Head and body with scales, about 55 in lateral series. Soft dorsal and anal elongate.

14. ARIOMMA LURIDA Jordan and Snyder, new species.

This species is represented by two specimens about 190 mm. long, in a very bad state of preservation, the scales having all been lost and the fins broken.

Head, 2.9 in length measured to base of caudal; depth, 4; depth of caudal peduncle, 7 in head; eye, 3; snout, 3.3; interorbital space, 4; dorsal spines, 10; rays, 17; anal, 15; pectoral, 20; scales in lateral series, 55 or more.

Width of body equal to a little more than half the depth, the caudal peduncle cylindrical and markedly slender. Interorbital space slightly convex. Lower jaw projecting a little beyond the upper; length of maxillary equal to width of interorbital space; jaws with a single row of slender, minute teeth, those on lower jaw curved backward; no teeth on vomer or palatines; pseudo branchiæ large; gill rakers on first arch, 9 + 19, those near angle long and slender, the others growing successively shorter toward either end of arch. Preopercle entire. Eye extremely large, with thin, transparent, adipose lids, the posterior extending to edge of pupil, the anterior not more than one-fifth as wide. Nostrils located near tip of snout.

Body with scales, probably between 55 and 65 in a lateral series; scales probably present on the head, including upper part of snout and cheeks, scale pits being present on occiput and below eye. Lateral line apparently present, its anterior part located below base of dorsal a distance equal to diameter of pupil.

Origin of dorsal above base of pectoral; soft dorsal and anal extending an equal distance posteriorly, the length of the caudal peduncle measured to bases of upper and lower rays equal to length of maxillary. Ventrals inserted on a vertical through second or third dorsal spine. Whether the anterior rays of anal are spinous or articulate could not be determined.

No distinctive color markings are visible, the general shade being a lurid brown.

Type.—No. 51400, U. S. National Museum. Co-type, No. 8441, Stanford University. Honolulu, Hawaiian Islands. Collector, Mr. E. L. Berndt.

Family LABRIDÆ.

15. THALASSOMA ANEITENSE (Günther).

One specimen poorly preserved, measuring 132 mm. in length, from Honolulu.

Head 3.7 in length to base of caudal; depth 3.4; snout 2.8 in head; eye 5.3; interorbital space 4; scales in lateral series 26; in series between spinous dorsal and origin of anal 11; dorsal spines 8; rays 13; anal spines 2; rays 11.

Teeth in both jaws growing gradually shorter from before backward; no enlarged teeth or canines. Head smooth; scales smaller on breast and belly than on sides and back. Lateral line extending along fourth row of scales to below base of eleventh articulated ray, where it bends downward across three rows of scales and passes along middle of caudal peduncle. First dorsal spine equal in length to about two-thirds diameter of orbit, the others successively longer, the last being 1.6 times diameter of orbit; articulated rays higher, about twice diameter of orbit. Anal spines rather strong, the first equal in height to third dorsal spine; the second equal to last dorsal spine. Dorsal and anal rays about equal in height. Pectoral 1.4 in head. Caudal probably truncate. Ventral 2 in head.

Color in spirits, pale brownish, the head dusky above; two dusky bars passing backward from eye, the lower of which extends toward angle of opercle; a broad semicircular bar extending from chin toward eye and bending downward toward lower edge of opercle; a smaller semicircular bar below the latter; scales with small white spots; distal half of pectoral blackish, the color fading out toward the lower edge; dorsal with a dark spot about the size of pupil on membrane of second and third spines.

Family CHÆTODONTIDÆ.

16. CHÆTODON MILIARIS Quoy and Gaimard; Honolulu.

17. CHÆTODON FREMBLII Bennett; Honolulu; Laysan.

18. CHÆTODON QUADRIMACULATUS Gray; Honolulu.

19. MICROCANTHUS STRIGATUS Cuvier and Valenciennes; Honolulu.

Family TEUTHIDIDÆ.

20. TEUTHIS GUTTATUS (Bloch and Schneider); Honolulu.

21. ZEBRASOMA FLAVESCENS (Bennett); Honolulu.

(*Acanthurus virgatus* Vaillant and Sauvage, young.)

22. ZEBRASOMA VELIFERUM (Block); Honolulu.

(*Acanthurus hypselopterus* Bleeker.)

Family MONACANTHIDÆ.

23. CANTHERINES SANDWICHIENSIS (Quoy and Gaimard); Honolulu.

24. STEPHANOLEPIS SPILOSOMUS (Lay and Bennett); Laysan.

Family TETRAODONTIDÆ.

25. TETRAODON LACRYMATUS Quoy and Gaimard; Laysan.

(*Tetraodon latifrons* Jenkins.)

Family OSTRACIIDÆ.

26. OSTRACION CAMURUM Jenkins; Honolulu.

27. LACTORIA GALEODON Jenkins; Hilo.

Two specimens from stomach of *Coryphæna hippurus*, sent by Mr. Henshaw.

28. LACTORIA SCHLEMMERI Jordan and Snyder, new species.

This species is closely related to *L. diaphana* Bloch and Schneider, of Japan and the East Indies. Compared with Japanese examples it differs in having the spines better developed, and in greater number, there being two on the dorso-lateral ridge, one of which is opposite the large median spine, the other between the former and the orbital spine; also in having the carapace deeper in the region of the ventro-lateral ridge and broader near the anal fin, and the plates posterior to the pectoral less granular. The only Hawaiian form with which it might become confused is *L. galeodon* Jenkins. In this species the ventral portion of the carapace is not translucent, the orbital spines are longer and project in a more horizontal direction, and there are no spines on the dorso-lateral crest posterior to the orbit.

Head measured to gill opening 3.7 in length to base of caudal; depth 2.3; snout 4.6; eye 2.7 in head; D. 9; A. 9.

Anterior profile of head very steep, interrupted by a constriction one-third of distance between tip of snout and middle of interorbital space; interorbital space V-shaped when viewed from before, the depression extending almost to a level with upper edge of pupil; carapace with five ridges, the dorsal ridge scarcely evident, with a large spine located midway between tip of snout and base of caudal fin; dorso-lateral crest with three spines, the anterior projecting upward and forward from the orbit; the posterior located slightly behind middle of dorsal spine, midway between anterior edge of orbit and posterior end of carapace; the median, which is small and weak, located somewhat nearer to the orbital than the posterior spine; ventro-lateral ridge with four spines, the first very small, the second larger, located below dorsal spine, the posterior one projecting backward the distance between it and the one of the opposite side equal to distance between center of pupil and dorsal spine. Ventral surface of carapace convex, a slight median depression extending from breast to anal fin. Plates granular, except ten or twelve in the region posterior to pectoral fin, each with a central granule usually larger than the others.

Dorsal fin located midway between dorsal spine and end of carapace; base of anal fin occupying most of the space between vent and end of carapace; pectoral just behind vertical through posterior edge of orbit.

Dorsal portion of body dusky, with small dark spots scattered over snout and back; ventral half of carapace translucent, with zigzag dusky bars along the region of crest, the color following the vertical sutures between the plates; throat and breast with scattered dusky spots somewhat smaller than pupil.

One specimen. Type No. 8440, Ichthyological Collections, Stanford University. Laysan Island. Length, 105 mm. Named for its discoverer, Mr. Max Schlemmer.

Family SCORPAENIDÆ.

29. SCORPAENOPSIS CATOCALA Jordan and Evermann; Honolulu; Hilo.

The specimen from Honolulu has the dark markings unusually intense. The dark spot between the fifth and seventh spines is deep black and well defined, while in other examples it is indistinct or even absent. The ventral also markedly dark. Length of specimen, 150 mm.

30. DENDROCHIRUS CHLOREUS Jenkins; Honolulu.

Family CEPHALACANTHIDÆ.

31. CEPHALACANTHUS ORIENTALIS (Cuvier and Valenciennes); Honolulu.

Family ECHENEIDIDÆ.

32. REMORA REMORA (Linnæus); Honolulu.

Family FIERASFERIDÆ.

33. FIERASFER UMBRATILIS Jordan and Evermann.

From the cavity of a Holothurian, at Hilo. Received from Mr. Henshaw.

Family BROTULIDÆ.

34. BROTULA MULTICIRRATA Vaillant and Sauvage; Honolulu.

(*Brotula townsendi* Fowler).

Family PLEURONECTIDÆ.

35. PLATOPHRYS MANCUS (Broussonet).

(*Rhombus pantherinus* Rüppell).
(*Passer marchionessarum* Valenciennes).

Honolulu.

Family ANTENNARIIDÆ.

36. ANTENNARIUS LAYSANIUS Jordan and Snyder, new species.

This species is distinguished by the following set of characters: Third dorsal spine movable only at tip, being closely bound down to the occiput and back; first spine long and slender, extending to middle of third; soft dorsal not nearly reaching caudal; color light with black spots.

Mouth large, the width equal to length of maxillary, 4.5 times diameter of eye. First spine long and slender, reaching middle of third when depressed, the tip with a small knob bearing filaments one of which is lanceolate, seven-eighths the length of spine, the others short and thread-like. Second spine inserted above anterior edge of orbit, reaching base of third when depressed, connected posteriorly with head by a thin membrane, the free edge of which is convex, the tip of spine with a movable joint. Third spine equal in length to maxillary, immovably and closely attached throughout its length to the occiput and back, the tip with a small, movable joint. Soft dorsal not connected with third spine by a membrane or crest, separated from the caudal by a space equal in length to 2.5 times diameter of eye, the last rays when depressed not reaching base of caudal; rays 12, the longest (posterior) equal in length to distance between base of first dorsal spine and tip of second when depressed; posterior margin of fin rounded; anal when depressed reaching base of caudal, rays 7, about equal in length to those of dorsal. Caudal rounded. Gill opening at base of pectoral.

Skin hispid with minute, simple, and bilobed lobed prickles; skin of upper half of eye with prickles; minute, filamentous, dermal appendages scattered about over the sides and back, especially prominent below dorsal spines and fin; none on ventral surface.

Color in spirits yellowish white, densely clouded with white dusky; a small ocellus midway between base of pectoral and origin of soft dorsal, many small black spots scattered about on breast and belly, an oblong black spot half as large as eye on posterior half of soft dorsal, a row of black spots along edge of dorsal fin, a large one on base of anal and two near border of fin; caudal with a few spots as large as pupil; dorsal, caudal, and anal narrowly edged with white; pectorals white below, dusky above; chin dusky, with an indistinct light ocellus; tongue with small black spots; filaments of dorsal dusky.

Type.—No. 8439, Ichthyological Collections, Stanford University, Laysan Island. Length, 97 mm.

37. ANTENNARIUS SANDVICENSIS (Bennett).

(*Antennarius horridus* BLEEKER).

One specimen from Honolulu corresponding closely to fig. C, plate 100 in Günther's Fische der Südsee. It is there regarded as a variety of *Antennarius commersoni*. Our specimen certainly corresponds to Bleeker's *horridus* and probably to Bennett's *sandvicensis*.

Eye very small, its diameter contained three times in length of maxillary. First spine hair-like, its length equal to that of maxillary, reaching beyond base of third spine when depressed, the tip with a cluster of short filaments; second spine reaching base of third when depressed, surrounded by thickened tissue, the membrane extending from near tip of spine to base of third, very thin; third spine easily elevated, connected with occiput by a thick membrane, the spine surrounded by a large amount of tissue, its width equal to diameter of eye; spine when depressed not reaching soft dorsal. Dorsal of the same height throughout, just reaching base of caudal when depressed; rays 12. Anal reaching beyond base of caudal, its edge rounded; length of space between base of anal and caudal one-half that between base of dorsal and caudal. Caudal rounded, its length $2\frac{1}{2}$ in length of body. Anal opening at base of pectoral.

Skin with very fine prickles, a few small cutaneous flaps on head, chin, and back.

Color in spirits light gray, thickly mottled and spotted with dark gray; a few white-edged blackish spots on body and fins, located as follows: at base of third dorsal spine, at origin of dorsal between eighth and ninth dorsal rays, on side between origin of dorsal and base of pectoral, on side posterior to pectoral, on anal fin, on upper and on lower edge of caudal.

Length, 78 mm.

TWO ORTHOPTERA HITHERTO UNRECORDED FROM THE UNITED STATES.

By Andrew Nelson Caudell.
Of the Department of Agriculture.

Through the kindness of Mr. C. Schaeffer, of Brooklyn, New York, I have had an opportunity of studying a small but interesting collection of Orthoptera from the Southern States, made by himself and others during the past year. The greater portion of the collection was made at Brownsville, Texas, and by agreement the results of the examination of that material is to appear in the Science Bulletin of the Brooklyn Institute of Arts and Science. This prohibits the discussion at present of several most interesting additions to our fauna. The following two species, however, not being from Brownsville, form no part of that report and are here recorded for the first time from the United States:

HAPLOPLUS EVADNE Westwood.

Haplopus evadne Westwood, Cat. Phasm., 1859, p. 85, pl. xviii, fig. 6, male.

One mature female (fig. 1) and one large nymph, also a female, were taken at Loggerhead Key, Dry Tortugas, Florida. The label bears no date nor reference to the collector.

This is the first record of the occurrence in the United States of any winged Phasmid, though a young male larva of what I now suppose to be of this species was mentioned in my recent paper on the Phasmidæ of the United States.[a] The large nymph exhibits characters intermediate between those of the small male specimen mentioned above and this mature female. Hence my inference that they all belong to the same species. If I am correct in this, as I now believe I am, the young *evadne* is seen to have the intermediary segment subequal with the metanotum and the legs bear small lobe-like expansions on the posterior and intermediate femora and on all the tibiæ. As the insect approaches maturity these expansions become obliterated on the anterior and posterior tibiæ. The young are also less acutely spined than the adult. The interme-

[a] Proc. U. S. Nat. Mus., XXVI, 1903, p. 884.

diary segment of the adult female as well as the nymphs is scarcely longer than the metanotum. The long-winged male insect as figured by Westwood seems also to have the intermediary segment subequal with the metanotum.

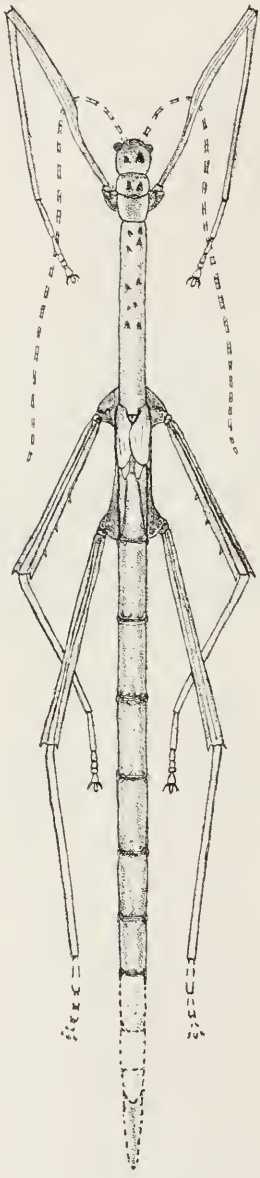


FIG. 1.—HAPLOPLUS EVADNE, FEMALE (ENLARGED).

The adult female, which has never been described, is shining brown above, yellowish below, the margins of the pronotum and elytra and the center of the dorsal surface of the intermediary segment longitudinally marked with chalky white, probably a variable character. The head (fig. 2) has the usual horn-like tubercles, the right one fully twice as large as the one on the left. Behind these main tubercles is a pair of smaller ones, likewise dissimilar in size. The pronotum is transversely divided mesially by a deep sulcus and the anterior lobe is divided longitudinally by a narrow sulcus and bears a pair of stout black-tipped sharp spine-like tubercles. The mesonotum bears ten irregularly placed, black-tipped spines or sharp tubercles. The elytra are about as long as the metanotum, the wings about the same length, though they project a millimeter beyond the tip of the elytra, being placed farther back. The abdominal segments are about three times as long as broad and are apically furnished with a slight crescent-shaped transverse blunt carina. The tip of the abdomen and the antennæ are gone but are drawn in dotted lines from the large nymph as a model. The legs are slightly lighter colored above than the body, below concolorous with the ventral portion of the body, unarmed except that the posterior and intermediate femora are armed below on the outer two-thirds with a few large black-tipped spines, the tip of the tibiæ below also furnished with an elevated longitudinal ridge.

Length, 80+mm.; pronotum, 4.75 mm.; mesonotum, 19.5 mm.; metanotum, 6 mm.; intermediary segment, 6.5 mm.; anterior femora, 19 mm.; intermediate femora, 15.5 mm.; posterior femora, 21 mm.; width of head, 3.5 mm.; pronotum, 3.5 mm.; mesonotum, 2.5 mm.; first abdominal segment, 3 mm.

The large female nymph is dark opaque brown in color, lighter below. Head armed as in the adult as are also the pro- and mesonotum, though the spines or tubercles are here quite small. Anterior legs unarmed, though the fore tibiæ of the small male specimen have a small compressed expansion near each end above, as have also all the tibiæ in that specimen. In the large female nymph these expansions are mantained only on the middle pair where there is, in both nymphs, also a small longitudinal expansion near the base below. Middle and posterior femora furnished above with a pair of parallel lobes near the apex and armed below with spines as in the adult, except smaller. The measurements are as follows:

FIG. 2.—HEAD OF HAPLOPUS EVADNE (ENLARGED).

Length, 69 mm.; antennæ, 24 mm.; pronotum, 3 mm.; mesonotum, 14 mm.; metanotum, 4.5 mm.; intermediary segment, 4.5 mm.; oviscapt, beyond the tip of the abdomen, 5.5 mm.; posterior femora, 13 mm.; intermediate femora, 10 mm.; anterior femora, 12 mm.; width of head, 3 mm.; pronotum, 3 mm.; middle of mesonotum, 2.75 mm.; of metanotum, 3 mm.; of first abdominal segment, 2.5 mm.

The right hind leg of this specimen has been broken off and regenerated, being therefore smaller then the other, the femora measuring but 9 mm. in length.

This species was described from Santo Domingo, West Indies, and is an unusually interesting addition to our fauna by reason of its being the only winged representative of the family occurring within our borders. The long-winged males are objects of note and suggest tropical forms. The asymmetrical horn-like tubercles of the head seem to be a constant character of the genus. Why one of these tubercles, usually the one on the right, should be longer or larger than its fellow is, so far as I know, unexplained.

HELIASTUS SUMICHRASTI Saussure.

Heliastus sumichrasti SAUSSURE, Prodr. Oedip., 1884, p. 213; Add. Prodr. Oedip., 1888, p. 90.

A pair of this Mexican species was taken at Galveston, Texas, by Mr. Schaeffer. No date is given. It exhibits certain characters somewhat at variance with those of typical specimens taken in Mexico. At first I thought it represented a new species, but Prof. Laurence Bruner, who is writing that part of the Biologia Centrali-Americana treating of the Acridiidæ and is well informed on the fauna of that region, thinks it is a variety of *sumichrasti*. The following description is made from these specimens (fig. 3), which may be designated by the varietal name *subroseæ*, varying from the typical form in the less roseate under wings, the

red not extending upward into the middle field, and the generally lighter color.

Head and thorax as in typical *sumichrasti* except the anterior border of the latter is even less noticeably notched than in that form, being practically entire. Antennæ long, compressed toward the apex. Elytra long and slender, surpassing the tips of the femora by about the length of the thorax, membranous in the apical fourth; color light testaceous, somewhat infuscated, the infuscation forming indications of two very illy-defined transverse bands or clouds, one at the humeral angle and one about the middle of the elytra; on the membranous tip the infuscation is in the form of somewhat rounded spots. Wings comparatively longer and more pointed than in *sumichrasti*, pale yellowish at the extreme base followed in the anal field by an area of bright but somewhat washed-out-appearing red color; beyond this red disk, which scarcely extends above into the middle area, is a narrow fuscous band, interrupted in the middle field and with scarcely any humeral tænia; beyond this fuscous band the wing is hyaline. Posterior femora longer and more slender than in typical specimens and the outer face somewhat less flattened and not banded with fuscous, but internally there are three black bands, a very narrow one near the base, a broad one with the outer edge at the middle of the femur, and another very narrow one at the middle of the apical two-thirds. Besides this the inner geniculation is piceous, and there is a broad pallid annulation at the tip of the femora. Hind tibiæ pale yellowish on the basal third followed by a very narrow black ring, the rest of the tibiæ red with the base on the inner side piceous and the spines tipped with black.

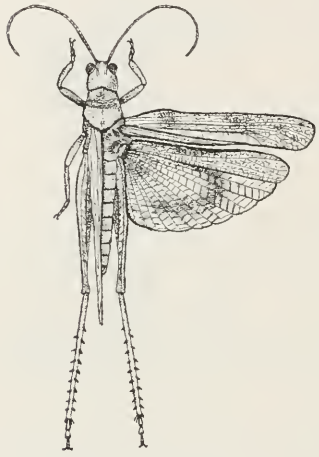


FIG. 3.—HELIASTUS SUMICHRASTI, VAR. SUBROSEA, MALE (ENLARGED).

Length, antennæ, male, 12 mm., female, ——?; pronotum, male, 4.5 mm., female, 5 mm.; elytra, male, 21 mm., female, 26 mm.; posterior femora, male, 12 mm., female, 15 mm.

Type.—Cat. No. 7774, U.S.N.M., male.

A NEW FERN, GONIOPHLEBIUM PRINGLEI, FROM MEXICO.

By William R. Maxon,
Aid in Cryptogamic Botany, Division of Plants.

The writer has had much pleasure in dedicating the following excellent species to its discoverer, Mr. C. G. Pringle, whose collections of Mexican plants have so long been widely and favorably known.

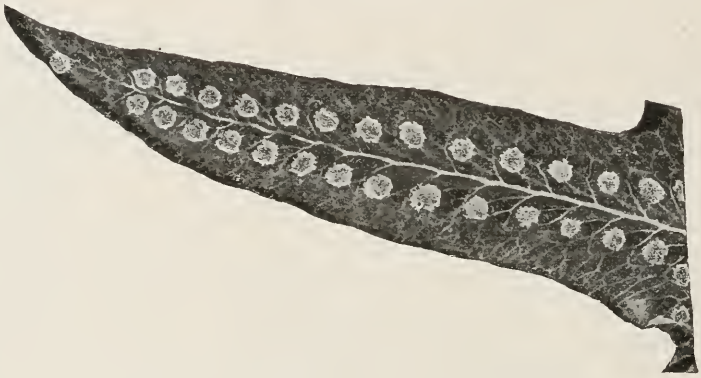
Goniophlebium pringlei sp. nov. Plate XLVIII.

Rhizome creeping, very firm, flexuose, slender, about 4 mm. thick, densely clothed with appressed dirty-white lanceolate acuminate brownish-centered chaff, and with rather sparse very dark brown lanose rootlets: frond glabrous throughout, about 5 dm. long: stipe 1 dm. long, stramineous, firm, terete, polished, very slender (only 1 mm. thick): lamina ovate, 4 dm. long, about 2 dm. broad below the middle, thin membranaceo-chartaceous, very translucent, comprising 11 pairs of subopposite entire narrowly lanceolate tapering acute-pointed pinnæ which decrease gradually above, giving rise to a terminal caudate division nearly equal in size to the largest pinnæ: lowermost pinnæ 9 cm. long by 2.3 cm. broad, subcordate and free below, fully adnate and dilated above into a foliar wing 5 mm. deep from sinus to rachis and connecting with the second pair of pinnæ which with the third pair are the longest (about 10 cm.): succeeding pinnæ gradually shorter, similarly dilated both above and below to form a continuous slightly broadening soriferous wing, the sinuses obtuse, rounded: venation manifest: sori, orbicular, large, about 15 pairs to the pinna, nearer the midrib than the margin: each sorus borne on the single included veinlet of the broad initial areole which extends half the distance to the margin: ultimate venation irregularly anastomose, very rarely with an included veinlet.

Type, No. 460764, in the United States National Herbarium: on trees, near Jalapa, State of Vera Cruz, Mexico, altitude 1,200 meters, C. G. Pringle, *no. 11855*, November 30, 1903. Known only from the type collection containing about 25 specimens taken for distribution.

The sheet in the Pringle herbarium at the University of Vermont differs only in its slightly greater breadth, the second and third pinnæ measuring about 12 cm. long.

The species is quite distinct from known members of the group to which it belongs. The most noticeable single character is its delicate transparency, the texture resembling closely that of certain thalloid marine algæ which become extremely transparent upon drying. The stipe is slight in thickness and relatively very short; the raised rachis is, except in the terminal cauda, of a pronounced old gold color, as are also the large sori; the midveins and initial venation of the pinnæ and of the terminal cauda are blackish and raised.



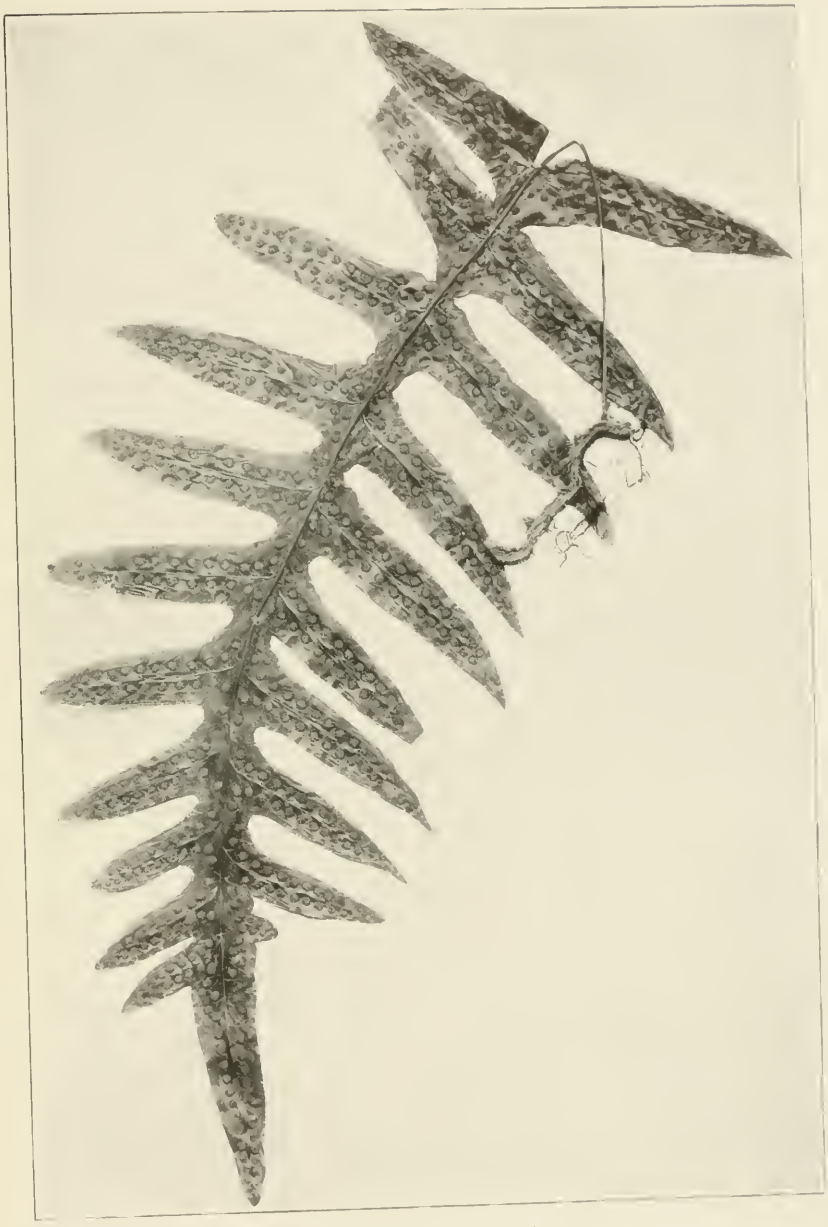
PINNA OF GONIOPHLEBIUM PRINGLEI (NATURAL SIZE).

The accompanying text figure is a natural size illustration of one of the fifth pair of pinnæ of the type frond. It is from a print obtained by placing the pinna directly upon sensitized paper and allowing the sunlight to strike through the transparent tissue, and shows perfectly the venation and the position of the orbicular sori.

Two additional sheets in the United States National Herbarium differ in having the second pair of pinnæ like the first, that is, free and cordate-clasping at the base below the midvein and fully adnate above, the adnate upper portion of the first pair overlapping the clasping base of the second, there being only a very slight connecting foliar wing along the rachis. In one of these (No. 460766), moreover, this condition occurs in the case of the third pair of pinnæ also, and the foliar wing becomes well developed only between the third and fourth pairs of pinnæ and between succeeding pinnæ. In all four sheets examined the superabundance of leafy tissue, which must have given a remarkable fluted appearance to the living fronds, is very noticeable.

EXPLANATION OF PLATE XLVIII.

From a photograph of the type specimen, no. 460764 in the United States National Herbarium. About one third natural size.



GONIOPHLEBIUM PRINGLEI MAXON

FOR EXPLANATION OF PLATE SEE PAGE 954.

THE PERSIMMON CREEK METEORITE.

By Wirt Tassin,
Assistant Curator, Division of Mineralogy.

The meteorite here described was found on the farm of Mr. W. W. Young, on Persimmon Creek, in the southern part of Cherokee County, North Carolina, in the spring of 1893. Mr. Young disposed of the same to Mr. Thorn Smith, chemist of the Isabella Copper Company, Isabella, Tennessee, from whom it was obtained for the U. S. National Museum. The date of the fall is unknown, but the appearance of the mass is such as to indicate that it had lain in the soil for a long period of time.

The weight of the main mass, as shown in Plate XLIX, was 9 pounds 6 ounces. From this a fragment weighing 1 pound 13 ounces had previously been broken, making the entire known weight 11 pounds 3 ounces, or 5.014 kilograms.

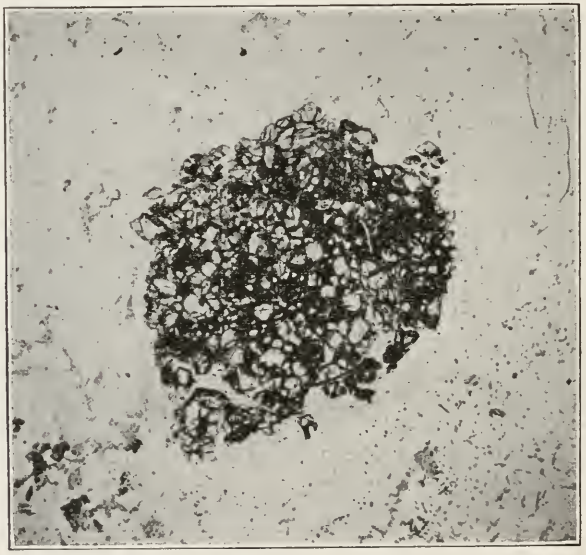
The meteorite is roughly triangular in cross section, with its surface deeply indented and much oxidized, so that the customary pittings are largely obliterated. The one large shallow pit still remaining is shown in the lower left of Plate XLIX.

GENERAL STRUCTURE.

Exteriorly the mass shows no characteristics of more than ordinary interest. However, it required but an inspection of a cut and polished surface to show that the iron was of an unusual type. This sawn surface shows the mass to be made up of a more or less continuous matrix of iron containing troilite, schreibersite, and carbon (Plate L). The troilite areas vary in their maximum diameters from 1 mm. to 1½ cm. Certain of these areas contain granular carbon in such quantities that the bronze yellow of the containing troilite appears only as specks through the carbon. In these graphitic areas is found fairly abundantly an olivine (see figure). This silicate also occurs very sparingly in the nickel-iron in minute granular aggregates. Schreibersite occurs sparingly, in a manner similar to the troilite.

The largest of the schreibersite areas is 3 by 6 mm. along its greatest diameters, and, like the troilite, it contains carbon, but unlike it, it does not carry olivine. This phosphide occurs also in very thin plates bounding the iron masses, and between them and the troilite. It occasionally occurs in small grains or plates in the iron constituent, and is then arranged in dendritic or moss-like aggregates. Schreibersite also occurs in thin plates lineally arranged and resembling tænite.

Etching the iron constituent develops a band of bright white iron next to the troilite and schreibersite areas and bounding them. This alloy may be "kamacite," but it was not possible to separate any of it to determine its composition. On each side of and bounding the white iron is a very thin plate standing in relief, which in certain instances



PHOTOMICROGRAPH OF OLIVINE IN GRAPHITIC TROILITE AREA.

is known to be schreibersite and in others tænite. The mass of the iron constituent is made up of a darker colored alloy, or eutectic. In this eutectic is seen fine lines of a tin-white color, which are in part tænite, and which penetrate the mass in zig-zag shapes. Examined under a glass the dark iron appears to be homogeneous, and to be made up of minute octrahedrons arranged in fine lamellæ. It should be here stated that the eutectic or dark iron does not contain any chlorides, and the very small amount of chlorides present was noted as occurring as lawrencite between the troilite and the boundary "white iron" alloy. The Persimmon Creek iron may be classed as a granular octahedrite containing numerous troilite and some silicate areas.

CHEMICAL INVESTIGATION AND ANALYSES.

A fairly representative area of the mass was taken for separation and analysis. This was placed in a large Erlenmeyer flask fitted with a two-way stopper, one hole of which carried a thistle tube reaching to the bottom of the flask, and the other carried a tube made from a 25 c. c. pipette, which led into an ammoniacal solution of cadmium chloride contained in two smaller flasks. The pipette tube was bent at such an angle that any vapors formed would condense and be returned to the larger flask. The apparatus was then connected with a pump and a gentle current of air drawn through, care being taken that the air passed through a water solution of copper sulphate and then through water before entering the apparatus, in order that no hydrogen sulphide be introduced from outside.

Dilute hydrochloric acid ($1HCl : 25H_2O$) was now added. The flask gently heated, and the evolved gas caught in the cadmium chloride solution. The action at a gentle heat at approximately 75° Centigrade, was allowed to continue for several weeks, fresh acid being added from time to time. When all action had ceased the solution was raised to boiling and the temperature continued for thirty minutes in order to expel the last traces of hydrogen sulphide from the solution.

All the combined sulphur was now precipitated in the smaller flasks as cadmium sulphide. This was filtered on a counterpoised filter, washed with water containing a little ammonia, dried, weighed, the sulphur content calculated and found to be 22.5 per cent.

The large flask contained the acid soluble and insoluble portions. These were filtered through counterpoised filters, washed with hot water, and the residue dried and weighed.

THE INSOLUBLE RESIDUE.

The residue (in which would be the carbon, schreibersite, tænite, cohenite, magnetite, chromite, silicates, etc., if any) was, after weighing, examined under a glass and then treated as follows: The carbon was first floated off with water, collected on a filter, dried, and burned in oxygen. The carbon-free residue was gone over with a magnet, thus leaving only the olivine. The magnetic portion was examined under a glass and found to consist entirely of schreibersite and a nickel-iron alloy (tænite?). It was collected in a 6-ounce flask and the schreibersite separated according to the following method: The flask and its contents were placed in a dish of cold water and 50 cc. of nitric acid, specific gravity 1.20, added. The flask was then removed from the bath and shaken till its contents were sensibly warm, care being taken to prevent any local heating. The flask was then placed again in the bath and allowed to stand till no more gas was given off. It was then filtered and the precipitate washed with hot water, and,

finally, with alcohol, this last washing being allowed to run into another beaker and thrown away. The filtrate contains all the nickel-iron alloy and perhaps about 1 per cent of the schreibersite, while at least 98 per cent of the phosphide is left on the paper. A complete solution of the nickel iron is effected in one to three minutes.

SCHREIBERSITE.

The mineral thus separated had a specific gravity of 7.17; a tin-white color; and under the glass was seen to be in pea-like nodules and in needles (rhabdite). An analysis gave the following:

Iron	69.33
Nickel-cobalt	17.26
Phosphorus	12.50
Total	99.09

NICKEL-IRON ALLOY.

The solution obtained from treating the magnetic residue as above stated gave, on analysis, the following results:

Iron	85.00
Nickel-cobalt	14.50
Phosphorus	1.00
Total	100.50

Calculating the phosphorus present as derived from dissolved schreibersite, this will approximate the formula Fe_6Ni, as given by Meunier[a] for tænite. Other analyses give: Fe_2 (Ni, Co),[b] $Fe_{13}Ni_3$,[c] Fe_5 (Ni, Co)$_2$,[d] etc.

From these results it is evident that the so-called tænite is of a very uncertain composition. Indeed, it is not to be expected that the results should be uniform, since the alloy obtained is necessarily dependent upon the nature of the solvent used in its separation.

OLIVINE.

This mineral occurs in small granules of a yellowish-green color, and that analyzed had been slightly attacked even by the very dilute acid (1 HCl:25 H_2O) used in the separation. An analysis gave:

Silica	39.10
Magnesia	48.20
Ferrous oxid	12.30
Total	99.60

Specific gravity, 3.39.

[a] Meunier, Meteorites, p. 49, 1884.

[b] Tassin, Proc. U. S. Nat. Mus., XXV, p. 73.

[c] Nichols, Field Columbian Publication 64, Geol. Series, I, p. 315.

[d] Weinschenk, Ann. Mus. Wien.

CARBON.

Before burning the carbon it was examined under the microscope for diamond and cliftonite, without finding either of these minerals.

THE ACID SOLUBLE PORTION.

The solution was evaporated to dryness, taken up with strong nitric acid, again evaporated to dehydrate any silica present, redissolved, filtered, the filtrate again evaporated and taken up with a few drops of nitric acid and hot water. This solution was now made up to 1,000 cc. with cold water and proportional parts analyzed.

The separation of the iron and nickel was effected by the succinate method, experience having shown that if the conditions here noted are observed it is quicker than the acetate method, and a complete separation is generally effected on the first precipitation and always on the second, while with the acetate method at least three precipitations are necessary and often more. The procedure is as follows:

Add ammonia slowly and with stirring to the dilute nitric acid solution till the color is a red brown. Should the solution become turbid, add a drop of acid to clear it. Then add a 30 per cent solution of sodium acetate, to which a drop or two of acetic acid has been added, till the color is deep red (an excess of sodium acetate does no harm). Then precipitate at the temperature of the water bath with sodium or ammonium succinate, using 3½ grams of the succinate for every gram of iron present; more than this dissolves the precipitate unless filtered cold. When the precipitate has settled, filter, wash with cold water, and then with warm water, carrying 20 per cent of ammonia. The filtrate is then concentrated and the nickel-cobalt contents determined as the operator pleases.

An analysis of the solution gave:

Iron	94.360
Nickel	3.723
Cobalt	.250
Copper	.290
Manganese	.010
Phosphorus	.270
Silica	.809
Alumina	Trace.
Platinum	Trace.
Magnesium	Trace.

The phosphorus contents may have been derived from dissolved schreibersite, or from an unknown phosphide, or from phosphorus in solid solution analogous to the conditions prevailing in certain manufactured irons, though metallographic methods have failed to develop anything that would warrant the last two assumptions. The silica and magnesia were derived from the olivine. The platinum, alumina, and magnesia contents were too small to weigh, and the first two may have been admitted during the analysis.

PERSIMMON CREEK METEORITE.

CROSS SECTIONS OF MASS SHOWING STRUCTURE.

SCHMIDTINA, A GENUS OF JAPANESE SCULPINS.

By David Starr Jordan and Edwin Chapin Starks,

Of Stanford University.

In a recent paper on the Cottidæ or Sculpins of Japan,[a] by the present writers, a new genus, *Schmidtia*, was defined for a species of sculpin, *Schmidtia misakia*, from near Misaki, Japan. As the name *Schmidtia* is already used in zoology, we would substitute for it, as the name of the genus of *Cottidæ*, the name *Schmidtina*, the species being *Schmidtina misakia*.

[a] Proc. U. S. Nat. Mus., XXVII, 1904, p. 237.

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