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UNITED STATES NATIONAL MUSEUM.

PROCEEDINGS

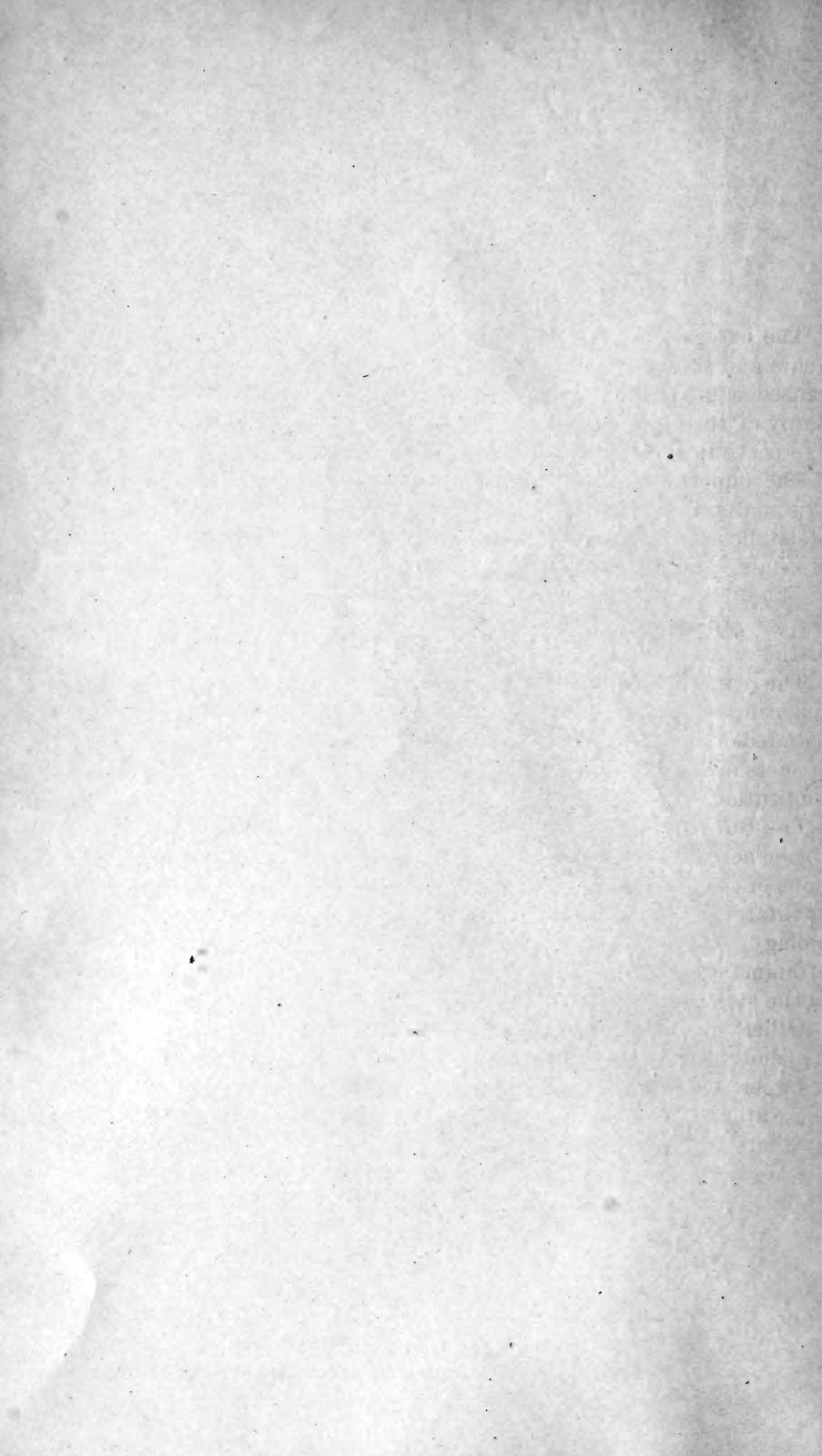
OF THE

UNITED STATES NATIONAL MUSEUM.

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ADVERTISEMENT.

The extension of the scope of the National Museum during recent years and the activity of the collectors employed in its interest have caused a great increase in the amount of material in its possession. Many of the objects gathered are of a novel and important character, and serve to throw a new light upon the study of nature and of man.

The importance to science of prompt publication of descriptions of this material led to the establishment, in 1878, of the present series of publications, entitled "Proceedings of the United States National Museum," the distinguishing peculiarity of which is that the articles are published in pamphlet form as fast as completed and in advance of the bound volume. The present volume constitutes the twenty-first of the series.

The articles in this series consist: First, of papers prepared by the scientific corps of the National Museum; secondly, of papers by others, founded upon the collections in the National Museum; and, finally, of facts and memoranda from the correspondence of the Smithsonian Institution.

The Bulletin of the National Museum, the publication of which was commenced in 1875, consists of elaborate papers based upon the collections of the Museum, reports of expeditions, etc., while the Proceedings facilitate the prompt publication of freshly acquired facts relating to biology, anthropology, and geology, descriptions of restricted groups of animals and plants, the discussion of particular questions relative to the synonymy of species, and the diaries of minor expeditions.

Other papers of more general popular interest are printed in the Appendix to the Annual Report.

Papers intended for publication in the Proceedings and Bulletin of the National Museum are referred to the Advisory Committee on Publications, composed as follows: Frederick W. True (chairman), Marcus Benjamin (editor), James E. Benedict, Otis T. Mason, Leonhard Stejneger, and Lester F. Ward.

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

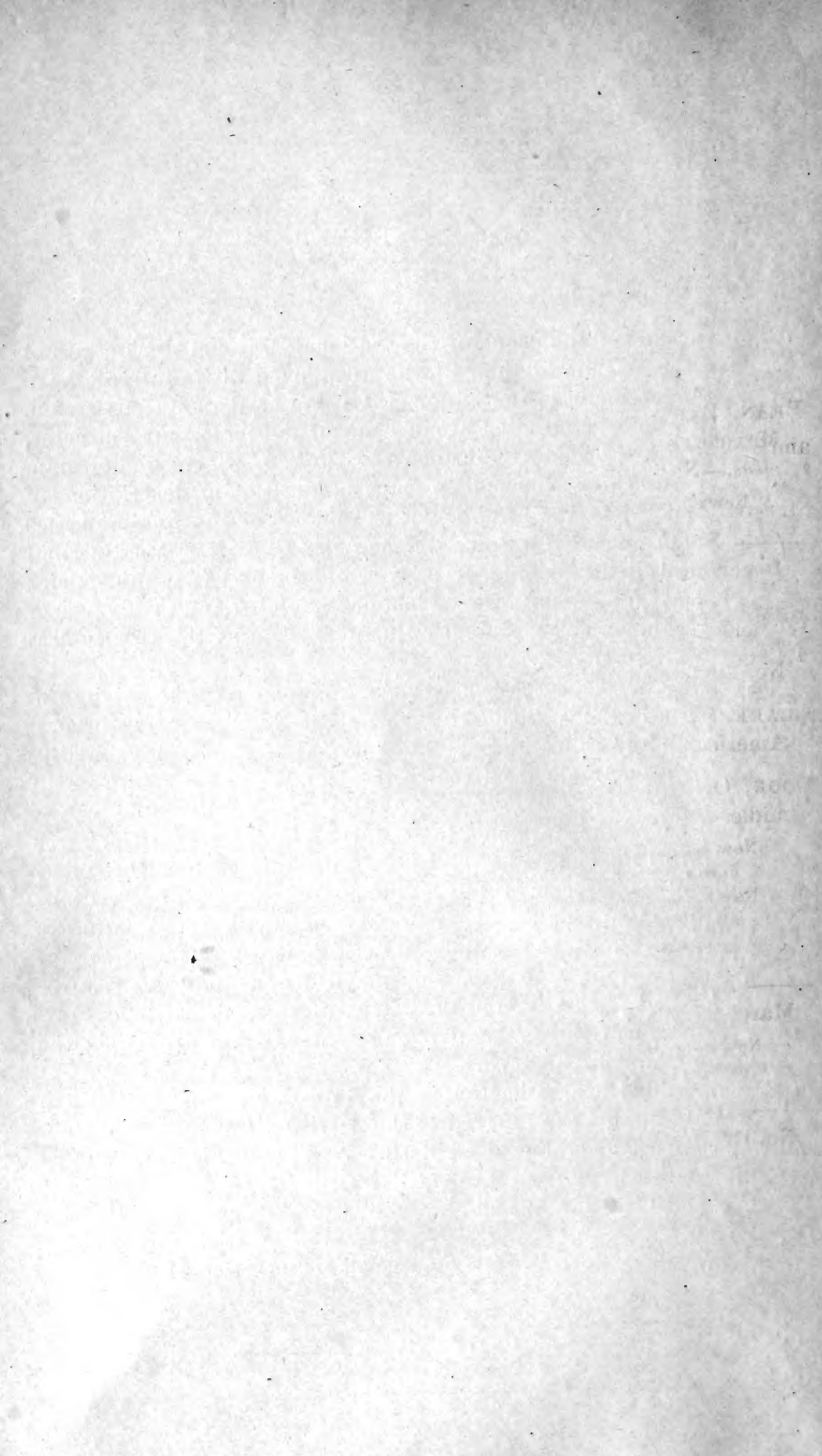


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CONTRIBUTIONS TOWARD A MONOGRAPH OF THE
LEPIDOPTEROUS FAMILY NOCTUIDAE OF BOREAL
NORTH AMERICA.

A REVISION OF THE SPECIES OF ACRONYCTA (OCHSENHEIMER) AND
OF CERTAIN ALLIED GENERA.

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INTRODUCTION.

By JOHN B. SMITH.

In 1883 I was employed by Dr. C. V. Riley, then Entomologist to the U. S. Department of Agriculture, as a special agent of his Division, and, in addition to the economic work assigned to me, it was planned that I should devote as much time as possible to the study of the lepidopterous family Noctuidae, or "Owlet Moths." Dr. Riley had bred many of the species from larvae which, under their common appellation of "cutworms," are well-known pests to agriculture, and it was his desire that we should cooperate in the production of a systematic work in which the early stages were, in the main, to be his especial share. My own task was solely with the adult stages, and in certain genera all the work was to be done by Dr. Riley. In pursuance of this plan a great amount of material was accumulated and much manuscript was prepared.

In 1885 I became Assistant Curator in the U. S. National Museum, Dr. Riley occupying at the time the place of Honorary Curator. It was then intended that our joint work on the Noctuidae should be continued; but it soon became evident that we could not at that time secure the publication of such a work as was planned, and it was abandoned. A great deal of additional material had been received since the work was started, and I began to publish such parts as had been prepared, after reviewing each group and bringing it up to the date of publication.

Among the genera reserved for study by Dr. Riley was *Acronycta*, which had interested him for years because of the differences noted among the larvae. Certain studies of structural characters were made by Mr. Theodore Pergande, of the Division of Entomology, and by myself, and under Dr. Riley's supervision most of the adults and all the obtainable larvae were figured in colors. It was intended that the work should make Bulletin No. 7 of the Division, to be published in 1885, and seven chromolithographic plates were actually printed. So many life histories were incomplete, however, and so much difficulty was encountered in obtaining missing species, that publication was postponed from time to time until, in 1891, Bulletin No. 7 was finally devoted to another theme, and the matter was allowed to rest for the time being. In 1889 I resigned my place in Washington to accept that now occupied by me in New Jersey, and all plans for combined monographic work by Dr. Riley and myself were abandoned.

Dr. Riley retired from the Department of Agriculture in 1894 and devoted himself to work in the U. S. National Museum, intending to take up and complete those lines of scientific study which were perforce abandoned through the burden of routine work in the Department. His untimely death prevented this; and in arranging his affairs his widow very kindly turned over to me the entire mass of papers and notes, together with all the original drawings and sketches referring to *Acronycta*.

On the occasion of my visit to the British Museum in 1891 I did not see the entire collection of *Acronycta*, partly because they were not then all included with the true Noctuidae by Mr. Butler, partly because, my time being limited, I relied upon the comparisons made by Dr. Riley.

The manuscript turned over to me contained the notes on the British Museum specimens made by Dr. Riley, and all the breeding notes and records accumulated for many years in the U. S. Department of Agriculture. There was no descriptive matter, however, and not even an outline of a proposed systematic division. All the systematic matter, therefore, is original.

To the kindness of Dr. L. O. Howard, who succeeded Dr. Riley as Honorary Curator of Insects in the U. S. National Museum, as he succeeded to his place in the Department of Agriculture, I owe the loan of the entire material, of every kind, in this group from both Museum and Department.

To this was added the collection accumulated by me for Rutgers College, and the rich material borrowed from Mr. J. Doll, of Brooklyn; Dr. R. Ottolengui, of New York; Mr. E. L. Graef, of Brooklyn; Mr. Philip Laurent, of Philadelphia; Dr. William Barnes, of Decatur, and Prof. George H. French, of Carbondale, Illinois. To Mrs. C. H. Fernald I owe a number of specimens from her own collection and others, with notes, from the collection of the Massachusetts Agricultural College Experiment Station.

Prof. J. H. Comstock kindly sent me all the material from the collections of Cornell University, and Dr. S. A. Forbes was equally liberal with material from the University collection at Urbana, Illinois. Mr. Beutenmüller, Curator of the Department of Insects in the American Museum of Natural History, kindly secured for me needed specimens from the Edwards collection and photographic reproductions of others. Dr. Henry Skinner allowed me to take desirable specimens from the collections of the Academy of Natural Sciences at Philadelphia and from that of the American Entomological Society, both of which are in his charge, and to these and to all others who have otherwise assisted me I offer sincere thanks.

The material accumulated was by all odds the best and most abundant ever gathered together in one place, and gave excellent opportunities for ascertaining the range of variation in the species.

Of recent years Dr. H. G. Dyar has systematically and critically studied the lepidopterous larvae, and proposed, in a pamphlet published by Mr. A. R. Grote, a scheme for the division of *Acronycta* on larval characters. I therefore asked Dr. Dyar to relieve me of the task of dealing with the early stages in this genus. As he kindly consented to do this, I turned over to him all the material and notes in my hands, and he is solely responsible for all pertaining to the immature stages. We worked independently toward a general system, and afterwards, comparing results, straightened out such slight discrepancies as were due to the use of subordinate characters. Each author is, therefore, solely responsible in his own branch; but the classification of the species is in all senses a joint result and a natural arrangement as based on adult as well as early stages.

THE GENUS ACRONYCTA AND ITS ALLIES.

By JOHN B. SMITH.

In the catalogues and lists of Noctuidae in general use, there is placed at the head a small series of species with plump, robust form, somewhat retracted head, and rather loose, divergent vestiture. This group has been variously named and vaguely defined; but there has never been any sharply marked character noted to differentiate it from the other Noctuids, though the title of some forms, like *Demas*, to be termed Noctuids at all has been disputed.

Following precedent, I arranged the series in my catalogue of 1893 as follows: *Panthea*, *Demas*, *Raphia*, *Charadra*, *Feralia*, *Momophana*, *Moma*, *Arsilonche*, *Merolonche*, *Acronycta*, *Harrisimemna*, and the genera allied to *Bryophila*.

In 1896, Mr. A. R. Grote¹ formed a "family" Apatelidae, for which no tangible characters of the imagines are given, and which is based in a vague way upon larval characters, of the genera *Demas*, *Charadra*, *Pan-*

¹ Mitth. a. d. Roemer Mus., Hildesheim, No. 3.

thea, *Trichosea* (exotic), *Harrisimemna*, *Feralia*, *Momophana*, *Diphthera* [*Moma*], *Microcoelia*, *Apatela* [*Acronycta*] *Arsilonche*, *Simyra* (exotic), and *Oxycesta* (exotic).

Merolonche is omitted, probably by accident, since it is referred to as a division of *Acronycta* in another part of the paper.

Taking this aggregation, whether as arranged by Mr. Grote or myself, as a whole, it is impossible to define it without including also all the other Noctuidae. Dr. Dyar finds, however, that the larvae of *Acronycta* and some other genera differ from those of the normal Noctuids, and for convenience his restriction can be followed, though it leaves some unsatisfactory situations. For the reasons which lead Dr. Dyar to his conclusions, his notes on the larvae should be referred to; it must suffice to say here that only *Demas*, *Panthea*, *Charadra*, *Harrisimemna*, *Merolonche*, *Arsilonche*, and *Acronycta* are included. *Raphia* and *Feralia* are rejected from larval characters, and *Momophana* and *Moma* from adult structures. *Microcoelia* is divided, and one of its species is included in *Acronycta* on both larval and adult characters.

As restricted above, there are two very sharply defined series, differing in important structural characters. *Demas*, *Charadra*, and *Panthea* have vein 5 of the secondaries quite as strong as any other on that wing, and arising from the end of the median vein close to 4. The median vein is, in this case, therefore, distinctly quadrid. Subordinate though congruent characters are hairy eyes and pectinated male antennae in all the species, and a certain similarity in habitus and type of maculation. But *Raphia* would seem to be, on adult characters, a proper member of this group, which for convenience I prefer for the present to regard as a tribe, *Pantheini*, though it is rather entitled to subfamily rank. It has the venation of the secondaries almost exactly as in *Charadra* and indeed agrees quite as well in the primaries also. The type of maculation is also similar and the body structure and pectinated male antennae are very like *Charadra*. The eyes are naked, but this is an unimportant character and only the male genitalia which are typically Noctuid and do not agree with those of the other species here associated bear out the larval indications. *Raphia* is therefore omitted in this treatise as I am at present unable to assign it a satisfactory position.

Among themselves the genera differ fairly well. *Panthea* and *Demas* are both incapable of feeding because of the weak, membraneous tongue, and both tend to a great variability in the origin of the veins about the accessory cell, which may be entirely absent or fully present in the same species. *Panthea* has more evenly triangular primaries with an almost straight inner margin, and the markings consist of band-like transverse lines. *Demas* has the primaries narrower, more abruptly widened at the base, giving the inner margin a curve at that point, and has the markings more normally developed. The differences are obvious but not striking.

Charadra is capable of feeding and has the antennae pectinated in both sexes, though shortly so in the female.

In the genera allied to *Acronycta*, which may be grouped as *Acronyctini*, the secondaries have vein 5 weak and arising from the cross vein quite remote from 4, though nearer to it than to 6. The character is an important one and not merely a greater or less development, which occurs within *Acronycta*: it is a difference of derivation which makes the median vein strictly trifid and 5 really "independent." So far as my present experience goes there is nothing in the venation of the *Acronyctini* that is in any way different from that of the *Agrotids* or *Hadenids*, and the tribal term has nothing to maintain it in the adults except a habitus, though it is well based in the larvae according to Dr. Dyar. On the contrary the *Pantheini* (or even *Pantheinae*) are sharply differentiated from all those immediately associated with them on adult characters, though they resemble *Acronycta* in the larval stage. In other words there is no real basis for associating the Pantheid series with the Acronyctid or any other true Noctuid series on adult characters alone, so far as they are now appreciated.

As subordinate characters in the Acronyctids we have uniformly naked eyes, usually simple antennae in both sexes, and an undescribable Bombycid appearance.

Four genera are indicated, which may be headed by *Acronycta*, in which the antennae are simple in both sexes, the tongue useful for feeding in all cases, the palpi fairly well developed, the vestiture hairy or with flattened hair and scales intermixed, and the transverse lines and ordinary spots fairly indicated in all cases.

Arsilonche differs in the weak tongue, which is useless for feeding, and in the strigate maculation, which leaves no trace of the transverse lines or ordinary spots apparent. The genus is a continuation and intensification of the characteristics of group *auricoma*, to which it belongs in the early stages.

Merolonche is a much more strongly marked offshoot from that same stem. The body is somewhat more robust, the vestiture longer and more shaggy, the head more retracted, the palpi small, the tongue weak, and the antennae shortly pectinated or rather lamellate in the male. In venation and genital structure there is no departure from the normal *Acronycta* type.

Harrisimemna is distinctly aberrant and tends to the Bryophilid series. Its peculiar maculation gives it a somewhat misleading appearance, but in venation and in all the essential structural characters it is a typical Noctuid. The shortly pectinated antennae are out of place in this position, and the scaly vestiture and exaggerated tuftings are totally unlike any of the other forms here associated. It is aberrant in all stages and really stands by itself, with close mimics of it found in the Bryophilid series. In the sexual characters there is an apparent leaning to the Pantheid series, but too little is known of these charac-

ters in seemingly allied genera to make this of any great importance at present.

It will be seen from this review that the last word on the relationship of the genera treated in this paper has not been said, and that their association as adults is not fully warranted except from convenience.

In tabular form the groups and genera above referred to may be arranged as follows:

ANALYTICAL KEY TO GROUPS AND GENERA.

- Vein 5 of secondaries as strong as the others and arising from the median vein close to 4; eyes hairy PANTHEINI.
- Tongue short and weak, useless for feeding; antennae pectinated in the male, simple in the female.
- Primaries broad, trigonate, inner and outer margin approximately equal in length *Panthea*.
- Primaries narrower, more abruptly widening at base, the inner margin longer than the outer *Demas*.
- Tongue moderate, useful for feeding; antennae pectinated in both sexes; though shortly in female *Charadra*.
- Vein 5 of secondaries weak, arising from the cross-vein remote from 4; eyes always naked ACRONYCTINI.
- Antennae simple in both sexes.
- Tongue moderate or strong; ordinary spots or transverse maculation at least traceable *Acronycta*.
- Tongue weak and short; maculation strigate, without trace of ordinary spots or transverse lines *Arsilonche*.
- Antennae shortly pectinated in the males.
- Ashen gray species with hairy vestiture, body plump, wings small; abdomen untufted *Merolonche*.
- Brightly colored and marked, with scaly vestiture; body slight; wings large, abdomen prominently tufted *Harrisimemna*.

THE EARLY STAGES OF ACRONYCTIDS.

BY HARRISON G. DYAR.

The descriptions of larvae, which I have prepared to supplement Professor Smith's account of the imagines, are taken almost entirely from my own notes. Professor Smith had practically no useful notes on early stages to turn over to me, but there was considerable material in alcoholic and inflated specimens. Most of this, however, consisted of the common species on which I already had notes, and only a few of the specimens were of service. Fortunately, my notes were rather full in the Acronyctid forms, though far from complete, as I had not made special efforts to finish them.

The larvae of the Lepidoptera present a number of well-marked differences in structure among themselves, affecting principally the clothing of hairs. These differences are very well marked in the Acronycta larvae. So great is the diversity that Dr. A. G. Butler formerly attached much importance to it, referring the several species of Acronycta to different families of moths, according as the larval

character corresponded. On these lines our *A. funeralis* would be an Agaristid or Noctuid, since this species and some Agaristids and Noctuids possess in common single spatulate hairs. *A. luteicoma* would be a Liparid from the brush-like tufts; *A. noctivaga* an Arctian from the tufts of stiff hairs and black coloration; *A. lobeliae* a Lasiocampid from the weak hairs and flattened form, etc. I mention these views of Dr. Butler's, though they have been long since refuted, not only because they refer specially to *Acronycta*, but also because they illustrate the difference between a classification based on superficial resemblance versus one on phylogenetic characters. I will briefly review these more fundamental points. They are seen in the position of the hairs (single or multiple) rather than in their modification. The modification is essentially adaptive, is quickly affected by a difference in habit, and hence not reliable in classification. The position, on the other hand, is only slowly affected by evolution and gives characters for large groups. These groups prove to be of the grade of superfamilies. The five primitive setae on the abdomen, as in Plate XVIII, fig. 1, are characteristic of the Tineides (the Micro-lepidoptera and allies), Saturnians, and Butterflies. Tubercle V moved up before the spiracle, is the condition in the Sphingines (Plate XVIII, fig. 2), while Tubercle IV moved up behind the spiracle is that of the Bombyces (Plate XVIII, fig. 3). The several families of the Bombyces are separated by a number of lesser characters. The lower families have single hairs, as in the figure. The higher ones have a tuft of hairs in place of each single hair. Among these there are two distinct lines of modification of the thoracic hair tufts (warts) which separate two large groups. The group including the Bombycidae proper leads up from the Notodontidae, culminating in the Lasiocampidae. The other starts from the Noctuidae and includes the Arctiidae, culminating in the Euchromiidae (Syntomiidae). The conversion of single hairs into warts has taken place several times independently among the Bombyces, so that the ultimate structure is not an absolute criterion of affinity. Moreover, a return to the single haired condition sometimes occurs, so that these characters have to be used with a certain caution. The result is that family characters are often not strongly marked in the larva, in which they contrast with the superfamily ones mentioned above—characters which are more strongly marked than those of the same grades in the imagines.

Now there are certain moths, usually classed as Noctuidae, whose larvae have many-haired warts. They have been recently discussed by Mr. Grote under the term Apatelidae. There are, however, no family characters in the moths, though Professor Smith deems himself almost warranted in separating part of them, as a subfamily. The other part, including *Acronycta*, are true Noctuids. It is this group, the Apatelidae of Grote or *Pantheinae* and certain genera of the *Noctuidae* which form the subject of the present article.

Eggs.—The eggs are circular and much flattened, the micropyle in the center of the upper side, ribbed and with faint cross-striae. The characters are the same as in the English species, as described by Dr. T. A. Chapman. So few of our species are known that it is impossible to generalize on them and useless to specially discuss the few cases.

Larvae.—The larvae of this genus are especially interesting from the wide range of the characters of the hairs. The range covers forms with single setae, with true many-haired warts and those in which this primary coating is almost completely replaced by a secondary one of the hairs growing from the skin. This is as great a range as is shown by any of the families of the whole Bombyces. All the species may be traced back to a ground form, which may be described as a typical Noctuid in which warts have been developed, accompanied by a tendency to the production of secondary hairs. The species have made the most of this comprehensive structure. In the single-haired forms degeneration has occurred, as may be seen by the presence of true warts in the earlier stages. The Arctian-like forms have preserved the warts intact without secondary hairs. Another series has developed the secondary hairs at the expense of everything else.

The species divide into four well-marked groups. The first comprises those with abundant secondary hairs. All the American species have a series of dorsal tufts or pencils, variously modified, and in some cases absent in the last stage. The coloration is very diverse. (Group *americana*.)

In the second group the warts are small, the secondary hairs weak, but present in some degree. There is a wide range in the coloration of these forms at maturity, where various adaptations and cases of mimicry occur, though before the last stage very diverse forms are often strikingly alike. (Group *lobeliae*.)

The third group have warts in the early stages in all the American species so far known, which may degenerate to single hairs in the last stage except in the case of tubercle VI. Secondary hairs are absent. In two cases the hairs are spatulate. This group appears at first sight a compact one, but from the results obtained from the study of the male genitalia of the moths it appears that the single-haired species are really derived from two different sources within the genus. One section (group *hamamelis*) has the structure of *retardata*, while the other (group *persuasa*) seems to have arisen from a point near *cuspid* and *tridens*. The structure of Group IV may be derived from Group III by the loss of the secondary hairs, and the only unexpected point that the male genitalia indicate is that the single-haired structure has been developed twice. The loss of secondary hairs would be expected to accompany this change. (Groups *persuasa* and *hamamelis*.)

The fourth group is more compact. The warts are well formed and bear spreading tufts of hair, in some cases supplemented by bunches of fine feathery hairs which in *luteicoma* become markedly developed.

Secondary hairs are absent. Most of the species are black or brown and are low feeders like Arctians. (Group *auricoma*.)

Four larvae, not belonging to *Acronyeta*, are known, which have nearly the same characters as the Acronyetids. They comprise the genera *Demas*, *Charadra*, *Panthea*, and *Harrisimemna*. *Raphia*, *Feralia*, and *Bryophila* have not these characters, while *Momophana*, *Diphthera*, *Cerma*, *Polygrammate*,¹ *Cyathissa*, and *Chytonix*, usually associated here,

¹Since this article was sent to the printer, I have bred *Polygrammate hebraicum*. The larva is an Acronyetid, but only a portion of the warts are many-haired. It is unlike all the other species, the only suggestion of affinity being in the habit of pupation, which suggests *Harrisimemna*. The following are the characters:

LARVA.

Stage I.—Whitish, the body a little green tinted at the end of the stage; width of head, 0.2 mm. Warts small, but apparently as in the following stage: I, two-haired; III, several haired. The length reaches 2 mm. The exact details of stage I and true number of stages not determined.

Stage II.—Flattened, the warts as in the following stages: III, large and many haired; width of head, 0.3 mm.; length, 4.8 mm. Whitish, with a green tint.

Stage III.—Head round, green, width, 0.5 mm. Body flattened, wart I, two haired; II, single; III, many haired. Green, a trace of a white subdorsal line. The body tapers behind and the feet are normal. Length, 6.5 mm.

Stage IV.—Head green, width, 0.9 mm. Wart I, two haired; II, IV, and V, single; III and VI, many haired. Wart III is very prominent, projecting from the sides. Green, a narrow white subdorsal line, below wart II and small intersegmental dorsal dots. Length at end of stage, 8.5 mm.

Stage V.—Green; head, 1.6 mm. Warts as before, the hair fine and pale. A single dorsal and paired addorsal white dots; subdorsal line on joints, 3 to 13; white, just below wart II. Anal feet divergent, as seen from above. Length, 14 mm.

Stage VI.—Head rounded, whitish green, mouth white; a tiny black dot in the middle of each lobe before; width, 2.2 mm. Body appears much less hairy than before. Wart I still has several hairs, but the tuft is so small as only to be seen by the lens; II has a single strong hair; III a strong hair and a few small, weak ones; IV a tiny hair; V a strong hair; VI several small hairs. The thoracic warts are similarly reduced. Color clear green, the dorsal intersegmental white dots elongated, addorsal ones round; subdorsal line straight, yellowish white; wart III shining; spiracles reddish; claspers of abdominal feet elongate. In some, the spiracles, warts V and VI of abdomen and III, IV+V, and VI of thorax are surrounded narrowly by red-brown. Dorsal hair dusky, subventral hair pale. Later the ground color is more whitish, less clear green, joint 2 and head a little yellowish, the markings less contrasted. At the end of the stage a marked change in color takes place. Head shaded with purplish leaving blotches of white dots confluent in groups over the faces of the lobes; ground color in front and on clypeus still greenish. Body grayish white over the back to wart V, all the warts orange color. White dorsal and lateral lines, the stigmatal region all white, broken obscurely by greenish in the incisures of the faint annulets. A series of numerous purple-brown spots in an irregular geminate row of four dorsally, the second single; before wart I, behind wart II, above and below the subdorsal line, small, diffuse; before and behind wart III; over most of the subventral space, forming a sharp lower border to the white stigmatal space, cut on the segmental incisures. Dorsum faintly purplish shaded. Setae all dark.

After acquiring this coloration the larvae left the leaves where they had hitherto rested and finally bored in soft wood to pupate, in the manner of *Harrisimemna*, throwing out the chips united by threads into small irregular balls.

Pupa.—Cylindrical, slender, light brown, slightly shining. The cases are smooth,

are unknown. Of the four that are known, *Charadra* and *Demas* fall in Group IV, though with important differences; *Harrisimemna* falls in Group III rather than any other, though aberrant, and *Panthea* falls doubtfully in Group I. *Charadra* and *Demas* have not the pupal characters of Group IV (*Viminia*), and they doubtless represent a different stem. These four Pseudo-Apatelid forms (*Pantheinae*) separate as follows:

True warts present, not degenerate:

Secondary hairs present, sparse, hair pencils present..... *Panthea*.

No secondary hairs.

Hairs stiff; pencils present..... *Demas*.

Hairs soft; no pencils..... *Charadra*.

Warts degenerate, single haired above VI..... *Harrisimemna*.

The following table will separate the American species of *Acronycta* whose larvae are known. The more important European species are also included for comparison. *Falcula*, *connecta*, and *lanceolaria* I have not seen, but have placed by the descriptions only, which, unfortunately, are usually silent on the crucial points. Therefore these species may not be correctly placed. In the special descriptions following, only very few cases of full life histories are made out.¹ The larvae have generally been found young and bred up, the first stage especially usually wanting. Except in Group IV, I have assumed six stages, following Chapman, and numbered those observed to correspond; but it should be noted that there may be more, and the relations and characters of Stage I need further study in nearly all cases, even where a stage is marked "I." From Dr. Chapman's remarks it appears that in certain of the species the primitive first stage may have disappeared; but our knowledge of the American species is too scanty to admit of more than mentioning that this point is to be looked out for.

The notes of Dr. C. V. Riley have been used when I have had none of my own, as well as some kindly communicated by Mrs. C. H. Fernald. Special acknowledgment is given in all cases to every author quoted. The specimens preserved in the U. S. National Museum, and mostly collected by Dr. Riley, have been freely examined, serving as the basis for several descriptions.

Three descriptions of *Apatela* larvae are not referred to. They are by Dr. Packard, in the Fifth Report U. S. Entomological Commission,² undetermined. They seem to be immature or non-Apatelid forms, and I can not guess what they may be.

the thorax above shagreened; abdominal segments rather thickly punctured, except in narrow posterior rims, which are smooth. No cremaster, but the last segment is enlarged above, smooth and shining, with a series of short longitudinal grooves in the depression preceding the enlargement; below the segment is less enlarged, not shining, and bears several slender hooks in a transverse row on either side, directed obliquely downward. Length, 9; width, 2.5 mm.

Food plant, sour gum (*Nyssa sylvatica*).

¹ Only *morula*, *furcifera*, *grisea*, and *noctivaga*.

² Pages 461, 498, and 897.

Pupae.—In his full and valuable account of the English Apatelae, Dr. Chapman divides the genus into three sections or genera on pupal characters. His third section comprises only *ligustri*, which is not an Acronyctid at all, and may be omitted from consideration. There remain two groups, the first with the pupa of the ordinary Noctuid pattern, smooth, brown, tapering regularly from the thickest part of the thorax to the anal segments, which are somewhat rounded, the abdominal segments punctured in front; cremaster with a series of curved spines or hooks in two sets, one above the other. This section includes the larvae of the first three groups.

The pupae of Dr. Chapman's second section (I have transposed his numbers) are black, or nearly so, with a rough wrinkled surface, the free abdominal segments as wide or wider than those in front, the terminal segments rapidly tapering. The posterior margin of each segment has a raised band, like a barrel hoop, which is smooth. Cremaster furnished with a bunch of stiff, brown bristles. This section corresponds to the fourth group of larvae.

There is thus an exact correspondence between pupal and larval characters, but the latter are more delicate, defining three groups where the pupae can show but one. On the other hand the characters drawn from the male genitalia are still more sensitive and indicate more groups than the larvae, while contradicting none.

ANALYTICAL KEY TO THE KNOWN LARVAE OF ACRONYCTA.

1. Warts, small, subfunctional, few or single haired at maturity; secondary hairs more or less developed, ranging from none to a complete development. Pupae smooth, tapering. (*Cuspidia* Chapman) 2.
- Warts, large, functional, many haired; secondary hairs absent from body, the wart hairs sometimes of two forms. Pupae rough, the posterior edges of the segments marked with smooth raised rings. (*Viminia* Chapman; larval section IV) 31.
2. Secondary hair abundant, predominant. (Larval section I) 3.
- Secondary hairs few or absent, never predominant 10.
3. Without contrasting dorsal hair pencils at maturity 4.
- With distinct hair pencils in the last stage, rising above the secondary hairs. 7.
4. Hair parting in irregular tufts to show a series of dorsal marks *aceris*.¹
- Hair not parted; black pencils present dorsally before the last stage. 5.
5. Hair long, thin, and pale 6.
- Hair dense, short, brown, and black *hastulifera*.
6. Hair soft, curving over unsymmetrically *leporina*.²
- Hair soft, but straight, not curved *frigida*.
7. Pencils only on joints 5, 7, and 12 8.
- Pencils on other joints besides 5, 7, and 12 9.
8. The pencils on joints 5 and 7 paired *americana*.
- No pencils paired *dactylina*.
9. No pencil on joint 6 *populi*.
- A pencil on joint 6 as distinct as the others *rubricoma*.

¹ European.

² American and European.

10. Secondary hairs present, though sometimes very few; warts more than one-haired at maturity. (Larval Section II) 11.
 No secondary hairs; warts usually single-haired in the last stage, except wart VI. (Larval Section III) 25.
11. Not green at maturity (nor the alternative brown) 12.
 Green on the sides at maturity, or the alternative brown 18.
12. A dorsal elevation on joints 5 and 12 13.
 No dorsal elevation on joint 5, but one on joint 12 *occidentalis*.
 No distinct elevated areas 15.
13. An elevation on joints 5, 8, and 12; dorsal band dark *morula*.
 No elevation on joint 8 14.
14. Dorsal band yellow, elevation on joint 5 long *psi*.¹
 Dorsal band yellow, elevation on joint 5 continued by long hair tuft *cuspis*.¹
 Dorsal band reddish, elevation smaller and no tuft *tridens*.¹
15. Black, with seven yellow lines, like *Datana* *radcliffei*.
 Black, with a broken dorsal red line *furcifera*.
 Of a uniform mottled brown, appearing flattened dorsoventrally 16.
16. Head black lined; a pale patch on joint 11 *megacephala*.¹
 A red patch on vertex of head; body uniformly colored 17.
17. Warts I and II dark, contrasting; head 3.7 mm. wide *betulae*.
 Warts I and II dark, two rows of lateral yellow spots *innotata*.
 Warts I and II pale, not contrasting; head 5.5 mm. wide *lobeliae*.
18. Olivaceous with darker green patches on joints 5, 8, 9, and 12 *impleta*.
 A dark-brown dorsal line 19.
 No dorsal line nor patches *rinnula*.
19. Dorsal line straight and even 20.
 Dorsal line widened on joints 7 to 12 without central patch 22.
 Dorsal line widened, but containing a central green patch 24.
20. Dorsal line continuous 21.
 Dorsal line broken, obscure, just touching warts I *fragilis*.
21. Dorsal line reaching to warts II *superans*.
 Dorsal line reaching only to warts I *falcula*.
22. Dorsal band widened on joints 8 to 12 23.
 Dorsal band widened only on joints 8 and 9 *pruni*.
23. A brown dorsal mark on joint 2 *strigosa*.¹
 Joint 2 green *lithospila*.
24. The central green patch present on joints 9 to 11 *grisea*.
 The green patch on joints 7 to 12 *tritona*.
25. Hairs multiple; segments with five transverse brown bands *retardata*.
 Hairs single, not enlarged 26.
 Hairs single, some of the dorsal ones spatulate at tip 29.
26. No subdorsal yellow line 27.
 A broad yellow subdorsal line *connecta*.
27. Body uniformly colored 28.
 A blackish lateral shade, inclosing a dorsal V-mark on joints 11 to 12 *erilis*.
28. With subdorsal cream-colored spots over tubercles I *orata*.
 Without these spots *hamamelis*.
29. Body brown, uniform *afflicta*.
 Body black, with large, segmental dorsal white spots 30.
30. These spots on joints 5 to 12 marked with two brownish crossed lines *alni*.¹
 These spots centered with a transverse black dash *funeralis*.
31. Body not green 32.
 Body green, hairs pale, mixed with a few black ones *lanceolaria*.
32. Warts with more or less fine, feathery hairs among the bristles 33.
 Warts without fine, feathery hairs, but the spines often soft 40.

33. These hairs forming collared tufts, resembling *Orgyia*..... *luteicoma*.
 These hairs not forming such tufts..... 34.
34. A distinct pale subdorsal line or row of spots..... 35.
 No distinct subdorsal line..... 36.
35. A dorsal row of red dots..... *rumicis*.¹
 Dorsal space black..... *auricoma*.¹
36. A dorsal red patch on joint 3..... *abscondita*.¹
 No such unpaired dorsal patch..... 37.
37. A distinct substigmatal row of lunate yellow spots..... *oblinita*.
 Substigmatal band faint, not yellow..... 38.
38. Warts I and II with contrasting white spots..... *xyliniformis*.
 Without these spots..... 39.
39. Black, substigmatal band reddish..... *noctivaga*.
 Tawny reddish, more or less suffused with black..... *sperata*.
40. Entirely black..... *menyanthidis*.¹
 Black with substigmatal pale line..... 41.
41. No pale subdorsal line..... 42.
 A pale subdorsal line present besides the substigmatal one..... 43.
42. Hair all black..... *myrica*.¹
 Hair pale, except for a few black ones on joints 5 and 12..... *distans*.
 Hair pale, foxy red at the ends of the body..... *impressa*.
 Hair red the whole length..... *euphorbiae*.¹
43. Black predominating, hairs mostly soft..... 44.
 Incisures broadly pale, hair more bristly..... *Simyra dentinosa*.¹
44. Warts not red..... *Simyra nervosa*.¹
 Warts red..... *Arsilonche albovenosa*.²

DETAILED ACCOUNT OF GENERA AND SPECIES.

PANTHEA Hübner.

Panthea HÜBNER, Verzeichniss, 1816, p. 203.

Plump, robust species, with retracted head, short quadrate thorax, long, stout, cylindrical abdomen, and large, trigonate, pointed primaries.

The head is broad, retracted, front flat, eyes widely separated, all the sutures obscured. Ocelli very small, concealed, somewhat remote from the extreme posterior angle of the eye. Tongue short and weak. Palpi small, slender, hardly extending to the front and practically invisible from above. Antennae heavily and rather lengthily bipectinated in the male; simple in the female. Eyes hairy, without lashes.

The thorax is quadrate, rather wider than long, with smooth, hairy vestiture, which is somewhat loose, but marks the collar and patagiae, and seems somewhat abruptly cut off posteriorly.

The legs are short, stout, very much of a size, clothed with rather long, loose hair. They are unarmed, except for the usual spurs which are short and rather weak. All the tarsal claws are simple in the species examined.

The abdomen exceeds the anal angle of the secondaries in both sexes, but in the female is much the longer, plump, and cylindrical. There are no tufts.

The wings are large, well clothed with scales, and are set well forward

¹ European.² American and European.

on the thorax. Primaries broadly trigonate, the outer margin oblique, the apex considerably produced, so that the costa is almost double the length of the inner margin. The venation is normal, except for the origin of the veins from the accessory cell. This latter may be entirely absent and is never well developed; but hardly two of my specimens are entirely alike. The only permanent feature is that veins 7 to 10, inclusive, always rise from this point, though 7 may be stalked with 8 + 9, or 8 + 9 may be stalked with 10. Sometimes all rise from one point, and again 7, 8 + 9, and 10 may be entirely distinct.

The secondaries are proportionate, well developed, with vein 5 as strong as the others and usually close to 4, so as to form part of the same series. This is not entirely uniform, however, and 5 may be quite well removed from 4, though always of full strength.

Three of the species agree in genitalic characters, the harpes being broad, somewhat irregular, and with a small, very stout, obtuse, curved, corneous clasper, at the lower angle of the tip. The odd species is *gigantea*, which has a very large, broad, corneous clasper, which is scoop shaped, quite abruptly bent and pointed at the tip.

The species agree closely in general type of maculation, all having the ordinary lines and the median shade a single, broad, black band, while the subterminal line is marked by a broad, black, dentate preceding shade. All are ashen gray or black powdered on a white ground.

Furcilla differs at once from all the others by lacking all trace of the ordinary spots. The lines are even, quite well defined, and the median line as a rule touches and for a short distance unites with the transverse posterior.

Gigantea has the reniform present and is at once the largest and darkest of the species. The primaries seem almost blackish, the thoracic markings are practically obscured by the powderings, and the transverse lines on the primaries are quite narrow and even.

Portlandia is almost white in ground color and only a little powdery. The reniform is distinct, a little diffuse, and the transverse lines also, while distinct, have the margins powdery and somewhat diffuse. All the lines are entirely separated in all the specimens under examination.

Acronyctoides is the smallest of the species, and in all the specimens I have seen the orbicular is present as a black spot. There is a dark shade between the median and transverse posterior lines which gives a broad, band-like effect below the middle, and the subterminal space is almost entirely dark filled.

The species are thus all distinct and may be arranged in tabular form as follows:

ANALYTICAL KEY TO THE SPECIES OF PANTHEA.

Ordinary spots of primaries entirely wanting.

The ordinary lines and median shade are prominent, broad, and black... *furcilla*.

Ordinary spots represented by the reniform.

Very dark, powdery gray, with the black transverse lines even and narrow.

gigantea.

- Ground color whitish gray, sparsely powdered, with the transverse lines broad and somewhat diffuse *portlandia*.
 Ordinary spots both present.
 Ground color whitish, the transverse shades very diffuse, and partially united. *acronyctoides*.

PANTHEA FURCILLA Packard.

(Plates VIII, fig. 37, larva; IX, fig. 1, adult female; XIX, fig. 2, male genitalia.)

Platyserura furcilla PACKARD, Proc. Ent. Soc. Phila., III, 1864, p. 374.—STRETCH, Zyg. & Bomb., 1873, p. 230, pl. IX, fig. 15.—GROTE, Bull. Geol. Surv., VI, 1881, pp. 258, 277.

Panthea furcilla SMITH, List Lepidoptera, 1891, p. 34.

Ground color very pale gray, more or less black powdered, changing the appearance of the insects considerably, as it is light or heavy; sometimes with a vague rufous tinge. Collar with a vague central banding; thorax with two or three somewhat undefined dusky transverse bands. Antennae yellowish in the males.

Primaries with the transverse bandings black, heavy, quite even, except for the subterminal line. Basal half line distinct and reaching the submedian vein. Transverse anterior line a little irregular, but as a whole outwardly oblique and very even. Median shade line broad, even, almost upright, and touching the transverse posterior line in the submedian interspace. Transverse posterior line a little oblique from the costa to vein 4, and then with a broad, even incurve to the inner margin. In paler specimens a whitish shade marks this line exteriorly. Subterminal line very irregular and sharply dentate, with a deep incurve between veins 4 and 6, sharp teeth on veins 3 and 4, and another deep incurve between veins 1 and 3. The line is most heavily black shaded toward the apex and becomes much less evident toward the inner margin. The line is followed by a more or less evident white shade, and there is sometimes a broken, dusky terminal line. The ordinary spots are entirely wanting. Secondaries whitish, smoky at base, with a vague, smoky exterior band and with a smoky discal lunule. There is also a broken dusky line at the base of the pale fringes. Beneath grayish powdery, disk of primaries darker, with the bands of the upper side indicated, and the subterminal line very sharply defined. Secondaries whitish, with two transverse dusky bands and a dusky discal spot.

Expanse, 1.35 to 2 inches (34 to 50 mm.).

Habitat.—Canada; Kittery Point, Maine, July 3 to August 14; Sharon Springs, New York, August 8; Albany, New York, July; "New York," in June; Minnesota, July; Florida.

There is considerable variation in this species, due to the irregularity of the black powdering. In some cases the shading is very even, leaving the black bands prominently relieved, while in others there is a real marbling and the lines are narrower, white-shaded, and more

diffuse. This latter type predominates among the northern specimens and makes a strong approach in appearance to *portlandia*, though the ordinary spots are always wanting, so far as my experience goes.

LARVA.

LINTNER, Twenty-sixth Rept. N. Y. State Cab. Nat. Hist., 1872, p. 132, fig. 7.—
THAXTER, *Papilio*, 1883, III, p. 11.—FERNALD, *Stand. Nat. Hist.*, 1885, II, p. 453.—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 774, pl. XI, fig. 8.

Stage VI.—"Head large, rounded, reddish. A pair of stiff spike-like tufts of hair, reddish at base, blackish at end, arise from the dorsal tubercles (of joint 2); a pair one-third as long (on joint 3). Body and hairs pale rust red; a lateral irregular whitish stripe, sending prolongations upward; an interrupted dorsal whitish line. Legs reddish." (Packard.)

Stage VII.—Head white, so thickly dotted with light reddish as to appear of that color; an irregular vertical white line on each side of the median suture and a transverse one on ocelli. Warts distinct, normal; a few secondary hairs, especially subventrally. Hair black from warts I to III, pale brown V, VI, all fine and rather short. From tubercle I on joints 2 and 3 and from II on 5 and 12 a distinct black pencil. Body light pinkish brown, whitish dotted; warts orange; an obscure white dorsal line and distinct substigmatal one excised at the spiracles; an undulating row of black dots laterally, four per segment. Spiracles white surrounded by a smoky black shade. Venter and legs rather pale. Another form is "glossy black, sparsely clothed with tufts of white hairs. Hair pencils clear white or tinged with olive. A lateral (substigmatal) row of white spots extending superiorly and anteriorly just below the stigmata." (Thaxter.)

Food plants.—Larch, pine.

PANTHEA GIGANTEA French.

(Plates IX, fig. 2, male; fig. 3, female adult; XIX, fig. 3, male genitalia.)

Platyserura gigantea FRENCH, *Can. Ent.*, 1890, XXII, p. 134.

Panthea gigantea SMITH, *List Lepidoptera*, 1891, p. 34.

Ground color whitish, so heavily black powdered that it seems black, with a powdering of white scales and hair. This also gives the wings a somewhat semitransparent appearance. The thorax is crossed by two rather indistinct transverse black bands, which are hardly relieved against the dark background. Primaries with the transverse lines single, black, and well defined. Basal half line present, but hardly traceable below the costal area. Transverse anterior line rather narrow, even, sharply defined, almost rigidly upright, and marked by a few preceding pale scales. Transverse posterior line even, black, well defined, evenly oblique from costa to vein 4; then with an even, well-marked incurve to the inner margin. This line is followed by a whitish shading. Median shade line less evident and narrower than the

others, best marked and with a distinct incurve across the cell, and below it almost straight, and much less defined. It does not touch the transverse posterior line in my specimens. The subterminal line is almost exactly as in *furcilla*, but a little less marked. There is a distinct dusky lunule representing the reniform; but the orbicular is absent. Secondaries in the male whitish, with a blackish shading along the inner margin; in the female smoky, with an indefinite darker exterior band. Beneath smoky, paler in the male, terminal space gray, the subterminal space darker, making a vague transverse band, which is continued across the secondaries, on which a discal spot is also apparent.

Expanse, 1.90 (male) to 2.30 (female) inches (48 to 58 mm.).

Habitat.—Colorado; Texas.

I have only a single pair of this fine species, through the courtesy of Mr. Philip Laurent; hence I can not speak as to variations. Nor have I any better or more accurate localities than above given. The species is sharply distinct from its allies in size, dark color, and in the structure of the male genitalia.

PANTHEA PORTLANDIA Grote.

(Plates IX, fig. 4, female adult; XIV, figs. 1, 5, head and thorax; XV, fig. 5, male antenna; XVI, fig. 1, venation; XVII, fig. 6, leg structure; XIX, fig. 1, male genitalia.)

Panthea portlandia GROTE, Mitth., a. d. Roem. Mus., Hildesh, 1896, No. 3, p. 14.

Ground color white or nearly so, more or less black powdered. Collar with a smoky shading at base and blackish line at tip. Patagiae crossed by two blackish bands and the bunching of scales and hair at the base of the thorax is also black tipped. On the primaries the black powdering is, as a whole, more dense along the inner margin, and before the subterminal line, which is thus shaded. It also tends to extend upward a little in the median space. Basal line traceable only across the costal area. Transverse anterior line single, broad, black, a little irregular, but, as a whole, outwardly oblique. Transverse posterior line upright to vein 4, but a little toothed on the veins; below that point with an even incurve broken by a tooth on the submedian vein. Median shade line well marked, as broad or broader than the others, almost rigidly upright to the submedian interspace, below which it runs close to and parallel with, but does not touch, the terminal posterior line. The subterminal line is broadly black shaded and prominently toothed. The most prominent teeth are on veins 3 and 4, and in the interspaces between 5 and 6, and 6 and 7. Between these and below vein 4 the line is incurved and less conspicuously dentate. There is a terminal black line which tends to break up into spots or lunules. The orbicular is wanting, but the reniform is present, either as a black lunule or as a crescent with black margin and whitish center. The terminal space is a little black powdered. Secondaries whitish, a

little dusky at the base, and with a blackish, diffuse, exterior band. Beneath, primaries smoky to the terminal space, all the markings of the upper side faintly visible; terminal space powdery white; secondaries whitish, with two narrow and one broad, diffuse, smoky transverse bands.

Expanse, 1.60 to 1.90 inches (40 to 48 mm.).

Habitat.—Victoria and Corfield, Vancouver; Northwest British Columbia; Seattle, Washington; Portland, Oregon.

This species has been taken in some numbers by Dr. Dyar, at light, and seems to be not uncommon. It is the palest of all our species and easily distinguishable from those resembling it in size. There seems to be little variation, save in the amount of the black powdering.

PANTHEA ACRONYCTOIDES Walker.

(Plates IX, fig. 5, male; fig. 6, female adult; XIX, fig. 4, male genitalia.)

Audela acronyctoides WALKER, Can. Nat. and Geol., 1861, VI, p. 37.—GROTE, Can. Ent., 1877, IX, p. 27; Bull. Geol. Surv., 1878, IV, p. 169.

Panthea acronyctoides SMITH, List Lepidoptera, 1891, p. 34.

Panthea leucomelana MORRISON, Proc. Ac. Nat. Sci., Phila., 1875, p. 428.—GROTE, Bull. Geol. Surv., 1878, IV, p. 169, pr. syn.

Ground color white or nearly so, quite heavily powdered with smoky and black scales. Disk of thorax smoky; tip of collar black; patagiae crossed by two blackish bands. Primaries quite heavily powdered with smoky or black, the tendency being to leave the basal space moderately pale, the cell almost whitish, and the terminal space gray. Basal line black and traceable across the cell. Transverse anterior line single, almost upright, but well outcurved in the interspaces. It is variable in width and in definition. Transverse posterior line irregular, narrow, denticulate, strongly incurved in the submedian interspace. Median shade line distinct, broad, diffuse, usually parallel with the transverse posterior line; the tendency being to fill the space between these lines completely. Subterminal line very strongly dentate; much as in *portlandia*, but the teeth yet more marked. The subterminal space is smoky almost to the transverse posterior line, leaving only a narrow white shade. There is a terminal dusky line tending to break into spots, and the terminal space is blackish powdered, sometimes becoming smoky. The orbicular is present as a black dot; the reniform as a small black crescent. Secondaries whitish; more dusky at base, with a blackish submarginal band which shades gradually toward the base and, as a whole, the female is much darker than the male. Beneath whitish, both wings crossed by three rather undefined smoky bands, which are much better defined on the secondaries.

Expanse, 1.45 to 1.55 inches (36 to 38 mm.).

Habitat.—River Rouge in June; Canada; Maine; New York; Massachusetts; Minnesota; Wisconsin; Corfield, Vancouver.

This is the smallest of the species in average expanse, though speci-

mens of *furcilla* run below it. It is most like a small *portlandia*, with all the teeth exaggerated and everything darkened. The tendency to darken the space between the median and transverse posterior line is quite marked in most specimens. This is the only species in which the orbicular is developed; but the dot which represents it is present in all the specimens I have had before me.

DEMAS Stephens.

Demas STEPHENS, Ill. Brit. Ent., Haust., 1829, II, p. 59.

Plump, yet somewhat slightly built species, with retracted head, very short thorax, long, cylindrical abdomen, and large, narrowly trigonate primaries.

Head strongly retracted, broader in the male than in the female, front flat. Tongue short and weak, useless for taking food. Palpi scarcely reaching the front and very slender. Eyes hairy. Ocelli very small and concealed. Antennae lengthily and heavily pectinated in the male, simple in the female; seeming short in proportion to the wings.

Thorax very short and weak, wider than long, collar and patagiae well marked, vestiture composed of flattened hair and scales, forming no tufts. The legs are short and stout, yet weak in proportion to the body, clothed with lengthy hair and scales. No armature, except the usual spurs, which are well developed and subequal.

Abdomen long, exceeding the anal angle of the secondaries in both sexes; longer and more cylindrical in the female. No tuftings.

The wings are of good size, large in proportion to the thorax. Primaries with the costa and inner margin arched so that the wing widens rather abruptly at base; outer margin oblique, arquate, the apices rectangular rather than pointed. Venation normal, except that the accessory cell is narrow, sometimes stalked beyond the cell, and occasionally wanting entirely. As a rule, 7, 8, 9, and 10 are very close together from the end of the small cell; when that is absent the stalk continuing the subcostal gives off in order 10, 7, 8, 9.

Secondaries proportionate, rather narrow, venation normal, save that 5 is as strong as any others and arises close to 4 from the median vein.

The genus is closely related to *Panthea*, and differs chiefly in the form of the primaries, which are less triangular, with more arched costa and more abruptly widened inner margin. The thorax seems yet smaller and more weak and the head more retracted, leaving the abdomen of disproportionate length, especially in the female. The antennae, especially of the male, seem unusually short, though this is less marked in *palata* than in the other species. In all, however, the pectinations are proportionately longer than in those of *Panthea*.

Three species are recognized as belonging here, *propinquinia* and *flavicornis* being closely allied, while *palata* is very distinct.

Propinquinia resembles *Panthea* in the form of the median lines, which are single and quite well marked; but the transverse posterior

line is more normally and evenly bisinuate, and the median line is diffuse and obscure. Both ordinary spots are present.

Flavicornis looks much like the preceding, and has been confused with it. The median lines are much more slender and are connected in the middle of the wing, while the median shade line is altogether wanting. There are numerous other points of difference, but these will serve here.

Palata is the prettiest of all the species, with the vestiture smooth, the markings clear-cut, black, and slender, on a clean gray background, and the median space more or less black filled. The median lines are connected by a cross line, and the median shade line is more or less obvious.

There is no marked agreement or disagreement in the sexual characters, which are rather indefinite and without obvious type.

In tabular form the species are as follows:

ANALYTICAL KEY TO THE SPECIES OF DEMAS.

Median lines not joined or connected; median shade line distinct....*propinquilinea*.

Median lines connected:

Markings obscure, grayish-powdery, not well defined; no median shade line.
flavicornis.

Markings black, sharply defined on a clear blue-gray ground; median shade line present; median space more or less black filled*palata*.

DEMAS PROPINQUILINEA Grote.

(Plates VIII, fig. 36, larva; IX, fig. 7, male; fig. 8, female adult; XIX, fig. 5, male genitalia.)

Charadra propinquilinea GROTE, Trans. Am. Ent. Soc., 1873, IV, p. 293, pl. I, fig. 96.

Apatele propinquilinea PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 499.

Demas propinquilinea SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 32.

Ground color white or nearly so, with brown and black powderings, giving the insect a dusty gray appearance. Head almost white, with a yellow tinge, while the male antenna is distinctly yellow. Collar with a vague dark shading centrally. Disk of thorax smoky posteriorly. Patagia blackish at tip and with two narrow blackish bands. Primaries with all the markings blackish and fairly evident, though not prominent. Basal line traceable through the cell. Transverse anterior line broad, single, upright, or even inwardly oblique, with three feeble outcurves. Transverse posterior line very evenly bisinuate, outwardly denticulate on the veins, inwardly a little indefinite. Median shade broad, diffuse, almost rigidly upright, and may be nearest to either transverse anterior or transverse posterior line. It does not touch either in my specimens, and the median lines are not in any way connected. Subterminal line denticulate on the veins, a little irregular, but as a whole parallel to the outer margin; inwardly diffuse, outwardly defined by a white shading. A dusky terminal line is preceded by pale lunules, which are variably distinct in the specimens. The orbicular is round or nearly so, brown ringed, centered with the white ground color.

The reniform is very narrow, upright, and somewhat imperfectly brown ringed. Secondaries smoky, paler at the base, with a vague discal lunule and darker in the female. Beneath whitish, a little darker on the disk of primaries; secondaries with a smoky exterior band.

Expanse, 1.35 to 1.50 inches (34 to 37 mm.).

Habitat.—Kittery Point, Maine, June and July; Massachusetts in June; Rhode Island and New York, May, June, and July.

This species differs from *flavicornis* in lacking all connection between the median lines, and in this respect it resembles the species of *Panthea* much more nearly than those of *Charadra* or *Raphia*, which the other resembles in character of markings. There seems to be little variation, except in the relative distinctness of the maculation and a little in the distance between the median lines. As a whole the lower portion of the median space is a little the darkest part of the wing.

LARVA.

GOODELL, Papilio, 1881, I, p. 15.—THAXTER, Papilio, 1883, III, p. 12.—A. K. DIMMOCK, Psyche, 1885, IV, p. 274.—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 499 (*Apatela* sp. 45).—DYAR, Journ. N. Y. Ent. Soc., 1895, III, p. 130; Can. Ent., 1896, XXVIII, 103.

Stage VI.—As in the next stage; but a few red hairs from wart I the whole length, especially from joints 6 and 7. No black marks on the body except on joint 2. Width of head, 2.5 mm.

Stage VII.—Head shining red or blackish brown, pale on the clypeus; width, 4 mm. Body very variable in color, the ground white with numerous little transverse wrinkles of a more opaque white, and a white substigmatal band, depressed at the spiracles and sometimes broken or absent. Black shading usually begins at this band, bordering it above, spreading upward, especially in the incisures and below around warts VI, till the body may be nearly all black. Hair short, rather stiff, but not spinose, from distinct warts nearly in a transverse line; IV very small; no secondary hairs. Hairs white or yellowish; from wart II on joint 3, a red or black pencil; from wart I on joints 5 and 12, a red or black tuft, the pair forming a single tuft. Spiracles white.

This larva presents no good distinguishing characters from the European *Demas coryli*. In my European specimens the black shading seems to appear first dorsally rather than stigmataally, as in the American form, and a red tuft has persisted on joint 6; but I doubt the constancy of these characters.

Cocoon.—Thin and frail; a few threads spun between leaves.

Pupa.—Smooth, very shiny, the wing cases somewhat coarsely wrinkled. Abdominal segments regularly tapering, perfectly smooth, shagreened in the incisures. Cremaster large, thick, a little bulbous at the end, corrugated and wrinkled, with a series of hooks at the end as in *Charadra*.

Food plants.—Birch, walnut, maple, oak, beech.

DEMAS FLAVICORNIS Smith.

(Plates IX, fig. 9, male; fig. 10, female adult; XVI, figs. 2, 3, 4, venation; XVII, fig. 8, legs; XIX, fig. 6, male genitalia.)

Demas flavicornis SMITH, Bull. Bkln. Ent. Soc., 1884, VII, p. 3.

Demas propinquinella SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 32.

Ground color a very pale dusty gray, on which all the markings are obscurely defined. Antennae of male yellow, head otherwise immaculate. Collar smoky tipped. Disc of the thorax smoky and patagia with a smoky tip and cross band. Primaries with the ornamentation smoky and in very slight relief. Transverse anterior line narrow, single, almost upright or even inwardly oblique, with a single outward tooth below the cell to meet a similar process from the transverse posterior line. Transverse posterior denticulate and a little outcurved over the cell, then with a deep incurve to meet the spur from the transverse anterior line. The inferior inclosed median space is usually the darkest part of the wing. Subterminal line denticulate, parallel with the outer margin and shading insensibly into the palest ground color inwardly. Terminal space dusky, ending in a broken dusky terminal line, which is preceded by pale lunules. Orbicular round, brown ringed, with a pale center. Reniform narrow, upright, incompletely outlined in smoky. Secondaries thinly scaled; whitish in the female, blackish in the male. Beneath gray to smoky, with a vague outer line and discal spot.

Expanse, 1.10 to 1.75 inches (27 to 44 mm.).

Habitat.—Newark, New Jersey, in May; Albany, New York, May 12; Long Island, New York.

In this species the male is much smaller, darker, and more obscurely marked than the female. As a whole the space beyond the middle is distinctly paler than toward the base, and this, with the united median lines, will serve to identify the species.

In a general way this species resembles the *propinquinella* of Grote, and I was so often informed in letters that my name was a synonym that I accepted the fact after an examination of Mr. Grote's material in the British Museum, in which only one form is represented. Comparing the true *propinquinella* with the real *flavicornis*, side by side, proves them abundantly distinct, though both have yellow antennae. The sexual structures are also sufficiently distinct, so that my name must be reinstated. The range of this species is probably similar to that of *propinquinella* and is certainly much greater than above given.

DEMAS PALATA Grote.

(Plate X, fig. 1, male adult.)

Charadra palata GROTE, Can. Ent., 1880, XII, p. 258; Papilio, 1881, I, p. 153.*Panthea palata* SMITH, List Lepidoptera, 1891, p. 34.

Ground color whitish, densely powdered with black, thus giving the insect a very bright, blue-gray appearance. Collar and patagiae black tipped, and the disc of the thorax is also blackish. Primaries with the ornamentation black, the lines narrow and sharply defined. Basal line traceable. Transverse anterior line single, broader than the others, outwardly convex, but as a whole its course obliquely inward, the line being closer to the base at the inner than at the costal margin. Transverse posterior line slender, somewhat irregular in the upper portion of its course, as a whole inwardly oblique and rather feebly bisinuate. Median shade broad, diffuse, darkening the space between the ordinary spots, and lost in the dark shading in the inferior portion of median space. The median lines are connected by a black bar in the submedian interspace, and below this the space is blackish. Subterminal line slender, black, only a little irregular, and as a whole parallel with the outer margin. A dusky terminal line is preceded by a series of pale lunules. Orbicular moderate in size, upright, oval, black ringed and black centered; the intervening space gray. Reniform upright, somewhat lunate, black ringed, centered with gray. The transverse anterior line is preceded, the transverse posterior and subterminal are followed, by paler shades. A darker shading runs through the center of the subterminal space, best marked near the internal margin. Secondaries white in the male, dusky in the female. Beneath gray, secondaries white. On the primaries the markings of the upper side are vaguely reproduced; on the secondaries there is an exterior dark band and a discal spot.

Expanse, 1.35 to 1.55 inches (34 to 38 mm.).

Habitat.—Colorado; Arizona.

This is the brightest and prettiest of the species; easily distinguished by the clear black and white powderings, which give the insect a clean and neat appearance. It resembles *Raphia* in appearance as noted in the original description, but is best placed in *Demas*, though not far remote from *Panthea*.

CHARADRA Walker.

Charadra WALKER, Cat. Brit. Mus., Het., 1865, XXXII, p. 445.

Plump, well-developed species, with large though not prominent head, quadrate thorax and rather stumpy, yet amply developed primaries.

Head of good size, broad, distinct, yet not prominent; front hardly convex, yet scarcely flat; eyes large and widely separated; hairy; ocelli well developed and not concealed. Tongue moderately developed and

useful for feeding. Palpi short and weak, hardly extending beyond the front so as to be visible from above. Antennae in the male rather short, lengthily pectinated; in the female, longer, very shortly pectinated.

Thorax fairly developed, almost quadrate, clothed with vestiture composed of flattened hair and scales, forming an indefinite little truncated posterior tuft. The collar and patagiae are distinct. The legs are well developed and of almost normal noctuid proportion to each other, though small in proportion to the insect. They are clothed with rather long hair, and are unarmed save for the usual spurs, which are short and weak.

Abdomen little or not at all exceeding the anal angle of the secondaries in the male, and not greatly exceeding it in the female. It is more or less conic in the male, more cylindrical in the female, and in both with a series of dorsal scale tufts which are very easily removed.

Primaries of good size, trigonate, and yet with a rather stumpy appearance, which is most strongly seen in *dispulsa*. The costal margin is hardly one-third longer than the inner, which is strongly curved toward base. The venation is quite normal.

Secondaries proportionate. Vein 5 quite as strong as the others and arising close to 4.

Altogether this is a strongly marked genus with an abundance of distinctive characters, not the least of which are the pectinated antennae of the female.

The genitalia of the male are of the same general type, with quadrate harpes, a long upper and a shorter lower clasper. They are quite complicated, however, and very different from each other; hence need not be further discussed here.

Three species occur, and of these I do not know *decora* Morrison. I have never seen the type nor do I know where it is. No collection known to me has a named specimen, and I suspect, from the description, that the insect does not belong to this series at all. The "simple" antennae—it is not stated whether of male or female—will serve to exclude it from this genus.

Deridens is somewhat the larger of the two species known to me, and has the markings black and sharply defined. The median lines are centrally connected and the ordinary spots are black centered.

Dispulsa is much paler and has a washed-out appearance. The median lines are slender and not in any way connected, while the ordinary spots are vaguely yellow and without trace of any dark centering.

In tabular form the two species appear so:

ANALYTICAL KEY TO THE SPECIES OF CHARADRA.

- | | |
|--|-------------------|
| Markings black, sharply defined; median lines connected centrally; ordinary spots black centered..... | <i>deridens</i> . |
| Markings blackish, not sharply defined nor contrasting; median lines not connected, ordinary spots yellowish, not dark centered..... | <i>dispulsa</i> . |

CHARADRA DERIDENS Guenée.

(Plates IX, fig. 12, male adult; XV, figs. 1, 2, antennae, male; XVII, fig. 5, legs; XIX, fig. 8, male genitalia.)

Diphtera deridens GUENÉE, Spec. Gen., Noct., 1852, I, p. 35, pl. III, fig. 8.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 36.

Charadra deridens GROTE and ROBINSON, Trans. Am. Ent. Soc., 1868, II, p. 86.

Acronycta circulifera WALKER, Cat. Brit. Mus., Het., 1857, XI, p. 709.—GROTE and ROBINSON, Trans. Am. Ent. Soc., 1868, II, p. 78, pr. syn.

Charadra contigua WALKER, Cat. Brit. Mus., Het., 1865, XXXII, p. 446.—GROTE and ROBINSON, Trans. Am. Ent. Soc., 1868, II, p. 86, pr. syn.

Ground color a creamy white, the ornamentation and powdering black. Antennae of male brownish. Collar with a central black band and inferiorly a little dusky. Patagiae with a black band and black tipped. Disc of thorax black powdered. Primaries with the ornamentation black and contrasting. Basal half line black, single, broken on the subcostal vein. Transverse anterior line black, single, bent on the costa and then almost upright to inner margin, giving off an acute outward tooth at its middle to meet a similar indentation of the transverse posterior line. Transverse posterior line single, black, slender, starting from a black blotch on the costa, beneath which it is sharply bent over the cell, denticulate on the veins and drawn in to meet the tooth of the transverse anterior line. Median shade diffuse, brownish rather than black, a little bent on the costa, and then evenly oblique between the ordinary spots to the inner margin. Subterminal line black, inwardly diffuse, outwardly defined by a white shade, very irregular but not dentate, best marked toward the margins and often quite vague centrally. There is a series of black terminal lunules, beyond which the fringe is dusky. Orbicular large, round, incompletely outlined, with a large central black spot. Reniform narrow, upright, best marked in black, outwardly. As a whole the basal space is well powdered, there is a clear shade before the transverse anterior line, the median space is quite clear except for the median shade, a clear shade follows the transverse posterior line, and this is bounded by a dusky area that sometimes becomes emphasized so as to form a dentate outer line. Terminal space moderately powdered. Secondaries smoky, somewhat paler basally; a dark line at the base of the fringes, which are whitish and cut with smoky. Beneath, primaries smoky on the disc, gray outwardly beyond a dusky outer shade; secondaries paler, gray, with an extra median dusky line and a discal lunule.

Expanse, 1.40 to 1.80 inches (35 to 45 mm.).

Habitat.—Canada south to Florida and Texas, west to Colorado. Canada in February; Kittery Point, Maine, June and July; Massachusetts in July; Evans Center and Sharon, New York, in July; "New York" in May.

This species is easily recognized by its large size, peculiar creamy tinged primaries and united median lines. The variation is confined

to the amount and extent of the black powdering, and even in size the range is not great if the sexes are separately compared, the male being almost uniformly larger than the female.

LARVA.

SAUNDERS, Can. Ent., 1870, II, p. 145.—LINTNER, Twenty sixth Rept., N. Y. State Cab. Nat. Hist., 1872, p. 157, fig. 12.—PACKARD, Am. Nat., 1874, VIII, p. 692.—THAXTER, Papilio, 1883, III, p. 11.—DIMMOCK, Psyche, 1885, IV, p. 274.—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 166.

Egg.—Hemispherical, with flat base and distinct vertical ridges, diminishing above and ending by becoming flattened to the surface of the egg near the micropyle; number, about 28. Reticulations distinct, rather square, a line at the vertex of each rib and one in each groove only slightly wavy; the cross reticulations forming the striae, all equally distinct. Reticulations smaller at the micropyle. Diameter, 0.9 mm.; height, 0.45 mm. Color pale whitish green, later with a black dot at vertex and a narrow concentric ring one-third the way down, irregular or broken.

Stage I.—Flattened, the legs spreading. Head rounded, whitish; width, 0.5 mm. Body whitish, green from the food; cervical shield reddish and a series of red subdorsal patches over wart II, very distinct on joints 3 to 7, entirely absent elsewhere. Warts many haired, the hair black and white, spinulose, the long ones smooth distally. Wart I with 4 hairs, II single, III with many hairs, IV absent, V single; no subprimaries. Skin spinulose, especially dorsally.

Stage II.—Head, 0.9 mm. wide, all pale whitish. Body whitish, food dark, against which a whitish subdorsal line is defined. Five dark-red subdorsal spots as before. Warts pale, large, and rounded, especially the subdorsal on joint 2, which is large and orgyia-like. All many haired; VI present. Hairs black and white. The red spots fade during the stage.

Stage III.—Head yellow, a black band over the eyes and another across at apex of clypeus; sutures of clypeus also black; width, 1.5 mm. Body whitish, broadly gray dorsally, with a central stripe, narrow subdorsal and broader lateral bands, all faint. Hair from distinct warts, short from I and II, long from the lower part of III and sub-ventrally; wart IV nearly obsolete.

Stage IV.—Head black, a yellow band across the clypeus, trisected by the black sutures; width, 1.9 mm. Body all pale whitish, with long white hairs from the warts. Rests in a house of two leaves webbed together.

Stage V.—No change. Width of head, 2.5 mm.

Stage VI.—No change. Width of head, 3.5 mm.

Stage VII.—No change. Head shining black, rather densely fine hairy; three large yellow spots, one occupying the central part of the clypeus, the others on each side of clypeus, triangular, somewhat above the level of the eyes; width, 4.5 mm. Body whitish, immaculate, cov-

ered with tufts of long, fine, silky white hair from distinct warts; no secondary hairs. A few long black hairs grow from the stigmatal wart on joint 2. In another example, body grayish black, with a series of whitish dorsal spots on joints 7 to 11. Feet and venter pale; anal plate white. Warts pale gray; hair white.

Cocoon.—Thin, rather loose, with some floss silk on the inside. Spun between leaves.

Pupa.—Robust, smooth, and shining, dark brown, all the abdominal segments gently tapering, the consolidated anal portion somewhat more rapidly. Abdominal segments perfectly smooth, finely shagreened in the incisures. Cremaster large, a long thick cylinder slightly bulbous at the end, corrugated and wrinkled, bearing at the tip a curved series of numerous hooks, stout, the central ones longest and larger at the end than base, the apices completely recurved and overlapping.

Food plants.—Oak, birch, elm.

CHARADRA DISPULSA Morrison.

(Plates IX, fig. 11, female adult; XIV, fig. 2, head and thorax; XV, figs. 3, 4, antennae, male; XVI, fig. 5, venation; XIX, fig. 7, male genitalia.)

Charadra dispulsa MORRISON, Proc. Bost. Soc. N. H., 1874, XVII, p. 314.—HARVEY, Bull. Buff. Soc. Nat. Sci., 1875, III, p. 4.

Ground color white, with very fine black or brown powderings, often with yellowish tinge over all. Antennae of male brownish. Collar with a black band just below the tip. Patagiae black tipped and with a narrow black transverse band; disk of thorax also with black and yellow scales intermixed. Primaries with the ordinary lines slender, black, and not too well defined. Basal line feebly developed and scarcely traceable. Transverse anterior line slender, black, very little outcurved, and narrowing quite regularly from costa to inner margin. Transverse posterior line slender, very abruptly bent over the cell, and quite strongly incurved below. The median shade when best marked is evenly oblique, diffuse, and most evident costally; sometimes it darkens the space between the ordinary spots and at others it is scarcely traceable below the submedian fold, where there is a faint suggestion of a very slender dark streak uniting the median lines. Subterminal line vague inwardly and scarcely defined by a paler following shade; very irregular, but not dentate. There is a slender black terminal line which is sometimes broken. Orbicular round, moderate in size, often with a yellowish tinge, outlined by brown scales and with a brownish center. Reniform narrow, upright, yellowish, incompletely defined, with a dusky central line and sometimes followed by a yellowish shade. Secondaries smoky, paler at base; in the male paler, the smoky portion more confined to the anterior margin. Beneath, primaries smoky, paler toward base; secondaries whitish, with a more or less obvious outer line and discal spot.

Expanse, 1.37 to 1.50 inches (34 to 37 mm.).

Habitat.—Texas in March, May, June, August, and October.

This is a decidedly whiter species and smaller than *deridens*. The ornamentation is much less distinct and the median lines are not connected, though there is a vague suggestion of a very narrow line through the submedian interspace. There is the usual difference in the amount of the black powdering, which sometimes gives the median shade almost the dignity of a band; but otherwise my specimens indicate no variation.

CHARADRA DECORA Morrison.

Charadra decora MORRISON, Proc. Ac. Nat. Sci. Phila., 1875, XXVII, p. 55.

?*Diphthera cavillator* GROTE, Can. Ent., 1880, XII, p. 258.

This species has been described by Morrison, as follows:

Expanse, 57 mm. Length of body, 23 mm. Eyes hairy. Antennae simple, black. Abdomen yellowish. Anterior wings white, with the usual markings black, wavy, and distinct; the ordinary lines are marked on the costa by heavy oblique black dashes; half line present; interior line strongly lobed; the orbicular spot black, figure-eight shaped, very conspicuous; median shade present; the reniform spot large, irregular, open above and below; the exterior and subterminal lines are drawn close together, forming wavy, irregular bands across the wings; at the costa and internal angle the subterminal line forms large black blotches; a series of short terminal black lines on the nervules; fringe white, checkered with black. Posterior wings pure white, with a single heavy oblique black dash at the anal angle. Beneath white.

Habitat.—California.

This large and beautiful species is closely allied to our three smaller Eastern ones.

The white ground color, the peculiarly shaped orbicular spot, and the black mark at the anal angle of the posterior wings will serve to identify it.

This must be a striking species from the description; but I have seen nothing like it. No information is given as to what part of "California" is to be credited with this insect, nor is the name of the collector given. Mr. Grote states that the specimen is Central American, and suggests its identity with the *Diphthera cavillator* of the British Museum lists, but he does not make the reference definitely, nor does he state why he denies the Californian habitat of the species. I have little doubt that Mr. Grote is quite right in this matter, but have no material or evidence to verify his statements, and hence simply reproduce the description.

ACRONYCTA Ochsenheimer.

Acronycta OCHSENHEIMER, Schmetterlinge, 1816, IV, p. 62.

Species of moderately robust form, tending to become slight in the smaller species. Head not prominent, yet usually distinct, though tending to become sunken. Eyes naked and of good size, but not prominent; there are no lashes or fringes of hair at the orbits. The front may be somewhat conic, evenly convex, or very much flattened, the former occurring most obviously in the *americana* group, while the latter occurs most frequently in the group *auricoma* and reaches its

climax in *oblinita* and its immediate allies. The flattening of the head is accompanied by a tendency to shorten and soften the tongue. The palpi are well developed though moderate in size, well clothed with scales, the second joint longest and stoutest, the terminal short and stumpy. As a whole, the palpi are oblique or curved upward on the front, on which they usually reach the middle, though in group *americana* the opposite is usual. Ocelli are distinctly present. The antennae are simple in both sexes.

The thorax is almost quadrate, rather small in proportion, and without distinct tuftings. There is a somewhat compact massing of scales posteriorly, overhanging the junction with the abdomen, but it forms no true tufting. The vestiture is a mixture of scales and scaly hair, varying somewhat so as to seem more hairy in the *americana* series and more scaly in the *lobeliae* group. The collar is sometimes a little uplifted, but not at all prominent, and usually lies closely applied to the body of the thorax. The patagiae are also applied to the body, so that in a well-preserved specimen at rest the thorax is evenly though somewhat feebly convex. The legs are moderately stout and proportionate, not spinulated or in any way armed except as usual on the tarsi, and with the spurs of the middle and hind tibiae normally developed. The tibial epiphysis of the fore legs varies somewhat in size and position, and in fact the range is as great as in the entire Noctuid family taken together, if we exclude the Deltoids. There is also a difference in the relative length of the various members, but nothing that is different from what may be found in allied genera. The fore wings vary in form from broadly trigonate to narrowly lanceolate, while the secondaries are proportionate, with an even outer margin. The outer margin of the primaries is also even, the fringes of moderate length, and never scalloped or even wavy. In some species of the *lobeliae* group there is a little tendency to form an obtuse angulation at about the middle of the primaries, but this is vague except in *falcula* and *parallela*.

The abdomen exceeds the hind angle of the secondaries, is rather long in proportion to the thorax, subequal and ending obtusely. There are no dorsal tuftings, but there is a loose mass of fine hair laterally at base. In the male the segments are marked laterally by projecting vestiture, which does not form positive tufts.

The venation offers nothing peculiar, and variation, so far as it has been found, seems to be individual or at most specific, and occurs only in that group originating from the end of the subcostal. Vein 5 of the secondaries is distinctly more weak than the others and arises somewhat nearer to 4 than to 6.

As a whole, the characters of the genus are negative. There is no distinctive feature, if we except the generally gray or white ground color and the tendency to the formation of *psi* markings on the primaries. This is not, in one sense, a structural character, yet ornamen-

tation, when it is of a persistent type, is as much an anatomical fact as the development of other dermal outgrowths like spines or claws. The combination, then, which makes the species of this genus recognizable consists of the somewhat retracted head, rather short untufted thorax, rather long untufted abdomen, unarmed legs, simple antennae in both sexes, and white or gray primaries, in which there is usually a black basal dash and a streak opposite the anal angle, which may or may not cross the transverse posterior line.

It has been the habit to refer to this genus as one in which the adults are remarkably similar and offer no strong characters, while the larvae and even pupae afforded obvious and definite features for systematic purposes. These statements are made without knowledge of the structure of the insects and the amount of variation that actually occurs.

Mr. A. R. Grote, to whom we are indebted for the descriptions of several of our species of *Acronycta*, has also given us a number of lists and classifications in which generic and subgeneric names are applied to the groups and other divisions. These divisions are in the main based upon superficial appearance and resemblance and not upon structure or other characters of real systematic value. They were therefore incapable of accurate definition, and with one exception none of the proposed names can be used. In 1896 he published *Die Apateliden* as No. 3 of the *Mittheilungen aus dem Roemer Museum in Hildesheim*, and this is based upon larval characters supplied by Dr. Dyar and upon the published work of Dr. Chapman. No addition is made to our knowledge of adult structure and only the order in which the species are arranged is original.

As a matter of fact, the species of *Acronycta* afford excellent characters for groupings in the adult stage, and this is only what we should expect. It is unquestionably true that there may be independent variation in the larval stage, necessitated by the environment, but it is equally true that there can be no variation in any important structural or anatomical detail which will not also be marked in the adult. I am not so certain that the opposite is true, however, and am inclined to believe that structural differences in the adult may exist without obvious effect on the early stages. I am not inclined to fully agree with Dr. Scudder that genera are as easily traced in the larva as in the imago, and rather believe that, while adaptive or protective variation may occur in the early stages without effect upon the adult, all anatomical differences originate in the adult. Variation in the adults is also determined very largely by environment, and this is particularly true of adaptive variation. It is quite conceivable that real changes of structure may have taken place which are not in the least indicated by the superficial appearance. This, indeed, has happened in *Acronycta*. The species as a rule rest during the day openly upon the trunks and branches of trees, or upon stones, and their colors and markings are well adapted to harmonize with such surroundings and to render the resting specimen invisible. So long as this imaginal habit persists there is not much likelihood of any change in the general character

of the ornamentation whatever changes might take place in other directions.

The organs that are most likely to be first affected are those of reproduction, and in the *Noctuidae* at least those of the male seem particularly sensitive. I am not ready to claim that this is a rule, because our knowledge of the life history of our species and of the larval structures is too incomplete, but it is certainly true in *Acronycta*. A good species is certain to have specific peculiarities in all its stages, and if we do not discover them the fault is with us. Any sound system of classification based on one stage will harmonize with that built upon any other, provided that the facts are rightly interpreted. If we accept evolution as a fact it simply can not be otherwise, since all changes must have acted upon the species as a whole, and larval characters could not be continued unless the resulting adult was in turn affected.

We find, therefore, that if we examine the genitalia of the male in *Acronycta*, the proposed classifications of Chapman and Dyar, based upon pupae and larvae, are fully confirmed, and that even more divisions are indicated by this character. Dr. Chapman finds two very distinct pupal types. Dr. Dyar finds four series in the larvae, of which two are not sharply defined. In the adults there are five distinct genitalic types and a sixth that, while recognizable, leaves a few intermediate species unplaced. Unfortunately, too few of the larvae are known to make our classification correspond completely, but there is no reasonable doubt that our further knowledge will result in the discovery of characters that will associate all those forms agreeing in genitalic structure. It is interesting to note here that while excellent group characters are obtainable from these sexual structures, they are not of much specific importance in this genus, because all the species of each group resemble each other quite closely in this particular. The group of which *lobeliae* is typical varies most, and it is from this that modifications seem to radiate.

Five groups in this genus may be typified by *americana*, *lobeliae*, *persuasa*, *hamamelis*, and *auricoma*, respectively.

Group *americana* is well characterized by having, in the male, very broad harpes or sidepieces, from almost the middle of which there arises a long, curved, chitinous process. This process seems to arise directly out of the membranous structure, and is not set on a chitinous ridge or other separate strengthening process from the base. Superficially the species agree in trigonate primaries, in which the outer margin is long and evenly curved to the somewhat prominent apex. The maculation, while complete in some cases, tends to become broken up into blotches, and the *psi* marks are rarely prominent. The palpi are shorter than in any other group and hardly reach the middle of the front, which in the species of this series tends very strongly to become conical and somewhat prominent. The thoracic vestiture is decidedly less scaly than in the other groups, and in some cases consists almost entirely of long, very narrow, flattened hair. Altogether this group is fairly well marked.

In group *lobeliae* the harpes are very slender and long and the claspers are broad and entirely separated from them, except at the base. The individual clasper is long, broad, becoming scoop-shaped toward the end, and at the upper angle of this scoop a finger of varying length and curvature is developed. In many cases another finger-like process arises from the middle of the upper margin and projects at right angles to it. This structure is accompanied by much less trigonate primaries than was found in the previous group. They widen more abruptly on the inner margin, which is more nearly parallel with the costa, and the outer margin is much shorter, more bulging centrally, and meeting the costa in almost a right angle.

Almost all the species in which this structure is typical have a more or less obvious basal dash, a distinct dash usually forming a *psi* opposite the anal angle, often a dash opposite the cell and sometimes a black line connecting the ordinary spots. The vestiture in such cases is smooth and even. The first obvious superficial change is in the character of the vestiture, which becomes roughened, while the scales on the primaries tend to become elevated. The typical markings become obscured and the male organs emphasize the departure by changing the form of the scoop of the clasper into a flat plate, then to a more cylindrical, spear or beak shaped process, while the superior process becomes in some cases dominant. In another direction, while the maculation is at first powdery the vestiture remains normal, and indeed becomes much more smooth and even, while the dashes and *psi* marks are reduced and become much less prominent.

It is in this group that the greatest difficulties in arranging the species are experienced, because of these several branchings, which will not fit into any linear series.

Group *persuasa* is an offshoot from the previous group through *brumosa*. The clasper is broad, flattened, chitinous, united superiorly to the inferior margin of the harpe, furnished at the upper angle of tip with a longer or shorter, more or less curved corneous process, and at the middle of the upper margin with a finger-like, upright process. All the species agree in these characters.

Superficially the group is characterized by moderately trigonate primaries, though they tend to vary, but all the maculation is obscured and tends to become blotchy. A prominent, pale, round orbicular, with a central dusky spot, is a characteristic feature and sometimes the only contrasting mark. The vestiture is extremely rough in most of the species.

Group *namamelis* is characterized by the comparatively small, beak-like clasper, which arises from an oblique thickening on the harpes and near their center. Superficially these species are characterized by the arched costa of the primaries, which broadens them near the base and makes the inner and costal margins almost equal in length, the outer margin being short and the apices almost rounded. Here also the vestiture is distinctly roughened in most of the species.

Group *auricoma* contains forms in which the male clasper forms a chitinous thickening at the base of the sidepiece, usually separating beyond the middle and forming a straight inferior process and a curved and more slender superior hook, the two diverging from an acute angle. The variation is in the proportion of these two processes, the lower of which tends to obsolescence.

Superficially the species divide into two series, one of which is characterized by short, stumpy primaries, with the maculation of the *persuasa* group, the other by long subequal or almost lanceolate forewings, derived out of the *tritona* type of the *lobeliae* group. We have also, in the second series, an obvious tendency to a flattened or even retreating front, accompanied by a weakened tongue.

We find, therefore, a diversity of structure in the adults relatively as great as any that occurs in the larvae, and that, similar as the species may seem at first sight, they are so in reality only to him who is content to look at the surface, in dread of disarranging a scale lest the specimen should become thereby less desirable for the cabinet.

The synonymy has been worked out as carefully as possible and is believed to be correct, though it differs from any heretofore proposed in some respects. None of the Guenée or Walker types have been actually compared by the authors, but Dr. Riley's notes contained memoranda of nearly all the species represented in the British Museum, and Dr. Butler's notes on the same specimens were also of much use. Each description was carefully compared, however, and specimens fully agreeing were in all cases secured. The names heretofore not identified from the "Species General" have all been applied, and here the references to the early stages have in some instances decided the question as to what was really intended.

SYNOPSIS OF GROUPS.

- Primaries well developed, trigonate, outer margin oblique, apices somewhat drawn out; all the markings usually normal, but tending to break up into spots or blotches on the transverse lines, which are often marked on the costa only; *psi* marks not prominent.....Group *americana*.
- Primaries rather abruptly widening on inner margin at base, less obviously trigonate, outer margin arcuate, the apices rectangular, or even a little rounded.
 - Vestiture smooth, the markings not picked out by elevated scales; the dagger marks prominent.....Group *lobeliae*. §
 - Vestiture rough or squamose, the markings picked out by elevated scales.
 - Psi marks evident, wing form as in *lobeliae*.....Group *lobeliae*. §§
 - Psi marks wanting or barely indicated, primaries trigonate, apices rectangular; broader than in *lobeliae* in proportion to lengthGroup *persuasa*.
 - Psi marks present or wanting, costal margin arcuate, the primaries widening abruptly near base and subequal.....Group *hamamelis*.
- Primaries short, trigonate, stumpy in appearance, or long, narrow, subequal or lanceolateGroup *auricoma*.

GROUPS ACCORDING TO GENITAL STRUCTURE.

- Lateral clasper a single, long, curved hook, arising abruptly from the harpes. *Group americana.*
- Lateral clasper scoop shaped, with a projecting long upper angle; with or without a finger-like process from upper margin..... *Group lobeliae.* §
- Lateral clasper flat, with a long projecting angle and a finger-like process from upper margin..... *Group persuasa.*
- Lateral clasper beak like, with or without a superior process; arising separately from harpes..... *Group lobeliae.* §§
- Lateral clasper hook or beak like; arising from an oblique thickening at the middle of the harpes..... *Group hamamelis.*
- Lateral clasper a slender claw, hook or process above, and a short, stout, inferior process, somewhat like a short thumb and a long curved forefinger. *Group auricoma.*

GROUPS ACCORDING TO LARVAL STRUCTURE.

- Warts small, few haired; secondary hair predominant..... *Group americana.*
- Warts small, secondary hair subordinate, always present at least slightly. *Group lobeliae.*
- Warts small or single haired; no secondary hairs..... } *Group persuasa.*
- Warts large, functional; no secondary hairs..... } *Group hamamelis.*
- Warts large, functional; no secondary hairs..... *Group auricoma.*

Group AMERICANA.

1. All the maculation distinct; ordinary spots well defined; median lines geminate, transverse anterior scalloped, transverse posterior denticulate; secondaries yellowish in both sexes..... *rubricoma.*
- Maculation more or less incomplete; median lines never both geminate, transverse anterior line not scalloped, and transverse posterior line not so strongly denticulate; secondaries various..... 2.
2. No longitudinal basal dash, line, or streak..... 3.
- A longitudinal black basal line, not divided at tip and not joined to the transverse anterior line, which is absent or marked on costa only..... 4.
- Basal dash very short, not reaching to the transverse anterior line, which is often indicated on the submedian interspace by an angulated mark... 7.
- Basal dash or streak extending to the transverse anterior line, or to the angulated mark indicating it..... 8.
3. Secondaries smoky in both sexes; median lines and ordinary spots fairly well marked; transverse posterior line geminate; size very large... *americana.*
- Secondaries yellowish white in male, smoky yellow in female; primaries with an ochreous tinge, best marked in male; dagger mark opposite anal angle sharply defined and crossing the transverse posterior line. *hastulifera.*
- Secondaries grayish white in male, smoky gray in female; primaries bluish ash-gray; dagger mark opposite anal angle is but vaguely indicated and does not cross the transverse posterior line..... *hesperida.*
- Secondaries white in male, smoky gray in female; primaries ash-gray; dagger mark opposite anal angle well marked and usually crosses transverse posterior line..... *dactylina.*
4. Primaries dark blue-gray, densely black powdered..... 5.
- Primaries paler ashy gray, black powdering more sparse..... 6.
5. Ordinary spots and median lines usually wanting; veins slightly darker, giving a somewhat strigate appearance; transverse posterior line sometimes well defined as a narrow pale band..... *felina.*

- Ordinary spots always discernible, sometimes well marked; transverse posterior line well defined and even.....*frigida*.
6. Darker, the black powderings evenly distributed, veins somewhat smoky, giving a strigate appearance; transverse posterior line continuous, without blotchy marking.....*pacifica*.
- More whitish, the black powderings irregularly massed, veins not so marked as to give a strigate appearance; transverse posterior line broken, with blotchy black markings.....*insita*.
7. Chalky white, black powderings very fine; ordinary spots well marked; transverse anterior line marked on costa, internal margin, and in submedian interspace; transverse posterior line interrupted and blotchy; dagger mark prominent and crosses transverse posterior line opposite anal angle.....*cretata*.
- White, with a faint creamy tinge; markings as before, but less prominent; powderings much less evident.....*leporina*.
- Grayish white, more evenly black powdered; orbicular absent; dagger mark not distinct and does not cross transverse posterior line opposite anal angle.....*populi*.
8. Transverse anterior line incomplete, but usually present in part..... 9.
Transverse anterior line complete, geminate..... 10.
9. White, with a creamy tinge, primaries rather sparsely powdered; orbicular distinct.....*lepusculina*.
- Ashen gray, primaries quite densely powdered with coarse black scales; no median shade line.....*cinderella*.
- Ashen gray, as before, but with an evident, smoky, angulated median shade line or band.....*transversata*.
10. Primaries dark bluish gray; transverse anterior line almost upright, its two parts almost equally distinct and quite widely separated; size smallest of the group.....*tota*.

Group LOBELIAE.

1. No black basal dash, line or streak and no black dagger marks of any kind... 2.
A black basal dash, streak, or line present in all cases; one or more dagger marks usually present..... 3.
2. Ground color creamy white; costal marks and transverse posterior line black.
innotata.
- Ground color luteous, the maculation but little darker and none of it black.
betulae.
3. The ordinary spots are more or less obviously tied or connected by a black line or dash..... 6.
The ordinary spots not connected by a black line or dash.
- Scaly vestiture of primaries smooth, decumbent..... 4.
Scaly vestiture of primaries elevated, rough, giving the surface a more or less velvety appearance..... 15.
4. Maculation strigate, all the ordinary lines and spots obscured..... 9.
A more or less obvious black mark or dagger line touches or crosses the transverse posterior line opposite the cell..... 5.
No trace of a dagger mark or black line opposite the cell of primaries..... 10.
5. Dorsum of the thorax discolorous, yellow, primaries creamy white with yellow shadings, secondaries smoky; size large.....*morula*.
- Dorsum of thorax concolorous.
- Size moderate, primaries ashen gray, no median shade line; all the dashes distinct and the markings well defined.....*occidentalis*.
- Size small, primaries with a more or less obvious median shade line.

- Ashen gray, with a slight reddish tinge; opaque; the dash opposite anal angle usually crossing the transverse posterior line.... *paupercula*.
 Glistening or shining white, with mossy olivaceous or bluish shadings; anal dagger usually not crossing the transverse posterior line. *vinnula*.
- Smoky or blackish, the maculation white; median lines very strongly dentate *fragilis*.
6. Primaries creamy white, a little shining, powdered with fine brown atoms; secondaries smoky yellow *laetifica*.
- Primaries ash or bluish gray.
 Dorsum of thorax concolorous; transverse markings normal..... 7.
 Dorsum of thorax discolorous, yellow; maculation strigate..... 8.
7. Secondaries smoky yellowish in both sexes.
 Largest of the series; expands 1.75 to 2 inches; all the black marks and dashes prominent and contrasting; the basal dash usually crossing the transverse anterior line..... *lobeliae*.
 Expands not to exceed 1.75 inches.
 Deep ash-gray, with a smoky tinge; secondaries smoky yellow in both sexes..... *furcifera*.
 Paler ash-gray, a little mottled in appearance; secondaries white, with a faint smoky shading *hasta*.
 Bluish ash-gray; maculation tending to become strigate; secondaries pure white..... *manitoba*.
8. Primaries gray, with a faint ochereous suffusion; all the ordinary spots and lines traceable; secondaries with a faint smoky tinge..... *thoracica*.
 Primaries blue-gray, without suffusions; the ordinary spots and lines scarcely or not at all traceable; secondaries pure white..... *strigulata*.
9. Primaries dark ash-gray, with a smoky suffusion; secondaries with a yellowish tinge, which is best marked in the male *lithospila*.
10. Internal margin of primaries darkened by a black shading from base below the dash to the transverse posterior line 14.
 Primaries uniformly gray; not darker along inner margin 11.
11. The dagger opposite anal angle crosses the transverse posterior line..... 12.
 The dagger opposite anal angle does not cross the transverse posterior line.. 13.
12. Very dark, even, blue-gray, the maculation obscure, except for the dashes and transverse posterior line; transverse anterior line scarcely traceable *tritona*.
- Ash-gray, powdery, all the markings evident.
 Darker and larger; space beyond transverse posterior line smoky, dagger mark opposite anal angle very heavy; secondaries soiled whitish in both sexes *revellata*.
 Smaller and paler, a little marbled in appearance; dagger mark opposite anal angle more slender; secondaries white, only a little soiled in both sexes *grisea*.
 Very even, ash-gray, without contrasts and with all the markings slender and neatly written; secondaries white in the male, smoky in the female *radcliffei*.
13. A quadrate black patch on primaries between the ordinary spots..... *quadrata*.
 No marking between the ordinary spots.
 An orange shading at base below the black dash; secondaries white in the male, soiled with gray in female..... *fulcula*.
 No orange shadings at base; secondaries white in both sexes, a little soiled outwardly in female..... *parallela*.
14. Bluish gray; the dark shading along inner margin is diffuse, not defined, and does not extend upward on the transverse anterior line..... *mansueta*.

- Bluish white, the dark shading along inner margin is black, sharply defined, and extends upward so as to form a tooth on the transverse anterior line *funeralis*.
15. A dark longitudinal shade extends through the middle of the primaries 16.
 Primaries without such a dusky central shade 17.
16. Smaller, smoky gray, a little suffused with luteous in the cell; not mottled or marbled *connecta*.
 Larger, ashen gray, a transverse as well as longitudinal dark shade giving the primaries a marbled or mottled appearance *superans*.
17. Very dark, powdery ash-gray; none of the dashes well marked; all the lines geminate, but obscure; secondaries smoky yellow, darker in the female *brumosa*.
 Paler ash-gray; at least the basal dash well marked.
 The dashes neatly defined; that opposite anal angle not diffuse... *spinigera*.
 The dashes diffuse; that opposite anal angle thick and not sharply defined. *pruni*.

Group PERSUASA.

- Almost entirely black; the orbicular white, round, contrasting, with a central dot; all other maculation obscured *afflicta*.
- Very dark ash-gray, mottled with black; all the maculation traceable, but, except the orbicular, not contrasting *persuasa*.
- Dark ashy gray, more evenly washed with smoky; the black shadings tending to become strigate *liturata*.
- Ground color bluish white; all the markings black, so that the primaries appear marbled *marmorata*.

Group HAMAMELIS.

- Dagger mark opposite anal angle usually distinct, always traceable.
 Secondaries of male white; ground color of primaries even, dark blue-gray, ordinary spots shaded with reddish; vestiture scarcely roughened, even of the ornamentation *albarufa*.
 Secondaries smoky in both sexes.
 Yellowish gray, the reniform yellow shaded; basal dash distinct, black, connecting with an inward angulation of the transverse anterior line, which is broadly black marked and so formed as to include an ovate basal space above the streak *ovata*.
 Essentially with markings as before, but the basal dash is linear or scarcely traceable and the transverse anterior line is not black marked; size smaller *modica*.
 Uniformly ash-gray, the geminate transverse anterior line evenly oblique, and the dagger mark opposite anal angle tending to disappear in the male *clarescens*.
- No dagger mark opposite anal angle; at most a diffused shading that suggests its presence.
 Expands more than 1.25 inches; ground color varies from ashen gray to blackish smoky; the markings either distinct and contrasting or barely traceable *hamamelis*.
 Smaller and of a much more evenly dark ground color; does not exceed and rarely reaches 1.25 inches in expanse *incerta*.
 Size as before, but ground color of a pale, whitish gray *retardata*.

Group AURICOMA.

1. All the ordinary maculation present, but not contrasting; no longitudinal streaks, dashes, or dagger marks; primaries elongate, subequal.....2.
- All the ordinary maculation present, more or less mottled and contrasting, tending to suffusion; primaries short and trigonate.....3.
- The ordinary maculation more or less obscured, tending to become more distinctly strigate; wings long, trigonate, tending to or becoming lanceolate...4.
2. Dull gray, with dense black powderings obscuring the maculation; secondaries grayish white *illita*.
- Brighter gray, primaries with sparser powderings and all the maculation clear; both wings with a yellowish suffusion, most marked in secondaries. *luteicoma*.
3. Even, pale, powdery gray, without a black basal dash or streak, and with no contrasting maculation..... *sperata*.
- Marbled black and white; the maculation contrasting..... *noctivaga*.
- Primary gray, more or less mottled; basal black streak present.
- Dark bluish gray, the maculation not prominent; secondaries soiled white in the male, smoky gray in female..... *emaculata*.
- Paler gray, with a slight yellowish tinge on both wings, the markings well relieved and the primaries, therefore, with a mottled appearance.
- Somewhat broader winged and the primaries less pointed at tip; transverse anterior line in female always well marked..... *impressa*.
- Narrower winged and the primaries more pointed at tip; transverse anterior line in female obscured by a dusky shading which extends from base to the anal angle *distans*.
4. The primaries so strigate as to appear blackish and the transverse maculation obscured 5.
- The primaries ash-gray, not prominently strigate; transverse maculation distinct; an obvious dagger mark opposite the anal angle..... 6.
- The primaries almost white, with black powderings, in form lanceolate and without a dagger mark opposite the anal angle..... 7.
5. All the maculation obscured, and only the reniform sometimes traceable. *barnesii*.
- Transverse posterior line fairly evident and lunulate; secondaries of female dusky *perdita*.
- Transverse posterior line evident and very strongly dentate; secondaries white in both sexes..... *edolata*.
6. A distinct black basal streak; transverse anterior line obscure or wanting; transverse posterior line strongly denticulate..... *extricata*.
- No black basal streak; transverse anterior line usually evident; transverse posterior line not strongly denticulate..... *xyliniformis*.
7. Grayish white, powdery; transverse posterior line lunulate; a series of black terminal dots..... *oblinita*.
- Bluish white, less powdery in appearance; transverse posterior line an even, continuous brown shading; no black terminal dots..... *lanceolaria*.

Group AMERICANA.

The species united in this group find their most important common feature in the sexual characters of the male. In all cases the harpes or sidepieces are broad, rounded at the tip, and the clasper consists of a single long hook, which arises directly out of the membranous side-piece much nearer to the base than to the middle. There is hardly any material variation in this plan of structure, and, while there are differ-

ences, they are merely specific; indeed, they can not be used satisfactorily for even specific separation, because in closely allied species the structures are so similar as to be within the range of possible variation.

Superficially the group is distinguished by the well-developed, trigonate primaries, in which the outer margin is long, oblique, evenly curved, and the apex is pointed. Yet the wings are never lanceolate or tending to that form. None of the species have the *psi* or dagger marks strongly developed, though in most instances that opposite the anal angle is at least indicated. The markings are of one general type and, while all present, tend to become broken and blotchy. While there is no distinctly roughened vestiture, yet there is throughout a powdery appearance which is quite characteristic, and which, with the wing form, makes it fairly easy to determine the group.

There is no uniformity in the structure of the male foreleg, yet the tendency is to locate the tibial epiphysis below the middle and extending to the tip.

Separated from all the other species by having all the maculation distinct and the median lines geminate is *rubricoma*. It is rather a variable form and narrower winged than the others. There is little contrast in the maculation and in most cases the lines can hardly be called even blackish. The species varies in size and may be either clear ashen gray, or may have a yellowish smoky suffusion throughout. When the gray and the yellowish forms are separated they seem quite distinct; but there are specimens that may be with equal propriety placed in either series; hence it is not safe to give even a varietal name.

The balance of the species may be separated into two series according as there is or is not a basal black streak, line, or dash.

In the first series no such line, streak, or dash exists, and of this *americana* is characteristic. This, the largest species of the genus, is really very much like *rubricoma* save that the markings become much less definite, and the transverse anterior line tends to obsolescence. The transverse posterior line, while it is dentate, is not nearly so well marked in this particular as is *rubricoma*, and finally, besides being the largest in the genus, the secondaries are uniformly smoky brown in both sexes, though much darker in the female. It is also remarkable for the extremely well-developed anterior femora in both sexes.

Hastulifera is a smaller species, of a somewhat paler gray, soiled with a yellowish suffusion, most obvious in the male, which is otherwise decidedly paler in color than the female. In the secondaries the same yellowish shade obtains, but those of the female are much darker and smoky. The difference between the sexes in this species is quite marked and much more obvious than elsewhere in the group. In all the specimens I have seen there is a distinct though slender dagger mark crossing the transverse posterior line opposite the anal angle.

Hesperida is a new species, from the Pacific coast, which has been mistaken for *dactylina*, and perhaps for *americana* in some cases. It is

almost as large as *americana*, but is of a bluish ash gray, very densely powdered with black scales. The secondaries in the male are white, with a faint, smoky gray tinge, and in the female they are gray powdered. As a whole, the female is darker and larger than the male, but the difference is not nearly so striking as in *hastulifera*. The *psi* mark, opposite the anal angle of primaries, is barely indicated by a diffuse shading which does not cross the transverse posterior line.

Dactylina is of a bright bluish gray, powdered with black atoms, but not so densely as in the preceding, than which it seems, therefore, decidedly paler. The secondaries are white in the male and grayish, powdery in the female. The *psi* mark, opposite the anal angle of the primaries, is distinct and crosses the transverse posterior line.

Of the species in this series it may be said, in recapitulation, that *americana* is distinguished by its large size and very dusky secondaries. *Hesperida* is almost as large, but is blue gray, the secondaries are nearly white in the male, and there is no *psi* mark crossing the transverse posterior line opposite the anal angle of primaries. *Hastulifera* and *dactylina* both have the *psi* mark, but the former has a distinct yellowish shade in both sexes, and smoky secondaries in the female, while the latter is bluish gray and powdery, and the secondaries of the female are gray. As between the males of these latter species there can rarely be doubt. As between the females some forms of *dactylina* can be separated from *hastulifera* only by the secondaries.

In the series in which there is a black basal dash, streak, or line three subdivisions are recognizable: First, where the basal streak is linear, terminating acutely and extending to the point which would be occupied by the transverse anterior line were it present; second, where the basal streak is very short and does not reach the point where the transverse anterior line is or might be marked—in this case it is quite usual to have the transverse anterior line marked in the submedian interspace by an angular mark; third, where the basal dash or streak reaches to and joins the transverse anterior line or the angular mark which invariably indicates it. This basis for subdivision seems at first sight to be rather slight, but a large series of specimens of each species proves that it holds good. There are cases, of course, where a specimen may at first seem doubtful, but such are usually due to an imperfection in the example or to an aberration which is rarely the same on both wings.

In the first subdivision, where the streak is slender and the transverse anterior line is wanting, there is a tendency to a strigate type of maculation. In *felina*, which is a very dark blue-gray, all the transverse maculation is lost, save that the transverse posterior line may be present as a paler shade. The other lines are rarely even indicated on the costa and the ordinary spots are practically wanting. There is no dagger mark opposite the cell.

Frigida is a close ally of and has been mistaken for *felina*. It is somewhat broader winged, however, has the transverse posterior line

at least indicated and usually distinct, the reniform evident, the orbicular at least traceable, and there is an evident dagger opposite the cell, crossing the transverse posterior line. The basal dash may extend through the submedian interspace so as to connect with the *psi* mark opposite the anal angle.

Pacifica is a smaller, narrower winged species, and is more ashen gray and more powdery. The transverse posterior line is distinct, while the transverse anterior line and median shade are marked on the costa. The reniform is vaguely lunate; the transverse posterior line is emphasized opposite anal angle and vaguely so opposite the cell, thus leading to the *leporina* type.

Insita continues this tendency. It is a paler blue-gray, the powdering is more sparse and seems coarser, while the transverse posterior line is broken and marked diffusely opposite the cell and the anal angle. The transverse anterior line and median shade are distinctly marked on the costa and the reniform is reduced to a somewhat obscure dusky lunule.

In the second subdivision, where the streak is very short, *cretata* is pure chalky white, with very fine black powderings on the primaries. The ordinary lines and median shade are prominently marked on the costa, the reniform is an obvious black lunule, and the broken transverse posterior line is marked opposite cell and anal angle, at which latter point a *psi* is distinctly formed.

Leporina is like the preceding, but the primaries have a faint creamy tinge and are less powdered. The maculation is less prominent, and the *psi* opposite anal angle is wanting or diffuse. In *cretata* the anterior femora are much stouter and comparatively shorter than in *leporina*. This is the only species of *Acronycta* common to Europe and North America, and our larvae are absolutely like those compared from Europe.

Populi is more grayish white, with the powderings more evenly distributed over the entire wing. The type of maculation is as in the preceding species, but everything is diffuse. The orbicular is absent and there is no black line or dagger opposite the anal angle.

In the third subdivision, where the black basal streak reaches to the transverse anterior line, the first species is *lepusculina*. This is like *populi* in markings, but the orbicular is always present, the transverse anterior line is often traceable, and there is a distinct dagger crossing the transverse posterior line opposite the cell. The question as between *lepusculina* and *populi* is settled, therefore, by retaining both names. Guenée and Riley both confused the species, and Guenée's description covers both forms. The form bred by Riley and since that time by others is that which I have here called *populi*.

Cinderella is more ashen gray and the powdering is more coarse and more dense. The markings are much as in *lepusculina*, but the color is darker, the transverse posterior line is continuous, and there is much less contrast.

Transversata is much like the preceding, but there is an evident median shade line crossing the wing through the outer part of the median space and reaching the inner margin at about its middle. It is the only species so marked in the group and hence easily recognizable.

Tota is the smallest of this group and unique in its uniform dark blue-gray primaries, and the very distinct, even, geminate transverse anterior line. Both parts of the transverse anterior line are equally well marked and they are well separated. There are no dagger marks and the ordinary spots are well outlined.

The only European member of this group, other than *leporina*, known to me is *aceris* and its variety *candelisequa*. The sexual structure is in full accord with that of the American species, and in superficial appearance it is nearest to some of our large specimens of *rubricoma*, standing somewhat intermediate between that species and *americana*.

ACRONYCTA RUBRICOMA Guenée.

(Plates I, fig. 4, adult; VI, figs. 14, 15, larva; XV, fig. 10, head; XVII, fig. 9, leg; XVIII, fig. 12, tarsal claw; XIX, fig. 10, male genitalia.)

Acronycta rubricoma GUENÉE, Spec. Gen., Noct., 1852, I, p. 49.

Acronycta acericola WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 57.

The ground color is somewhat luteous gray; the yellow tinging sometimes faintly visible, sometimes very prominent. The head and thorax are powdery, the collar a little darker at the tip, and the edges of the patagia somewhat dusky tipped, though this is a variable character. The primaries are well powdered with black atoms, which give them a roughened appearance. Sometimes the powdering is quite evenly distributed. Occasionally it is more distinctly massed at the base and a little beyond the transverse posterior line, and quite frequently there is a more or less complete median shade which crosses obliquely from the costa over the reniform and is rarely traceable below that point. The median lines are geminate, and in well-marked specimens they are all distinct. The basal line is also geminate, sometimes marked on the costa only, sometimes distinct to a narrow, blackish, longitudinal line which extends from the base to the transverse anterior line. The transverse anterior line is blackish, as a whole outwardly oblique, and irregularly dentate and lunulate. The transverse posterior line is very strongly lunulated, so that it is outwardly dentate on the veins. The outer part of the line is usually more distinct than the inner, and the included shade is paler than the ground color; sometimes almost white. There is no distinct subterminal line; but sometimes this is indicated by a slight difference in shade in what may be called the terminal space. There is a series of blackish terminal dots beyond which the fringes are cut with brown. The orbicular is round; of moderate size, ringed with blackish, sometimes with a discal dot and occasionally entirely suffused. The reniform is large, kidney shaped, rather well defined in most specimens, but often obscured by a dusky shade.

There is a vague dusky shade in the submedian interspace from the transverse posterior line outward, which represents the ordinary *psi* mark. Occasionally this is fairly distinct and sometimes we have a more or less obvious streak, which crosses the transverse posterior line. The secondaries are whitish, with a faint yellowish tinge in the male, darker and a little smoky in the female. There is usually a vague discal dot and a discal outer line, which are rather a reflection of what is found on the under side than a distinct marking of the upper surface. Beneath the color varies from white to yellowish smoky, in all cases with a more or less obvious discal dot and an outer shade line on both wings.

Expanse, 1.25 to 1.80 inches (31 to 45 mm.).

Habitat.—Long Island, New York, March 6; Washington, District of Columbia, April 28, July 10, September 3; St. Louis, Missouri, March 3; Texas, April 11 and 21, August 12. Occurs throughout the Middle and Southern States and has been found in Canada.

This insect varies remarkably in size, and this seems to be, to some extent at least, due to locality, for all my large examples are from Texas, while the smallest are from Long Island. Some of the latter seem to be bred specimens, and it may be that this is in some measure responsible for the small size. At first sight it almost seems as if the species could be divided into two by the ground color, because the larger specimens are more generally shaded with yellow; but nothing in the structure or markings will authorize the separation even into varieties. The original description of the species fits best to the well-marked specimens from the southern range of the species. The head is usually distinct: the front is prominent and a little conical. The clasper of the male genitalia is moderate in size, quite stout, and not very strongly curved. The harpes are oblong, with an oblique tip. The anterior legs of the male are usually short and stout, the femur is very strongly developed, and the tibia is short and thick, with the epiphysis attached at the middle and extending to the tip. The tarsi are also stout and rather short. The species differs from all the others in the group by its complete maculation, and in this respect it somewhat resembles the European *aceris*, with which it was compared by its describer. The longitudinal black line at the base is never very prominent and sometimes scarcely traceable. Indeed, in some of the paler specimens it is altogether absent. Eight males and fifteen females have been compared for this description from divers collections.

LARVA.

FRENCH, Sixth Rept. Ill. State Normal Univ., 1880, p. 45.—MARTEN, Tenth Rept. Ill. State Entomologist, 1881, p. 132.

Stage IV.—Width of head, 2 to 2.2 mm.; shining dark brown over the lobes, clypeus and mouth pale whitish. Body greenish white, with traces of a powdery blackish dorsal shade most distinct on joints 5 to 9 and 12. Hairs whitish, not very abundant, the primary form small,

concolorous warts, secondary not numerous, similar to the primary. Dorsally on joints 5, 6, 7, 8, 9, and 12 a thin pencil of black hairs.

Stage VI.—Head shining black, the clypeus brownish, its suture pale; width, 4.5 mm. Body greenish white, with a dorsal blackish band, pulverulent, obscurely geminate, often entirely absent, except for a double black mark on the cervical shield and a black spot on joints 5 to 13, or 5 to 9 and 12. Thoracic feet pale brown, leg plates pale. Warts very small, the hair mostly secondary, short dorsally, and spreading each way from the center of the segment; quite long laterally. Dorsal pencils tapering, moderately long, broadest at base and arising from a single large area representing tubercles I. The pencils may be present on joints 5, 6, 7, 8, 9, 10, and 12, with a trace of one on 11 or else only on joints 5 to 9 and 12. All the hairs, both pencils and general clothing, white or pale yellow, the pencils becoming black with yellow tips, apparently at maturity, as in the case of all the hairs of *leporina*. Length, 40 mm.

Pupa.—Abdominal segments finely punctured for more than the anterior half, regularly tapering; wing cases grooved and wrinkled. Cremaster very short, consisting only of an elliptical wrinkled area from which the hooks arise, a bunch of four or five in the upper row, the central one strongest, and a line of four or five on each side below, the most anterior one strongest, none much recurved. Color rather light red brown, shining. Length, 16 mm.

Food plant.—Hackberry.

ACRONYCTA AMERICANA Harris.

(Plates I, fig. 2, adult; VI, fig. 17, larva; XIV, fig. 11, ovipositor female, 3; 6, thorax from side; XVII, fig. 10, leg; XVIII, fig. 4, palpus; XIX, fig. 11, male genitalia.)

Acronycta americana HARRIS, Rept. Ins. Mass., 1841, p. 317; Ins. Inj. Vegetation, 2d ed., 1852, p. 317; Ins. Inj. Vegetation, Flint ed., 1862, p. 436, figs. 216–218; Ent. Corr., 1869, p. 311, fig. 111.—LINTNER, Twenty-sixth Rept. N. Y. State Cab. N. H., 1872, pp. 135–157.

Apatela americana GROTE, Bull. Buff. Soc. Nat. Sci., 1874, II, p. 154.—COQUILLET, Papilio, 1881, I, p. 6.—PACKARD, Ins. Inj. Forest Trees, 1881, p. 111.—GROTE, Papilio, 1883, III, p. 111.—PACKARD, Forest Insects, 1890, p. 397.

Megaacronycta americana GROTE, Mitth., a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 10.

Phalaena aceris SMITH and ABBOT, Ins. Ga., 1797, II, p. 184, pl. XCIII.—GUENÉE, Spec. Gen., Noct., 1852, I, p. 48 = *acericola*.

Acronycta acericola GUENÉE, Spec. Gen., Noct., 1852, I, p. 48.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 57.

Acronycta hastulifera, larva, GUENÉE, Spec. Gen., Noct., 1852, I, p. 47.

Apatela obscura HENRY EDWARDS, Ent. Amer., 1886, II, p. 169, pr. var.

The ground color is a somewhat pale, powdery ashen gray, with a more or less obvious yellowish tinge, which is often entirely absent. Head and thorax are slightly black powdered, but even in color throughout. The primaries have the ordinary marks fairly well traceable, but not contrasting and hardly distinct. The basal line is marked

on the costa only. The transverse anterior line is geminate, usually incomplete, sometimes hardly traceable. As a whole it is outwardly oblique, strongly dentated, and outcurved between the veins. The transverse posterior line is more distinct, lunulated outwardly, denticulated on the veins. The inner line is less marked than the outer, and the intervening space is usually paler, sometimes quite prominently so. There is no subterminal line and no distinct trace of any such in any specimen before me. In some specimens there is a fairly distinct shade line running obliquely from the costa to and darkening the middle of the reniform, but this does not extend below that point in any specimen that I have seen. The ordinary spots are fairly distinct in most specimens; the orbicular is round or oval, ringed with blackish, and without a central spot in the specimens before me. The reniform is large, kidney shaped, usually somewhat incomplete, and occasionally vaguely defined. It has always a central, dusky lunule, and is sometimes entirely dark. There is a distinct black dash in the submedian interspace crossing the transverse posterior line, and there is another, much less obvious, which crosses the line opposite the cell. In some cases a dusky shading accompanies the first mentioned of these spots. There is a series of dark terminal dots, beyond which the fringes are cut with smoky. The secondaries are yellowish gray or white in the male, more or less smoky and sometimes quite dark in the female. In some specimens the outer line of the underside is visible through the wing. Beneath, whitish or smoky, both wings with a discal spot and a more or less obvious outer line.

Expanse, from 2 to 2½ inches (50 to 62 mm.).

Habitat.—From Canada to Texas, west to Salt Lake City. It is taken in New York from May to July almost continuously, and again in September; Washington, District of Columbia, May 10; New Hampshire, July 12; Mount Airy, Pennsylvania, May 1 and 18; Texas, in April; Canada, June and July.

This is the largest species of the group, and can hardly be mistaken for any other. While on close examination it has almost identically the markings of the preceding, yet they are much less evident and more broken. The dagger marks crossing the transverse posterior line are usually quite evident, though that opposite the cell is not infrequently wanting. Besides being larger, the wings of this species are also more evenly trigonate than are those of the preceding. There is some variation in ground color, but not much in other directions. Mr. Edwards has described an unusually dark form from Salt Lake City as *obscura*; but similar forms occur in the East, and the difference, such as it is, is hardly worthy of a separate name. Smith and Abbot considered this to be the same as the European *aceris*; but, as Guenée pointed out, the similarity is not very strongly marked.

The clasper of the male is of moderate length and stout, quite evenly curved. The harpes are unusually broad at the center and taper to a rounded point. The anterior leg of the male is very strongly devel-

oped, the femur being actually and proportionately the largest found in the genus. It is excavated inferiorly near the tip to receive the short, stout tibia. The epiphysis is attached at a little below the middle and extends to the tip. Eighteen males and twenty-three females were compared.

LARVA.

SMITH and ABBOT, Lep. Ins. Ga., 1797, II, pl. XCIII (*aceris*).—HARRIS, Ins. Inj. Veg., 1841, p. 317.—GUENÉE, Spec. Gen., I, 1852, p. 47 (*hastulifera*).—HARRIS, Ent. Corresp., 1869, p. 311.—LINTNER, Ent. Cont., 1872, p. 158 (*hastulifera*).—COQUILLETT, Papilio, 1881, I, p. 6.—DIMMOCK, Psyche, 1885, IV, p. 274.—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 397.—COMSTOCK, Manual Stud. Ins., 1895, p. 307, fig. 373.

Egg.—Solitary, on the upper side of the leaf. Circular, flat, with almost eighty ribs on the margin, the ribs finely wavy at the summit. Grooves between even, smooth, becoming confluent reticulate toward apex and diminishing rapidly in number. Micropyle coarsely irregularly reticulate. Green, the upper part dotted with brown so thickly as to leave only rings of little green spots. Diameter, 1.2 mm; height, 0.25 mm.

Stage I.—Head round, bilobed, mouth produced, tips of jaws brown; width, 0.4 mm. Body colorless, green from food; setae single from low concolorous tubercles, 1 on joints 5 to 14 black, the rest whitish, long and slender, spinulated. Head setae above, and one of cervical shield also black. Tubercles whitish. Skin shining, faintly annulate, without marks.

Stage II.—Head bilobed, white; width, 0.6 mm. Body green from food, no marks; hairs fine, long, and white, a few black ones dorsally rising in bunches from small concolorous warts, normal. Joint 12 a little enlarged.

Stage III.—Head white, a large black patch over the lower half of each lobe, irregular above, and a small patch over clypeus; width, 1 mm. Body green from food; no marks. Hair long, abundant, from low, small warts, white, a few black ones dorsally, especially in straggling tufts on joints 5, 7, and 12. Possibly a few secondary hairs, but not distinct. Later traces of a geminate dorsal and single subdorsal black line.

Stage IV.—Head bilobed, all black, labrum and setae white; width, 1.65 mm. Body greenish white, a double dorsal and a lateral black line more distinct than before. Hair long, dense, all white, except a long black pencil from wart 1 on joint 5, 7, and 12 arising from a black patch, those on joints 5 and 7 double and divaricate. Warts white, obscure subventrally. Much short secondary hair is present. Thoracic feet, abdominal leg plates, and joint 14 black. Later the hair is yellowish, except at the tips.

Stage V.—Head black; width, 2.5 mm. Body greenish white, with double dorsal, single lateral, and stigmal black lines, and black shading subventrally and ventrally. Legs black and the whole of joint 13 dorsally, as well as dorsal spots on joints 5, 7, and 12. Hair

yellowish white. Pencils long, black, double on joints 5 and 7; single on joint 12 as in the mature larva.

Stage VI.—Head shining black, the sutures pale; width, 4.6 mm. Body greenish white, above marked with a geminate dorsal, a single lateral, and stigmatal black lines, all broken. Subventral region, feet and venter, with joint 13 above, also sooty black, the legs and plates shining. Hair abundant, about 2 mm. long, not concealing the body, and all of about uniform length, except a few long ones on joint 3, white. Black pencils dorsally on joints 5, 7, and 12, as in the next stage. Length, 45 mm.

Stage VII.—Head large, rounded, scarcely bilobed, shining black; the clypeus is high, reaching three-fourths the height of the head; the sutures on the sides and the one dividing the two lateral clypeal segments pale yellowish; labrum pale; width, 6 mm. Body pale greenish white, a series of geminate dorsal dots in the incisures of joints 5 to 12, a broad stripe on joints 12 to 13, narrowing in front, a broken obscure stigmatal line and traces of a lateral line posteriorly, as well as the thoracic feet, abdominal leg plates, and a broad ventral shade on joints 11 to 13, black. Warts small and obscured by the abundant secondary hairs, which are longer laterally than on the dorsum, diffusely spreading, pointing in all directions, rather short, not concealing the body, white or pale yellow. On joints 5, 7, and 12 wart I bears a long, slender pencil, forming a well-separated paired tuft on joints 5 and 7, consolidated into a single pencil on joint 12. Spiracles white, with black border. Length, 70 mm.

Cocoon.—Double, a thin outer web of silk and larval hairs and a thick inner cocoon of silk and chips of wood thickly interwoven. The cocoon is formed on a piece of wood, and consists half of the cocoon and half of the cavity in the wood formed by the removal of the chips to construct the cocoon. Length, 40 mm.; width, 20 mm.

Pupa.—Shining brown. Wing cases longitudinally grooved and shagreened. Abdomen regularly tapering, the segments smooth and punctured on the anterior portion. Cremaster rounded, blunt, coarsely wrinkled, the upper hooks a dense cluster of three or four, the lower a line of three to five on each side.

Food plants.—Maple, elm, chestnut, linden, poplar, birch, alder, oak, hickory, ash, sycamore.

ACRONYCTA HASTULIFERA Smith and Abbot.

(Plates II, fig. 12, female; III, fig. 5, male adult; VI, figs. 12, 13, larva; XVII, fig. 11, leg; XIX, fig. 14, male genitalia.)

Phalaena hastulifera SMITH and ABBOT, Ins. Ga., 1797, II, p. 183, pl. XCII.

Acronycta hastulifera GUENÉE, Spec. Gen., Noct., 1852, I, p. 47.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 56.

Acronycta acericola larva † GUENÉE, Spec. Gen., Noct., 1852, I, p. 48.

Ground color a pale gray, almost whitish in the male, with a bluish tinge in the female. The head and thorax slightly powdery, without distinct marking. The primaries have the ordinary maculation mostly

traceable, but more or less broken. The basal line is entirely wanting, or is marked on the costa only. The transverse anterior line is never entirely complete, and rarely even traceable across the entire wing. It is geminate, the inner line more distinct, and often this is prominent only just below the cell, where it forms a little inward tooth from which the line is feebly traceable to a costal spot on the one hand and to a more vague blotch on the inner margin near its middle. The transverse posterior line is single, consisting of a series of connected lunules which are black and quite obvious, somewhat emphasized by a preceding paler shade. The line is only a little toothed on the veins, and as a whole makes an even outcurve, followed by one as evenly inward in the submedian interspace. There is a vague median shade, often traceable across the entire wing, but obvious only as an oblique mark from the costa to the reniform. Beyond the transverse posterior line is a dusky shade, which gradually merges into the ground color before the outer margin. There is a series of terminal black spots, beyond which the fringes are marked but not entirely cut by dusky. There is a distinct dash crossing the transverse posterior line opposite the anal angle, but there is no line opposite the cell. The orbicular varies in size and shape; sometimes small, sometimes large, and it may be entirely rounded or distinctly oval. It is always ringed with blackish and is not dark centered. The reniform is kidney shaped, large, more or less incomplete, and with a central dusky lunate mark. The secondaries are whitish, with a faint yellowish tinge in the male, smoky brown in the female. In both sexes there is a series of terminal lunules, which are sometimes almost connected. Beneath, the wings are whitish or smoky, powdery, and in the male with a more or less obvious discal spot; in the female also with a more or less obvious outer line.

Expanse, 1.70 to 2 inches (42 to 50 mm.).

Habitat.—New, York; Philadelphia, Pennsylvania; New Jersey; Washington, District of Columbia, May 29; Massachusetts; California; Canada in June; Georgia; Central States.

I have 7 males and 6 females representing this species, which has been generally confused in collections, sometimes with *dactylina* and sometimes with *americana*. It resembles both and differs from both, and its most obvious character is the difference between the sexes. The males are smaller and much paler throughout, not only in the secondaries, but in the primaries as well. The secondaries are much more robust, and the fore wings are distinctly broader and less trigonate than they are in the male. This species was properly figured in both stages by Smith and Abbot, and can be readily separated from *americana*, on the one hand, by its paler ground color, smaller size, and single transverse posterior line, and from *dactylina* by the yellowish shading, which is totally absent in the latter species.

LARVA.

SMITH and ABBOT, Lep. Ins. Ga., 1797, II, pl. XCII (*hastulifera*).—GUENÉE, Spec. Gen., Noct., 1852, I, p. 48 (*acericola*).

Stage III.—Head bilobed, black, a few hairs; width, 1.8 mm. Body black, warts concolorous; hair thick, but short, obscuring the body, tawny brown, tipped with black and white, scant subventrally. On joints 5, 7, and 12 a black dorsal tuft, higher than the rest of the hair, and in the subdorsal space on joints 5 to 13 the hair is white.

Stage IV.—Head bilobed, smooth, black, and shining; a few white hairs; labrum whitish; width, 2.4 mm. Body black, spiracles white, warts III, IV, and V orange. Hairs as before, the brown strongly tipped with white.

Stage V (interpolated).—Head as before, slightly creased; width, 3.2 mm. Body black, all as before, but the dorsal tufts are scarcely longer than the other hairs, while all are tipped with white.

Stage VI.—Head black and shining, labrum pale; a V-shaped pale line parallel to the sutures of clypeus; width, 4.6 to 4.8 mm. Body black, spiracles white. Hair dense, of even length, not long, the secondary hairs not abundant. Warts distinct though small, few-haired, III and IV reddish. Hair dark brown except in a broad dorsal band on joints 5 to 13, which is black, containing the concolorous tufts on joints 5, 7, and 12, which exceed the other hairs very slightly. Both the black and the brown hairs are sparsely barbed and end in very slightly enlarged colorless tips, which give the larva a hoary appearance quite characteristic. The hairs form bands across the segments as in *dactylina*, but the bare incisions are much narrower than in that species. A few longer hairs from the extremities; dorsal hair not keeled. Length, about 35 mm.

Cocoon.—Elliptical, rather narrow, tough, and firm; composed of silk and some larval hairs intermixed; no wood, chips, or earth. Length, 30 mm.

Pupa.—Shaped as in *leporina*, the abdominal segments punctured on the anterior half; quite regularly tapering. Cremaster a low, wide elevation, with a cluster of four hooks on either side above and a single remote one below and farther in front. Color, dark blackish brown, slightly shining. Length, 18 mm.

Food plants.—Alder.

ACRONYCTA HESPERIDA, new species.

(Plates X, fig. 9, female adult; XIX, fig. 15, male genitalia.)

Ground color bluish ash gray, with very fine black and coarser smoky powderings. The ordinary markings are distinct in the male, but somewhat washed and indefinite in the female. The basal line is marked on the costa only, and then but feebly. The transverse anterior line is outwardly oblique, geminate, outcurved between the veins, and reaches

the inner margin at about its middle. In the male the two lines are equally distinct, and are smoky, the intervening spaces of the ground color. In the female the line is broken, and sometimes disappears almost entirely, the outer portion being often represented by a dot in the middle of the wing, and a dusky blotch on the costa and inner margin. The transverse posterior line is black or blackish, lunulate, well removed outwardly, strongly incurved below the cell, and thus bisinuate. The black lunules are preceded by a whitish shade and also, opposite the cell and in the submedian interspace, by a smoky mark. The line is followed by a dusky shade, which merges insensibly into the ground color. Subterminal line wanting. There is a series of black or smoky terminal spots in the interspaces, which may or may not cross the fringes. In the female all this marking is obscured; but on the other hand there is a vague, smoky, almost upright median shade, which darkens the reniform and forms a smoky blotch on the inner margin. The ordinary spots are distinctly outlined in black in the male, but vague and partly obscured in the female. The orbicular is round and usually small, sometimes minute; the reniform is large, kidney shaped, and has a smoky central mark which, in the female, obscures the entire spot. There is no basal streak, and only a poor indication in some specimens of a dagger mark opposite the anal angle, an outward tooth of the transverse posterior line, which is here usually best marked, giving the appearance of a small dash. The secondaries are whitish, a little soiled in the male, strongly gray powdered in the female, in which there is a more or less obvious, diffuse, outer smoky band. The veins are smoky, and there is a traceable discal lunule. On the under side the wings are whitish in the male, smoky in the female; in both sexes with a discal lunule and in the female also with a diffuse outer shade line. The head and thorax are without marks of any kind, save there is a blackish mark between the eyes and the base of the wings in some specimens. The sides of the palpi are also black.

Expanse, 2 to 2.25 inches (50 to 56 mm.).

Habitat.—"California;" Seattle, Washington; Tacoma, Washington, August 7; Nanaimo, Vancouver.

Two males and six females are before me, nearly all of them in fair condition. The Californian specimens are probably from the Sierra Nevada Mountains, but I have no definite data concerning them. Types are in the U. S. National Museum, the American Museum of Natural History, and in the collections of Messrs. Graef, Dyar, and Doll. This species is intermediate in most respects between *hastulifera* on the one hand and *dactylina* on the other. It has most the appearance of *dactylina* and has been mistaken for that species. It is probably not at all rare, and replaces *dactylina* in the Northwest. Where a series of specimens can be compared there is no difficulty at all in recognizing the distinctness of this species. It is larger, in the first

place; it is also much darker bluish gray. In the male the secondaries are somewhat soiled instead of nearly white, as in the Eastern species. The markings in the female are much more obscure, and the dagger mark opposite the anal angle is entirely absent, although its position is indicated by the angle in the line which has been referred to in the description. The sexual characters of the male do not differ from the ordinary form in this series.

ACRONYCTA DACTYLINA Grote.

(Plates I, fig. 3, adult; VII, figs. 18, 19, larva; XVII, fig. 11, leg; XIX, fig. 13, male, genitalia; XVI, fig. 8, venation.)

Apatela dactylina GROTE, Proc. Bost. Soc. N. H., 1874, XVI, p. 239.—MORRISON, Psyche, 1875, I, p. 42.—GROTE, Papilio, 1883, III, p. 111.

Megaconycta dactylina GROTE, Mitth. a. d. Roem. Mus., Hildesh, No. 3, 1896, p. 10.

The ground color is bluish gray with rather dense, fine powderings. Head and thorax without distinct markings, but powdered like the rest of the upper surface. Primaries with the ordinary maculation broken, basal line rarely marked even on the costa; transverse anterior line variably evident, geminate near base, evenly oblique outwardly, and moderately outcurved between the veins. In many cases a mark below the cell is all that is present. The transverse posterior line is single, black, lunulate, more or less dentate on the veins, preceded by a paler and followed by a darker shading. There is a series of terminal spots at the base of the fringes, from which a line sometimes cuts through to the outer edge. The median shade is marked only by a more or less indefinite, dusky, oblique shade on the costa, which extends to and darkens the center of the reniform. The orbicular is small, round, or oval, dark ringed, and centered with the ground color. The reniform is kidney shaped and more or less dusky centered. The secondaries are white in the male, gray, with a slight smoky tinge, in the female. Beneath white or gray, more or less powdery, all wings with a discal spot, and in the female with a more or less obvious outer line.

Expanse, 1.70 to 2 inches (42 to 50 mm.).

Habitat.—Massachusetts, in June; New York, in June and July; Minnesota, July 20; New Jersey, June 23; New Hampshire, July 20; Maine; District of Columbia, in May; Canada, in July; Colorado.

This species is quite widely distributed north of the Potomac and west to the Rocky Mountains, but does not extend very far north of the Canadian line, so far as the specimens before me indicate. The species differs by its bluish-gray color from all those that have preceded it, and the white secondaries are also distinctive. Occasionally a dark female may cause doubt as to whether it is not referable to *hastulifera*; but in this case the locality comes to our aid to some extent, because the present species does not extend south so far as does the other, while *hastulifera* does not extend north as far as *dactylina*. The front in this species and in *hastulifera* is evenly convex, but not at all bulging and

not in the least conic. The sexual pieces are also strongly alike in both. They are oblong, the tip diagonal, while the clasper is of moderate length and only a little curved. Twenty males and sixteen females have been compared.

LARVA.

DIMMOCK, *Psyche*, IV, p. 274.—PACKARD, *Fifth Rept. U. S. Ent. Comm.*, 1890, p. 498 (sp. 42, birch ins.); *Ibid.*, p. 626 (*hastulifera*).—EDWARDS and ELLIOT, *Bull. Am. Mus. Nat. Hist.*, 1892, IV, p. 77.

Stage I.—Colorless, whitish, the food showing green. Hairs from warts, long, silky white, mixed with a few black ones from warts I on joints 3, 5, 7, and 12. Head bilobed, whitish, eyes black, mouth brown; width, 0.7 mm.

Stage II.—Head shining black with two concave white bands close to the clypeus and connected above it by a cross-bar; a white mark above ocelli, another behind; clypeus greenish centrally, mouth parts pale; width, 1.2 mm. Hair long, curved, soft, white, with long, distinct, single black pencils from tubercle I on joints 5, 7, and 12. Warts colorous, body whitish, a slight irregular black marking subdorsally.

Stage III.—Head entirely black; width, 1.8 mm. Body as in the mature larva, but only partly black, being spotted and streaked with yellow, especially substigmatically. Primary hairs from distinct pale warts, IV behind the spiracle, V and VI small; hairs long, barbed. Secondary hairs shorter, most numerous dorsally. Primary hairs all white except the black pencils; secondary hair yellowish, shading to fleshy brown on the back.

Stage IV.—As before, the body blacker, very black in the incisures. Secondary hair abundant, the black pencils long. Primary hairs stiff and pale, radiating from the warts. Width of head, 2.4 mm. The appearance of segmentary bands of hair is heightened by the pale color of the center of the segments contrasting with the black incisures. Thoracic feet and venter black.

Stage V.—Like the mature larva; width of head, 3.6 mm. Lateral hair all fleshy brown except stigmatically and subventrally, where it is yellowish. Body all black except on the folds where the hair is very thick and there it is pale yellow. No continuous yellow substigmatal band. A narrow, faint, yellowish dorsal line of hairs.

Stage VI.—Head black, the lobes separated by a vertical notch; width, 4.5 mm. to 5 mm., line above labrum white. Body black, densely covered with secondary hairs, except rather broadly in the incisures, forming bands of short hair, obscuring the body except laterally where it is much thinner; slightly keeled along the dorsal line. Hair light yellowish on the sides, shading into fleshy brown on the back. On joints 5, 7, and 12 a single erect black pencil, twice as long as the other hair, yet relatively shorter than in the previous stage. A few long white hairs from the extremities. A faint yellowish irregular substig-

matal band, excavated for the spiracles and concolorous with the lateral hairs; spiracles white.

Cocoon.—Single, elliptical, not very thick but tough, composed of coarse silk with larval hair scattered over the outside, spun among leaves, etc.

Pupa.—Abdomen tapering, the segments sparsely punctured on the anterior side; wing cases creased and shagreened. Cremaster short and blunt, coarsely shagreened and wrinkled, the upper hooks in a dense cluster of about eight on each side, the lower ones absent or represented by one or two slight hooks.

Food plants.—Alder, willow, birch.

ACRONYCTA FELINA Grote.

(Plates XI, fig. 9, female adult; XIX, fig. 22, male genitalia.)

Apatela felina GROTE, Bull. U. S. Geol. Surv., 1880, IV, p. 208.

Ground color a very dark blue gray, densely black powdered. Head and thorax as usual immaculate. Primaries with all the lines absent, or only vaguely indicated. The veins are somewhat darker than the rest of the wing, which thus gives a somewhat strigate appearance. There is a distinct black basal line, which extends well toward the middle of the wing, and in some cases nearly meets another which reaches the outer margin and represents the dash that in better-marked species crosses the transverse posterior line. In some specimens the transverse anterior line is marked on the costa, and occasionally the transverse posterior line is indicated by a pale shade. The ordinary spots are wanting; but in some instances the reniform is vaguely indicated. The fringes are cut by somewhat indistinct dark lines opposite the interspaces; but there are no distinct terminal dots; occasionally a black dash is traceable opposite the cell, about where the transverse posterior line should cross. Secondaries white, in the female more or less black powdered. Beneath powdery white, with a more or less obvious discal dot and outer shade line.

Expanse, 1.60 to 1.80 inches (40 to 45 mm.).

Habitat.—Seattle, Washington; Sierra Nevada, California; Colorado (Bruce), Glenwood Springs in October (Barnes).

Twelve specimens, evenly divided as to sex, are before me, and offer very little in the way of variation. The species is quite characteristic and its very dark gray color with the almost entire absence of the ordinary marks will be sufficient to distinguish it. The head is rather smaller than usual, and more retracted. The front is hardly bulging and the tongue is a little weakened. The anterior legs of the male do not differ essentially from those of the immediately preceding species. The harpes of the male are more elongate than usual, quite even in width, and obtusely rounded at the tip. The clasper is rather short, strongly curved, and moderately stout.

ACRONYCTA FRIGIDA, new species.

(Plates XI, figs. 6, 10, male and female adults; XX, fig. 4, male genitalia.)

Acronycta lepusculina † HENRY EDWARDS, Proc. Cal. Ac. Sci., 1875, VII, p. 23.

Apatela felina † FRENCH, Can. Ent., 1889, XXI, p. 36.

Ground color dark blue gray, quite densely powdered with black. On the primaries the veins are marked with smoky, giving the wings a strigate appearance. Markings variable, but as a rule the ordinary spots and the transverse posterior line are fairly well marked, the reniform being distinct in all the specimens before me. The basal line is marked by a black dot on costa, or it may be entirely absent. The transverse anterior line may be absent, or may be marked by a blotch on the costa and an angulated mark in the submedian interspace. The median shade is marked by a spot on the costa and another on the internal margin, though both of these may be absent. The transverse posterior line is feebly lunulate, rather evenly bisinuate, and preceded by a slightly paler shade. In one specimen it is hardly traceable. The fringes are cut by smoky marks in the interspaces. The ordinary spots are obscure; the orbicular oblong, feebly black ringed, the reniform an indefinite black lunule. There is a distinct black basal streak which almost joins the dagger opposite the anal angle. The dagger mark opposite the cell is also very distinct. The secondaries are quite evenly smoky white, with the discal spot of the under side showing through. Beneath, the wings are whitish, powdery, the disk of the primaries smoky. On the primaries is a discal spot from which a spur is sent out, reproducing in a diffuse way the dagger mark of the upper side. The secondaries have a distinct outer transverse line, and a discal spot which, in one specimen, sends a dusky line to the base. The head and thorax are without markings save that there is a distinct line from the eyes to the base of the wings, and the sides of the palpi are blackish.

Expanse, 1.70 inches (43 mm.).

Habitat.—Sierra Nevada; Truckee, California.

Four specimens, one male and three females, are before me. Two are from the collection of the United States National Museum, one from the Rutgers College collection, and one from the collection of Prof. George H. French. The male is labeled July, Alameda County, California. One female is marked April, Alameda County, California, larva on willow. The specimen from the college collection is labeled Sierra Nevada, while the specimen from Professor French is marked from Truckee, and is dated May 6. This specimen was bred by Professor French and was mistaken by him for *felina*, which indeed it closely resembles at first sight. The specimen appears to have been mounted when fresh, and though not crippled looks somewhat undeveloped as compared with the others before me. The male is slightly smaller than the females and seems to be also a little paler in color, while the

markings are a little more distinct. As compared with *felina* the wings are shorter and proportionately broader. The markings are much better defined than in any specimens of *felina* that I have seen, and with a series of the insects at hand there is no difficulty whatever in recognizing their distinctness. The sexual structures are very similar in the two species, the harpes in *frigida* being proportionately a little broader, while the clasper seems to be rather longer and more slender; but the differences are slight and would hardly be considered of specific importance were it not for the other characters.

This is also the species referred to by Mr. Henry Edwards as the Pacific coast form, which he believed to be the true *lepusculina* Guenée.

LARVA.

EDWARDS, Proc. Cal. Acad. Science, 1875, VII, p. 23 (*lepusculina*).—FRENCH, Can. Ent., 1884, XIX, p. 49 (*felina*).—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 566 (*felina*).

Stage I.—"Dull whitish, upper part and sides of joints 2, 4, 5, 7, 8, 9, 12, and 13 reddish purple; brown hairs in clusters from the tubercles, the dorsal ones larger than the body; head black, feet purplish." (French.)

Stage II.—"White, the dark dorsal joints black; tubercles and head black; hair from the dorsal tubercles gray, the rest whitish." (French.)

Stage III.—"Creamy white, joints 2-5, 7-10, 12, and anal plate black above; a fine, white dorsal line. Tubercles bearing hairs of various lengths, the two dorsal ones on joints 5, 7, and 12 with small pencils of short black hairs and a few black hairs on the other dark joints. Head and feet black." (French.)

Stage IV.—"A dorsal gray stripe with central white dorsal line; a subdorsal gray stripe; sides greenish pale yellow. Hairs in thick clusters, spreading, with black tufts on joints 5, 7, 8, and 12 and forming a long fringe on each side of the body and behind." (French.)

Stage V (interpolated).—Head shining brown-black or pale, mottled with black spots; width, 4 mm. Body greenish white without marks, warts very small, primary and secondary hairs alike, long, fine, radiating in all directions, but straight, not curved; small black dorsal pencils on joints 5, 7, and 12 shorter than the other hair.

Stage VI.—Head pale, reddish mottled; width, 4.5 mm. Body without marks, the numerous long, soft, fine hairs radiating in all directions, yellow, not obscuring the body. No black hairs. Thoracic feet black.

Cocoon.—"Of silk and wood fiber; thin, firm, and tough." (French.)

Pupa.—Abdominal segments regularly tapering, slightly punctured in front; cases shagreened; mahogany brown. Cremaster short and wide, coarsely wrinkled above, upper hooks single, lower six to eight on each side, some projecting laterally, others backward, recurved.

Food plants.—Willow and poplar.

ACRONYCTA PACIFICA, new species.

(Plates XI, fig. 5, male adult; XX, fig. 2, male genitalia.)

Ground color a powdery ashen gray, in which all the markings are more or less obscure. The transverse anterior line is feebly traceable, geminate, twice outcurved, so that the inward angulation in the submedian interspace connects with the black basal streak. The median shade line is marked on the costa by a smoky blotch. The transverse posterior line is even, smoky, bisinuate; best marked in the submedian interspace, where it is crossed by a slender black dagger mark; subterminal line wanting. The fringes are cut by smoky lines opposite the interspaces. The orbicular is very small, oval, marked by black scales, and may be scarcely traceable. The reniform is also indefinite and consists of a shapeless smoky mark. Beyond the transverse posterior line the wing is somewhat more densely powdered and seems darker. The secondaries are white in the male and only a little smoky in the female. On the underside the wings are white, with discal marks and an outer line on each.

Expanse, 1.50 to 1.75 inches (37 to 45 mm.).

Habitat.—California.

Three males and one female are before me. All of the specimens are directly or indirectly from the Henry Edwards collection. Two of them are from the American Museum of Natural History, numbered 9615. One is labeled Sierra Nevada, while the solitary female, from the collection U. S. National Museum, is simply labeled California. In genital structure the species much more nearly resembles the *populi* series than *frigida*, although in markings it approaches most closely to some pale specimens of the latter. The harpes are very broad, and widen toward the tip, while the clasper is very long, slender, and pointed.

ACRONYCTA INSITA Walker.

(Plates IV, fig. 3, male adult; X, fig. 8, male adult; XVII, fig. 13, leg; XIX, fig. 16, male genitalia.)

Acronycta insita WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 61.—GROTE, Papilio, 1883, III, p. 111.

Ground color white, strongly black powdered, giving the creature a somewhat bluish ash-gray appearance. Head and thorax without distinct markings. Primaries with the ordinary lines more or less indefinite, but all of them marked on the costa. There is a distinct black basal streak, which usually extends to the point at which the transverse anterior line is ordinarily found; but sometimes it is abbreviated and in one specimen very slightly marked. The basal line is indicated by a black dot on the costa. The transverse anterior line is indicated by a black spot on the costa, by a more or less indistinct angular mark below the cell, and sometimes by a blackish mark on the inner margin. Sometimes the costal spot only is present. A distinct black spot near

the middle of the costa indicates the median shade. The transverse posterior line is single. When well marked it is lunulate, but it tends to become disconnected, and occasionally it is marked only by a difference in shading, the terminal portion of the wing being somewhat darker. It is better marked, as a rule, opposite the cell, and there may be one or two rather distinct black marks indicating the position of a dagger. The lunule in the submedian interspace is always evident, crossed by a dark mark, and usually more or less shaded with blackish. There is a series of black terminal dots, beyond which the fringes are cut with black. The orbicular is wanting in most specimens, but is sometimes faintly outlined. The reniform is indefinite and forms a vague black lunule. The secondaries are white, a little soiled in the female, and in both sexes with a series of blackish terminal lunules. Beneath it is white, with a more or less obvious discal spot, and, in the female, with outer shade lines on both wings.

Expanse, 1.50 to 2 inches (38 to 50 mm.).

Habitat.—Ithaca, New York, June 5; Chicago and Urbana, Illinois; Volga, South Dakota.

This species has never before been satisfactorily identified. Mr. Grote has several times named specimens *insita*; but in almost every instance they have been male *hastulifera* or specimens of *dactylina*. The species is very easily distinguished from either by the fact that the basal streak is present, and it is therefore really much nearer to *populi* and *lepusculina*. The species is a very simply marked one, and Walker's description is quite characteristic and applies perfectly. Mr. Grote has mentioned the fact that he has examined the type and that it seemed a good species, and this is borne out by the identification just made. I have two other specimens which may belong to this species, but differ very decidedly in ground color by being very much darker and having the secondaries more powdery. The maculation is the same, however, and as both my specimens are females, I do not feel justified in giving the form a name. One of the specimens is from "Murray Bay, Province of Quebec, July or August, E. Corning, jr." The other is from Calgary, Canada, June 25. In case further material proves this form a distinct one, I would propose the term *canadensis*, which may be applied for the present as a varietal term. The foreleg of the male is rather evenly developed; the femur is not unusually thickened, and seems rather long in proportion to its width. The tibia is stout, more than half the length of the femur, the epiphysis reaching to the tip and inserted at about the middle. The harpes of the male are broad and rather short, narrowing from each edge to the pointed tip. The clasper is rather stout and long, and is more strongly curved than usual. Four males and seven females are before me, including the two mentioned as varieties.

ACRONYCTA CRETATA, new species.

(Plates XI, figs. 3, 4, male and female, adult; XVII, fig. 15, leg; XIX, fig. 18, male genitalia.)

Ground color chalky white, with a sparse powdering of black scales, which are chiefly massed along the costa, the internal margin, and behind the transverse posterior line. The basal line is indicated by a small black dot on the costa. The transverse anterior line is marked by a black spot on the costa, a triangular mark in the submedian interspace, and an irregular blotch on the internal margin near its middle. The median shade is marked by a black spot on the costa above the reniform, and it may send a vague shade to that spot. The inception of the transverse posterior line is also marked by a black spot on the costa, the line bending outwardly very strongly and then bisinuate, more or less broken, to the inner margin. The line is emphasized opposite the cell by two more or less obvious black marks which indicate a dagger, and in the submedian interspace it is very prominent and crossed by a distinct dash, forming a typical *psi*. The subterminal line is wanting. There is a series of distinct black terminal dots, which extend to the middle of the fringe in the interspaces. The ordinary spots are not well marked. The orbicular may be absent; it may be a small black dot or a small circle. The reniform is blackish or black and irregularly lunate. There is a short black basal streak which does not reach to the transverse anterior line. Secondaries white, the veins a little smoky, and in the female a more or less obvious discal spot. Beneath pure white, both wings with a discal lunule, and in the female with a more or less well-marked outer line; a series of terminal spots on both wings. The head and thorax are without markings, save for the very prominent black line which extends from the sides of the palpi across the eye and to the base of the wings.

Expanse, male, 1.45 inches (36 mm.); female, 1.80 to 2 inches (45 to 50 mm.).

Habitat.—Garfield County, Colorado; 7,000 feet.

Three specimens collected by Mr. Bruce are types in the collections of U. S. National Museum and Rutgers College. The male is numbered 833, the females 827, 828. Whether the difference in size between the sexes is always so strongly marked as in the specimens before me I can not say, but I am inclined to doubt it. The male specimen here is probably undersized, and the markings are much less definite than they are in the female. This species is easily distinguished from its nearest ally, *leporina*, by its chalky white ground color and its more powdery markings. The genital structures are also quite obviously distinct. In *cretata* the harpes are much narrower and the tip is irregularly rounded, while the clasper is much shorter and stouter than in its eastern ally. The structure of the front legs in the male is also different, the femur being much the stoutest in *cretata*, while the tarsi are relatively longer.

ACRONYCTA LEPORINA Linnaeus.

(Plates VIII, fig. 26, larva; XI, figs. 1, 2, male and female adults; XVII, fig. 14, leg; XIX, figs. 17, 19, male genitalia.)

Phalaena noctua leporina LINNAEUS Syst. Nat., 1766, I, 2, p. 109.

Acrionicta leporina HÜBNER, Verzeichniss, 1818, p. 201.—TREITSCHKE, Schmett. Eur., 1825, V, 1, p. 51.

Apatela vulpina GROTE, Can. Ent., 1883, XV, p. 8; Papilio, 1883, III, p. 68; Can. Ent., 1888, XIX, p. 20.—PACKARD, Forest Insects, 1890, p. 461.—GROTE, Mitth. a. d. Roem. Mus., Hildesh, No. 3, 1896, p. 91.

Apatela sancta HENRY EDWARDS, Ento. Amer., 1888, III, p. 185.

Ground color creamy white, the black powdering sparse and not prominent. Head and thorax without markings; the primaries with the ordinary lines more or less incomplete. The basal line is usually marked by a dot on the costa; but that is not always present. The transverse anterior line is marked by a distinct black costal spot and by a small angulated mark below the cell. Occasionally there is a dusky shade on the inner margin. The median shade is marked by a black spot at about the middle of the costa. The transverse posterior line is usually broken, but occasionally it is almost continuous, sinuate, and as a whole follows the outer margin. When the line is broken it consists of a series of somewhat lunate spots opposite the cell, and a lunate mark in the submedian interspace, which is crossed by a more or less obvious black dash, though this may be entirely wanting. There is a series of black terminal spots beyond which the fringes are distinctly cut with black. The orbicular may be wanting, or may be indicated by a black dot or by a small circlet. The reniform is marked by a more or less distinct but indefinite black lunule. There is a short black basal streak, which does not reach the angular spot indicating the transverse anterior line. The secondaries white in both sexes, sometimes with quite an obvious series of terminal lunules. Beneath white, with a variably evident discal spot and outer line—always more distinct in the female.

Expanse, 1.50 to 1.80 inches (38 to 45 mm.).

Habitat.—Ontario, Canada; Maine; Jefferson, New Hampshire; Massachusetts; New York; Northern Illinois.

Three male and four female specimens have been compared with a greater number of both sexes from Europe, and I am unable to discover any difference between them. As a whole, our specimens are perhaps a trifle more powdery than the usual run of those from Europe; but even this is not constant, and I have European specimens that are more powdery than some American examples. The only variations that occur, so far as I have seen, are in the distinctness of the transverse posterior line and in the relative size of the black spots. Occasionally specimens occur in which the black markings are very much reduced, so that the wing at first sight seems rather irregularly black spotted. The head is moderate in size, the front bulging, but not prominent; the

tongue normal. The anterior leg of the male is stout, the femur somewhat widened in the male, and a little excavated inferiorly at the tip. The tibia is stout and rather short, with the epiphysis as usual inserted at about the middle. The harpes of the male are elongated and rather narrowed at the tip; the clasper is moderate in length, rather slight, and not greatly curved.

LARVA.

THAXTER, *Papilio*, 1883, III, p. 14 (*vulpina*).—DIMMOCK, *Psyche*, 1885, IV, p. 274.—ELLIOT and SOULE, *Can. Ent.*, 1886, XVIII, p. 124 (no name).—PACKARD, *Fifth Rept. U. S. Ent. Comm.*, 1890, p. 461 (*vulpina*).

Stage I.—Head scarcely bilobed, nearly white; width, 0.65 mm. Body white, rather opaque, the dorsum of joints 2, 4-5, 7-9, and 12 broadly pale purplish brown; hairs black and white mixed. Warts with a radiating crown and central hair, IV small with two setae, VI present, elongate; several setae on the leg plate.

Stage II.—Head white; width, 1 mm. Body as before or all white; the warts large, the hair long and abundant, with a few stiff black ones the whole length, but more particularly on joints 5, 7, and 12. A few secondary hairs.

Stage III.—Head creamy white, bilobed, with or without a vertical line of spottings on the face of each lobe; width, 1.6 mm. Body whitish, scarcely touched with any brown marks, even in the most heavily spotted examples of the previous stage. Warts large, concolorous, the hairs long and soft, white, curving, some of them secondary. A black pencil dorsally on joints 5, 7, and 12, or 5, 7, 8, and 12, or on 5, 7, 8, 9, and 12. The larva sits in J-shape. The body is visible through the hairs.

Stage IV.—Head white or with a black mottled streak up each lobe, full, rounded, scarcely bilobed; width, 2.6 mm. Body white, faintly tinged with green. Hairs very long, both primary and secondary, fine, curving a little, abundant, but not concealing the body, white, a few short black ones dorsally on joints 5, 7, and 12 or on the other joints as before. Warts rather large, but low and inconspicuous, normal. Another larva had a black pencil 5, 7, 8, and 12, with a black dot on joint 9 to represent a fifth pencil.

Stage V (interpolated).—In one instance this stage was observed; in most larvae it was omitted. Structure and coloration as before.

Stage VI.—Head greenish white, immaculate, or with a little blackish marking in the middle of each lobe; width, 4 mm. Body greenish white, immaculate, or with black dorsal spots to represent the hair pencils. Pencils now absent, the hair abundant, very long, curving over all around, brushed forward on the right side, backward on the left. Warts small, white; secondary hair abundant, rather finer than the primary. Hair white or yellow, a few short, bristly, black ones on the ends of the body. Before descending from the tree to pupate the head turns dull brown and finally black, except at the tip; the body

becomes dull brown, tinged with green, and the hair olivaceous blackish, shading to yellow at the tips.

Cocoon.—Very slight, consisting of a few threads only.

Pupa.—Regularly tapering, the anterior sides of the segments punctured; shining, mahogany brown, cremaster blunt, wrinkly, slightly bilobed, contracted at base, and with a series of recurved hooks, the upper row a single hook or absent, the lower of four or five on each side; length, 19 mm.; width, 6 mm.

Food plants.—Poplar, willow, birch.

ACRONYCTA POPULI Riley.

(Plates VII, fig. 25, larva; XI, fig. 7, female adult; XVII, fig. 16, leg; XIX, fig. 20, male genitalia.)

Acronycta populi RILEY, Second Rept. Ins. Mo., 1870, p. 119, figs. 87, 88.—GROTE, Trans. Am. Ent. Soc., 1872, IV, p. 28 = *lepusculina*.—RILEY, Index and Suppl. to Mo. Repts., 1881, p. 74, ? *lepusculina*.

Apatela populi PACKARD, Ins. Inj. Forest Trees, 1881, p. 116, fig. 55.—GROTE, Papilio, 1881, I, p. 127 = *lepusculina*.—HENRY EDWARDS, Ent. Amer., 1888, III, p. 185, sp. dist.; Bull. U. S. Nat. Mus., No. 35, 1889, p. 81, an sp. dist. *lepusculina*.

Megacronycta populi GROTE, Mitth. a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 6.

Ground color white, with very fine black powderings that are quite evenly distributed. Head and thorax without definite markings, save that sometimes there is a blackish shade across the collar, and the sides of the palpi are, as usual, black. The primaries with all the markings broken. The basal line is marked by a black costal spot, usually by an angulated mark below the median cell, and sometimes by a black spot at just about the middle of the inner margin. The median shade is marked by quite a prominent black spot on the costa, but rarely extends beyond that point and never extends beyond the reniform. The transverse posterior line is most nearly complete, but never continuous, so far as my specimens show. At its best it is somewhat lunulated, only a little sinuate, more emphasized opposite the cell and the anal angle. When least marked there is only a black spot or two opposite cell, and a black lunule opposite the anal angle. There is every possible intergrade between these two forms. Opposite the cell there is usually an indication of a short, black streak from the transverse posterior line, and opposite the anal angle there is a similar indication emphasized by a blackish shading. In rare instances this black mark extends across the line inwardly. The terminal space is a little darker than the rest of the wing. There is a series of black terminal dots, beyond which the fringes are cut with black. There is a short black basal streak which does not extend to the transverse anterior line, and does not connect with the angular mark which represents that line in most of the specimens. The orbicular is wanting, or is at most very faintly indicated. In one specimen only of all those before me is it outlined in black. The reniform is a vaguely defined, blackish, lunate

mark. Secondaries white, the fringes marked with a series of black dots at base. Beneath white, with a more or less distinct outer line and discal spot. The spots at the base of the fringes are also duplicated from the upper side.

Expanse, 1.30 to 1.90 inches (33 to 47 mm.).

Habitat.—Canada; London, Ontario, May 29; Urbana and Chicago, Illinois, June 28; Massachusetts; New York; Long Island; Missouri in May; Kansas; Nebraska; Seattle, Washington.

Twenty-four specimens, almost evenly divided as to sex, are before me from the various localities mentioned. All the dates are in May and June, and the specimens run quite evenly and without any marked variation. The absence of the orbicular and the very short basal streak will serve to distinguish this species in all cases. From its near ally *lepusculina*, with which it has been generally confounded, it differs by the broader wings of the female, by a paler and less apparent ground color, as well as by the basal dash and orbicular, as already mentioned. Altogether the species has a very distinctive look when the specimens are brought together and separated from the others. The front is moderately bulging, but is not prominent, while the palpi never exceed the middle, and sometimes do not reach it. The genitalia of the male have the side pieces broad, very obtusely and somewhat irregularly rounded at the tip, while the clasper is of moderate length and rather slender. The legs are moderately stout, the femur quite evenly proportioned, the tibia with the epiphysis extending to the tip, as is usual in this section. Compared with *leporina* the species is narrower winged and more powdery, and the markings are a little more complete; otherwise the resemblance is close.

LARVA.

RILEY, Second Rept. Ins. Mo., 1870, p. 119, (*populi*).—FRENCH, Trans. Dept. Agr., Ill., 1877, XV, p. 201.—MARTEN, Trans. Dept. Agr., Ill., 1880, XVIII, p. 130.—SAUNDERS, Can. Ent., 1882, XIV, p. 221, fig.; Rept. Ent. Soc. Ont., 1883, p. 24, fig.

Stage IV.—Width of head, about 2 mm. All whitish, with a greenish tint. Hair long and white, with black pencils on joints 5, 7, and 12, and a few black hairs the whole length from tubercles I and II, almost forming a pencil on joint 8.

Stage VI.—Width of head, 4 to 4.8 mm. Shining black, as, also, the cervical shield and thoracic feet. Body covered with long, light yellow secondary hairs; five single dorsal black pencils from tubercle I on joints 5, 7, 8, 9, and 12. Those on joints 5 and 12 are the most persistent; some or all of the others may be weak or absent. Skin sordid white; brownish dorsally on joints 3 and 4. Warts small, concolorous, obscure; hairs simple, very long, not obscuring the body. Venter shaded with brownish; leg plates partly black. Spiracles black rimmed.

Cocoon.—Composed of silk and chips of wood.

Pupa.—Robust, the abdomen regularly tapering, the segments coarsely, rather densely punctured anteriorly; wing cases creased and shagreened. Cremaster large, thick, constricted at the base, coarsely densely wrinkled; upper hook single, strongly recurved; lower hooks, four or five on each side, well separated and bent down subparallel to the surface of the pupa.

Food plant.—Poplar.

ACRONYCTA LEPUSCULINA Guenée.

(Plates I, fig. 1, adult; XI, fig. 8, female adult; XIX, fig. 21, male genitalia.)

Acronycta lepusculina GUENÉE, Spec. Gen., Noct., 1852, I, p. 46.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 55.

Apatela lepusculina GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 130; Can. Ent., 1874, VI, p. 154.—HENRY EDWARDS, Ento. Amer., 1888, III, p. 185.

Ground color white, quite strongly powdered with black. The ordinary lines distinct in most cases and always traceable. Basal line marked by a black spot on the costa. Transverse anterior line marked by a black costal spot, and from this point it is geminate, with an even outcurve, to the middle, where it meets the basal dash and begins another even outcurve to the internal margin. The line is rarely entirely complete, but its geminate character is marked in all the specimens that are before me, and it is in almost every instance traceable on both sides of the basal streak. The median shade is marked by a black spot on the costa, and as a rule extends across the reniform, but not beyond. The transverse posterior line is quite usually complete, lunulate, and quite strongly dentated on the veins; sometimes the line is quite narrow, and sometimes dentated in both directions. More usually the lunules are quite distinct, generally the line is somewhat emphasized opposite the cell, and is also more distinct opposite the anal angle, where it is usually crossed by a black dagger mark. There is a series of terminal dots, beyond which the fringes are cut with black. There is a distinct black basal streak, which extends to and is connected with the transverse anterior line. The orbicular is marked in all the specimens that I have seen, and, though small, is black ringed. The reniform is usually an indefinite dusky lunule, but is sometimes completely outlined and large kidney shaped. The secondaries are white, usually with a terminal dark line, sometimes with a series of terminal dots. Beneath white, more or less powdery, with an outer discal line and a more or less evident discal spot.

Expanse, 1.50 to 2 inches (37 to 50 mm.).

Habitat.—Long Island, New York; Manchester, New Hampshire; Florida; Kansas in September; Volga, South Dakota; Colorado; Montana.

The only date of capture that I have for this species is September, and unfortunately the entire collection contains only nine specimens. These, however, run very constant, and in the characters that I have

pointed out differ strongly from *populi*. I have selected this species as the type of Guenée's description, because it is, without any doubt, included by him in his characterization. It is also quite certain that Riley had both forms before him when he described his species; so, strictly speaking, the names referred to the same aggregation of examples. As there are two forms, however, and as Riley's figure and type refer distinctly to the form in which the basal streak is very short, it seems fair to retain his name and to apply Guenée's term to the other form, which has been mixed with it. One other point that was not mentioned in the description of the preceding species as distinguishing it from the one now under consideration is that here the transverse anterior line is in almost every case more or less evident, and yet distinctly geminate. In no example of *populi* do we find any approaching to this. The species is, on the whole, narrower winged, and as it is also more coarsely black powdered it has quite a distinctive appearance. In male genital characters it does not differ essentially from the preceding; but the side pieces are rather narrower as a whole, while the clasper is shorter and proportionately very much broader.

ACRONYCTA CINDERELLA, new species.

(Plates XI, fig. 11, male adult; XX, fig. 1, male genitalia.)

Ground color very pale ash gray, almost whitish, but with coarse black powderings, which give it the ashen appearance. Head and thorax of the ground color as is usual. The primaries have the ordinary markings rather imperfectly written. The basal line is marked by a small black dot on the costa, very close to the base. The transverse anterior line is more or less complete; in one case entirely distinct, but in most instances only partly defined. It is always geminate, however, so far as it is obvious. In the worst case it is marked by a distinct costal spot, by a pair of angulated marks below the cell, and by a pair of spots on the internal margin. A black spot over the reniform marks the origin of the median shade, which is not traceable, however, beyond that point. The transverse posterior line is continuous in all the specimens, usually lunulated and sometimes quite strongly dentate on the veins. It may or may not be emphasized opposite the cell; but is always marked opposite the anal angle where there is also a slender black line crossing it. The terminal space is a little darker than the rest of the wing. There is a series of black terminal dots, beyond which the wings are cut by blackish marks. The basal streak is distinct for half its length, and beyond that lessens to a narrow line which reaches the transverse anterior cross line. This difference in the strength of the line is noticeable in all the specimens. The orbicular is marked in all the specimens, irregularly oval and black ringed. The reniform is a dusky, undefined lunule. Secondaries white, with the outer margin a little soiled, a series of blackish terminal marks beyond which the fringes are cut with dusky. On the under side the wings are white

or nearly so, powdered, with a more or less obvious outer line and discal spot.

Expanse, 1.25 to 1.80 inches (32 to 45 mm.).

Habitat.—Colorado, without date or definite locality; Miles City, Montana, June 3.

Five males and two females are at hand for comparison. The species is most nearly like *lepusculina*; but it differs by the much darker ground color, the somewhat narrower and more powdery primaries, while the transverse posterior line is continuous in all the specimens. The harpes are narrower and more pointed than in its ally, and the clasper is quite stout and well developed. The front is moderately bulging, but not prominent. The palpi reach to its middle and in leg structure it does not differ apparently from *lepusculina*.

ACRONYCTA TRANSVERSATA, new species.

(Plates X, fig. 10, male adult; XX, fig. 3, male genitalia.)

Ground color ashen gray, distinctly and quite densely black powdered. The head and thorax are, as usual, without markings except for a black line reaching to the base of the primaries from the sides of the palpi. The ordinary maculation is more or less distinctly traceable in all the specimens before me, though never quite complete. The basal line is marked by a black spot on the costa. The transverse anterior line is marked by a black spot on the costa, which is sometimes double, by a pair of angulated marks below the cell, and by one or two lunules on the inner margin. In one case the connection between these spots and marks is almost complete, so there is nearly a full transverse anterior line. The median shade is marked by a blackish spot on the costa, extending obliquely to darken the reniform, thence abruptly bent and running parallel with the transverse posterior line to the inner margin. The transverse posterior line is well marked, continuous, narrowly lunulated, more or less obviously marked opposite the cell, where there is usually a distinct dagger. The line is black shaded opposite the internal angle, and there is an evident dagger crossing it. The terminal space is darker than the rest of the wing, and there is a series of small terminal dots, beyond which the fringes are cut with black. The black streak at the base is distinct and extends without break from the base to the transverse anterior line. The orbicular is round, or nearly so, black ringed. The reniform is undefined and dusky. Secondaries white, or nearly so, in the female outwardly soiled. Beneath whitish, with a more or less complete outer line, and an obvious discal spot on all wings.

Expanse, 1.60 to 1.80 inches (40 to 45 mm.).

Habitat.—Colorado, no date or special locality.

Three males and one female of this species are at hand, and it differs obviously from all those that have preceded it by the complete median shade line. It is also somewhat darker than any of the other species,

and is narrower winged in both sexes. On studying a series of species beginning with *cretata*, we find a very pretty and gradual development from a perfectly white form, in which the markings are all blotchy and the wings in the female are very broad, through a very similar type seen in *leporina*, to a more powdery but still broad-winged form like *populi*, all with only a short basal streak; then a form like *lepusculina*, where all the markings tend to become complete, to *cinderella*, where they are nearly so, to *transversata*, where the median shade line first becomes distinct throughout its whole course. In this species we have the most completely marked type, and also the narrowest wings in both sexes. There is little variation in the specimens before me, but probably the range is greater than is indicated by my specimens. It is not inconceivable that this is an extreme form of the species just previously described, and there is nothing in the structural characters opposed to that idea. As the material stands now, however, the species is well based, and is recognizable by the characters already enumerated.

ACRONYCTA TOTA Grote.

(Plates X, fig. 11, female adult; XVII, fig. 17, leg; XIX, fig. 23, male genitalia.)

Apatela tota GROTE, North Am. Ent., 1879, I, p. 12; Papilio, 1883, III, p. 69.

Ground color a very dark blue ash gray, with dense black powderings. The basal line is feebly or not at all marked. Transverse anterior line distinct throughout its entire course; geminate nearly upright, just a little drawn in below the cell. The two parts of the line are quite well separated, leaving the ground color visible between. The median shade is marked on the costa, but not prominent, and is vaguely extended to the reniform. The transverse posterior line is unusually near the outer margin; is more or less distinctly geminated, the outer line most distinct, while the included space is pale. It is very even, and as a whole not very strongly bisinuate. There is a series of black terminal dots, and the fringes are rather indistinctly marked with smoky. The black basal streak is distinct and extends to the transverse anterior line without break. There is no dagger mark or other shade emphasizing the transverse posterior line. The orbicular is small, nearly round, black ringed. The reniform is very large, kidney shaped, completely ringed, and with a dusky inner lunule. The secondaries are white in the male, smoky in the female, in which sex there is also a distinct discal spot, and a pale outer line running through the smoky exterior part of the wing. Beneath, the wings are whitish, with the usual discal spots and outer line.

Expanse, 1.28 to 1.40 inches (32 to 35 mm.).

Habitat.—Texas in March.

Eight specimens are before me, most of them females, and four of them collected by Belfrage. One specimen is marked Comal County, and is the only one with a definite locality. This species can not very well be mistaken for anything else. It is the smallest in this group, as

well as the darkest and most simply marked. There is absolutely nothing to compare with the unique, geminate, transverse anterior line, which will serve to characterize the species. The harpes are almost ovate, at least half as broad as long, and the clasper is stout and well curved. The anterior leg is also well developed for an insect of this size, but rather in the tibia and tarsi than in the femur. The epiphysis is, as usual, attached to the middle and extends to the tip. The head is larger in proportion to the size of the insect than is usual in this genus; but the palpi, on the other hand, are very short, scarcely even reaching beyond the edge of the front. The latter is a little convex, but scarcely bulging.

Group LOBELIAE.

The most obvious superficial characters of this group are the usually prominent *psi* or dagger marks, and the moderate primaries in which the inner margin is not much shorter than the costa. The outer margin is quite evenly arcuate, only a little oblique, and the apex is rectangular, or even a little rounded. The costa is rather evenly arched and does not form a shoulder, so the wing seems trigonate rather than subequal. Yet the group as defined above is not a strictly natural one, and it has been impossible to so arrange the species in tabular form as to show relationships. On the other hand, while the sexual structures of the male serve to mark two very distinct subgroups, there are offshoots that confuse. The best-developed type may be considered that found in *hasta*, *furcifera*, and *lactifica*, in which the lateral clasper is separated from the harpes, is broad, scoop-shaped, and has a long, finger-like projection superiorly. Roughly, the structure may be compared to a hand from which thumb and all save the index finger have been removed, the palm being a little doubled up. To this structure is added, in *lobeliae* and several allied forms, a finger-like process which arises superiorly, as if to the structure above described the thumb had been added and extended at right angles to the palm. The size and form of this upper process varies, and sometimes the palm or scoop adds an inferior process, as if part of the little finger had been also restored. This we find illustrated in *pruni*. In *brumosa* (*subochrea*) we find a break in a new direction. The thumb or upper process becomes longer and more slender, the palm becomes more flattened, and the upper process is beak-like. It is an obvious member of the *lobeliae* type, but it introduces the structures which become fully developed in the *persuasa* group.

With *lithospila* begins another break. The palm becomes reduced in size, the upper margin bends over, the finger process thus becomes somewhat beak-like, while the thumb becomes more slender. In *tritona* the process is continued, and we get a structure that consists of a long, excavated, tapering process, with a slender finger-like structure from its superior margin. Dropping this superior finger-like structure, we get *vinnula*, but if we reduce it in size and make the process itself

beak-like we get first *parallela* and finally *grisea*, in which only the beak-like process is developed. In *connecta* the clasper, while it strongly resembles that of *tritona*, becomes inferiorly united with the sidepiece, the superior process becomes larger and more prominent, and apparently arises much nearer the middle of the harpes. In *fragilis* and *funeralis* there is a curious similarity in development. The inferior portion of the clasper is somewhat flattened, united to the harpes except at the tip where it is freed, and has the inferior angle prolonged. From these forms the transition into the *hamamelis* type is easy and requires only the loss of the inferior process of the clasper.

In this connection a study of the European *psi*, *cuspis*, and *tridens* is interesting. None of them lack the superior process and none of them have the scoop-shaped clasper distinctly developed. *Cuspis* is curiously intermediate between *lobeliae* and *persuasa*, while in *alni* we see distinctly the structure which brings *funeralis* close to *afflicta*, while also indicating the *tridens* derivation. *Tridens* is most nearly like *lithospila*, while *psi* contains all the *hamamelis* possibilities and those of the group *auricoma*. None of the species examined by me show any resemblance to our *grisea* type, while on the other hand we have nothing in the least resembling *megacephala*.

As we find thus, in the sexual structures, variations in several directions, so we find in the adults that from the strongly developed *psi* type the maculation tends to the strigate *lithospila*, to the dentate *fragilis*, to the powdery roughened *superans*, and to the smooth, uniform, cleanly defined type in *falcula*, *parallela*, and allies. The same type of maculation is duplicated in two or more divisions; hence any arrangement on superficial appearance will be certain to contradict that made on structural characters merely. For convenience of determination, superficial characters will be used in the table and in the review of the species.

While there is no absolute agreement, nevertheless as a whole the members of this group have the epiphysis of the anterior tibia of the male inserted at or above the middle, the lappet not reaching the tip of the member, while the tarsi are proportionately longer.

First of all we may separate *innotata* and *betulae* as having no black lines, streaks, or dagger marks of any description. The wings are a little shorter and broader than usual, but the general scheme of maculation is similar. *Innotata* is white or yellowish, with the transverse posterior line emphasized by black scales, while *betulae* is of a peculiar reddish clay or luteous, without a trace of black anywhere.

Morula, *occidentalis*, *paupercula*, *vinnula*, and *fragilis* are united by having a black streak at base, a dagger mark, which may or may not cross the transverse posterior line, opposite the anal angle, and another, much less marked, opposite the cell. The ordinary spots are not in any way united or tied by a black line or mark. The vestiture is smooth, and the markings are not picked out by raised scales. *Morula* and

occidentalis are allied in sexual structure to each other and to *lobeliae*; *paupercula* and *vinnula* are much more nearly allied to *tritona* and *grisea*, while *fragilis* stands pointing to *funeralis*, *hamamelis*, and *grisea*, with indications toward *connecta* or *tritona*.

Morula is easily known by its large size, its discoloured yellow thoracic disk, and the yellowish shades in the primaries.

Occidentalis is very similar, but much smaller, and the thoracic disk is not yellow or otherwise discolored. In the structure of the male claspers the species differ little. In *occidentalis* the process from the superior margin is reduced to a small angulation, while in *morula* it is a flat triangular process.

Paupercula might pass for a small *occidentalis*, but it has a reddish shade, and the black streak from the base to the transverse anterior line is very heavy, and has a small spur or angle inferiorly as if the line had started to divide, and in this character it agrees with *vinnula* and all the species that have the same general type of genital structure. This seems at first sight like a very small character; but it is constant within specific limits, and all the species with similar male claspers have this spurred or broken basal streak. Unfortunately, some of the species with a diffuse streak sometimes have a similar spur, so that the character is not satisfactory for isolating just this group.

Vinnula is unique by its glistening white vestiture, which is marked by bluish, brown, or mossy-green shadings. All the transverse lines are well developed, and there is also a very distinct median shade line.

Fragilis is unique. The wings resemble the *albarufa-hamamelis* type, the ground color is smoky brown or blackish, and the very strongly dentate black median lines carry contrasting white accompanying shades. Altogether it is easily separable from all others in the section, to which only its superficial characters refer it.

Laetifica, *furcifera*, *hasta*, *manitoba*, *thoracica*, and *strigulata* agree in a general resemblance to the preceding series, but have the ordinary spots distinctly tied or connected by a black streak or dash or curved line. Of these the last-mentioned two have a discoloured thoracic dorsum and a tendency to strigate maculation, while all the others are normal in this respect. All the species grouped here are allied in genitalic structure and, except for the strigate forms, resemble each other closely.

Laetifica differs from the others of the series by the pale, milky-white primaries, in which it agrees with *occidentalis*. The species has been confused with *furcifera* which it does not resemble at all, and with *occidentalis*, with which small, obscurely marked examples may be confounded. These small specimens, however, in which the connecting mark between the ordinary spots is sometimes wanting on one or both sides, have the secondaries very dark, smoky brown, and the black markings of the primaries much thicker and more prominent than in *occidentalis*.

Lobeliae is the largest of this series in average expanse and much the best marked. All the black dashes and dagger marks are fully developed, and the basal streak is heavy and crosses the transverse anterior line in most instances. The ground color is, on the whole, only a little darker than in *laetifica*.

Furcifera is a decidedly darker, bluish-gray species, and distinctly smaller in average size. Yet a large *furcifera* may fully equal a small *lobeliae*, and in that case the darker ground color of the present species and the darker, smoky secondaries may be relied upon. As a rule the basal streak, though as prominent as in *lobeliae*, does not cross the inner transverse anterior line, and the dagger mark opposite the cell is less prominent and rarely crosses the transverse posterior line. Though on superficial characters there may be occasionally a doubt as between *lobeliae* and *furcifera*, the male claspers of the former have always a long finger-like process from the upper margin, of which those of *furcifera* show no trace.

Hasta is very closely allied to *furcifera*, and the species are mixed in almost all collections. With a series of both species at hand separation is easy; with a few specimens only there may be doubt. *Hasta* as a whole is of a clearer ashen-gray ground color, to which the smoky shadings give a peculiar mottled appearance which is not present in *furcifera*. In the latter species the secondaries are in the male distinctly smoky, while in *hasta* they are almost white, with only a slight smoky yellowish tinge. In the female the difference is less obvious, but also present. The male genitalia are practically alike in the two species.

Manitoba is a very distinct species, continuing in the direction in which *hasta* diverges from *furcifera*. The primaries are yet clearer ash gray, the mottling tends a little to the strigate type, and the secondaries in the male are white, with only a very narrow, soiled outer edge.

Thoracica is yet paler, the transverse anterior line is almost lost, and the strigate character of the marking is obvious. Besides the discoloration of the thoracic disk, there is a vague yellowish shading in the primaries. A prominent black streak extends from the costa obliquely outward between the ordinary spots, which are very close together and not at all well defined.

Strigulata forms the end of this line, with very pale blue-gray strigate primaries, in which nearly all the transverse maculation is obsolete, and pure white secondaries in both sexes. The discolored thoracic tuft is small and sometimes almost obsolete; but the relationship to *thoracica* is evident.

Lithospila, with its strigate, dark, smoky, blue-gray primaries, is unique and not easily mistakable. The transverse maculation is practically obsolete, the ordinary spots are barely traceable, and there are no obvious streaks or dagger marks. Altogether the species is inter-

mediate and leads toward the *tritona-grisea* series on one hand and to *alni* on the other.

Tritona, *revellata*, *grisea*, and *radcliffei* are blue-gray species which have no dagger mark opposite the cell; but do have such a mark crossing the transverse posterior line opposite the anal angle. Except *radcliffei* these species are allied in structure, *tritona* forming the intermediate type to the typical *grisea* form. *Radcliffei* in structure resembles *occidentalis* or *lobeliae*, but differs from all the other species in that series by its very even gray primaries, on which the markings are very neatly defined, the dash opposite the cell being entirely absent in all the specimens seen by me.

Tritona is very dark, the tint being also very even. The transverse anterior line is altogether wanting, but the transverse posterior is distinct, and the *psi* mark opposite the anal angle is very prominent.

Revellata and *grisea* have powdery gray primaries and almost white secondaries. The maculation is well written in both, but the former is larger, a little darker, yet brighter and more contrasting. The former occurs in the Rocky Mountains, the latter is northeastern.

Quadrata, *falcula*, and *parallela* resemble *grisea*, but are very evenly colored, and the black line opposite anal angle does not cross the transverse posterior line.

Quadrata is very distinct, and recognizable at once by the fact that the space between the ordinary spots is filled by a somewhat quadrate black spot. The species is quite unique in this respect, but while the superficial appearance refers the species here, the male genitalia are like those of *occidentalis*, and, like *radcliffei*, this species is evidently an offshoot from the main line of development.

Falcula and *parallela* are closely allied and structurally near to *grisea*. The primaries are a very even blue gray, darker in *falcula*, and the markings are very neatly defined. In *falcula* the base is shaded with orange inferiorly, and there is a distinct orange shade beyond the transverse posterior line. In *parallela* these shades are wanting or at most very feebly indicated, and here the secondaries are white in both sexes, while in *falcula* those of the female at least are distinctly smoky.

Mansueta and *funeralis* have in common only the black shading along the inner margin of the primaries. Omitting this black shading, *mansueta* is intermediate between *grisea* and *parallela*, and so the male genitalia refer it.

Funeralis is unique in all respects, yet when the wing form and the markings are considered closely it finds its nearest allies here. The peculiarities of the male genitalia have been already referred to. Above the middle the primaries are white, mottled with bluish, while the black shading along the internal margin is very well defined and sends up a distinct spur on the transverse anterior line.

All the others in this series have the vestiture more or less roughened and the scales somewhat elevated. Almost all these species are some-

what aberrant, not very nearly related, and pointing in different directions.

Spinigera and *pruni* are most nearly allied and are evident offshoots from the typical *lobeliae* type, which they resemble in maculation and in the genitalic structure of the male. The roughening of the vestiture is quite evident enough to separate the species from their allies, but it is not a striking feature, and serves rather to give a peculiar softness and indefiniteness to the ornamentation.

Spinigera, or *harveyana*, as it has been renamed, is somewhat less squamose in appearance, and has all the dashes slender and neatly defined. The genitalia of the male are of the *lobeliae* type, but show a departure from the normal in the development of a knob-like process from the inferior margin.

Pruni, which is generally known as *clarescens* in collections, is smaller, much more roughened in vestiture, and the dashes are all obscured or diffuse, particularly that opposite the anal angle. The genitalia of the male differ from the normal *lobeliae* type in that both angles of the scoop-like clasper are prolonged into finger-like processes.

Superans is quite unique in this series in its general appearance, yet on close study it is apparent that we may have here an extreme development of the tendency started in the preceding species. All the markings are normally present, but everything is obscured by the elevated, rough vestiture, aided by a general blackish suffusion which gives the primaries a marbled appearance. In a general way the ground color is gray, but there is a broad smoky or blackish longitudinal shade which extends from base to outer margin below the center of the wing, and this is joined by a broad band which extends transversely from the costa just beyond the orbicular. Another peculiarity is a patch of yellow scales at the extreme base, inferiorly, that contrasts sharply with the rest of the wing. The claspers of the male are but little different from those of *lobeliae*.

Connecta is a much reduced *superans* in maculation, but so modified as to give quite a different first impression. The ground color has a faint reddish shading; the longitudinal black shade is better defined and much more contrasting, and the dusky shade from the costa is more diffuse and much less prominent. The relationship to *alni* and *funeralis* is evident, as is that to *grisea* through *mansueta*. In the structure of the male claspers we have a very interesting intermediate form. It would require little change to develop into the *lobeliae* type on the one hand, to the *afflicta* form on another, to the *grisea* type in the third, and even the form of the *auricoma* group could be easily secured. The species is, therefore, a highly important and interesting one.

Brumosa Guenée, which replaces *subochrea* Grote, is an extreme development of the line started by *spinigera*. It is very dark blue-gray, the markings obscure, diffuse, and mottled, and the secondaries smoky luteous, but glistening. In well-marked specimens all the orna-

mentation of *pruni*, but much obscured, are easily traceable. In male genital structure this species is distinctly unique, and while it is evidently a *lobeliae* derivative, becomes an easy intergrade to the *afflicta* type.

Of the European species known to me, *psi*, *tridens*, *cuspidis*, *strigosa*, and *alni* belong to this group. All of these save *strigosa* have been already mentioned. Of these, the first-mentioned three belong to that small series of which *lobeliae* is typical. All have the dagger opposite the cell more or less obvious and crossing the transverse posterior line, and all have the ordinary spots more or less distinctly tied by a black line or dash. In all the basal dash or streak is distinct, and in all we find well marked the spur from the inferior margin, which, in our own species, is characteristic of the *grisea* series. The structure of the male genitalia has been already referred to, and, altogether, while at first sight there may seem a close resemblance between these European and some American forms, yet they are really quite remote from each other. Variation has been much greater and specialization more active in America; hence our species have diverged more and in a greater number of directions.

In its pattern of maculation *alni* resembles *superans* and *connecta* at least as much as, if not more than, it does our *funeralis*. It has not only the longitudinal shade of *superans*, but also the broad shade bands extending from the costa behind the orbicular to meet it. So the vestiture in *alni* is much more roughened than it is in the American species, and in this particular it is also much closer to our *connecta*.

Strigosa is the European representative of our *connecta*, but is smaller, more slightly built, and more brightly colored. The male claspers are those of *connecta*, but on a much smaller, more compact plan, and much better adapted for a starting point to our group *hamamelis* or to the group *auricoma*.

ACRONYCTA INNOTATA Guenée.

(Plates II, figs. 17, 18, adult; XVII, fig. 18, leg; XX, fig. 5, male genitalia.)

Acronycta innotata GUENÉE, Spec. Gen., Noct., 1852, I, p. 50.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 59.

Apateia innotata GROTE, Papilio, 1883, III, p. 114.

Diphthera graefii GROTE, Proc. Ent. Soc. Phila., 1863, II, p. 68, pl. III, fig. 6.—MORRISON, Can. Ent., 1875, VII, p. 79, pr. syn.

Ground color a somewhat dirty yellowish white. Head and thorax without distinct markings, except a black line from the sides of the palpi to the base of the wings. Primaries with the ordinary lines traceable, and a variously distinct basal line, marked by a black spot on the costa. Transverse anterior line marked by a black spot on the costa. Beyond that it is geminate, neither of the defining lines complete nor always well marked at the same points. As a whole the line is outwardly oblique and rather even. Sometimes it is reduced to the

costal spot, to a dot or a pair of dots below the cell and another on the internal margin; occasionally it is entirely wanting. The median shade is indicated by a black spot on the costa and sometimes a shade extends to the center of the reniform. The transverse posterior line is well marked, in most specimens continuous or nearly so, more or less obviously lunulated, but not dentated on the veins. It is quite squarely bent out over the cell and with a well-marked incurve opposite the anal angle. There is a series of terminal dots, but the fringes are not cut. There is no longitudinal line at base and the orbicular is wanting in most specimens. Occasionally it is marked by a feeble dot and sometimes even by a small ring. The reniform varies from a distinct black crescent mark to a vague dusky lunule. Secondaries white in the female, with a more or less obvious discal mark and an outer median line which is sometimes marked in the middle on the veins. In both sexes there is a series of blackish terminal marks. Beneath there is the usual outer line and the discal lunule on both wings.

Expanse, 1.40 to 1.85 inches (35 to 47 mm.).

Habitat.—London, Ontario, June 28; Maine in June; New Hampshire; Rochester, Ithaca, Long Island, New York; Pennsylvania.

This broad-winged species can not be easily mistaken. Its pale colors and simple markings, without trace of black dashes or dagger marks, are quite characteristic. It varies from a form in which all the described markings are easily distinguishable to one in which nothing except the transverse posterior line is evident, and even this hardly black marked. It is rather common within its range, which seems to be not very extended, and thirty or forty specimens have been examined. The head is very distinct, the front a little bulging, the palpi well developed and reaching the middle in most of the specimens. The legs are stout and the femur is quite strongly dilated and abruptly narrowed at the tip. The tibia is slender, the epiphysis inserted at about the middle, but not reaching to the tip. The tarsus is long in proportion to the rest of the leg. The harpes of the male are narrow and subequal. The clasper is of the usual form, with the upper finger stout and long, while the process from the upper margin is short and rather slender.

LARVA.

BEUTENMÜLLER, Ent. News, 1891, II, p. 153.

Stage VI.—Head pitchy brown on the vertices of the lobes; face sordid white; body dull grayish brown; warts I and II shining black; two rows of yellow spots along each side, with a row of black spots [or tubercle III?] between; legs concolorous; secondary hair sparse, sordid white; venter dull grayish.

Cocoon.—Of bits of wood rudely united.

Food plant.—Probably hickory (after Beutenmüller).

ACRONYCTA BETULAE Riley.

(Plates II, fig. 19, adult; V, figs. 4, 5, larva; XVI, fig. 9, venation; XVII, fig. 19, leg; XVIII, fig. 6, palpus; XX, fig. 6, male genitalia.)

Acronycta betulae RILEY, Bull. Bkln. Ent. Soc., 1884, VII, p. 2, fig. 1.

Apateia betulae PACKARD, Forest Insects, 1890, p. 495, fig. 176.

Hyboma betulae GROTE, Mitth., a. d. Roem. Mus., Hildesh., 1896, No. 3, p. 7.

Ground color a rather pale ocher yellow, shading into luteous. Head and thorax even, the usual black line at the sides of the palpi becoming brown; primaries with the ordinary markings very little defined and never contrasting. The basal line is feebly marked on the costa, or is entirely absent. The transverse anterior line is geminate, oblique, very even but very faintly marked; the defining lines are only a little darker than the ground color, even on the costa. The median shade is marked by an oblique dash on the costa extending to the reniform, and in some specimens inwardly bent and traceable to the inner margin at its middle. In most specimens this shade is not traceable beyond the costa, and it is never more than dusky even here. The transverse posterior line is narrow, rather sharply defined, irregular, distinctly toothed on veins 3 and 4, and with a sharp inward bend in the submedian interspace, forming a blunt tooth. Beyond this line there is a dusky shade which follows what would ordinarily be the subterminal space were a subterminal line defined. There are no terminal dots, and the merest trace of a terminal line is indicated in some specimens. There is no basal dash; the orbicular is absent or vaguely defined. The reniform varies from an undefined lunule to a large reniform spot, and is of a little richer brownish color than the ground. Secondaries of a paler shade of luteous, with a vaguely indicated discal lunule and outer line. On the under side we have the same general color, but paler, and the usual outer line and discal spot. The outer line in this case is quite distinctly angulated at about its middle.

Expanse, 1.40 to 1.48 inches (35 to 37 mm.).

Habitat.—Washington, District of Columbia, March and August; Long Island, New York; Pennsylvania; Missouri; Jefferson, New Hampshire.

Twelve specimens have been examined and offer very little variation. It is simply a question of the greater or less distinctness of the markings. Its nearest ally in appearance is *innotata*; but there is no chance of mistaking the species. In structure it resembles *innotata* in the frontal characters and in the general character of the legs. The harpes of the male taper quite regularly to a blunt tip. The clasper, while of the general shape of *innotata*, is more clumsy, and lacks the process from the superior margin.

LARVA.

RILEY, Bull. Bkln. Ent. Soc., 1884, VII, p. 2.—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 495.

Stage IV.—Width of head, 1.35 mm. Green; the warts yellow. A dorsal yellow line, faint and broken, with traces of a subdorsal one on the thorax. Dorsally on joints 5, 8, 9, and 12, and faintly on 11, small brown patches surrounded with yellow, most distinct on the sides. Dorsal hair long, dark, a central seta with a crown of short hairs from each wart. Joints 5 and 12 slightly enlarged.

Stage V.—Head green, with purplish mottlings on the lobes, the apices pale brown; width, 2.2 mm. Body green, the warts and dorsal line yellow on joints 4 to 12, yellow elliptical patches covering warts I and II on joints 5, 8, 9, and 12, with red centers; a red dot on joint 11. Only a trace of the subdorsal line on joints 3 and 4. Skin granules sparse, with short pile and a few true secondary hairs. Primary hairs few. Later the dorsal brown dots become more numerous, small on joints 4, 6, 7, large on 8, 9, small on 10, 11. Dorsal line enlarged to include tubercle I on joints 8 and 9, I and II on joints 5 and 12.

Stage VI.—Head pale brownish, thickly mottled with black spots above, the apices of the lobes orange; width, 3 to 3.7 mm. Body, dull olivaceous brown; minute brown-black skin thorns on a greenish ground. No marks on the skin except a faint, pale dorsal line. Joints 5 and 12 a little enlarged dorsally, 12 square. Warts small, few haired, I and II black, but with pale hair tubercles, the other warts pale greenish; all pale on joint 13. Hair short, black and white; secondary hairs present only subventrally, but rather abundant there, pale.

Cocoon.—"Web up in a piece of old wood or between leaves." (Riley.)

Pupa.—Cylindrical, regularly gently tapering, the abdominal segments punctured in front; smooth, shining brown, the wing cases finely transversely wrinkled. Cremaster short, nearly sessile, several longitudinal ridges above and below at the margin. No dorsal hooks, the lower row in a close series of six, corresponding to three on each side, but not separated. Length, 17 mm.; width, 8 mm.

Food plant.—Birch.

ACRONYCTA MORULA Grote and Robinson.

(Plates II, fig. 10, adult; VII, figs. 20, 21, larva; XIV, figs. 7, 13, thorax and male genitalia; XV, figs. 12, 17, head; XVII, fig. 20, leg; XX, fig. 7, male genitalia.)

Acronycta morula GROTE and ROBINSON, Trans. Am. Ent. Soc., 1868, II, p. 196, pl. II, fig. 75.—LINTNER, Ent. Cont., 1878, IV, p. 137.

Apatela morula THAXTER, Papilio, 1883, III, p. 13.—GROTE, Papilio, 1883, III, p. 67.—PACKARD, Forest Insects, 1890, p. 272.

Hyboma morula GROTE, Mitth., a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Acronycta ulmi HARRIS, Ent. Corresp., 1869, p. 312.—SMITH, List Lepidoptera, 1891, p. 35, pr. syn.

Ground color a pale ashen gray, with a yellowish tinge. The thorax has the disk distinctly yellow, the collar is usually brown-tipped, and

the edges of the patagiae are narrowly black marked. The primaries have all the markings traceable and in most instances fairly distinct. The basal line is marked by geminate yellow or brown marks on the costa. Transverse anterior line geminate, brownish yellow, as a whole outwardly oblique, quite strongly toothed on the subcostal and more or less distinctly out-bent on all the veins. The tendency is for the line to become faint or entirely wanting below the middle, and it is often indistinct, even in the upper part of its course. The median shade is marked by a rather defined yellow or brown line from the costa obliquely to the reniform, and occasionally there is a very even shading which extends almost or quite to the inner margin. The transverse posterior line is narrow, brown or black, distinctly defined, preceded by a paler and followed by a darker brownish or yellow shading. The line is rather even, most sharply toothed on veins 3 and 4, below which it makes a deep incurve opposite the anal angle. There is an indistinct but traceable subterminal line in most of the specimens which is irregular and paler. The fringes are cut with brown or black opposite the interspaces. There is a distinct basal dash which is black and extends through the basal line. There is a dark dash opposite the cell, which extends from the transverse posterior line to the outer margin and sometimes crosses the line inwardly. Another dash opposite the anal angle extends from the margin through the transverse posterior line, forming a distinct *psi*, which is shaded with blackish and quite prominent. The orbicular is small, round, ringed with brown, yellow, or black. The reniform is large, kidney shaped, somewhat undefined, except at its inner edge, where it is black marked. As a whole it is shaded with yellowish. The secondaries are smoky, darker in the female, and with a more or less obvious discal spot and outer line. Beneath the color is yellowish white, powdery, and on both wings, with an incomplete outer band and a rather distinct discal spot.

Expanse, 1.60 to 2 inches (40 to 50 mm.).

Habitat.—Ontario, Canada; Rochester, New York; Kendall, New York; Long Island, New York; Otto, New York, July; Evans Center, New York, July; Wisconsin; Central Missouri in May; Washington, District of Columbia, in August; Maine; Illinois; Pennsylvania; Texas in June.

In a general way this insect occurs west to the Rocky Mountains from Canada southward. Some twenty-odd specimens of each sex have been examined and very little variation occurs. Some specimens are a little paler, some a little darker; some of them are a little brighter marked than others; but on the whole the species is remarkably constant and is always easily recognized by the yellowish shading in the fore wings and by the yellow disk of the thorax. It is also the largest species next to *lobeliae* with which it can not be easily confused. The front is bulging but hardly protuberant. The anterior legs are well developed, all the parts being well proportioned to each other; the epiphysis of the fore tibia is inserted much nearer to the base and does not reach to the

tip. The harpes narrow quite abruptly before the tip, then dilate, principally on the lower margin, before terminating in an obliquely rounded tip. The clasper is well developed, not very broad, the finger long and stout, a little excavated within, while there is a short angular process from the upper margin, which can hardly be called finger-like.

LARVA.

HARRIS, Ent. Corr., 1869, p. 312, pl. III, fig. 10.—THAXTER, Papilio, 1883, III, p. 13.—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 272; Ibid., p. 273 (*ulmi*).

Eggs.—"Very small, much flattened, whitish." (Thaxter.)

Stage I.—"Dirty greenish white, without marks; a few white hairs; a subdorsal row, black; head tinged with brown" (Thaxter). Width of head, probably 0.3 mm.

Stage II.—Head whitish, not shining, no marks; width, 0.4 mm.; body pale green, with indications of a whitish subdorsal line; warts conic, with a long central seta and crown of short hairs, a few glandular tipped, part light, part dark, some of the small ones black; on joint 12 tubercles I and II form a square, IV with only one seta, VI present, the warts much in line transversely; leg plates a little yellowish, with several pale setae. Of the four setae on the cervical shield, only the posterior lower one is supplemented by short hairs and elongated into a wart, but there is a row of little hairs along the front edge of the shield. No secondary hairs on the body as yet.

Stage III.—Head, 0.7 mm; as before, brighter green; the pale, whitish subdorsal line more distinct, continuous; hair dark dorsally, pale subventrally. Later there is a pale brown dorsal shading on joints 2, 5, and 12.

Stage IV.—Head, whitish green, bilobed, the apices pointed; a small patch of brown mottlings in front, below the apex of each lobe; width, 1.2 mm. Body green, subdorsal line faint, yellowish; joints 5, 8, and 12 shaded dorsally with dark brown; hair long and white. There are a few short secondary hairs; but on the dark patches inclosed by tubercles I and II on joints 5, 8, and 12 they are more numerous, black, with enlarged ends; subventrally only a few, and these white. The longer dorsal primary hairs are black.

Stage V.—Head bilobed, pale green, covered over the apex of each lobe with a large patch of spots composed of brown and black dots on a pale whitish ground, the patch reaching to the ocelli; apices of lobes brown; ocelli black; width, 1.8 mm. Body green, a raised brown area dorsally on joints 5, 8, and 12, surrounded by a yellow ring, the one on 8 passing also on to 9. Warts small, bearing two to four short black hairs on I to III on abdomen; larger more numerous on warts IV to VI, IV small, behind the spiracle. Secondary hairs represented by minute pile, most distinct in the elevated dorsal patches. Tubercles on the edge of the cervical shield blackish, warts yellowish.

Stage VI.—As before, the dorsal patches darker, blackish brown, the yellow borders narrow and dull. Tubercles I and II surrounded by black. Width of head, 2.8 mm.

Stage VII.—Head large, held out flat, the sutures deep; black, shagreened, apices of lobes tipped with red; clypeus with sutures broadly greenish white; width, 4 to 4.5 mm. Body light olive gray, a lozenge-shaped dorsal enlargement on joints 5, 8, and 12, bearing tubercles I at the corners, darker than the body and bordered with black. A dorsal gray band, whitish centrally, enlarged on each segment to include tubercle II. Lateral region irregularly shaded with gray. A lateral brown band, defined by blackish marks stigmatically. Hair thin, white, very scant, almost absent dorsally, longer subventrally. Secondary hairs numerous, short, the dorsal ones flattened, the subventral ones long and normal. Warts normal, rather small, with few to several hairs, those on the sides whitish.

Cocoon.—"Spun under loose bark or in the crevices" (Thaxter); "tough" (Riley).

Food plants.—Elm, apple, linden.

ACRONYCTA OCCIDENTALIS Grote and Robinson.

(Plates II, fig. 8, adult; V, figs. 7, 8, larva; XX, fig. 8, male genitalia.)

Acronycta occidentalis GROTE and ROBINSON, Proc. Ent. Soc. Phila., 1866, VI, p. 16.—SPEYER, Stett. Ent. Zeit., 1875, XXXVI, p. 108.

Apateia occidentalis GROTE, Ann. Lyc. Nat. Hist., N. Y., 1876, XI, p. 302; Papilio, 1883, III, p. 67.—PACKARD, Forest Insects, 1890, p. 167.

Hyboma occidentalis GROTE, Mitth., a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Acronycta psi GUENÉE, Spec. Gen. Noct., 1852, I, p. 43.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 42.—GROTE and ROBINSON, Proc. Ent. Soc. Phila., 1866, VI, p. 16, pr. syn.

Acronycta interrupta GUENÉE, Spec. Gen., Noct., 1852, I, p. 46.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 55.—GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 78.—SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 46.

Ground color ashen gray and quite even, sometimes with a faint yellowish shading. Head and thorax immaculate, except for the line extending from the sides of the palpi to the base of the wing. Primaries with the ordinary markings fairly well defined. The basal line is marked by geminate black lines on the costa. The transverse anterior line is geminate, black on the costa, becoming broken and less defined toward the inner margin, which is reached just a little within the middle. As a whole the line is even and outwardly oblique. The median shade is marked by an oblique blackish line from the costa to the reniform, of which it darkens the outer margin. The transverse posterior line is somewhat indistinctly geminate, the outer portion being narrow and black, a little lunulate, the inner portion being hardly distinct and principally evident by the somewhat paler included space. There is a very vaguely defined pale subterminal line, which is irregular in course and hardly traceable in most specimens. The basal dash is black and

distinct, crossing to the outer portion of the transverse anterior line, and sometimes extending even a little beyond it. There is a black dash which crosses the transverse anterior line opposite the cell, and another which crosses it opposite the anal angle. This latter is much the heavier, and is usually accompanied by a dusky suffusion, which makes this part of the wing most prominent. The orbicular is round, black or brown ringed, fairly well defined. The reniform is kidney shaped, fairly well defined inwardly, and sometimes complete. It is a little marked with yellowish in some specimens. There is a series of black terminal dots, beyond which the fringes are cut with black on the interspaces. The secondaries are smoky in the female, distinctly paler and more whitish in the male. Beneath, powdery pale gray, with a quite obvious outer line and a more or less evident discal spot.

Expanse, 1.40 to 1.68 inches (35 to 42 mm.).

Habitat.—Ontario, Canada; Schenectady, New York, in July; Kendall, Rochester, and Long Island, New York; Maine; New Hampshire; Pennsylvania; Georgia; West Point, Nebraska, in June; Washington, District of Columbia, in May; New Jersey in June.

This is one of the most common species in this group, and probably extends throughout the Eastern United States. In fact, I have seen it from most of the States, although I do not at the present time have specimens before me. In my catalogue I have it recorded from Illinois in August, and in the Harris collection, Massachusetts, are specimens dated April 25, May 25, and June 1. It is recorded in Canada from May to August, and in New York to September. The species varies little and is quite easily distinguished. It differs from *morula* in its smaller size and by the lack of the yellow in the thorax and primaries. From *hasta* and its allies it differs by lacking a black connecting dash between the ordinary spots. There is little variation, except in the relative distinctness of the markings. The front is moderate, convex, but hardly bulging. The anterior legs of the male have the femur quite stout, the tibia and tarsi quite long, and slender in proportion. The epiphysis is attached above the middle and does not reach to the tip. The harpes of the male are a little narrowed just above the clasper, and widen slightly just before the rounded tip. The clasper is moderately developed, the finger quite strongly curved and not very long. There is the merest projection from the upper margin to indicate the presence of an additional process.

LARVA.

GUENÉE, Spec. Gen. Noct., 1852, I, p. 46 (*interrupta*).—HARRIS, Ent. Corr., 1869, p. 311 (*sagittaria*).—SAUNDERS, Can. Ent., 1872, IV, p. 49 (*occidentalis*).—MARTEN, Trans. Dept. Agr. Ill., 1880, XVIII, p. 129.—EDWARDS and ELLIOT, Papilio, 1883, III, p. 132.—SAUNDERS, Ins. Inj. Fruits, 1883, p. 165.—DIMMOCK, Psyche, 1885, IV, p. 274.—PACKARD, Fifth Rep. U. S. Ent. Comm., 1890, p. 167.

Stage III.—Head white, the lobes pointed; a black patch at the vertex, one on each side of the clypeus and one over the eye; width,

0.9 mm. Body white, warts I to III black, the rest pale, pointed conic, with a crown of hairs; all the body thickly covered with short secondary hairs enlarged at the tips. Tubercles I and II on joint 12 form a square. Dorsum broadly streaked with dark brown, cut by dorsal and subdorsal white lines. Hair black and white, even some of the secondary ones black. Warts normal, IV rather small, all nearly in a single transverse line.

Stage IV.—Head black, a geminate white spot at apex of clypeus and white streaks on the sides; apices of lobes pointed, pale brown; width, 1.4 mm. Body whitish as before; dorsal and subdorsal lines white, distinct; sides shaded with brownish, joint 13 pale. Secondary hairs short, club-shaped. Tubercles actually pale, but more or less closely ringed with dusky brown. Later a broad faint reddish patch covers tubercles I, II on joints of abdomen.

Stage V.—Head bilobed, black, dark red on the apices of the lobes; width, 2.5 mm. Body dull purplish, dorsal line pale, shading into reddish in the center of each segment around tubercles I and II; subdorsal space purple; subdorsal line white, bordered below with purple; a faint reddish stigmalal line. Warts black, I and II containing pale rings, joint 12 nearly all black dorsally. Thoracic feet and leg plates black. Hair black dorsally, white subventrally, the secondary ones much reduced, short, fine, black, not evident with a lens, pointed tipped, numerous, but long and white subventrally. Cervical shield black, tubercles pale.

Stage VI.—Head large, slightly bilobed; median suture deep before the vertex, but shallow behind; flat in front; blackish mahogany red, shining, darker below; clypeus black, with the sutures purplish; sides posteriorly mottled with pale; width, 3.5 to 3.8 mm. Body purplish or flesh color, of even width, joint 12 enlarged dorsally in a rounded quadrate elevation which bears tubercles I and II on the corners and pulsates centrally. Warts slight, consisting of an aggregation of three to ten piliferous tubercles with a slightly enlarged common base; IV rather small. Hair thin, long, reddish, with a few short, pale secondary ones subventrally, but the secondary coating in general nearly absent. The lilac color of the body shades into blackish subventrally. Dorsally a broad blackish band, marked with a series of black patches on joints 5 to 11, each throwing out a lateral spur which curves around wart II, and containing the pale tubercles I and two red spots situated in the dorsal line. Sometimes the red spots are connected into a single hourglass-shaped spot. The hump on joint 12 is uniformly black. Tubercle I shining blue-black at base; II in a small yellowish white patch. A faint lateral black line above tubercle III. Spiracles black with white center. Length, 25 mm.

Cocoon.—A thin web spun in the earth or "covered with a leaf." (Harris.)

Pupa.—Light brown, abdomen tapering, the segments rather coarsely

but indistinctly punctured anteriorly; wing cases grooved and shagreened. Cremaster wide, short, ending in a transverse rim which bears three ridges below and about eight above, somewhat curved and irregular. Terminally three long spines, slightly hooked, on one side of the cremaster, on the other side nothing. Length, 14 mm. (only one specimen).

Food plants.—Elm, apple, sugar plum, beach plum, birch.

ACRONYCTA LOBELIAE Guenée.

(Plates II, fig. 11, adult; VII, fig. 24, larva; XVII, fig. 22, leg; XX, figs. 10, 11, male genitalia.)

Acronycta lobeliae GUENÉE, Spec. Gen. Noct., 1852, I, p. 44.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 54.

Apatela lobeliae GROTE, Papilio, 1883, III, p. 68.—PACKARD, Forest Insects, 1890, p. 168.

Hyboma lobeliae GROTE, Mitth., a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Ground color whitish ashen gray, with a vague yellowish tinge throughout. Head and thorax without markings, save the usual black line from the palpi to the base of the wings, which extends a little on the thorax in this case, and is somewhat connected by a more or less evident line across the front of the head. The primaries have all the ordinary markings very distinct. Basal line geminate, well marked on the costa. Transverse anterior line geminate, well marked on costa, but more feeble beyond that point and in rare cases entirely wanting. As a whole it is quite even and outwardly oblique. The median line is marked on the costa by an oblique shade, which reaches to and a little darkens the center of the reniform. The transverse posterior line is lunulate, continuous, strongly outcurved over the cell and incurved beneath. The black lunule is preceded by a distinct whitish shade, which renders the line decidedly more prominent. The subterminal line is pale, more or less incomplete, not defined, and in some cases almost at the base of the fringes. There is a series of black terminal dots, beyond which the fringes are cut with black. In well-preserved specimens it is seen that the fringes are also interlined. The basal black streak is very heavy and prominent, extends clean across the transverse anterior line, and usually a little into the median space. In many specimens the internal vein is well marked with black through nearly the entire median space. There is a distinct dagger mark opposite the cell, which usually crosses the transverse posterior line, and there is another much heavier dash which crosses the line in the submedian interspace. The ordinary spots are well marked and of the ground color. The orbicular is round or nearly so, well defined inferiorly, but usually not complete above. The reniform is large, kidney-shaped, well marked interiorly, but rarely complete outwardly. A distinct black line connects the two spots along the lower margin. Secondaries smoky, sometimes considerably paler in the male. Beneath

whitish, powdery, the tips of the wings sometimes a little smoky; both wings with a more or less distinct outer line and discal spot.

Expanse, 1.80 to 2.40 inches (45 to 60 mm.).

Habitat.—From Canada to Florida and Texas, west to the Rocky Mountains. Texas, in March, April, and May; Illinois, April, May, and July 1; Washington, District of Columbia, in April; New Jersey, in June and August; Evans Center, New York, in June; Minnesota, in August; Douglas County, Kansas; Louisiana, in April.

This is as large as *morula*, and one of the most common species in this series. It is as a rule easily recognized by the large size and by the very prominent contrasting black dashes, which are better marked than in any other species. There is considerable variation in size and considerable variation also in the color of the hind wings, especially of the males. It has been impossible, however, for me to separate them into species on any tangible character, and I have been compelled to hold them together. Ordinarily the very heavy black markings, combined with the dark under wings and quite pale gray primaries, will be sufficient to recognize the species. The head is quite distinct, the front bulging and a little prominent. The legs are well developed, the femur being very stout at the base and somewhat abruptly narrowed toward the tip. The tibia has the epiphysis attached quite close to the base and not extending much beyond the middle. The harpes of the male are narrow, bluntly rounded at the tip, sometimes a little broader just before. The clasper is well developed, the superior process curved and moderately long, a distinct finger-like process of good length from the upper margin near the base of the clasper. The species is well represented in all the collections before me and a very large series of both sexes has been under examination.

LARVA.

GUENÉE, Spec. Gen., Noct., 1852, I, p. 44.—COQUILLETT, Papilio, 1881, I, p. 6.—PACKARD, Fifth Report U. S. Ent. Comm., 1890, p. 168.

Egg.—Circular, about 45-ribbed, of the shape of a segment of a sphere, flattened. Ribs free at ends, not diminishing in number till one-third the distance to apex, when the alternate ones terminate; the others end in a circular ridge around the micropyle, which is reticulated, highest in the center. Ridges wavy; the grooves between likewise wavy; no cross striae. Diameter, 1 mm.; height, 0.3 mm.

Stage I.—Whitish, a large purple-brown dorsal spot on joints 2, 4, 5, 8, 9, and a smaller one on 12 and anal plate, varying in distinctness. Head pale, with a similar spot on each lobe; width, 0.3 mm. Tubercles large in the dark marks, smaller elsewhere, and concolorous, normal, single-haired, the hairs of I to IV black, V white, a small white seta on the leg plate. On thorax Ia+Ib dark, IIa black, IIb small and pale, as also IV and VI.

Stage II.—Head whitish, a brown spot above and two below on the

face of each lobe; width, 0.4 mm. Body white, the dorsum dark purple-brown on joints 2, 4-5, 8-9, and 12, the spot on joint 2 double. Warts conic, with a crown of glandular-tipped hairs and central long seta, two setae on wart I; I to III black. Secondary hairs black in the dark spots, white on the white ground; hairs of wart VI pale, not glandular. Later the spots on the head become confluent behind, leaving the points of the lobes marked by white. The green food contrasts with dorsal patches on the pale segments.

Stage III.—Head, 0.8 mm.; white, with four brown-black spots in front and a streak on the neck. Brown dorsal patches on the body connected by a faint subdorsal line inclosing white patches on the pale segments, greenish in the incisures. Sides whitish. Warts as before, some glandular secondary hairs also arising from the skin.

Stage IV.—Head square, bilobed, apices reddish, ground whitish, four large black spots in front, and mottlings on the sides; width, 1.5 mm. Body whitish, dorsum above wart III all shaded with dark brown, heaviest on joints 2, 4-5, 8-9, and 12, the other segments yellow. A broken pale dorsal line. Hair black dorsally, white subventrally, the short secondary hairs on both the low conic warts and body glandular tipped and concolorous with the markings. Later the dorsum becomes more brownish, leaving, besides pale, broken dorsal and subdorsal line, yellow patches around wart I on joints 3, 6, 7, 10, 11, and 13.

Stage V.—Head large, bilobed, narrowing above; ground color white, thickly mottled with black patches, apices of lobes red; width, 2.2 mm. Body gray, dotted with black; a whitish dorsal and subdorsal line; tubercles I to III whitish, with two or three black hairs, IV very small, V and VI with abundant soft white hairs; I and II in a square on joint 12. A tiny black dot before tubercle I and a reddish shade between I and II.

Stage VI.—Head as before; width, 3.5 mm. Body gray, with very faint grayish-white dorsal and subdorsal lines. Hairs from small, nearly concolorous warts, I to III with a few black hairs, IV obscure; abundant fine whitish hair subventrally, mostly secondary. Skin above with fine black points. Small orange-yellow spots between tubercles I and II on joints 5 to 11. Spiracles black ringed. Later bluish gray, a yellowish-gray diamond-shaped patch on joints 5 to 12; those on joints 5 and 12 shaded with blackish. This marking only appears when the larva is full fed.

Stage VII.—No change whatever; width of head, 4.4 mm.

Stage VIII.—As before, till near the end of the stage, which lasts eleven days. Width of head, 5.7 mm. On leaving the plant the larva changes color. The head is large, scarcely bilobed, shagreened; black above, obscuring the red apices, a broad, shaded grayish-white band transversely, festooned up over the clypeus; clypeus gray; mouth black. Body appearing a little flattened, slaty gray, a greenish-white dorsal and subdorsal line and diffuse lateral and substigmatal patches.

Warts small, several haired; hairs short and black on tubercles I to III, white subventrally, both secondary and from tubercles V and VI. Dorsum thickly covered with black points. A diffuse yellow patch below warts I and II and around III. Joint 12 slightly enlarged dorsally. A few long black hairs at the extremities.

Cocoon.—Single, but firm and tough, composed of silk and bits of wood bitten off, a considerable portion formed by the supporting wood.

Pupa.—Brown, shining, gently tapering, the abdominal segments punctured all over, the punctures extending back to the finely shagreened incisures; wing cases grooved and transversely wrinkled. Cremaster short, subconic, with large longitudinal wrinkles. Upper hook one; lower, three on each side, regularly spaced; all large, with recurved tips.

Food plant—Oak.

ACRONYCTA FURCIFERA Guenée.

(Plates II, fig. 13, male; figs. 14, 15, female adult; VI, fig. 10, larva; XVIII, fig. 30, leg; XX, fig. 12, male genitalia.)

Acronycta furcifera GUENÉE, Spec. Gen., Noct., 1852, I, p. 44.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 54.

Apatela furcifera GROTE, Papilio, 1883, III, p. 68.

Apatela lobeliae † FRENCH, Can. Ent., 1886, XVIII, p. 118.

Ground color dark bluish ash gray, quite heavily powdered and with a somewhat smoky suffusion. Head and thorax without markings, except for the usual lateral line. Primaries with all the markings fairly well defined. Basal line geminate, smoky, sometimes extending to the basal dash. Transverse anterior line geminate, outwardly oblique, and quite even. It is usually a little better marked at the costa, but is traceable clear across the wing in all the thirty-odd specimens before me. The median shade is marked on the costa by a rather feeble oblique line, which crosses the reniform and is continued below it parallel with the transverse posterior line to the internal margin. This shade, while not distinct or prominent, is traceable in almost every specimen clear across the wing. The transverse posterior line is geminate, the inner line smoky and not well marked, the outer line black, lunulate, the intervening space paler than the ground color. As a whole the line is quite evenly bisinuate. The subterminal line is pale, very slightly marked in most of the specimens, but quite evident in some of the darkest forms. It is sometimes entirely obsolete. There is a series of black terminal dots at the base of the fringes, beyond which the latter are cut with black. The basal streak is broad and thick, extending to the outer portion of the transverse anterior line, but very rarely beyond it. There is a dagger mark opposite the cell which touches but rarely crosses the transverse posterior line. A similar mark in the submedian interspace usually crosses the transverse posterior line, and is much heavier than the other, without becoming as prominent as in *lobeliae*.

The ordinary spots are fairly well defined. The orbicular is small, a little irregular, sometimes oval, quite usually complete. The reniform is of moderate size, usually undefined outwardly. The two spots are connected inferiorly by a black line. Secondaries smoky white in the male, darker in the female. Beneath whitish, more or less powdered, with the usual outer line and discal spot.

Expanse, 1.50 to 1.80 inches (37 to 45 mm.).

Habitat.—Canada to Florida, west to Colorado; Kittery Point, Maine, in August; Carbondale, Illinois, in May; Union County, New Jersey, in July; Washington, District of Columbia, in August.

This is another common species with all the essential markings of *lobeliae*. It is much darker, however, distinctly smaller in size, and without the peculiar yellowish tinge. On the whole, the black markings are not so prominent as in the preceding species, but it is difficult to point out distinctive characters other than such as have already been noted. With a good series of specimens at hand there is rarely a doubt as to the species; but occasionally an intermediate example may be troublesome, unless reference is had of the male sexual characters. The head structure is essentially as in *lobeliae*. The leg is not quite so heavily built, and its heaviest point on the femur is nearer to the center. The tibial epiphysis is at about the middle and extends nearly to the tip. The harpes are long and narrow and somewhat acutely rounded at the tip. The clasper is rather slender, the superior processes being very long and well curved. There is a finger-like process from the upper margin, and this character will always separate this species from *lobeliae*. Between thirty and forty specimens have been under examination.

LARVA.

FRENCH, Can. Ent., 1886, XVIII, p. 118 (*lobeliae*).

Egg.—Round, very flat, the well-marked vertical grooves becoming obscure at the apex and less numerous. Transverse striae scarcely indicated. A slight rim at the base, where the egg is applied to the leaf. Colorless, whitish, not entirely transparent; diameter, 1 mm.; height, about 0.25 mm.

Stage I.—Translucent white, without marks. Head higher than wide, mouth pointed; width, 0.3 mm. Setae single, normal, long, curved, I and II dark, the rest pale and finer, subprimaries absent.

Stage II.—Head squarer than before, with pointed lobes, colorless; eye black; width, 0.5 mm. Body colorless, except for the food showing by transparency; a little opaquely whitish. Warts large, concolorous, each bearing a crown of short, pale setae besides the central dark one. Subventral setae all pale; IV small, situated on the white tracheal line, VI distinct, elongated longitudinally. A few setae on the leg plates. Later the body becomes pale green, with a broken white subdorsal line along tubercles II.

Stage III.—Head, about 1 mm. Body higher than wide, all pale

green; a pale, broken, yellowish subdorsal line. Warts concolorous; hairs more numerous than before, more than one long one from each wart, pale, except some of the long dorsal ones. In another specimen a series of dorsal creamy white patches composed of a bar connecting tubercles I reaching back on the sides to II and again connected by a narrow line behind II. These are small on joints 3 and 4, large on 5 to 13, that on 12 with both transverse lines large.

Stage IV.—Head bilobed, whitish, faintly brown mottled on the upper part of the face; width, 1.8 mm. Body green, with a yellow subdorsal line between tubercles I and II, divergent on the thorax. Hairs few, black and white; warts concolorous, I and II forming a square on joint 12. A few fine secondary hairs laterally, seen under a half-inch objective. Later the dorsal space becomes faintly touched with brown on joints 2 to 12 between the yellow lines. In another specimen there were white dorsal patches as before, but red centered, the transverse bars broken by the red, the side parts fusing into the usual subdorsal line.

Stage V.—Head green, mottled with red brown on a white ground over the apex of the lobes and face; clypeus green; width, 2.5 mm. Body green, a red dorsal line on the narrow ridge-like dorsal space edged with yellow along warts II, reaching joint 13 and marked with blackish on the thorax and joint 12. Hairs thin, dark dorsally, white subventrally, and supplemented by secondary ones. Later the color of the head becomes yellowish; dorsal band brownish red, darker on joints 3 to 5, broken by yellow in the incisures, obsolete on joint 2, enlarged on 12 and reaching 13.

Stage VI.—Head bilobed, shining black, with a red patch at the apex of each lobe, slightly shagreened, the coarse setae pale; width, 3.7 mm. Body dull black, the warts (except I) pale brown, with central hair and tiny crown of reddish hairs, the brownish setae resembling the rather numerous secondary hairs. A dorsal bright red stripe on joints 3 to 11, narrowly edged with velvety black, broken broadly in the incisures. Joint 12 black on top, slightly elevated; feet pale.

Another larva had but five stages, with the following widths of head: .3, .5, 1, 2.2, 3.6 mm.

Cocoon.—"Spun up above ground, covered with small fragments of wood" (Riley).

Food plants.—Wild cherry, fire cherry, choke cherry.

ACRONYCTA HASTA Guenée.

(Plates I, fig. 14; IV, fig. 2, adult; XVIII, fig. 30, leg; XX, fig. 13, male genitalia.)

Acronycta hasta GUENÉE, Spec. Gen., Noct., 1852, I, p. 45.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 54.

Apatela hasta GROTE, Papilio, 1883, III, p. 67.

Acronycta telum GUENÉE, Spec. Gen., Noct., 1852, I, p. 45.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 54.

Apatela telum GROTE, Bull. U. S. Geol. Surv., 1883, VI, p. 571.

Ground color rather pale ash gray, mottled with smoky. Head and thorax with the usual lateral line. Primaries with all the markings fairly well defined. Basal line geminate, evident on the costa, and sometimes continued to the black dash. Transverse anterior line geminate, well marked throughout in most of the specimens, but occasionally becoming faint, especially in the female, and in some instances entirely wanting. The median shade is marked obliquely on the costa, and sometimes it is traceable below that point. Occasionally it may be followed for its entire course. Transverse posterior line geminate; but the inner line is very feebly if at all defined, and indicated by the paler included shade. The outer portion of the line is black, narrow, more or less lunulated, and as a whole the line is somewhat S-shaped. There is a fairly evident subterminal line, which is pale and irregular, varying much in distinctness. There is a series of black dots at the base of the fringes, which are cut with black beyond them. There is a heavy black basal dash, which extends to the transverse anterior line, and sometimes crosses it into the median space, though this is rare. A narrow black dagger mark, which tends to obsolescence, is opposite the cell; a more prominent dash opposite the anal angle crosses the transverse posterior line in the submedian interspace. The ordinary spots are of the ground color or a little paler. The orbicular is irregular, somewhat oval. The reniform rather small, kidney-shaped, well marked inwardly, but usually vague outwardly. The spots are distinctly connected by a black line. Secondaries in the male whitish, with a faint smoky tinge; in the female smoky. Beneath white or nearly so, more or less black powdered, the primaries sometimes a little smoky, both wings with the usual outer line and dusky discal spot.

Expanse, 1.50 to 1.80 inches (37 to 45 mm.).

Habitat.—Canada in June; Maine to Washington, District of Columbia, west to the Mississippi; White Mountains, New Hampshire, in July; Ithaca, New York, June 17; Otto, New York, July 18; Delaware in March and May.

It is probable that the range of this species is greater than is indicated, but all my material is from the more northern portions of our country. The species is not uncommon in New Jersey, and seems to be not rare in Northern New York and New Hampshire. I have some thirty-odd specimens before me which show very little range of variation, except in size. On the whole, the species resemble *furcifera* quite closely, but the ground color is a much cleaner gray and the forewings are rather peculiarly mottled by smoky shadings, which are not so distinctly localized that they can be described. The markings contrast more than in *furcifera*, and finally, the secondaries in both sexes are much paler than in the previous species. In the male they are almost white; in the female they are not as dark as in the male of *furcifera*. In the character of the head this species agrees in general with *lobeliae*. In the leg structure the resemblance is on the whole to *furcifera*, though comparatively somewhat smaller. The harpes of the male are

rather short, distinctly constricted before the tip, so that this seems enlarged and obliquely rounded. The clasper is stout, well developed, with the superior process long, strong, and well curved. There is no finger-like process from the superior margin.

ACRONYCTA LAETIFICA, new species.

(Plates III, fig. 12, adult; XVII, fig. 21, leg; XX, fig. 9, male genitalia.)

Ground color a creamy white, more or less black powdered. Head and thorax as usual, the disk sometimes faintly yellowish. Primaries with all the markings fairly evident. Basal line geminate, brown, marked on the costa and sometimes extending to the basal dash. Transverse anterior line geminate, oblique, more or less broken, black or brown, varying much in distinctness. On the whole, it is outwardly oblique. The median shade is black marked on the costa, extends obliquely to the reniform, and is sometimes traceable as a brown shade line parallel with the transverse posterior line to the inner margin. Transverse posterior line narrow, black, more or less lunulated, preceded by a white shade and followed by a blackish or smoky shading, which darkens the outer portion of the wing and relieves a paler subterminal line. The latter is more or less broken, not defined, and in pale specimens scarcely traceable. There is a line of black dots at the base of the fringes, beyond which they are cut with black. There is a distinct black basal dash, which usually extends only to the inner portion of the transverse anterior line, and in only one case, among the specimens before me, beyond the outer part of this line. There is a distinct black dagger mark, which crosses the transverse posterior line opposite the cell, and another that is much more prominent and accompanied by a dusky shade, which crosses it in the submedian interspace. The ordinary spots are well defined, of the ground color. The orbicular is oval, irregular, black-ringed; the reniform quite small, well defined inwardly, and sometimes entirely complete. In most cases a black line unites the spots inferiorly, but this is sometimes wanting or very feebly defined. Secondaries smoky in both sexes, paler in the male, and with a yellowish tinge. Beneath white, powdery, with a more or less obvious irregular outer line, and on all wings a discal spot.

Expanse, 1.50 to 1.60 inches (37 to 40 mm.).

Habitat.—New York, New Jersey, Florida. There are no dates on any specimens.

This species has been confused with *furcifera*, with which it really has very little in common. The creamy white primaries are much nearer like those of *morula* or *occidentalis*, although paler and with a more silky luster than either. This will distinguish them quite readily from all other forms in which the ordinary spots are tied. In this species the connecting line between the ordinary spots tends to become obsolete, and in the specimens before me three have the connection

entirely wanting. Such examples will be apt to fall with *occidentalis* in the table, especially as the latter species sometimes tends to have a slight connection between the ordinary spots. The present species, however, is larger, the wings are comparatively a little broader and square, the ground color is different, and the primaries are not so even as in *occidentalis*. This latter species also tends to lose the orbicular, which is always distinct in the new form, and finally the very dark smoky secondaries in this species give it an altogether different appearance. The head structure is like that of *lobeliae* in all essential features. The legs resemble those of *furcifera*, but the femur is comparatively a little shorter and stouter. The harpes of the male are long, slender, and just a little enlarged before the tip. The clasper is stout, the superior process moderately curved and quite heavy. There is no finger-like process from the upper margin. Types are in the collections of the U. S. National Museum. Cornell University, Rutgers College, and Messrs. Graef and Doll.

ACRONYCTA MANITOBA, new species.

(Plates XII, fig. 1, female adult; XVII, fig. 24, leg; XX, fig. 14, male genitalia.)

Ground color a dark bluish ash gray and very powdery. Head and thorax with the usual lateral line, which extends to the ends of the patagia in this case. Primaries with all the ordinary markings traceable. Basal line geminate, blackish. Transverse anterior line geminate, blackish, outwardly oblique. Median shade extending obliquely from the costa over the reniform, and then parallel with the transverse posterior line, and, vaguely defined, to the inner margin. Transverse posterior line geminate, the inner line smoky, the included space white, the outer line narrowly black and a little lunulated. As a whole, bisinuate. There is an irregular, undefined, pale subterminal line. There is a series of black dots at the base of the fringes, beyond which the latter are cut with dusky, and there is also a series of blackish rays, which extend inwardly from these terminal dots. The black basal dash is heavy and reaches the outer portion of the transverse anterior line. There is an obvious black dagger mark which crosses the transverse posterior line opposite the cell, and another heavy mark of the same character in the submedian interspace. Orbicular round, of good size, black ringed, white centered. Reniform moderate in size, kidney shaped, more or less obscured by the median shade. These spots are inferiorly tied by a heavy black mark. Secondaries in the male pure white, a little soiled outwardly toward the tip; beneath smooth, only a little powdery, with a vaguely indicated exterior line and a better marked discal spot.

Expanse, 1.60 to 1.70 inches (40 to 42 mm.).

Habitat.—Winnipeg, Manitoba (Hanham); Glenwood Springs, Colorado, July 16 (Barnes).

I have two males of this species, one of them a perfect specimen,

through the kindness of Mr. Hanham; the other an electric-light capture and a little rubbed, from Dr. Barnes. The species is very distinct and differs from anything else in the series. It is the only one with the ordinary spots tied that has pure white secondaries. The peculiar clear ashen-gray color with the dense powderings will also serve to make the species recognizable. In frontal structure it resembles *lobeliae*. The anterior femur of the male is quite heavy and short, the thickest part central. The tibia has the epiphysis attached above the middle and extending nearly to the tip. The harpes of the male are quite broad and very slightly dilated before the tip. The clasper is stout and well developed, the superior process moderately curved.

ACRONYCTA THORACICA Grote.

(Plates III, fig. 8, adult; XX, fig. 15, male genitalia.)

Apatela thoracica GROTE, North Am. Ent., 1880, I, p. 94; Papilio, 1883, III, p. 68.

Ground color bluish ash gray, a little mottled with yellowish shadings. Head and thorax well powdered. Head with the front black marked, the thorax with the disk yellow. Primaries with the transverse lines tending to become imperfect, while the veins are so emphasized as to give the species a somewhat strigate character. The basal line geminate on the costa. Transverse anterior line geminate on the costa, but beyond that vague and in none of my specimens traceable across the wing. On the costa the line is blackish; beyond that point it has a yellowish tinge. The median shade is marked obliquely and quite prominently on the costa, and extends between the ordinary spots. Transverse posterior line widely outcurved, lunulate, narrow, blackish, followed outwardly by a yellowish dusky shading which merges into the ground color before the outer margin. There is a series of black terminal dots, beyond which the fringes are cut with blackish, and from which rays are sent inwardly in the interspaces. There is no subterminal line. The basal black line is distinct, extending through the transverse anterior line and into the median space, in one case nearly meeting the well-marked black dash which crosses the transverse posterior line in the submedian interspace. There is a distinct dagger mark crossing the transverse posterior line opposite the cell. At the extreme base of the wing inferiorly there is a patch of yellow scales. The ordinary spots are incompletely defined. The orbicular is oval, a little paler than the ground color, incompletely ringed with blackish. The reniform is well marked inwardly, kidney shaped, marked with yellowish. There is a distinct connecting line between the ordinary spots, and the narrow space between them is filled by an extension of the median shade. Secondaries whitish; in the female with a feebly developed outer line. Beneath white somewhat powdery, with a more or less complete outer line and discal spot.

Expanse, 1.60 to 1.70 inches (40 to 43 mm.).

Habitat.—Tucson, Arizona; near Hot Springs, Las Vegas, New Mexico, 7,000 feet, July.

This species is easily distinguishable. The distinct yellow disk of the thorax, the yellowish patch at the extreme base of the wings and in the reniform, and the general yellowish tinge beyond the transverse posterior line are all characteristic.

ACRONYCTA STRIGULATA, new species.

(Plates XII, fig. 6, female adult; XVIII, fig. 26, leg; XX, fig. 16, male genitalia.)

Ground color an even bluish ash gray, very finely powdered. Head and thorax of the ground color; thorax with the disk smoky, but with a yellowish tinge in the male. Primaries with the transverse maculation more or less obsolete, and veins, being more or less white, give the wing a longitudinally strigate appearance. Basal line wanting in the specimens before me. Transverse anterior line marked on the costa by a pair of smoky lines, which are not traceable beyond their inception. The median shade is indicated by an oblique smoky streak. The transverse posterior line is very slender, blackish, lunulate, and best marked in the submedian interspace. There is a series of black terminal dots, beyond which the fringes are cut with black, and from which rays are sent inwardly. Three of these rays just below the apex are quite prominent, the third of them forming a dagger mark which reaches to and extends a little beyond the transverse posterior line. In the submedian interspace there are two of these rays, the upper of which is shaded and connected by a smoky shade with the lower, which forms a little dash and extends across the transverse posterior line at this point, nearly meeting the long basal dash, which in this case is superiorly margined by the median vein. The ordinary spots are very indefinite. The orbicular is usually white or nearly so, but is not well margined and may be entirely obsolete. The reniform is of moderate size, kidney shaped, and only marked inferiorly. There is a curved black streak which indicates a connecting line between the ordinary spots, and to this point the oblique shade from the costa extends. Secondaries white, with the fringes a little dusky at base. Beneath white, with a more or less well-marked outer line and discal spot.

Expanse, 1.36 to 1.55 inches (34 to 39 mm.).

Habitat.—Colorado (Bruce); Glenwood Springs in July (Dr. Barnes).

I have three males and two females before me which do not vary, except in size, and that very slightly. The species is smaller than *thoracica* and is an intensification of the characters found in that species. The practical absence of all the transverse maculation, the small size, and peculiar blue color of the primaries will serve to identify this form. The head is convex without being prominent, the femur is well developed, the tibia rather slight, the epiphysis attached very close to the base, but extending almost to the tip. The harpes of the male are broad and rather short, somewhat dilated and oblique near

their termination. The clasper is very stout, the superior process not very long, unusually broad, and only a little curved, the finger-like process from the upper margin longer and well developed, almost straight.

ACRONYCTA VINNULA Grote.

(Plates IV, fig. 11, adult; XVII, fig. 23, leg; XXI, fig. 9, male genitalia.)

Microcoelia vinnula GROTE, Proc. Ent. Soc. Phila., 1864, II, p. 436, pl. IX, fig. 2.

Acronycta vinnula GROTE, Trans. Am. Ent. Soc., 1868, II, p. 118.

Apatela vinnula GROTE, Papilio, 1883, III, p. 68.

Ground color milky white, more or less suffused with greenish or luteous mottlings. The disk of the thorax is quite usually dark, and sometimes the tip of the collar is almost blackish. The patagiae at the sides are also black marked. The primaries have all the ordinary markings distinct, but very variably evident. The basal line is geminate and marked on the costa, sometimes black, sometimes greenish gray, or of an intermediate shade. The transverse anterior line is also geminate, outwardly oblique, more or less toothed on the veins, yet as a whole quite even in course. It may be black or greenish gray, or the inner line may be black and the outer green, or parts of both may be of either color. There is a distinct median shade running obliquely from the costa across the reniform and thence with an almost right angle to the inner margin. The line may be entirely greenish, or the part from the costa to the reniform may be black. The transverse posterior line is indistinctly geminate, the outer line black and distinct, a little lunulated, but as a whole with a very even outcurve over the cell. The inner line is well marked on the costa, but in most cases is very vague beyond that point. The intermediate space is often white marked and quite prominent, though sometimes of the usual ground color. The subterminal space is greenish and vaguely defines an irregular subterminal line by its contrast with the terminal space. There is a series of black terminal dots, beyond which the wings are cut with blackish. There is a more or less distinct black mark between veins 5 and 6, extending from the margin inwardly and sometimes reaching the transverse posterior line. There is a black dash opposite the anal angle, which reaches to but does not cross the transverse posterior line, and which is more or less shaded with black and green. There is a distinct basal black streak, which is almost broken in the middle. The orbicular is round, or nearly so, completely defined in either black or greenish. The reniform is moderate in size, well defined in most instances, and crescent rather than kidney shaped. The secondaries are dirty whitish in the male, dark in the female. Beneath whitish, with the disk of the primaries mostly smoky; secondaries with a distinct discal dot, and both wings with an outer line, which is much more defined on the secondaries.

Expanse, 1.20 to 1.30 inches (30 to 32 mm.).

Habitat.—Canada to Texas, west to the Mississippi Valley; New Jersey in June; Albany, New York, in May and June; Evans Center, New York, July; Long Island, New York, August; central Missouri in July; Texas in May, June, and July.

This pretty little species is quite easily recognizable and is unlike anything else in the genus. The primaries have a peculiarly smooth, almost metallic, vestiture, on which the greenish mottlings are well defined. It varies quite considerably in the amount of contrast between the ground color and the markings, and it easily fades in the cabinet, so that fresh specimens are often quite different at first sight from those that have been kept in the collection. The front is flat, or bulges but little; the palpi are well developed and extend easily to the middle of the front. The legs of the male are normally developed, all the parts proportionate, and none of them particularly heavy. The epiphysis of the tibia is attached nearer to the base than to the middle, but extends almost to the tip. The tarsi are perhaps longer in proportion to the rest of the leg than is usual. The harpes are rather short, even, rounded at tip. The clasper is very stout and strong, forming a single beak-like structure, the edges of which are irregular and toothed. They are therefore quite distinctive and unlike anything else found in the genus. Altogether, this is a very well marked form in all its features.

LARVA.

Stage VI.—Head bilobed, rounded, a pulverulent brown patch on the upper part of the face of each lobe, reaching to the median suture. Clypeus high as usual, but the side pieces indistinct and fused with the lobes, so that only the triangular center is distinct; width, 2.8 mm. Body higher than wide, thorax thicker than the head, joint 12 scarcely enlarged. Tubercle II on joints 5 and 12 produced, prominent, all the others greatly reduced, small, and obscure, except the thoracic ones, which are moderate. Body green, a narrow subdorsal band bent up to tubercle II on joints 5 and 12, elsewhere reaching somewhat below it. A faint, straight, pale dorsal, and substigmatal lines. Prominent tubercles brownish. Warts with a central seta and crown of short ones, dark from warts I to III, pale IV to VI, with some fine, short, pale, secondary hairs subventrally. Length, 24 mm.

Food plant.—Elm.

ACRONYCTA FRAGILIS Guenée.

(Plates XII, fig. 3, female adult; XXI, fig. 7, male genitalia.)

Microcoelia fragilis GUENÉE, Spec. Gen., Noct., 1852, I, p. 34.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 31.—GROTE, Proc. Ent. Soc. Phila., 1864, III, p. 80.—MORRISON, Psyche, 1875, I, p. 42.

Bryophila spectans WALKER, Can. Nat. and Geol., 1861, VI, p. 38.—GROTE, Can. Ent., 1877, IX, p. 27, pr. syn.

Ground color whitish, almost completely overlaid by smoky brown scales. The head is black spotted; the collar is black marked on the

disk, tipped with white. The disk of the thorax is marked with smoky black, and the patagiae are black edged. The primaries with all the ordinary maculation distinct. Transverse anterior line geminate, black, the included space white; the lower part of the basal space is much darker than the upper, where the smoky scales overlying the white base are rather sparse. The transverse anterior line is geminate, black, toothed on the veins, the two parts equally distinct, the intervening space white. As a whole, its course is a little oblique outwardly. Most of the veins through the median spaces are white marked, and on the internal margin is a black mark which does not quite cross the median space. The median shade line is marked on the costa, running obliquely to the reniform and then very close to the transverse posterior line to the internal margin. It is not well marked, but a little darker than the smoky suffusion of the wing. The transverse posterior line is geminate, the outer line black, distinct, lunulate, strongly dentate on the veins; the inner blackish and best defined by the white included space. Beyond the transverse posterior line the wing is nearly black, relieved by a dentate white subterminal line. There is a white line at the base of the fringes, which are black, or nearly so, and cut with white lines. The basal dash is merged into the general dark shading of the lower part of the basal space. The orbicular is rounded, or nearly so, black ringed and white centered. The reniform is of moderate size, kidney shaped, black ringed, and centered with the smoky ground. Secondaries yellowish white in both sexes; in some specimens with an obvious outer darker line. There is a broken terminal line, and the fringes are more or less evidently cut with blackish. Beneath, both wings are yellowish white, powdery, with a more or less obvious outer line and discal spot.

Expanse, 1.20 to 1.35 inches (30 to 33 mm.).

Habitat.—Canada to New Jersey, west to the Mississippi; Canada in June and July; Manchester, Vermont, August 3; Lancaster, New York, August.

This species is quite different from anything else in the genus, and has been heretofore associated with *diphtheroides* under the generic term *Microcoelia*. In all structural characters it agrees with *Acronycta*, and I can not see any reason, except that the markings are a little different, for removing it from the present genus. It is well associated with the species with which it is here placed, and the sexual characters justify the reference, though they are unique, and remind one rather of *tritona*, or even *funeralis*. The harpes are broad, somewhat oblique inferiorly, and pointed at the tip. The clasper is very strong, the inferior plate produced into a curved hook at the lower margin, while from behind the middle of the upper margin there arises a very long, stout, curved, hook-like process which can best be compared to that in *funeralis*. The front is round, but hardly bulging, and the leg structure is normal, not differing greatly from the species with which this is associated.

LARVA.

Egg.—Much flattened, round, with a rim-like margin; ribs distinct, some confluent as they diminish in number toward the vertex, wavy, about sixty on the edge; micropyle irregularly ridged; cross lines just perceptible in certain lights; shell colorless, white; diameter, 0.7 mm.

Stage I.—Body glassy, colorless; food green. Tubercles colorless, normal, I to V present, VI absent, I and II in a square on joint 12. Setae single, long, pale. Leg plates concolorous, with three setae. Width of head, 0.3 mm.

Stage II.—Width of head, 0.4 mm. Colorless; food green; faint white spots along warts II. Warts normal, VI present, rather elevated, each with a seta and crown of shorter ones. Hair pale, some dark ones dorsally.

Stage III.—Whitish; food green; width of head, 0.6 mm. A row of white subdorsal spots along warts II, all as before.

Stage IV.—Green, warts II broadly white; head whitish; width, about 1 mm. (calculated, 0.86 mm.), bilobed. Hair black and white, very long. Warts conic, with a crown of soft hairs.

Stage V.—As before, darker green, but still pale. White patches over warts I and II distinct, somewhat oblique. Hair long, dark dorsally; some scattered pale secondary ones on the body, most numerous subventrally. Width of head, 1.2 mm.; wart IV small. In male larvae the sex glands show plainly in joint 9, whitish.

Stage VI.—Head bilobed, rounded, green, with pale setae; no angles nor tubercles; width, 1.8 mm. Body thick, round, joint 12 a little enlarged, segmental incisures all well marked. Warts small, with fine hairs, normal, IV very small. Hair long, black from warts I to III, shorter and white from V and VI. Body green; a broad yellow subdorsal line, covering warts II, broken in the incisures. Toward the end of the stage the dorsal space is dotted with purple brown along warts I, but not continuously.

Stage VII.—Head slightly bilobed, green, a reddish-brown shade over the vertex of each lobe; ocelli and jaws dark; width, 2.4 to 2.6 mm. Body elevated at joints 4 to 7 in position of rest, head held down, joint 12 a little enlarged dorsally. Hairs few, black from warts I to III, the rest pale, with a few short, fine, dark secondary ones. Green; a narrow, broken, yellowish-white subdorsal line along warts II; wart I shaded with purplish brown in the area just around it, especially on joint 12, but all the shading rather faint. Spiracles dark brown, small. The dorsal shading may be more extensive, suggesting the filling in of the dorsal space, but not complete.

Food plants.—Birch, mountain ash, apple.

[NOTE.—*Acronycta minella* DYAR (*Apatela minella* DYAR, Journ. N. Y. Ent. Soc., 1898, VI, p. 41) was published too late for full treatment here.]

ACRONYCTA PAUPERCULA Grote.

(Plates XII, fig. 2, male adult; XVIII, fig. 29, leg; XXI, fig. 8, male genitalia.)

Apatela paupercula GROTE, Proc. Ac. Nat. Sci. Phila., 1874, p. 197.—HARVEY, Bull. Buff. Soc. Nat. Sci., 1875, III, p. 4.—GROTE, Papilio, 1883, III, p. 68.

Ground color whitish, with an undefined reddish-luteous suffusion, the disk of the thorax sometimes marked with this suffusing color. The lateral edges of the patagiae are sometimes black. The primaries with most of the markings fairly evident; but the transverse anterior line much less defined than the others. Basal line marked on the costa by a black line, which is sometimes wanting or replaced by a pair of luteous marks. Transverse anterior line geminate, as a whole evenly oblique, but more or less irregular on the veins. It is not complete in any of the specimens before me, but is usually well marked on the costa, and the inner line at least is marked a little below its junction with the basal streak. The median shade is marked by an oblique line from the costa across the reniform and from that point it is usually obsolete, though sometimes traceable to the inner margin. On the costa it is blackish shaded; beyond that it is vaguely luteous. The transverse posterior line is feebly geminate, the outer portion narrow, black, more or less lunulated. The inner line is mostly defined by a difference between the white included shade and the ground color of the wing. The subterminal space is irregular and variably darker, so that in some specimens no subterminal line is traceable. There is a series of black terminal dots, beyond which the fringes are cut with black. There is sometimes a narrow black streak from the transverse posterior line to the outer margin opposite the cell; but this is never prominent and in most instances altogether absent. The dagger mark in the submedian interspace is distinct, and except in rare instances crosses the transverse posterior line. There is an evident black basal streak which is almost broken at its middle and evidently made up of two portions. The orbicular is narrowly oblique, completely ringed by blackish or luteous. The reniform is well marked on the inside, but often somewhat vague outwardly. It is crescent rather than kidney shaped. The two spots are unusually close to each other and often touch. Secondaries in the male whitish, in the female a little darker. In both cases soiled outwardly. On the under side powdery, whitish, the primaries inclined to be smoky. Secondaries with a distinct discal spot; both wings with an outer dark line, which is much more evident on the secondaries.

Expanse, 1 to 1.25 inches (25 to 31 mm.).

Habitat.—Texas, February, March, June, and July.

This species most nearly resembles *vinnula*, but it has a different ground color and differs in details of maculation. It is very difficult to describe the color difference, because it is a matter of shading and tinting; but there is no greenish in this species, that shade being replaced

by a peculiar dirty reddish luteous. In this species the transverse anterior line is much less evident, and the ordinary spots are very close together. The median shade line, which is a distinct and constant character in *vinula*, is scarcely traceable in a few specimens of this species, while the dagger mark in the submedian interspace crosses the transverse posterior line in all my specimens. The front is slightly bulging, but not prominent. The palpi are fairly well developed and reach the middle of the front. The anterior legs of the male are rather short and stout, the tibiae particularly being stout, the epiphysis inserted just a little above the middle and not reaching to the tip. The tarsi are short in proportion to the rest of the leg, and altogether this is a stouter built limb than occurs in *vinula*. The harpes of the male are moderate in length and quite broad, the tip being oblique. The clasper is small and somewhat hook-like, ending in a somewhat longer point. Eighteen specimens, representing both sexes, have been under examination.

ACRONYCTA LITHOSPILA Grote.

(Plates I, fig. 13, adult; XVI, fig. 10, venation; XXI, fig. 2, male genitalia.)

Acronycta lithospila GROTE, Proc. Bost. Soc. Nat. Hist., 1874, XVI, p. 240.

Hyboma lithospila GROTE, Mitth., a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Ground color a very dark bluish gray, with a more or less evident smoky suffusion. Center of the collar and the disc of the thorax smoky. Primaries with all the transverse markings obscure and more or less obsolete. The veins are more or less black marked, and the dusky shadings are longitudinal in their general character, leaving the spaces below the middle of the wing slightly paler than elsewhere. All of these characters give a strigate appearance. The basal line is marked by an oblique streak on the costa. The transverse anterior line is marked in the same way, and nothing is to be seen of it below that point. The median shade is also marked by a smoky streak obliquely across the costa. The transverse posterior line is traceable across the wing and it is broken, narrow, formed of lunules or dots, which are sometimes only a little defined. There is a series of black terminal dots from which blackish rays extend inward in the interspaces. The fringes are interlined with dusky. There is a very slender longitudinal black line at base which reaches near to the middle of the wing, and sometimes almost connects with another black line which represents the ordinary dagger mark opposite the anal angle. A more or less evident black line crossing the transverse posterior line opposite the cell represents the dagger mark usually found in that position. The ordinary spots are scarcely traceable in most specimens. When best marked the orbicular is very small, faintly outlined by black scales, and a trifle lighter than the ground color. The reniform is an indefinite, kidney-shaped spot, which is a little brown shaded. The secondaries are whitish, with a faint yellowish tinge in the female; in

both sexes a little dusky outwardly. Beneath whitish, with the usual outer line and discal spot.

Expanse, 1.25 to 1.46 inches (33 to 37 mm.).

Habitat.—Canada to Florida, west to the Pacific coast; Mississippi; Colorado; Portland, Oregon, in May; Central New York in May; Georgia in April; Massachusetts in June.

This species is easily recognized by its very dark colors, the almost total absence of the transverse markings, and the narrowly strigate character of the ornamentation as a whole. The wings seem to be almost subequal and are only a little oblique on the outer margin, so that the creature seems narrower winged than its immediate allies. The front is convex and a little protuberant. The palpi are well developed, are free from the front and reach to fully its middle. The harpes of the male are slender, rounded at tip. The clasper is distinct, stout. The upper process is heavy, only a little curved, and of moderate length. The finger-like process from the upper margin is slender and almost straight. Twenty specimens of both sexes have been under examination.

LARVA.

EDWARDS and ELLIOT, *Papilio*, 1883, III, p. 132.

Egg.—Flattened, like two-thirds of a sphere, with about forty-eight ribs, diminishing in number above, not confluent; smooth, a wavy line on the apex and in the hollows. Micropyle finely reticulate.

Stage I.—Whitish, translucent; the food green. Purplish dorsal patches on joints 5, 8, 9, and faint on 12. Dorsal setae, I–III, black, lateral, IV–V, white, all single, no subprimaries, skin smooth. Head, 0.3 mm. wide.

Stage II.—Head whitish; width, 0.45 mm.; slight brown streaks in the angle of the lobe. Body nearly colorless, green from the food, a purplish-brown patch covering warts I and II on joints 5, 8, 9; and 12 and trace of a white subdorsal line in dashes over warts I and II on the pale segments. Dorsal hairs blackish, lateral pale. Warts with long setae, two from wart I, and clusters of short secondary hairs with slightly bulbous tips, concolorous with the marks. Later a white subdorsal line is more distinct, shaped in outline of the markings of the mature larva.

Stage III.—Head, 0.8 mm. wide, bilobed, the lobes pointed; whitish, with a brown shade below the apex of each; shining. Body green from the food, otherwise nearly colorless; a white subdorsal line touching each segment, most distinct on joints 7–10, where it borders a faint brown patch dorsally on joints 8 and 9. A slight tint of brown also on joints 5 and 12. Hairs long and dark, sparse, with many slender, short, finely bulbous-tipped pale ones spreading slightly on the skin as secondary hairs, only a few dark even in the dark marks.

Stage IV.—Much as in the next stage, the marks fainter; dorsal

band mostly yellow, dark in the darkest part, the pattern recognizable; width of head, 1.2 mm.

Stage V.—Head bilobed, green, yellowish above, the apices of the lobes dotted with dark brown, running down on the outer angle; width, about 2 mm. Body humped up at joints 4–5 and 12, a little angularly enlarged. Sides green, a dark-brown dorsal band, edged with yellow, on joints 3 to 13, slightly widened on joint 5, but not reaching wart II till joints 8–12, where it widens to between warts II and III, gradually contracting till it just covers II on 12; narrowly continued to the end of the body. On joints 8 and 9 it is shaded with black centrally, no green inclosed patch, but a faint paler, scarcely whitish dorsal line. Warts small, several haired. Hairs blackish dorsally, pale subventrally, with a few secondary ones. Some minute brownish pile dorsally.

Stage VI.—Head bilobed, narrowing to the vertex, green, the apices of the lobes dark chocolate brown, spotted down the face; width, about 3 mm. Joint 12 with a sharp hump, warts I and II in a square. Markings as before throughout.

Stage VII.—Head green, the apices of the lobes narrowly sordid purplish brown, shining, a few black dots; the color shades down the angles in mottled spots on a yellowish ground, reaching about halfway to the ocelli; width, 4.2 mm. Body clear green, a little whitish frosted down the sides. Dorsal band on joints 3 to 13, chocolate brown, slightly milky, very narrowly yellow edged. It is widened on joint 3 centrally where it begins sharply; cervical shield all green; the band passes inside tubercle I on joint 4, just covers I by a slight expansion on joints 5 to 7, then widens between II and III on joints 8 to 10, just over II on 11, and narrows further to the square top of joint 12; still narrower to the end of joint 13; end of anal plate green. Joints 8 and 9, especially the warts, slightly shaded with blackish. Spiracles white with black rim. Hair quite long, but very fine and sparse, black from I to III, the rest whitish, as also a few secondary hairs subventrally. A number of small whitish dots on the sides. Skin minutely spinulose.

Food plants.—Hickory, oak, chestnut.

ACRONYCTA MANSUETA, new species.

(Plates XII, fig. 7, male adult; XXI, fig. 13, male genitalia.)

Ground color a bright bluish gray, very smooth and even. Head more or less marked with brown, not forming distinct lines. Collar also mottled with brown, forming an indefinite band at the base and another one near to the tip, the edge being marked by lighter scales. The disk of the thorax is sometimes a little darker, but more usually of the ground color. The patagiae are marked with black at the base of the wing. Primaries with the ordinary maculation fairly evident, but not very strongly marked. The basal line is feebly indicated on the costa, sometimes single, sometimes geminate, but always one line much stronger than the other if both are present. The transverse

anterior line is geminate, brown, a little outcurved from the costa to the submedian interspace, where it becomes lost in the dark shading of the wing. The median shade is marked on the costa and extends outward sufficiently to darken the space between the ordinary spots. The transverse posterior line is distinct, squarely outcurved over the cell, and with a deep inward curve in the submedian interspace. It is geminate, the outer line lunulate and black, but fine, the inner line brown, slender, frequently defined only by the fact that the included space is paler. The space beyond the transverse posterior line is a little brown shaded, and the terminal space is more evenly dark, relieving a diffuse, whitish, irregular subterminal line. There is a slender black terminal line and a series of small terminal dots, beyond which the interlined fringes are cut with blackish. There is a black basal streak which extends to the transverse anterior line and below this the wing is shaded with blackish brown or smoky. Beyond the transverse anterior line this shade extends nearly to the transverse posterior line, being best marked on each side of the internal vein, where there is a black streak extending nearly across the median space. An arrow-shaped mark extends from the outer margin, just above the anal angle, inwardly to the transverse posterior line, which it barely crosses. The ordinary spots are fairly evident but not prominent, a little lighter than the ground color, very narrowly ringed. The orbicular is almost round and varies in size. The reniform is kidney-shaped and has a slightly yellowish shade, which is also somewhat marked at the base of the wing. In some specimens the shading just outside of the transverse posterior line is brownish. Secondaries pure white in the male, with a smoky line at the base of the fringes; in the female the outer margin is a little dusky. Wings beneath white, very slightly powdery, with hardly traceable outer lines and discal dots.

Expanse, 1.20 to 1.40 inches (30 to 35 mm.).

Habitat.—Los Angeles, Nevada County, and Sierra Nevada, California; eastern Washington; Garfield County, Colorado, 7,000 feet (Bruce); Glenwood Springs, Colorado, May and September (Barnes).

I have seen 10 specimens of this species, evenly divided as to sex, and very little difference indeed between them. The species is very easily distinguished by the dark shading along the internal margin, resembling in this particular *funeralis*, but differing from it in the more arched costa, the less curved outer margin, and in the fact that the black shading does not send up spurs along the interior part of the transverse anterior line. There is very little variation in the species so far as it is represented in the series before me. The size of the orbicular varies somewhat; there is a little change in the depth of the ground color, and in some specimens a dull ochery tinge is evident. The head seems small, the front flat, the palpi well developed and reaching to the middle of the front. The harpes of the male are oblong, a little curved, evenly rounded at the tip. The clasper is well developed, beak-like at

the tip, and distinctly curved and twisted. There is a superior pointed process from the middle of the upper margin, which is of moderate length.

ACRONYCTA FUNERALIS Grote and Robinson.

(Plates III, fig. 7, adult; XVIII, fig. 27, leg; XXI, fig. 5, male genitalia.)

Acronycta funeralis GROTE and ROBINSON, Proc. Ent. Soc. Phila., 1866, VI, p. 17, pl. III, fig. 8.—GROTE and ROBINSON, Trans. Am. Ent. Soc., 1870, III, p. 179.—SPREYER, Stett. Ent. Zeit., 1875, XXXVI, p. 200.

Apatela funeralis GROTE, Check List Noct., 1875, pl. I, fig. 1; Mitth., a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 11.

Jochearea funeralis GROTE, Papilio, 1883, III, p. 111.

Acronycta americana† HARRIS, Ent. Corresp., 1869, pl. III, fig. 3 (larva only).—LINTNER, Ent. Cont., 1874, III, p. 157, pr. syn.

Ground color chalky white, more or less overlaid by gray scales, so that in some cases the wing really seems evenly gray with a little bluish shading. The head and thorax share in the differences in ground color, and vary all the way from almost white, to nearly black in the darkest specimen. In all cases a few dusky scales are intermixed which are most prominent along the sides where there is a distinct line extending from the palpi to the base of the wings along the patagiae. The primaries have the ordinary markings all traceable; but none of them well defined and the wing looks blotchy. The basal line is black, single and marked on the costa only. The transverse anterior line is usually single, marked by an oblique black dash on the costa, and sometimes traceable as a geminate brown line to the longitudinal black dash. A small portion of this line is visible in the shape of an upward spur from the black basal streak. The median shade forms a black or blackish blotch on the costa, darkening the upper portion of the space between the ordinary spots. The transverse posterior line is squarely bent outward over the cell, moderately incurved below, geminate on the costa and below the median vein. The outer line is narrow, black, irregular, not lunulated, the included space of the palest ground color. The inner portion of the line is dark shaded in the submedian interspace. Beyond the transverse posterior line the wing is quite uniformly bluish gray, through which an irregular, pale, diffuse subterminal line is traceable. There is a series of black marks at the base of the fringes, beyond which the latter are cut with black. There is a broad black streak at the base, extending through the transverse anterior line nearly to the transverse posterior line and in some cases touching it, and below this the wing is black or very dark smoky. From the outer margin just above the anal angle a broad black streak extends inward, crossing the transverse posterior line and joining with the black shade beyond it so as to connect with the blackish shading from the base. The ordinary spots are incompletely defined and sometimes scarcely traceable. In dark specimens they are quite contrasting, because they are always of the lightest ground color. The orbicular is round or nearly so, varying much in size. The reniform is kidney shaped, some-

times a little constricted and not margined outwardly. It may have a smoky interior line. The secondaries in the male are white, with the veins a little smoky, and sometimes dotted to indicate an outer transverse line. There is a smoky line at the base of the fringes, from which a dirty shading sometimes extends a little toward the base. In the female the secondaries are white at the base; but become blackish outwardly, the wings being dark marked and having the outward line much better indicated than in the opposite sex. The dark line at the base of the fringes is also much better marked. Beneath whitish, the primaries smoky or at least black powdered, both wings with a more or less distinct outer line and a blackish discal spot.

Expanse, 1.24 to 1.42 inches (31 to 38 mm.).

Habitat.—From Canada southward; west to the Mississippi Valley; Jefferson, New Hampshire; Keene Valley and Long Island, New York; Mount Airy and Pittsburg, Pennsylvania; Kansas City, Missouri.

This is a characteristic yet variable species. The variation does not, however, change the prominent features of the wing and consists rather of a change in the ground color from white to quite dark smoky gray, or perhaps better in the amount of the gray shading which overlies the white base. The wing thus gets a mottled or marbled appearance which is much enhanced by the broad black mark on the middle of the costa, and by the blackish shading along the interior margin. The upward extension of this black mark on the transverse anterior line is quite characteristic and is evident in all the specimens. The black shading is really made up of two separate parts, that from the base extending to the transverse posterior line, while a broad bar extends through the submedian interspace from the outer margin inwardly through the transverse posterior line. The front in this species is distinctly bulging, and somewhat inflated. The palpi are well developed and reach the middle of the front, the anterior legs are moderately developed, the femur is slender, the tibia quite stout in proportion, with the epiphysis above the middle. The harpes are rather broad, a little curved, evenly rounded at the tip. The clasper is unique. It consists of a flat basal piece which extends from about the middle of the clasper to near its tip and then branches, the upper branch being rounded at the tip, the lower being long and pointed. From the base of this flat piece a very long stout curved process, which is pointed at the tip, extends upward.

LARVA.

HARRIS, Ent. Corr., 1869, p. 313, pl. III, fig. 3 (*americana*).—LINTNER, Twenty-sixth Rept. N. Y. State Mus., 1874, p. 135 (*americana* Harris); Twenty-sixth Rept. N. Y. State Mus., 1874, p. 157 (*funeralis*).

Stage VI.—Head large, slightly bilobed, black, coarsely shagreened; width, 3.4 mm. Body dull sooty black, a transversely elliptical, slightly raised, creamy white patch on each segment from joints 2 to 13 and anal plate, reaching to wart II. The patches on joints 3, 4, 11, and

13 are a little smaller than the others and those on 5 and 12 have a central, transverse, depressed, narrow black line, very faintly reaching between warts I and II, as if about to divide the patch. Warts I and II white, III to VI shining black, single haired except VI, which bears two or three hairs. Hairs short black, two on each side of the cervical shield, seta II on joints 5 to 10, 12 and 13 very large, long, spatulate, and striated. Length, 38 mm.

Cocoon.—"Leaves fastened together with a few threads" (Harris).

Food plants.—Hickory, birch, elm, apple.

ACRONYCTA TRITONA Hübner.

(Plates II, fig. 9, adult; XV, fig. 9, maxilla; XXI, fig. 3, male genitalia.)

Triaena tritona HÜBNER, Zutraege, 1818, p. 21, figs. 107, 108; Verzeichniss, 1818, p. 201.

Acronycta tritona GÜENÉE, Spec. Gen., Noct., 1852, I, p. 42.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 53.

Apatela tritona GROTE, Can. Ent., VII, 1875, p. 221; Can. Ent., 1880, XII, p. 87; Papilio, 1883, III, p. 68.

Hyboma tritona GROTE, Mitth. a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Ground color very dark bluish gray, with a more or less distinctly marked fuscous suffusion. Head and thorax without distinct markings. Primaries with the transverse markings mostly indefinite. Basal line wanting or only vaguely indicated on the costa. Transverse anterior line very feebly marked, in the best case geminate, brown, outwardly oblique, a little outcurved between the veins. In many cases it is entirely obsolete. The median shade is marked by an oblique streak from the costa crossing the reniform. The transverse posterior line is single, black, somewhat irregularly shaded outwardly, preceded by a very narrow pale line. It is rather squarely bent over the cell and incurved in the submedian interspace. A brown, smoky shading beyond the transverse posterior line merges gradually into the ground color, interrupted by a broken subterminal line, which is sometimes scarcely traceable. There is a series of discal terminal spots, beyond which there is a discal line at the base of the fringes. There is a black streak at base, extending to the inner portion of the transverse anterior line. A prominent black streak extends inwardly from just above the anal angle through the transverse posterior line. This is diffusely shaded with black and forms the most prominent character on the otherwise very evenly colored wing. The ordinary spots are very feebly marked; the orbicular is small, round, of the ground color, very faintly outlined, and sometimes scarcely traceable. The reniform is undefined, of moderate size, kidney shaped, and a little shaded with brown. The secondaries are smoky in both sexes, darker outwardly, but as a whole paler in the male. Beneath it is whitish-powdery, with very feebly marked outer lines and discal spots, which are in many cases entirely absent.

Expanse, 1.36 to 1.48 inches (34 to 37 mm.).

Habitat.—Canada to Florida; west to the Pacific coast; central New York in May; Portland, Oregon, in May; Minnesota; Mississippi; Colorado.

This species is very constant in its general appearance, and is also recognizable by the very dark, blue-gray, even ground color, on which the only prominent markings are the black basal streak and prominently shaded dagger mark close to the anal angle. The wings have rather a stumpy appearance and are thickly scaled. The front is convex and bulging, but hardly inflated, the palpi being rather short, closely applied to and hardly reaching the middle of the front. The anterior legs in the male are stout, rather short, the femur a little dilated, the tibia with the epiphysis rather near to the base. The genitalia of the male are characteristic; the harpes are oblong, distinctly broadened just before the tip; the clasper is corneous, broad, clumsy in appearance, forming a somewhat bent scoop, from the upper margin of which projects a long, finger-like process. It may be somewhat fancifully compared to the large claw of a lobster, in which the lower, movable jaw is bent to its fullest extent. The species is not at all rare, although it can scarcely be said to be very common.

LARVA.

DYAR, *Insect Life*, 1891, III, p. 391 (*tritona*).

Stage IV.—Head bilobed, apical tubercle produced, greenish testaceous, a brown line up from the eye to the apical tubercle, then down on the front a little way; width, 1.2 mm. Body compressed, tubercle I produced, and II also, on joint 12, especially so. Color yellowish green, greener from the food; a faint brown paired dot on joints 2 and 3, a distinct spot on 4–5, reaching wart II on 5 and divided by a pale dorsal line; a subdorsal dark line on joints 7–10, widest on 7 and narrowing behind, covering warts I–II, on joints 7–8, over II only on joints 9–10, just joining another spot on joints 11–12, which widens and covers all of joint 12, warts I–III and is narrowly produced on joint 13 to anal plate. These lines inclose a green dorsal patch on joints 8–11. Hairs few, several from a wart, pale; all simple, not glandular; a number of shorter secondary ones subventrally below the white tracheal line.

Stage V.—Head as before; the brown shade runs down from apical tubercle on the face and inward to notch of vertex, as well as all down the outer side to eyes; width, 1.5 mm. Body green, as before. Joint 6 is the only one without any brown marks. A whitish subdorsal border to the brown band on joints 7–10.

Stage VI.—Head as before; width, 2.4 mm. Body green, the brown dorsal band furcate on joint 2, widening to wart II on joint 5, suddenly absent on joint 6, beginning again at wart II on joint 7, branches running along warts II only on joints 8–11, a single band again on joint 12 covering warts I and II, which are in a square, then narrowly produced

to anal plate. Warts small, green, a central long hair; subventrally spreading from wart VI.

Stage VII.—"Head medium, flattened in front, finely wrinkled; rosy pink, becoming darker on the sides and merging into shining light brown mottled with darker spots on top; neck, under side of head and antennae light colored. Clypeus transversely wrinkled, light drab. Body soft yellowish green. Two convergent black stripes on joint 2, meeting on joint 3 a broad deep purplish brown dorsal stripe, which extends across joints 3, 4, and 5, widening a little on joint 5; on joint 7 this stripe begins again, but after extending halfway across the segment it splits into two lighter dull purple stripes, which diverge slightly, then run parallel, grow darker and approach each other, meeting on joint 12, thus inclosing an elliptical area; the stripe becomes more purple in color and extends over the anal plate. Tubercles slightly raised, of the same color as the surface from which they arise, most of them crowned with a short, dark, blunt bristle and surrounded with a few long hairs. Ventral surface, especially about the legs, with a fine white pubescence. Spiracles small, oval, black. Length, 27 mm.; breadth, 4.5 mm." (C. P. Lounsbury, manuscript.)

Width of head, 3.5 mm. Sparse pale secondary hairs subventrally. Joint 12 is square above, sharply elevated, the anterior part of the body not compressed, and apparently dislocated by the green joint 6.

Cocoon.—Composed of "earth and silk." (Lounsbury.)

Food plants.—Cranberry, deerberry, *Azalea viscosa*.

ACRONYCTA QUADRATA Grote.

(Plates III, fig. 1, adult; XVII, fig. 28, leg; XX, fig. 18, male genitalia.)

Apatele quadrata GROTE, Bull. Buff. Soc. Nat. Sci., 1874, II, p. 154. Papilio, 1883, III, p. 114.

Ground color a light bluish ash gray, with a more or less well-defined reddish-brown suffusion. Head and thorax without particular markings, except for a black line at the base of the wings. Primaries with the markings fairly evident, but scarcely prominent. The basal line is geminate, but very feebly marked on the costa only. Transverse anterior line geminate, very evenly oblique outwardly. Transverse posterior line single, black, a little shaded outwardly, preceded by a paler shade inwardly and almost rigidly oblique from the costa to the hind margin, practically parallel with the outer margin. The median shade is brown, not prominent, outwardly bent over the costa between the ordinary spots, and then inwardly oblique to the hind margin at or near the transverse anterior line. The costal region usually more or less brown shaded, and beyond the transverse posterior line the wing is dusky, crossed by a pale, rather irregular subterminal line. There is a brown line at the base of the fringes, which is interrupted on the veins. A prominent black basal streak extends across the transverse anterior line. There is a small black streak in the submedian interspace between

the transverse posterior line and the upper margin, and very often not reaching either one. The space between the ordinary spots is more or less black filled, forming in the best cases an almost quadrate black mark. The orbicular is large, round, of the palest ground color, and not distinctly defined. The reniform is of good size, rather narrowly kidney shaped, variably defined, but never completely so. Secondaries white in both sexes, but in the female outwardly smoky and showing traces of an outer transverse line. Beneath powdery, varying from white to smoky, with or without an outer line and discal spot.

Expanse, 1.36 to 1.68 inches (34 to 42 mm.).

Habitat.—California; British Columbia; Calgary, Canada; Nebraska, and Kansas.

This species, though widely distributed, seems to be rare, and there are no great number of specimens in any collection. I have no dates of capture. The specimens vary somewhat in ground color, and particularly in the amount of brown that may be in the wing. The species is unlike any other and easily recognizable by the square patch between the ordinary spots. The very sharply limited dash within the anal angle is also characteristic, because it does not in any instance trench upon the transverse posterior line, while in most cases it does not even reach the outer margin. Another characteristic feature is the remarkably even transverse posterior line, which is scarcely sinuate in any case and sometimes nearly straight. The head is distinct, the front bulging and a little inflated; the palpi are very well defined and reach to the middle of the front at least. The legs are strongly built, but not particularly prominent; the femur is quite moderate, the tibia strong in proportion, with a small epiphysis situated just above the middle and yet reaching to the tip. Somewhat unusually short, stout tarsi. The male characters resemble those of *occidentalis*, but the harpes are rather broader toward the tip; the clasper is distinct, with the ordinary curved upper hook and a short, rather stout pointed process from the middle of the upper margin. Four males and one female are now at hand, but I have compared others which did not show any noticeable differences.

ACRONYCTA RADCLIFFEI Harvey.

(Plates V, fig. 9, larva; VI, fig. 10, larva; XII, fig. 4, male adult; XX, fig. 17, male genitalia.)

Apatela radcliffei HARVEY, Bull. Buff. Soc. Nat. Sci., 1875, II, p. 270.—GROTE, Papilio, 1883, III, p. 114.

Hyboma radcliffei GROTE, Mitth. a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Ground color is of a very even, pale bluish ash gray. The head and thorax without obvious markings. The vestiture and coloring of the primaries is very even and smooth. The ordinary markings are all evident and usually well marked. The basal line is geminate, smoky, usually traceable from the costa to the black streak. The transverse

anterior line is geminate, outwardly oblique, and rather even. The inner portion of the line is black, the outer smoky. The transverse posterior line is geminate, the outer portion black, the inner smoky and hardly distinct, mostly relieved only by the included pale shade. There is a slight brown shade just beyond the black portion of the transverse posterior line, and as a whole it is quite evenly bisinuate. The median shade is feebly marked by an oblique shade on the costa. There is a very vague, undefined, somewhat paler subterminal line and a series of smoky terminal dots. The longitudinal black streak at base is distinct and very neatly marked, extending through and a little beyond the transverse anterior line. The dagger mark opposite the anal angle is also very neatly defined and crosses the transverse posterior line, forming a distinct *psi*. The ordinary spots are of good size, incompletely ringed, a little paler than the ordinary ground color; the orbicular round or oblong; the reniform kidney shaped. Secondaries white in the male, but becoming smoky outwardly in the female. Beneath powdery, primaries smoky, secondaries almost white with a more or less defined outer line and discal spot.

Expanse, 1.50 to 1.60 inches (37 to 40 mm.).

Habitat.—Canada; New Hampshire; Massachusetts in June; Center and Albany, New York, May and June; Adirondack Mountains, New York, in August; Virginia in May.

This is a very neatly marked species which does not seem to vary much. The ash-gray color is remarkably smooth and even, and the markings are very neatly defined, making the insects easily recognizable. The head is distinct, the front convex, but hardly bulging, the palpi are well developed and rarely exceed the middle of the front, especially in the female. This latter sex is also a little broader winged than the male, and as a whole darker in color. The legs are moderately developed, the tibial epiphysis being situated unusually close to the base. The male genitalia resemble those of *occidentalis* and its near allies. The upper process is well developed and curved, with a distinct finger-like projection at right angles to the upper margin.

LARVA.

THAXTER, *Psyche*, 1878, II, p. 121.—DYAR, *Can. Ent.*, 1894, XXVI, p. 17.

Stage IV.—Head pale, a little brown dotted in front; width, 1.2 mm. Body pale, food green; no marks except an orange-colored patch on joint 12 covering tubercles I and III. Hair black and white; warts with central setae and crown of short hairs. concolorous; a few secondary hairs.

Stage V.—Head large, bilobed, pale behind, but thickly dotted all over the front and apex with light red brown; clypeus paler, eyes black; width, 2.2 mm. Body greenish white, not very opaque; a broad, dorsal, olive-green band reaching to wart II, tinged with brownish, and extending from joint 2 to the square dorsal part of joint 12; warts,

concolorous; hair, black and white, rather sparse, a few pale secondary ones subventrally. Later the sides are green; dorsal band brown with a faint yellow edge and a central reddish dorsal line; dorsal band not scalloped by warts II and not extending on joint 13.

Stage VI.—Head bilobed, black below, the upper half red, contrasting; width, 3.5 mm. Joint 12 enlarged and bearing tubercles I and II in a square. Body black with straight, even, yellow lines—dorsal, subdorsal (II), lateral (III), and subventral (V), the latter twice as broad as the others, all reaching from the cervical shield to the hump on joint 12; a perpendicular yellow line from wart II on joint 12 to the substigmatal line; joint 13 black above; warts small, pale, the dorsal ones bearing long white hairs (7 mm.), those on the sides short; a few, nearly obsolete, secondary hairs; length, 26 to 33 mm. The larvae have the habit of elevating the anterior end when disturbed. A single specimen, apparently destroyed by a fungus, has an abnormally marked head (Plate V, fig. 9a). The larva as shown in fig. 9 was made by Dr. Riley apparently from this specimen, and the coloration can not be reliable.

Cocoon.—Formed of silk and bits of wood bitten off.

Pupa.—"Slender and has a curious olive tint" (Thaxter).

Food plants.—Wild cherry and sugar plum.

ACRONYCTA FALCULA Grote.

(Plates XII, fig. 8, female adult; XXI, fig. 14, male genitalia.)

Apateia falcula GROTE, Can. Ent., 1877, IX, p. 86; *Papilio*, 1883, III, p. 68.—PACKARD, Forest Insects, 1890, p. 637.

Ground color a very even, dark bluish gray, which is shaded with red brown in the basal space inferiorly, and beyond the transverse posterior line; most markedly so in the submedian interspace. Head and thorax are without distinct markings, except for a black line at the base of the patagia. The primaries have the transverse markings evident, if not very prominent; the basal line is smoky, geminate, marked on the costa only. The transverse anterior line is geminate, well marked on the costa, the inner line black to the basal streak, and beyond that more or less lost. The outer portion of the line is marked on the costa, but loses itself in the ground color long before it reaches the inner margin. As a whole the line is oblique and without distinct curvings. Transverse posterior line geminate on the costa; but beyond that the outer line, which is black, is less distinct. It is broadly bent over the cell, a little toothed on veins 3 and 4, and incurved below that point. There is a vague, irregular, paler subterminal line, and a series of blackish terminal spots. The basal black streak is very distinct, prominent, with a short spur inferiorly at about the middle, and it reaches through the transverse anterior line. There is a very prominent black streak just above the anal angle, which reaches to, but does not cross, the

transverse posterior line. This black streak is often more or less brown shaded. The median shade is vaguely indicated by a brown streak on the costa. The ordinary spots are very feebly defined; the orbicular is round or nearly so, a little paler than the ground color, but not ringed; the reniform is very even, lunulate rather than kidney shaped, with a few black scales defining it inwardly, but defined only by its own paler color elsewhere. The secondaries in the female are whitish at base, smoky outwardly. Beneath, the wings are whitish powdery, with the usual more or less evident outer lines and discal spots.

Expanse, 1.40 to 1.45 inches (35 to 36 mm.).

Habitat.—Illinois; New York; Minnesota; Winnipeg, Manitoba.

Unfortunately I have females only of this species;¹ one of them, a specimen sent me by Prof. George H. French. The name of this insect is a mistake, and based upon an imperfection in the specimen. The margin below the apex is almost straight, and the least disturbance of the fringes at this point gives the impression of an excavated margin. As a matter of fact, in the four specimens before me there is only one which gives the least color to the name. The species is an easily recognizable one by the very dark, blue-gray primaries with a prominent black streak at base, and by the reddish shades which are found in the basal space and beyond the transverse posterior line. These are characteristic and unlike any other species known to me. The front of the head is a little protuberant and convex; the palpi are unusually long and well developed, extending above the vertex in one of my specimens.

LARVA.

COQUILLETT, *Papilio*, 1881, I, p. 6.—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 637.

Stage VI.—From the only observations on record the following may be gathered: Head brownish in front, pale greenish on the sides. Body dark brown, mottled with pale greenish; a darker dorsal line reaching to tubercle I; venter greenish white. Warts small, with one or two hairs, I and II on joint 12 larger than the others. Length, 32 mm. (Coquillett). I assume this to be the brown form of a normally green larva.

Food plant.—Hazel.

ACRONYCTA PARALLELA Grote.

(Plates III, fig. 9, adult; XVIII, fig. 28, leg; XXI, fig. 15, male genitalia.)

Apatela parallela GROTE, Can. Ent., 1877, IX, p. 53; *Papilio*, 1883, II, p. 168.

Ground color a very even, dark, bluish ash gray. Head and thorax more or less suffused with blackish. The collar has a blackish line near the base and another near the tip, while the tip is marked by

¹ Since the above was written I obtained a male specimen, which shows the characters of the series in which I have placed it in all essential features.

whitish scales. The head has a white line between the antennae and there may be another one across the middle. The little tuft at the base of the abdomen is unusually distinct and is often black tipped. The primaries have the ordinary markings fairly evident and sometimes very distinct. The basal line is geminate, blackish, marked on the costa only. The transverse anterior line is narrowly geminate, black, a little outcurved to the middle, where it is distinctly drawn in, and again outwardly oblique below to the inner margin. In most cases the line is more or less indistinct. The transverse posterior line is geminate, the outer portion of the line black, rather even, only a little drawn in in the submedian interspace. It is accompanied by a brownish shade, which is perceptible but not easy to locate. The inner portion of the line is smoky and not very distinct, best marked by the pale intermediate filling. There is a more or less evident, but hardly defined, subterminal line, which is paler than the ground color and somewhat diffuse. There is a narrow black line at the base of the fringes, which are cut by the broad, smoky shades. The median shade is more or less smoky, forming an oblique, blackish shade from the costa through the reniform, there bent and running inwardly as a smoky shade, reaching the internal margin at the transverse anterior line. Any portion or the whole of this shade may be absent. The basal black streak is well marked and has a short spur from the middle inferiorly. A black streak extends inward from the outer margin above the anal angle, and reaches the transverse posterior line just above vein 2. There is a shorter black dash extending nearly to the subterminal line. The ordinary spots are fairly defined; the orbicular round or nearly so, outlined in black scales, within which is a pale annulus and a center of the ground color. The reniform is of moderate size, kidney shaped, inwardly marked by black scales, then by an almost complete pale ring, the center being of the ground color. Secondaries white in the male, outwardly smoky in the female. Beneath, more or less powdery, sometimes smoky in the male. Secondaries with a more or less evident discal spot and outer line, which is frequently wanting in the male.

Expanse, 1.28 to 1.40 inches (32 to 35 mm.).

Habitat.—Texas in May; Garfield County, Colorado, 7,000 feet; Denver, Colorado (Bruce); Kansas.

Six males and two females are before me, and I have seen others. The species is a distinct one, and while it very closely resembles *falcula* in all essential characters it is yet quite easily separable from it. There are none of the red shades which occur in the more Eastern species, and the details of the markings differ quite obviously. One of the most prominent points is in the fact that there is a short streak above the second vein instead of the usual simple dagger mark. This gives quite a different character to that part of the wing and makes the species an easily recognizable one. The front is convex but

hardly protuberant, the palpi are well developed and reach to the middle of the front or even a little above. The anterior legs of the male are slender, the femur a little dilated at the base, the epiphysis of the tibia situated well toward the base. The harpes of the male are oblong, even, and evenly rounded at the tip. The clasper is rather slender, with a short, pointed, beak-like tip. From the middle of the upper margin is a moderate, pointed, straight process.

ACRONYCTA REVELLATA, new species.

(Plate XXI, fig. 10, male genitalia.)

Ground color a bluish ash gray. Head and thorax without special markings. Primaries with the ordinary maculation fairly well defined. Basal line brown, geminate, marked on the costa, and sometimes traceable to the basal dash. Transverse anterior line geminate on the costa, but beyond that point the outer line is obsolete, leaving only the inner black line, which is best marked from the subcostal to the submedian vein. As a whole, it is outwardly oblique, a little drawn in on the basal streak. The transverse posterior line is single, black, outwardly shaded with brown scales, bent outwardly over the cell, toothed on veins 3 and 4, and to a less extent on vein 1. There is a pale, undefined subterminal line, which is evident in proportion to the darkness of the terminal space. There is a series of blackish terminal lunules, beyond which the fringes are cut with brown. Basal streak black, distinct, extending through the transverse anterior line and almost meeting the black dash which crosses the transverse posterior line and reaches the margin above the anal angle. The basal dash has a short spur inferiorly at about its middle. Vein 1 has a black dash or shade accompanying it through the median space. The ordinary spots are fairly well marked; the orbicular round or nearly so, ringed by blackish scales; the reniform moderate in size, kidney shaped, a little marked with brownish scales. Secondaries white, with a faint yellowish tinge; in the female smoky outwardly. Beneath, white, more or less powdery, with a variably evident outer mark and discal spot, which is not marked in the males.

Expanse, 1.50 to 1.60 inches (37 to 40 mm.).

Habitat.—Glenwood Springs, Colorado, in June; Salida, Colorado, 7,500 feet; Washington.

Four males and one female are represented in the series before me, and as a whole the species is much larger and broader-winged than in *grisea*. It has much the same ground color and much the same pattern of maculation. It is a little darker, however, and it has the black dash opposite the anal angle much more prominent and heavier than in any specimen of *grisea* that I have seen. The head is small, well applied to the thorax, the front convex, but hardly bulging; the palpi distinct, free from the front, and reaching to the middle or above. The harpes of the male are broad, a little narrowed to the tip, which is rounded.

The clasper small, beak-like, and a little twisted. The specimens before me show practically no variation, and types are in the collection U. S. National Museum, Rutgers College, Mr. E. L. Graef, and Dr. William Barnes. The forelegs of the male are well developed, the femur long, dilated at the middle, the tibia moderately stout, with the epiphysis inserted unusually close to base.

ACRONYCTA GRISEA Walker.

(Plates III, fig. 4, adult; XVII, fig. 25, leg; XXI, fig. 11, male genitalia.)

Acronycta grisea WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 56.—GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 78.

Apatela grisea GROTE, Can. Ent., 1875, VII, p. 222; Ill. Essay, 1882, p. 39; Papilio, 1883, III, p. 68.—PACKARD, Forest Insects, 1890, p. 272.

Hyboma grisea GROTE, Mitth., a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Acronycta pudorata MORRISON, Ann. Lyc., Nat. Hist., N. Y., 1875, XI, p. 93.—GROTE, Can. Ent., 1875, VII, pp. 221, 222, pr. syn.; Can. Ent., 1880, XII, p. 188, pr. syn.

Ground color ash gray, a little mottled with brown, giving it a somewhat marbled appearance. Head and thorax without defined markings. Primaries with the basal line geminate, brown marked on the costa only. Transverse anterior line geminate, the outer line brown and more or less obsolete, the inner line blackish, also more or less obsolete; as a whole quite evenly oblique, outwardly. The median shade is indicated by a smoky streak from the costa, extending obliquely between the ordinary spots. Transverse posterior line black, single, preceded by a slightly paler and followed by a brownish shade. It is outwardly bent over the cell, strongly toothed on veins 3 and 4, and less so on vein one. A vague, undefined, irregular, pale subterminal line. A series of smoky marks at the base of the fringes, beyond which these are cut with black. There is a distinct black basal streak, which extends through the transverse anterior line and is forked from the lower side at about its middle. The black dash opposite the anal angle extends through the transverse posterior line, and is well marked and quite neatly defined. The ordinary spots are evident, though not prominent; the orbicular is round or nearly so, a little paler than the ground color, and outlined by smoky scales; the reniform is of moderate size, kidney-shaped, very imperfectly outlined, the center just a little brown shaded. The secondaries are soiled whitish, in the female smoky toward the outer margin. Beneath powdery, the disk of primaries smoky in the female, a more or less evident outer line and discal spot in both sexes.

Expanse, 1.25 to 1.40 inches (31 to 35 mm.).

Habitat.—Canada, southward to Georgia, west to the Mississippi; central New York in June; Minnesota in July.

This is quite a widely distributed species, though nowhere common. It is very constant in its general appearance; and in the examples that

I have had before me there has been no noticeable variation, except that of size, and a little in the ground color. The head is small, closely applied to the thorax; the front convex, but not bulging; the palpi well developed, free from the front and extending at least to its middle. The anterior legs of the male are well developed; the femur of moderate size, quite distinctly dilated at the middle, and the tibia moderately broad, with the epiphysis inserted close to the base. The harpes of the male are short and quite broad, a little narrowed at the tip and rounded. The clasper is distinct, twisted, beak-like, with a little tuft of diverging hair. This species can not be easily mixed with any other within its range, and its nearest ally is the Western species just described as *revellata*.

LARVA.

EDWARDS and ELLIOT, Papilio, 1883, III, p. 131.—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 272.

Stage I.—Head whitish; width, 0.3 mm. Body translucent whitish, shield and anal plate dusky luteous. Setae large, distinct, dark, the bases so large as to be nearly touching, single, normal; subprimaries absent. On joints 4, 5, 6, 9, and 12 a brown dorsal patch.

Stage II.—Head bilobed, angular, with pale setae, whitish; a brown shade at the vertex; width, 0.5 mm. Body whitish, sides of the cervical shield brown. Three dark red-brown patches on joints 4-5, 8-9, and 12, covering tubercle I on joint 4, on the rest reaching to tubercle II; on joint 12 tubercles I and II nearly in line; the patch is lighter brown and extends forward on joint 11. Warts with a long hair and a few short ones, wart IV as large as any, VI present; on joint 12, II has more hairs than elsewhere. Warts conical, concolorous with the markings. Later a whitish subdorsal band appears between warts I and II, partly broken by the brown patches.

Stage III.—Head square bilobed, pale greenish, a brown oval ring mark on each side, which is produced inward and joins its fellow at the vertex; width, 0.7 mm. Body as before, wart II with three or four hairs, smaller than wart I.

Stage IV.—Head whitish, clypeus green, the ring-shaped marks on each lobe strigose, with a concentric dash above; width, 1 mm. Body pale green, subdorsal band yellowish, dorsal patches as before. Hair rather long, partly blackish.

Stage V.—Head whitish, with brown strigose mottlings over the apex and front of each lobe, except the green clypeus; a tubercle at the apex; width, 1.4 mm. Body as before; warts tubercular granular, few haired. Later the yellow band is obsolete except bordering the patches; tubercles I on joints 6 and 7 have a touch of the brown color, and the patch on 11, 12 is fureate before. In the position of rest joint 6 is much humped up, and 12 is also prominent, the head held down.

Stage VI.—The same. Width of head, about 2 mm. Practically no secondary hairs.

Stage VII.—Head purplish brown, except the green clypeus and a narrow green area outside it, slightly mottled with paler; width, 2.8 mm. Body soft yellowish green, a purple-brown dorsal band, furcate on joint 2, touching the warts I on joints 5 to 7, broken in the incisures, widening into an elliptical patch on joints 8 to 11, narrowing on 12, and continued still more narrowly to the anal plate; on joints 9 to 11 a green patch is inclosed, narrow on the posterior half of 9, where it begins, wide on 10 to cover wart I, and occupying more narrowly the entire length of joint 11. Brown spottings on the sides, especially around the spiracle and wart VI. Warts small, I on joints 5 to 8 and I and II on 12 slightly produced. Hairs short, sparse, black from I to III, the rest white, two to ten hairs on a wart. Secondary hairs nearly absent; only one or two can be distinguished on a segment subventrally. Spiracles white, with narrow black border. There is a form which is "pale brownish with a flesh tint, but agreeing in all its markings with the green form" (Edwards and Elliot).

Food plants.—Apple, birch, willow, elm, arrowwood.

ACRONYCTA CONNECTA Grote.

(Plates II, fig. 16, adult; XVIII, fig. 7, palpus; XXI, fig. 4, male genitalia.)

Acronycta connecta GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 79.

Ground color a dirty yellowish gray, more or less shot with reddish through the center of the wings. The head with a black line across the front. Thorax with a blackish line at the base of the collar; patagiae black marked at the sides. Primaries with all the markings more or less traceable, but all of them obscured by a blackish shade which extends from the base through the center of the wing and reaches the outer margin above the anal angle. This shade is not well defined, and includes the ordinary basal black streak and the black dash through the transverse posterior line to the outer margin above the anal angle. The basal line is geminate, brown, marked on the costa only. The transverse anterior line is geminate, brown, outwardly oblique, a little incurved between the veins, and more or less obscure through the central portion of its course; sometimes it is hardly traceable beyond the costa. The median shade is marked by an oblique smoky streak on the costa, extending between the ordinary spots and sometimes darkening the entire space from that point to the longitudinal dark shade. Transverse posterior line blackish, slender, lunulate, usually denticulate on the veins, very strongly incurved in the submedian interspace. There is a more or less evident pale subterminal line, beyond which the terminal space is usually a little black shaded, most prominently so just opposite the cell and again in the submedian interspace. There is a series of black terminal dots, beyond which the fringes are cut with smoky. The ordinary spots are more or less obscure; the orbicular, when traceable, is round or nearly so, more or less marked

by blackish scales and centered with brown; the reniform quite large, kidney shaped, defined inwardly by black scales, but outwardly diffuse. It is shaded with reddish, which extends a little beyond it and shades into a whitish space following the interval between it and the transverse posterior line. Secondaries smoky, paler at the base; in the female with an indefinite discal spot and outer line. Beneath whitish, powdery, all wings more or less evidently marked with an outer line and a blackish discal spot.

Expanse, 1.25 to 1.40 inches (31 to 35 mm.).

Habitat.—Canada in August; Staten Island, New York, in July; Washington, District of Columbia, in August; Illinois in July.

This species is quite easily recognizable by the blackish shade which extends through the wing below its middle, from the base to the outer margin. It differs altogether from *funeralis*, because the shade does not reach the internal margin, and is indefinite, shading gradually from smoky into the ground color. The wings are rather narrow, the outer margin a little obtuse. It varies in the depth of the dark shading, and sometimes becomes rather confusedly marked throughout. The vestiture is a little rough, and under the lens the scales are seen to be distinctly elevated. The head is rather small, the front convex, but not bulging; the palpi are well developed but do not reach above the front. The legs are rather slender, the femur hardly dilated, the tibia long, with the epiphysis slender and inserted quite close to the base. The harpes are broad, somewhat abruptly narrowed from the under side to a rounded tip. The clasper is very stout, gradually narrowing to a coarse, beak-like process, giving rise on the upper margin to a stout, long, slightly curved process. It has a distinct resemblance in this respect to *funeralis*, although the lower process is altogether different in its character.

LARVA.

Stage VI.—Green form: "Head with a red stripe at each upper side, reaching from vertex and pointing toward ocelli, diminishing in size and becoming darker toward tip. Body largest in the middle, joint 2 somewhat suddenly depressed from side view; dark green, a broad subdorsal sulphur yellow line" covering tubercle II and just passing outside of I, "and a faint subobsolete pale stigmatal one; sparsely covered with long white hairs." Tubercles I and II "jet black, each giving rise to about one black hair. Joint 2 with two black marks, parallel, bent at right angles outward at the front end." (Riley manuscript.)

Brown form: "Carneous, the dorsum bluish and margined each side with deep yellow. Dorsal trapezoidal spots with a pale bluish annulation. Under a lens the body is covered with extremely fine elevated speckles, especially on dorsum. Joint 2 with two elbowed lines, diverging in front. Dorsal warts with black hairs, the rest long and light. Venter immaculate. Head and spiracles black." (Riley.)

Cocoon.—"Larva eats into wood, where it constructs a cocoon." (Riley.)

Pupa.—Smooth, light brown, regularly tapering; abdominal segments coarsely punctured on the anterior third; wing cases slightly shagreened. Cremaster flat, thin but wide, the lateral margin produced into a wing-like plate, blackish on the edge, smooth. Posteriorly the margin is fluted and double. Hooks slender, pale, recurved at tip, the upper one on each side on top of the plate, the lower three on each side in a row situated between the two fluted rims.

Food plant.—Willow.

ACRONYCTA BRUMOSA Guenée.

(Plates XIII, fig. 1, female adult; XVII, fig. 30, leg; XX, fig. 21, male genitalia.)

Acronycta brumosa GUENÉE, Spec. Gen., Noct., 1852, I, p. 52.—WALKER, Cat. Brit.

Mus., Het., 1856, IX, p. 59.—BUTLER, Ent. Amer., 1887, III, p. 36=*persuasa*.

Acronycta impleta WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 57.

Acronycta subochrea GROTE, Bull. Buff. Soc. Nat. Sci., 1874, II, p. 153.

Apatela subochrea GROTE, Can. Ent., 1875, VII, p. 227, pl. 1, fig. 10.—BUTLER, Ent. Amer., 1887, III, p. 36=*impleta*.

Ground color very dark, powdery, ash gray. The vestiture on the primaries elevated. Head with a transverse black line in front, collar with a blackish line inferiorly; the balance of the head and thorax black powdered. The wings are mottled with smoky brown, which obscures the ordinary markings. The basal line brown, geminate, complete. Transverse anterior line brown, geminate, tending to become indistinct below the middle; as a whole oblique outwardly. In some dark specimens the line becomes black instead of brown. The median shade is brown, best marked on the costa, where it extends obliquely into the reniform, is there bent at nearly a right angle and then runs almost upright to the internal margin. The latter part of its course is very largely obscured, and sometimes altogether wanting. Transverse posterior line geminate, the inner line only a little marked, the included space paler and lunulate; the outer line consisting of a series of black lunules, and as a whole being denticulated on the veins. It is very nearly parallel with the outer margin and only a little sinuated. The subterminal line is pale, irregular, broken, and diffuse. The terminal space is crossed between the veins by black streaks, opposite which the fringes are cut with blackish. There is a brown shading below the median vein from the base to the transverse anterior line, but no distinct basal streak. There is a similar shading opposite the cell, and another opposite the anal angle, taking the place of the ordinary streaks, which in some cases may be faintly traced. Between the transverse anterior and median lines there is a black streak just above the internal vein. The ordinary spots are traceable, of good size, but not prominent; the orbicular round or nearly so, black ringed; the reniform large kidney shaped, obscured by black scales. Secondaries

yellowish white in the male, smoky yellow in the female. Beneath yellowish white, powdered, with the usual outer line and discal spots, more or less well marked.

Expanse, 1.28 to 1.60 inches (32 to 40 mm.).

Habitat.—Canada, southward to Virginia, west to the Rocky Mountains; Ontario in July; New York, May and June; Washington, District of Columbia, in August; Lancaster, Pennsylvania, in June; Racine, Wisconsin; Garfield County, Colorado, 7,000 feet.

This species is recognizable without much trouble by the very dark mottled primaries, and by the equally dark, smoky secondaries. The primaries are more than usually parallel, and rather narrow. These points, together with the elevated vestiture on the primaries, will make the species recognizable. There is little variation; some specimens are darker than others, in some the lines are black rather than brown, and in some the smoky suffusion is more distinct than in others. The species here identified as *brumosa* is what was described by Mr. Grote as *subochrea*. The original description will fit either one of two or three species, and this reference, which is so different from any that has been heretofore made, is largely due to the suggestion made by Dr. Dyar from the larval characters given. Mr. Butler thought the species to be *persuasa*; but the description will not allow this reference. It is possible to mistake *subochrea* for a rubbed *persuasa*, and I believe Mr. Butler's reference to be based upon an erroneous determination or a bad specimen. The head is of very good size, though not prominent, the front bulging, the palpi reaching to the middle and distinct. The genitalia of the male are unique; the harpes are rather narrow, long, a little dilated just before the tip; the clasper is broad, looking somewhat like a mitten with an unusually long thumb projecting from the upper side; from the upper margin there is also a very long, slender, straight process. We have here an almost perfect intermediate type between what may be considered the typical *lobeliae* form on the one hand and the form usual in the *persuasa* group on the other. The anterior leg of the male is well developed, although not unusually long. The femur is a little dilated toward base; the tibia is stout, with the epiphysis inserted above the middle.

LARVA.

GUENÉE, Spec. Gen., Noct., 1852, I, p. 52 (*hamamelis*).—DYAR, Can. Ent., 1894, XXVI, p. 18 (*subochrea*).

Stage III.—Head subquadrate, lobes pointed; pale whitish with eight brown spots, one covering the eyes, one before the apex of each lobe, and two smaller ones respectively above and below the other two; width, about 1 mm. Body deeply incised between the segments. Warts concolorous, IV obsolete. Pale translucent yellowish, a white subdorsal line below wart II. Warts II and III on joint 2 and II on joint 3 brown. Brown patches dorsally on joints 5, 8, and 9, and irregular ones on joints 11 and 12. Hairs sparse, fine, blackish.

Stage IV.—Head as before, but the lobes less pointed; upper spot twice indented; width, 1.5 mm. Body incised between the segments, joint 12 slightly enlarged. Pale green, marked as before. Hair short, blackish dorsally, fine and scant. Length, 9 mm.

Stage V.—Head much as before, the mark over the eye connected with the one above it, mottled, diffuse; width, probably 2.6 mm. Body greenish, similar to the next stage.

Stage VI.—Head bilobed, pale, with brown mottled spots on the face of the lobes, except in the middle of each at vertex; width, .4 mm. Body higher than wide, slightly enlarged at joints 5-6 and 12, these parts humped up in the position of rest. Olive green, paler subventrally, a broad yellowish white dorsal band, somewhat pinkish tinted, reaching to wart III, broken by a large dark brown spot on joints 5, 8, 9, and 12, the spots diffuse at the edge. A fainter similar mark on joint 3 and on joint 11 below wart II. Warts I to III small, with few short hairs; IV to VI small, more flattened and diffuse, with pale hairs; a few long hairs at the extremities. Secondary hairs very weak, a few present in the subventral region. Length, 43 mm.

Rarely there is a brown form, but I have no notes on it.

Cocoon.—Made of silk and bits of wood or other material on which it may be built.

Pupa.—Shining brown; length, 21 mm.

Food plant.—Witch hazel.

ACRONYCTA SUPERANS Guenée.

(Plates I, fig. 6, adult; XVIII, fig. 21, leg; XXI, fig. 1, male genitalia.)

Acronycta superans GUENÉE, Spec. Gen., Noct., 1852, I, p. 53.—WALKER, Cat.

Brit. Mus., Het., 1856, IX, p. 59.—BETHUNE, Can. Ent., 1869, I, p. 85.

Apatela superans MORRISON, Psyche, 1875, I, p. 42.

Hyboma superans GROTE, Mitth., u. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Ground color a very pale ash gray, or almost whitish. Head with the front black or nearly so, and a black or brown line above the antennae. Collar with a blackish line at the base, and also black tipped. The patagiae are also sprinkled with black scales. Primaries very strongly marked with black or brownish shades, which in a general way extend first from the base through the submedian space to the outer margin just above the anal angle, and, second, from the costa downward between the ordinary spots, including the reniform and joining the longitudinal shade. A blotchy shade extends from the transverse posterior line to the outer margin opposite the cell. These shadings vary in intensity and obscure the ordinary markings. The basal line is black, geminate, marked on the costa only. Transverse anterior line black or brown, geminate, the outer line more or less broken and quite well separated from the inner, which is obscure through the shaded portion of the wing. As a whole, the line forms two outcurves and is a little drawn in at its center. The median shade is obscured by the

blackish shading, but is traceable in some specimens, and is then found to extend obliquely from the costa through the reniform, then bent inward to form the outer margin of the blackish shade as far as it extends. It is evident in the form of a lunule on the internal margin. The transverse posterior line is geminate, the inner line even, powdery, and continuous; the outer line lunulate, dentate on the veins, and emphasized by the included pale shading. The line is interrupted by the longitudinal shade. There is a pale, irregular, more or less ill-defined subterminal line, which is interrupted opposite the cell and above the anal angle. The terminal space is marked with blackish between the veins. There is a series of black terminal lunules, beyond which the interlined fringes are cut with smoky. The ordinary spots are traceable; the orbicular round, of the pale ground color, ringed by blackish scales and centered by blackish; the reniform large, kidney-shaped, but obscured by the transverse shading. At the base of the wings there is, inferiorly, a contrasting yellow patch, on which is massed a tuft of long scales which give the wing a very characteristic appearance. Secondaries smoky in both sexes; in the males a little paler. Beneath, very pale yellowish, powdery, both wings with a very distinct discal dot and outer line.

Expanse, 1.60 to 1.80 inches (40 to 45 mm.).

Habitat.—Canada, southward to Washington, District of Columbia, west to the Mississippi and Central States; Canada and New York, June and July.

This is a very strongly marked species which can not be easily mistaken for anything else. It is a large form and broader winged than usual, the primaries being more nearly triangular than in those immediately associated with it. The peculiar markings give it a blotchy appearance. A broad streak running from the base to the outer margin, joined by a broad band from the middle of the costa, gives us a pale space at the base, another one toward the tip, and a narrow pale line along the inner margin, all of these spaces, however, being broken by blackish. Finally, the peculiar patch of yellow scales at the inferior base of the wing is quite characteristic. The fore legs of the male are unusually long and slender; the femur a little dilated just before the middle, the tibia with a very large epiphysis inserted rather close to the base. The harpes of the male are very long, narrow, nearly equal, and round at the tip. The clasper is very well developed, unusually rolled together, the finger-like process from the upper angle very long and not much curved, the process from the upper margin toward base short and rather stout. The species seems to be not at all uncommon. The front is bulging and a little inflated. The palpi rather short and scarcely reaching to its middle.

LARVA.

LE BARON, First Rept. Ill. State Entom., 1871, p. 52.—MARTEN, Trans. Dept. Agr., Ill., 1880, XVIII, p. 131.—COQUILLETT, *Papilio*, 1881, I, p. 6.—SAUNDERS, *Ins. Inj. Fruits*, 1883, p. 166, figs. 174, 175.

Stage II.—Head white with four black dots on each lobe, one on the side, one on the eye, and one beside the clypeus; width, 0.6 mm. Body white with dark brown patches dorsally on joints 2, 5, 8-9, and 12. Warts black; a narrow, white dorsal line. The warts bear a long seta and bushy crown of small hairs with enlarged ends; a few secondary hairs. Joint 12 with warts I and II in a square.

Stage III.—Head white with black spots as before; lobes pointed; width, 0.9 mm. Body white, the warts all black, pointed conic with a crown of hairs, thickly covered with short secondary hairs with enlarged tips. Dorsum broadly streaked with dark brown, cut by dorsal and subdorsal white lines. Hairs black and white.

Stage IV.—Head bilobed, whitish, a large mottled black patch below the vertex divided centrally, one over the eye, and another close to it beside the clypeus; width, 1.7 mm. Body greenish with a series of dark dorsal segmentary patches. Warts dark, those on the sides narrowly so. Primary and secondary hairs much as before.

Stage V.—Head dotted with black down the face, cut across the middle by a pale whitish band; apices of lobes pale brown; width, 2.5 mm. Body green, a chocolate-brown dorsal stripe reaching wart II, narrow on joint 13, but reaching the anal plate, broadened on the cervical shield. Hairs few, black and white.

Stage VI.—Head brown at the apices of the lobes, shading into pinkish below, mottled with black spots, especially on the front angles and in a triangular patch on the ocelli, sides and labrum nearly white; width, 3.7 to 4 mm. Body higher than wide, joint 12 angularly elevated, pointed; soft green, a narrow, rather faint, yellow subdorsal line just below wart II borders a velvety, brownish black dorsal space, narrowed at the incisures of joints 5 to 11 and a little at joint 12, continued very narrowly to the end of the body, widened on the cervical shield. Spiracles white with black rim. Claspers of feet pinkish. Warts low with only two or three hairs, I to III black, IV to VI pale, only one hair from IV, many short ones from V and VI. Some pale secondary hairs subventrally. The dorsal hairs are long, though sparse.

Food plants.—Sugar plum, apple, birch, mountain ash.

ACRONYCTA SPINIGERA Guenée.

(Plates XII, fig. 5, female adult; XVII, fig. 26, leg; XX, fig. 19, male genitalia.)

Acronycta spinigera GUENÉE, Spec. Gen., Noct., 1852, I, p. 45.—WALKER, Cat. Brit.

Mus., Het., 1856, IX, p. 55.—SMITH, Bull. U. S. Nat. Mus. No. 44, 1893, p. 39.

Apatela spinigera GROTE, Ill. Essay, 1882, p. 39; Bull. U. S. Geol. Surv., 1883, VI, p. 572.

Apatela harveyana GROTE, Proc. Ac. Nat. Sci. Phila., 1875, p. 418; Ill. Essay, 1882, p. 39, *spinigera* Walker in part.

Ground color a very pale ashen gray, with a slightly yellowish tinge. Thorax with a smoky line near the tip, and a more or less obvious smoky margin to the patagiae. Sometimes a smoky line crosses the front below the antennae. The wings have the vestiture slightly elevated, and there is a considerable covering of smoky scales, which occasionally darkens the wing. The ordinary markings are well written. The basal line is distinct, geminate, and usually reaches to the basal dash. The transverse anterior line is brown or black, distinctly geminate, and as a whole outwardly oblique, very little irregular. The median shade line is well marked over the costa, extending obliquely into the reniform. From that point it runs a little inward to the inner margin, but is much fainter, and in some cases altogether wanting. The transverse posterior line is geminate, the inner portion very faint and sometimes scarcely marked, the intervening space whitish, the outer line black, lunulate, and more or less denticulate on the veins. As a whole it is squarely bent over the cell and deeply incurved opposite the anal angle. There is an irregular, diffuse, subterminal line, which is pale and variably marked through the terminal space. There may or may not be a series of blackish spots, most evident toward the apex of the wing. There is a series of terminal dots, beyond which the fringes are also marked with dusky. There is a slender black streak at the base, extending to the inner portion of the transverse anterior line, but not across it in any specimen that I have seen. Just opposite the cell there is a black line which extends from the subterminal line inward, and indents the transverse posterior line, but does not cross it in any of the specimens before me. A slender black line extends inwardly through the submedian interspace and across the transverse posterior line at that point. The ordinary spots are well marked and of moderate size; the orbicular round or nearly so, black ringed, sometimes with a smoky center; the reniform kidney shaped, distinctly black ringed, with a more or less well-marked smoky center. The secondaries are smoky in the male, a little paler at base; in the female more dusky throughout. Beneath whitish, powdery, the primaries often a little smoky on the disk; both wings with a more or less obvious outer line and discal lunule.

Expanse, 1.50 to 1.80 inches (37 to 45 mm.).

Habitat.—Maine to Texas; west to the Mississippi; New York in June; Wisconsin; Kansas City, Missouri, May 22.

This species is recognizable among those with the elevated vestiture by the very neat black dashes and the general distinctness of the markings. It is thus easily differentiated from *pruni*, which is its nearest ally, and than which it is also a little larger. Mr. Grote never positively identified the *spinigera* of Guenée, and generally specimens of *xyliniformis* have been marked in collections with this name. Mr. Grote mentions, however, that in the British Museum there is a specimen of *harveyana* under a *spinigera* label, and therefore Mr. Walker's *spinigera* has been cited to *harveyana* as a synonym. As a matter of fact, Guenée's description leaves no doubt that Walker was right in his identification, if indeed the name was not really attached by Guenée himself. The description fits this species completely, and fits nothing else; therefore I believe the British Museum specimen to be correctly named.

The anterior leg of the male is unusually developed; the femur is very stout and abruptly narrowed toward the tip. The tibia is short, stout, and the epiphysis is very small and inserted at just about the middle. The head is moderate, a little convex, but not bulging, the palpi easily reaching to the middle of the front, and sometimes nearly to the vertex. The harpes of the male are broad, quite regularly narrowing toward the tip, where they are rounded. The clasper is stout, of moderate length, the upper process unusually strong and curved. From the middle of the upper margin is an upward, finger-like process of moderate length, and directly opposite on the lower margin is an irregular, knob-like structure, which is furnished with a few little bristles. This species does not seem to be a common one, and I have no very large number of specimens for comparison.

ACRONYCTA PRUNI Harris.

(Plates IV, fig. 4, adult; VII, figs. 22, 23, larva; XVII, fig. 27, leg; XVIII, fig. 8, palpus; XX, fig. 20, male genitalia.)

Acronycta pruni HARRIS, Ent. Corresp. 1869, p. 313, pl. iv, fig. 13.—SMITH, Bull. U. S. Nat. Mus., No. 44, 1893, p. 44.

Apateia clarescens GROTE, in lists and coll.—HARVEY, Bull. Buff. Soc. Nat. Sci., 1875, III, p. 4.—BUTLER, Ent. Amer., 1887, III, p. 36, an sp. dist. *clarescens* Guenée.—SMITH, Bull. U. S. Nat. Mus., No. 44, 1893, p. 44, pr. syn.

Ground color a pale whitish gray, more or less black powdered and a little tinged with a greenish yellow in well-marked specimens. Head with a blackish line below the antennae. Thorax with a blackish line just below the tip, and a little tuft of yellow scales on the disk just behind the collar. This tuft is very distinct in the males, but has a tendency to disappear in the females. The primaries with the vestiture elevated, and the markings all more or less indistinct and obscure. Basal line geminate, blackish, well marked on the costa, and generally to the basal streak. Transverse anterior line geminate, blackish, outwardly oblique, a little outcurved in the interspaces, tending to become obsolete below the basal streak. The median shade is marked on the

costa and extended into the reniform; but below that point it is very vaguely indicated, in some specimens traceable as a brownish shade to the internal margin. Transverse posterior line geminate, the inner portion usually more or less obscure and a little denticulate on the veins; the intervening space consists of whitish lunules. There is an irregular, pale, subterminal line, beyond which the terminal space is marked with blackish between the veins, and a little dart extends inwardly opposite the cell, indicating the ordinary black streak at that point; but this is quite usually wanting, and the streak is never distinct. There is a basal black streak which extends through the transverse anterior line and is shaded beneath with blackish. A dagger mark extends through the transverse posterior line and reaches the outer margin above the anal angle. This also is accompanied by a diffuse blackish shade, usually above the streak. The ordinary spots are of moderate size, not very well defined, more or less completely outlined by black scales; the orbicular is round or nearly so, of the ground color; the reniform is kidney-shaped and may be a little marked with yellowish. The secondaries are dirty whitish in the male; more smoky or yellowish in the female. Beneath, the wings are powdery, the primaries with the disk smoky, secondaries with a distinct discal spot, both wings with an outer line which is much more distinct on the secondaries.

Expanse, 1.40 to 1.72 inches (35 to 43 mm.).

Habitat.—Nova Scotia, southwest to Texas, west to Kansas; Nebraska; Central New York, May to July; New Jersey, May and June; Texas, March 15 to 28; Kansas, in May.

This species is, in most instances, easily distinguishable by the little tuft of yellow scales just behind the collar, combined with the elevated vestiture and the general pattern of the wing. In the female there is a tuft of hair-like scales, varying from yellow to black, visible between two of the segments near the tip of the abdomen. As a rule these hairs are yellow; but they may vary all the way to blackish. It is the only instance known to me of a character of this kind in the genus, and I have not, unfortunately, examined a fresh specimen to study the characters closely. Judging by the dried specimens it seems probable that the insect has the power to extend these tufts, one of which is clearly set on each side of the middle on the upper surface. The tufts are between the sixth and seventh apparent dorsal segments. The legs of the male are moderately developed, the femur quite even and not at all dilated; the tibia stout and short, with a small epiphysis situated above the middle. The whole structure, therefore, is entirely unlike the closely allied *spinigera*. The harpes are moderate in length and strongly dilated at the tip, which is round, and the clasper has both angles produced, so that it becomes somewhat fork-like, the lower angle being longer than the upper. From the upper margin is a slender, straight process of moderate size. As a whole, the species is a very well marked one, and resembles nothing as closely as itself.

LARVA.

HARRIS, Ent. Corresp., 1869, p. 313, pl. iv, fig. 13 (*pruni*).—FRENCH, Can. Ent., 1895, XXVII, p. 332 (*spinigera*).

Stage III.—Head sharply bilobed, light green, with three red-brown bands on each lobe, the first with an angle above reaching nearly to the vertex of the lobe; second short, lower down; third on the side, long furcate below, one branch covering the ocelli; width, about 1.3 mm. Body light green, a dark-brown dorsal band reaching to wart I, inclosing wart II on joints 5, 8, 9. Dorsal warts on joints 3 to 7 high, on joints 12 also high, especially wart II; I and II in a square. Hairs rather numerous, dark from warts I and II, the rest pale; softer subventrally, with a few secondary ones. A faint pale subdorsal line.

Stage IV.—As before; width of head, about 2 mm. There is now no projection on the dorsal band at joint 5; it contains a pale dorsal line.

Stage V.—Head greenish on the clypeus and sides, face of the lobes pink, banded as before, the spaces filled with brown mottling so as to obscure the pattern; width, about 3 mm. Body hunched up at joints 3-7, 12 sharply elevated, especially at wart II. Wart I on joints 3 to 7 and 12 and II on 12 are elongated; the others low rounded, all with a small crown of hairs. A few soft secondary hairs laterally and subventrally. Sides green, with a whitish cast below, white dotted. Dorsal band brown, with pale central line, and pale yellow borders not quite contiguous to it; broad on joint 2, only a double line over wart I and joint 3 to 7, suddenly widened to wart II on joints 8-9, just covering wart I on joints 10 to 12, continued to anal plate. Dorsal hairs dark.

Stage VI.—Green form: "Bright green, the lateral tubercles scarcely discoloring the sides, slightly yellowish green. A dorsal dark reddish-purple stripe, nearly as wide as the head, on the anterior part of joint 2, about half as wide on 3, narrow on 4 to 7, expanding in two ellipses on 8 and 9, the rest of the way narrow. From 2 to back of tubercles on 3 the stripe is bordered on each side by clear white, colored a little with green on 8 and 9, with a faint greenish central line. Head rosy red, whitish on the sides, with three rows of black spots." (French.)

The brown form is the more common. Head with clypeus green, the lobes mottled with black and red on a white ground, the lines broken into patches of segregated dots; width, 3.8 mm. Body clear velvety greenish brown. Dorsal band vinous brown, conspicuously edged on joints 2 and 3, with white; very narrow and passing above tubercle I, then broadened to II on joints 8-9, reaching over I on joint 10, and mottled with salmon color, vinous on joint 13. Tubercles I on joints 3 to 7 and I and II on 12 are produced, red; the others small, concolorous. Hair black; a central hair and crown of small ones around it; a few secondary hairs subventrally. Spiracles white, with black border. Length, 30 mm.

Cocoon.—Partly bored in soft wood and formed of silk and chips of wood.

Pupa.—Red-brown, smooth, shining, abdominal segments tapering, coarsely densely punctured on the anterior third, mostly in the posterior half of the incisures; wing cases grooved and shagreened. Cremaster low, rounded, sessile, not sculptured nor differentiated from the pupa in color; two long spines on either side, scarcely curved, crossing each other at the tips, smooth, blackish, the two pairs remote, probably corresponding to the lower row. Length, 20 mm.

Food plants.—Apple, mountain ash, wild cherry, cherry, plum.

Group PERSUASA.

The species referred to this group agree perfectly in the form of the male genitalia, and differ sharply from any species in any other group. The clasper is broad, nearly flat and corneous, but is not separated from the side piece or harpe, being united by its superior edge to the inferior edge of the membraneous structure. We get thus the appearance of a pair of unusually wide harpes, abruptly narrowing near to the tip, and inferiorly much more highly chitinized. From the upper margin of the clasper there arises at the tip a stout, slightly curved, beak-like process, and from the middle of the upper margin comes a finger-like process which is usually longer, much more slender, and a little curved or bent.

Superficially the species are much alike and tend, in appearance, on the one hand to *superans* in the *lobeliae* group, and to *hamamelis* in the group of that name on the other.

The primaries are trigonate, widening quite evenly, the inner margin not greatly shorter than the costa, and the outer quite evenly arcuate to the rectangular tip. The maculation is suffused and obscured by the elevated scales, which leave no lines or dashes distinct, and the only prominent bit of ornamentation in all the species is the white or pale gray, round orbicular, in which there is always a smoky central dot.

Afflicta is recognizable by being very dark smoky or black, with all the markings broken up and only vaguely traceable. The white orbicular is the only distinct feature in the primaries, which are narrower than in any other species.

Persuasa is larger and broader-winged, of a dark ash gray, mottled with black shades. These shadings are really the diffuse ordinary streaks, and an oblique shading from the costa between the ordinary spots. The secondaries are white, with soiled veins and outer margin in the male, a little smoky in the female.

Liturata resembles *persuasa* quite closely, but it is of a clearer gray, with the darker suffusions more even, and a strigate character to the shadings. The secondaries are white in both sexes, those of the female sometimes soiled on the veins.

Marmorata is the odd species in this group, and while the markings and structure evidently refer it here, it really resembles most an exaggerated *fragilis*. The ground color is almost white, and all the ordinary lines and spots are fairly evident. The transverse posterior line is quite strongly dentate, a median shade line is traceable, and the dagger opposite the anal cell is quite obvious. The arrangement of shades and tints gives the wing a somewhat marbled appearance which makes it easily recognizable.

There are no European species known to me that belong to this group.

ACRONYCTA AFFLICTA Grote.

(Plates I, fig. 15, adult; V, figs. 1, 2, larva; XXI, fig. 19, male genitalia.)

Acronycta afflictata GROTE, Proc. Ent. Soc. Phila., 1864, II, p. 438, pl. IX, fig. 4; Trans. Am. Ent. Soc., 1870, III, p. 179.

Apatela afflictata PACKARD, Forest Insects, 1890, p. 168.

Hyboma afflictata GROTE, Mitth., a. d. Roem. Mus., Hildesh., No. 3, 1896.

Ground color whitish, so densely overlaid by black scales that the creature seems almost black at first sight. Head and thorax mottled with gray and black scales. The head and base of the collar almost entirely black. The patagia also with black markings at the margins. The primaries with all the maculation obscured and in most cases hardly traceable. All the transverse lines are fragmentary and indicated by elevated black scales; but it is scarcely possible to pick out the course of any of them satisfactorily. There is a broken, zigzag white subterminal line which is quite distinct, and there is a narrow white line preceding a series of terminal black dots. The fringes are marked alternately white and black. The orbicular is round, contrasting, whitish, with a dusky center. The reniform is obscured by the black ground color. Secondaries white in the male, becoming dusky outwardly, the veins more or less soiled. In the female the secondaries are dark as a whole, and there is a more or less obvious outer dusky line. Beneath white, strongly black powdered, both wings with a discal spot and a more or less obvious outer line.

Expanse, 1.40 to 1.72 inches (35 to 43 mm.).

Habitat.—Canada, south and southwest to Texas, west to the Rocky Mountains. Massachusetts in June; New York City in August; St. Louis, Missouri, March; Texas, March and April.

This is quite an easily recognizable species and by no means uncommon. The almost black of the primaries is relieved by the white of the secondaries and by the contrasting orbicular spot, all the other markings being more or less swallowed in the black overlaying of the scales. The inner margin of the wings is a little more gray than the rest, and when the insect has them folded it seems like a gray streak running the full length from the head to the parting of the wings. There are two rather distinct forms, though marked only in the males. In the first the primaries are almost black and the secondaries almost white,

with a very narrow marginal dusky band; the second form has the primaries much more sordid in hue, the secondaries are soiled, and there is a considerable suffusion of smoky in the outer part of the secondaries. These forms run into each other, however, in such a way as to make it impossible to believe them to be even varieties, much less species. The head is distinct, rather large, the palpi well developed and reaching to the middle of the front, which is only a little convex and not at all bulging. The fore leg is very stout, the femur is much thickened, abruptly narrowed toward the tip, where it is inferiorly excavated to receive the tibia. The tibia is stout, the epiphysis inserted below the middle and reaching to the tip. The tarsi are quite stout and rather short in proportion to the rest of the leg. The male characters are as described for the section. The corneous part is squared at the tip, where there is a somewhat beak-like projecting process extending toward the middle of the upper portion of the harpes. Further toward the base there is a shorter stout corneous process or finger. There seems to be considerable range of variation in size, some of the smaller specimens seeming almost crippled in comparison to the largest.

LARVA.

THAXTER, *Papilio*, 1883, III, p. 17.—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 168.

Stage V.—Head fleshy purple brown, shaded over the front of the lobes, thickly mottled with little pale dots segregated into patches; the upper epicraneal setae black, the rest white, coarse; width, 3 mm. Body, sordid orange greenish, brighter on joints 2 and 12, tubercles red. Dorsal vessel dark, centered with pale pigment. An obscure, double lateral line between warts II and III, resembling the faintly showing tracheae, but less straight. Warts I and II surrounded by faint pale rings. No distinct marks. Spiracles black edged. Warts I to III elongated, with a central hair and crown of smaller ones at the apex; white, except the central hair on I and II, which is black. Warts IV and V single haired, VI with several pale hairs. No secondary hairs.

Stage VI.—Head wide, slightly bilobed; brown, with purple reticulations and whitish dots over the face of the lobes, slightly shagreened; width, 4.5 mm. Body nearly uniform reddish brown, a dusky black dorsal stripe, and a faint reddish lateral one. Tubercles very small, not prominent, all single haired except VI; orange color. Setae short and fine except II on joints 5 to 7, which are long, black, slender, with small spatulate tips. In others these spatulate hairs are present on joints 5–8, 12; 3, 5–9, 12 or 3–10, 12, the number being variable to this extent. Spiracles, black rimmed. Dr. Thaxter states that there is also a “rich yellow green” form.

Cocoon.—Quite tough, composed of silk and bits of wood, partly formed by the substance on which it is made.

Pupa.—Rather thin, brown, tapering, abdominal segments very smooth, scarcely punctured at all, shining; cases very slightly shagreened. Cremaster rather broad, low, irregular and lumpy, creased below, blackish; upper hooks one on each side, slender, directed backward; lower hooks three on each side, straight, subparallel, with recurved tips. Length, 17 mm.

Food plant.—Oak.

ACRONYCTA LITURATA, new species.

(Plates XIII, fig. 8, female adult; XXI, fig. 21, male genitalia.)

Ground color a pale powdery ash gray, more or less suffused with smoky. Head with a brown line below and another above the antennae; a blackish line crosses the middle of the collar, and the edges of the patagiae are more or less black marked. The primaries have all the markings traceable, but rather obscured. Basal line is geminate, brown or black marked on the costa only. The transverse anterior line is geminate, brown or black, outwardly oblique, irregular between the veins. The median shade is narrow, obscure outwardly; oblique from the costa through the reniform and then irregular, obliquely inward to the hind margin. Transverse posterior line geminate, brown or black, the inner portion of the line less defined, the included space white or nearly so, the outer line slender and denticulate on the veins. The subterminal line is white or nearly so, very strongly dentated, interrupted opposite the cell and in the submedian interspace. The terminal space has, in the interspaces, blackish markings, more or less evident, and a series of black terminal lunules, beyond which the fringes are cut with black or brown. There is a more or less distinct basal black streak which extends through the transverse anterior line and almost to the middle of the wing. It is accompanied by a more or less obvious blackish shade which continues through the submedian interspace to the outer margin. It is sometimes sharply interrupted at the median line, leaving the space between it and the transverse posterior line of the paler ground color. There is also a blackish streak from the reniform outwardly, which becomes broader and more diffuse on the margin. In a vague sort of way the middle of the wing between the ordinary spots and to the longitudinal shade is also a little more dusky. The ordinary spots are traceable; the orbicular being rather distinct, white, outlined in black and centered with brown; the reniform may or may not be outlined by black scales, and there is usually a blackish lunule in the center. Secondaries white in the male, a little soiled at the edges; in the female the soiling extends farther toward the base of the wing. Beneath, more or less powdery; the primaries sometimes smoky, the ordinary outer lines and discal spots variably evident.

Expanse, 1.60 to 1.68 inches (40 to 42 mm.).

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Habitat.—Garfield County, Colorado, 7,000 feet; Glenwood Springs, Colorado, in July; Oregon.

This species strongly resembles *persuasa* in its general appearance; but it is much paler and the markings are better defined. The secondaries in the female are almost as light as those of *persuasa* male. The harpes of the male are unusually short and broad and the corneous portion serving as clasper is hardly as distinct as in the other species. The beak near to the upper angle is moderate in size and only a little curved, while the process near the base is very short, stout, and pointed. In leg structure the species resembles *afflicta*, no essential differences having been observed. Four male and two female specimens form the types, represented in the collection U. S. National Museum, Rutgers College, Dr. William Barnes, and Mr. J. Doll.

ACRONYCTA PERSUASA Harvey.

(Plates III, fig. 11, adult; XVII, fig. 29, legs; XVIII, fig. 10, palpus; XXI, fig. 20, male genitalia.)

Apatela persuasa HARVEY, Bull. Buff. Soc. Nat. Sci., 1875, II, p. 271.—BUTLER, Ent. Amer., 1887, III, p. 36=*brumosa* Guenée.

Ground color a deep bluish ash gray, heavily powdered with black and with a more or less smoky suffusion. Head with a line below the antennae and one on the vertex. Collar with a black line above the middle and the patagiae margined with black. Primaries with all the markings traceable; but all more or less broken, and more or less obscured by the smoky shading. Basal line geminate, black, usually marked on the costa only. Transverse anterior line geminate, black, outwardly oblique, the lines well separated and equally distinct. Median shade line slender, oblique from the costa through the reniform, thence almost straight to the hind margin. It is traceable in all the specimens that I have seen, and distinct in most. Transverse posterior line geminate, the inner portion of the line brown, the intervening space whitish, the outer line black, lunulate and dentate on the veins; it is squarely bent outwardly over the cell and not very strongly incurved below. The subterminal line is whitish, irregularly dentate, and more or less interrupted. There is a series of terminal dark marks, beyond which the fringes are marked with blackish. There is a black basal dash which reaches the transverse anterior line and a black mark from the transverse anterior line to the median shade. Both of these are accompanied by smoky or black shadings which more or less fill the submedian interspace to the median shade line. There is a distinct black streak through the transverse posterior line to the outer margin, above which there is a smoky shade extending nearly to vein 3. Another shading beyond the transverse posterior line is opposite the cell, and here we have a more or less triangular black mark. The ordinary spots are large, the orbicular round or a little oval; it is white or gray, centered with smoky, and outlined by black

scales. The reniform is large, kidney-shaped, outlined by black scales and with a blackish center. Secondaries smoky, whitish toward the base, distinctly darker in the females than in the males. Beneath whitish in the male, very strongly black powdered on the primaries. In the female both wings are black powdered, and in all cases there is a more or less well marked outer black line and a black discal spot.

Expanse, 1.50 to 1.80 inches (37 to 45 mm.).

Habitat.—Southern States; Florida; Texas; Archer, Florida, in March; Texas in March and April (?); Colorado (?); New Mexico (?).

This is one of the few species that is confined to the southern part of the United States. There have been some records from Colorado and New Mexico; but it is questionable whether these are correct. Mr. Butler referred this species to *brumosa*, but as I have already shown erroneously. The localities, therefore, that have been recorded for *brumosa* can not be held as fitting to this species. In between twenty and thirty specimens before me not one of them comes from any northern locality; though this does not exclude, of course, the possibility of its occurring there. The species is quite constant, rarely becoming so dark as to make it possible to confuse it with a rubbed *afflicta*. In a general way the impression is given of a somewhat blotchy appearance, a dusky shade occurring over the reniform, another one just outside of the basal space at about the middle of the wing, a third just above the anal angle, and a fourth opposite the cell beyond the transverse posterior line. The head is of good size, the front convex but not bulging, the palpi are rather small, although they reach to the middle of the front. The anterior legs of the male are heavy, the femur very large and much dilated, rather suddenly narrow toward the tip and grooved to receive the short, stout tibia, in which the epiphysis is attached below the middle and reaches to the tip. The tarsus is short and stout. The harpes of the male are moderate in length, that portion forming the clasper being square at the tip. The process at the upper angle is stout, moderately curved and pointed at tip; that from the upper margin is slender, quite long and a little curved. Altogether the species is a well marked one.

ACRONYCTA MARMORATA, new species.

(Plates XIII, fig. 3, female adult; XXI, fig. 22, male genitalia.)

Ground color white, with a slight yellowish suffusion. Head mottled by black scales. Collar with a broad black band just below the tip and the tip black marked. The patagiaë with a black submargin. Primaries with all the markings contrasting and black, giving the wing a marbled appearance. Basal line geminate, black, reaching to the basal streak. Transverse anterior line geminate, black, outcurved between the veins, so as to form almost a series of loops, both parts of the line being equally distinct. The median shade line is distinct, black, outwardly bent from the costa to the reniform, then forming a

right angle and a little oblique outwardly to the inner margin. Transverse posterior line geminate, black, denticulate on the veins; the inner portion very narrow and brownish rather than black; the outer part black and lunulate, very little sinuate, and as a whole nearly parallel with the outer margin. The subterminal line is white, very irregularly dentate, and beyond it the terminal space is black marked. There is a series of black terminal lunules, preceded by a white lunulate line, the fringes cut with black. There is a black basal streak, which extends to the transverse anterior line; another streak extends through the submedian interspace from the median shade line through the transverse posterior line nearly to the anal angle. The ordinary spots are distinct; the orbicular round, white, black margined, and with a dusky center; the reniform large, kidney shaped, outlined by black scales and obscured by the median shade. Secondaries whitish, the veins marked with smoky, and a smoky outer line. Beneath white, black powdered, with a broken outer line and a discal dot on all wings.

Expanse, 1.36 to 1.56 inches (34 to 39 mm.).

Habitat.—Folsom, California, in July; Montana.

I have three males and one female before me. The Californian specimens are from the U. S. National Museum, the other from the collection of Mr. J. Doll. The species is quite different from any of its allies by the marbled appearance and the distinct white ground color. There seems to be considerable variation, but there is not enough material at hand to say just exactly what its range is. The front is convex, but hardly bulging; the legs in the male are as in the rest of the species of this series. The tibia have an unusually small epiphysis, set unusually close to the tip. The genitalia of the male have the harpes unusually short and broad, the clasper with the outer process stout, only a little curved and pointed at the tip. The process near to the base is very long, very slender, and a little twisted at the tip. It is thus radically different from anything else in the genus or in the section, and the species is undoubtedly a good one.

Group HAMAMELIS.

The species referred here agree in having the primaries rather abruptly widened at base, forming on the costa a somewhat well-marked arch or shoulder. In all of them the maculation is fairly well defined or distinct, and the ordinary spots are obvious. The transverse anterior line is geminate when completely present, and the dashes or dagger marks may or may not be obvious. The male characters are decided and practically alike in all the species. The harpes are well developed, with a diagonal chitinous ridge from the base of the upper side to the inferior margin some distance from tip, and from this arises a single, rather short, stout, curved, beak-like clasper. There is no chance of confusing this type of structure with any other in the genus and the superficial characters also ally the species fairly well, if we except *albarufa*.

Albarufa is the inevitable oddity, resembling, except for wing form, the *grisea* series in the *lobeliae* group. It is blue-gray in color, much as in *falcula* and *parallela*, and it is only by a little stretch of the imagination that the vestiture can be said to be roughened or elevated on the lines of ornamentation. The basal dash joins the transverse anterior line, which here bends inwardly, and thus there is an outcurve toward the costa and another toward the inner margin from this dash. The large reniform is centered by a reddish shade, which is characteristic, and seems to give a tint to the entire wing.

All the other species are of some shade of ashen gray or yellowish and none other has the reddish shade in the reniform.

Ovata is separated from all the others by having the basal dash and transverse anterior line exactly as in *albarufa*, that is, the prominent, inferiorly diffuse dash meets the transverse anterior line at an incurve and it darkens both the outcurves of the line for a short distance. In ground color the primaries are a pale ash-gray, with a yellowish tint, which is intensified in the large reniform. The *psi* mark opposite the anal angle is always present, usually distinct and sometimes prominent. The black mark opposite the cell is marked in all my specimens either by a distinct line, a short dash from the outer margin, or a more diffuse shading.

Modica is similar in color, but smaller. The basal dash is a fine line; the transverse anterior line is complete, geminate, evenly oblique, or with but the merest central incurve. The *psi* marks are as in *ovata*, but much less distinct. On the whole the species is a feeble copy of the preceding on a smaller scale.

Clarescens, or, as it is better known, *haesitata*, is the largest species of the group and of an even, pale ash gray, on which all the markings are well defined, though not prominent. The transverse anterior line is distinctly geminate and evenly oblique, while the basal streak is rarely well marked and may be entirely absent. The dagger mark opposite the anal angle is usually distinct, slender, and black, and is more or less evident in nearly every instance. The dash opposite the cell may be marked on the outer margin, but it is not complete in any specimen seen by me.

Hamamelis is very dark ashen gray with a smoky suffusion. In dark specimens the markings do not contrast, but when the ground color becomes paler the lines are relieved and the wings seem more or less banded. There is no evident dagger mark opposite the anal angle, and this, with the ground color, will suffice to distinguish it from the preceding form.

Increta is a much smaller and decidedly darker species, in which all the maculation of *hamamelis* is reproduced. The primaries are proportionately narrower and more subequal, and this, with the very dark colors, sometimes inclining a little to olivaceous, will make the species recognizable.

Retardata averages yet smaller, but is a very pale, whitish gray,

with distinctly wider primaries. The maculation is intermediate in type between *ovata* and *hamamelis*, while on the whole the tendency to a darker basal space makes the similarity to the latter most obvious.

The species in this group are somewhat closely allied, but, I believe, distinct. So far as I am aware they have no European counterparts.

ACRONYCTA ALBARUFA Grote.

(Plates III, fig. 10, adult; XII, fig. 9, female adult; XVI, fig. 11, venation; XVII, fig. 32, leg; XXI, fig. 24, male genitalia.)

Apatela albarufa GROTE, Proc. Bost. Soc. N. H., 1874, XVI, p. 239; Papilio, 1883, III, p. 68.

Acronycta walkeri ANDREWS, Can. Ent., 1877, IX, p. 98.—GRAEF, Bull. Bkln. Ent. Soc., 1879, I, p. 93, pr. syn.

Ground color a very dark bluish gray, with a more or less evident reddish suffusion, which is more obvious on the primaries. Front whitish, with a black line at the base and some black scales at the tip, which do not form a complete line. The primaries have all the markings fairly distinct. The basal line is geminate, marked on the costa only, and sometimes not well marked even here. Transverse anterior line geminate, black, broken, outwardly curved from the costa to the basal dash, where it is drawn in very considerably. It is again outwardly curved toward the hind margin, but rarely reaches that point in its completeness. Median shade line obliquely bent from costa to between the ordinary spots. This space may be broken, and the line then extends almost upright to the inner margin. As a rule, however, the line is very faint below the ordinary spots and frequently it ends at that point. Transverse posterior line geminate, broadly outcurved over the cell, and moderately bent in the submedian interspace. The inner portion of the line is not defined and is evident only by the fact that the included space is usually whitish, or at least paler than the ground color. The outer line is narrowly black, sometimes a little lunulate and shaded outwardly with reddish. There is a vague paler subterminal line, which is sometimes quite evident and very even and again entirely obscured. There is a series of terminal lunules preceded by a white shade, and beyond them the fringes are cut with dusky. There is an evident black basal streak which extends to the transverse anterior line. It is slightly curved, so that meeting the transverse anterior line it incloses an oval space at the base. There is a somewhat well-marked dagger in the submedian interspace extending from the margin to and sometimes even through the transverse posterior line, although this is rare. Opposite the cell a blackish spur may be seen from the terminal space which in extreme cases reaches the transverse posterior line, but may be entirely wanting or marked only by a somewhat more dusky patch between veins 5 and 6. The ordinary spots are large and well marked; the orbicular round, pale, sometimes with a dusky center, neatly ringed with black in most instances. The reni-

form is large, kidney shaped, outwardly somewhat undefined, the center reddish brown, somewhat contrasting with the rest of the wing. Secondaries in the male white, a little margined with dusky at the base of the fringes, in the female smoky, but variable in this respect and sometimes white. Beneath white, with black powderings varying to smoky in dark females. Both wings with a more or less distinct outer line and discal spot.

Expanse, 1.20 to 1.50 inches (30 to 37 mm.).

Habitat.—Canada, south to Georgia, west to New Mexico and Colorado, Massachusetts in July; St. Paul, Minnesota, in June; central New York in May; Hot Springs, New Mexico, 7,000 feet, July and August; Denver, Colorado, July.

This species varies considerably in ground color, but not in essential characters. Sometimes the red shade is altogether wanting, and in one case the specimen is as dark as *tritona* both in primaries and secondaries. There is a great difference between the sexes, the males being much lighter throughout than the females. There seems to be a difference also between the Western forms and those from the more Eastern localities; the former being lighter throughout and appearing different on casual comparison. I have been unable, however, to discover any real difference either in maculation or in structure after examining the long series of specimens before me. The head is of good size, the front full but not prominent, the palpi distinct, reaching to the middle of the front or a little beyond. The legs are short and stout, the epiphysis of the anterior tibia being small and situated at about the middle. The genitalia of the male offer nothing peculiar, and simply agree with the description that has been already given for the group.

ACRONYCTA OVATA Grote.

(Plates IV, figs. 7, 8, adult; V, fig. 3, larva; XII, fig. 10, female adult; XIV, fig. 12, female ovipositer; XXI, fig. 25, male genitalia.)

Acronycta ovata GROTE, Bull. Buff. Soc. Nat. Sci. 1873, I, p. 80, pl. II, fig. 14.

Lepitorea ovata GROTE, Papilio, 1883, III, p. 112.

Apatela ovata PACKARD, Forest insects, 1890, p. 169.

Hybona ovata GROTE, Mitth., a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Ground color a dirty yellowish gray, the yellow powdering more or less well marked in places, giving the characteristic shade to the wings. Head with a dusky line across the front; collar with a dusky line at base. Primaries with all the markings fairly evident. Basal line dusky and marked on the costa only. Transverse anterior line geminate, black or blackish, the intervening space dusky. The line curves outwardly from the costa to the black basal streak, where it is well drawn in; beyond that point it again curves outwardly, but rarely reaches the internal margin. It is usually also broken just below the costa. The median shade line is oblique from the costa to the reniform, which is sometimes a little darkened by it, and occasionally the line may be traced below the reniform to the inner margin. Transverse

posterior line geminate, both lines fairly evident, though the inner is sometimes obscure, the intervening space whitish. The outer line is black or brown, sometimes a little lunulated, as a whole outwardly bent over the cell and well drawn in below. The space beyond the transverse posterior line is dusky, and through it is a more or less evident pale subterminal line which is very irregular in some specimens and strongly zigzag, though in others it is almost even. There is a series of blackish terminal lunules, usually preceded by a waved paler line, and the fringes beyond them are cut with dusky. There is a black streak at base, which is a little curved and meets the transverse anterior line in such a way as to include an oval space at the base. There is a distinct dagger mark crossing the transverse posterior line in the submedian interspace, and extending to the subterminal line only. Between veins 5 and 6 a black mark extends inwardly and sometimes reaches the transverse posterior line; but it tends to become obsolete and in some specimens is hardly even indicated. The ordinary spots are large, the orbicular irregularly ovate, black ringed, usually a little paler than the ground color. The reniform is large, kidney shaped, usually not well defined, but made prominent by the yellowish filling. Secondaries smoky in both sexes, in the females a little darker, with an outer line and a discal spot fairly evident in most cases. Beneath smoky, powdery, both sexes with an outer line and usually also with a discal spot.

Expanse, 1.20 to 1.60 inches (30 to 40 mm.).

Habitat.—New York to Texas, west to the foot of Rocky Mountains; central New York in June; Washington, District of Columbia, in May; Newton, Massachusetts, May 25; St. Paul, Minnesota, June 29; Texas in July.

I have no doubt that this is a good species. It has been asserted by those who have bred the insect that it is the same as *hamamelis*; but I believe that this is due to an error in the observations on the larvae. Certainly there is never any difficulty in separating the adults from those of *hamamelis*, and until both species have been raised from eggs laid by a female of one species I am not ready to admit that the two are the same. The most characteristic features which distinguish this species are the pale ground color through which there is a more or less evident yellowish shade; the transverse anterior line, which is more or less black filled and distinctly drawn in to meet the basal black streak so as to form an oval spot in the upper part of the basal space, exactly like that in *albarufa*. There is very little variation in the species, except that some are a little darker than others and in some the yellow is more evident than it is in others. I have examined over fifty specimens in comparison with the other species in this series and have not found any examples that were in the least doubtful. In wing form this species also approaches *albarufa* and is different from *hamamelis*. The head is distinct, front a little bulging, the palpi reaching to the middle.

The anterior legs of the male are stout, the epiphysis small and inserted at about the middle. In all essentials it is like *albarufa* and the genitalia of the male are of the same type.

LARVA.

COMSTOCK, Man. Stud. Ins. (1895), 308, fig. 374 (*hamamelis*).

Egg.—Less than hemispherical, well reticulated, the vertical ribs low and rounded, the cross lines distinct; cells at the apex without ribs, very small at the micropyle; diameter, 0.8 mm.; height, 0.5 mm.

Stage II.—Head whitish; width, 0.55 mm. Body translucent, nearly colorless, the food showing green. Warts normal, colorless, I to III elongated, each wart with four to six colorless hairs, the central primitive seta the longest. Warts I and II nearly in line on joint 12.

Stage III.—Width of head, 0.8 mm. All nearly colorless whitish, hairs all pale. Tubercles I to III distinctly elongated, with the hairs in a crown at the vertex. A few very small secondary hairs.

Stage IV.—Head whitish, with a trace of brown mottlings on the lobes; width, 1.4 mm. Body whitish or greenish, translucent, tubercles I to III yellow with a single seta and crown of hairs, contrasting, the rest whitish; several hairs on wart VI. A broken yellowish dorsal line, a broken double lateral one over warts II and III and a narrow straight stigmatal line. Subventer and feet whitish. A few little spine-like secondary hairs.

Stage V.—Head pale whitish, faintly mottled with brown in front; width, 2.2 mm. Body translucent whitish, with no marks below wart II, or the bands of the preceding stage yellowish and interrupted. Warts I and II, surrounded by a brown ring; a faint brown dorsal shading. Tubercles with but one hair, except VI, which has several hairs. Secondary hairs absent.

Stage VI.—Head dull purplish red, pale whitish over the clypeus; lower part and central suture, the upper two-thirds mottled with spots composed of groups of little whitish dots in clusters; width, 3.3 mm. Body brown, pale whitish ventrally; warts yellow, single haired. A series of large, rounded, oblique, pale yellow patches on joints 3 to 12, covering warts I and II, tinted with orange and each extending a little on to the next segment. Two lateral rows of similar spots, smaller and interrupted, not oblique. Spiracles white with black borders. Later the spots may become wholly suffused with red, becoming orange color. The skin has a covering of microscopic pile, absent on the tubercles.

Cocoon.—Composed "of bits of wood and grains of earth on or near the surface" of the ground (Goodell).

Pupa.—Light brown, shining, abdominal segments regularly tapering, sparsely but distinctly punctured almost to the posterior border; wing cases slightly grooved and shagreened. Cremaster rather prominent, rounded, slightly flattened; dorsal hook small, slender, bent backward

and outward, not recurved; three equally short, stout lower hooks on each side, projecting outward, divergent from each other, slightly bent down or doubly bent, not recurved. Length, 14 mm.

Food plants.—Oak, beech, chestnut.

ACRONYCTA MODICA Walker.

(Plates II, fig. 4, adult; IV, fig. 9, adult; V, fig. 6, larva; XVIII, fig. 25, leg; XXI, fig. 26, male genitalia.)

Acronycta modica WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 56; BUTLER, Ent. Amer., 1887, III, p. 36.

Acronycta exilis GROTE, Proc. Ac. Nat. Sci., Phila., 1874, p. 197.

Lepitorcuma exilis GROTE, Papilio, 1883, III, p. 112.—BUTLER, Ent. Amer., 1887, III, p. 36, ? pr. syn.—SMITH, Bull. U. S. Nat. Mus., No. 44, 1893, p. 44, pr. syn.—GROTE, List Eupterotidae, etc., 1895, p. 14, an var. pr.

Ground color a dirty, very pale yellowish gray. Head with a dusky line in front; collar usually yellow at base, above which is a black line, and this may be followed by a paler line before the tip. The primaries have all the markings more or less evident, but always broken. Basal line geminate, blackish, marked on the costa only. Transverse anterior line geminate, blackish, always more or less broken, but as a whole outwardly oblique or a little drawn in near the middle. The intervening space is of the ground color, never prominently darkened. The median shade line is marked by an oblique dash from the costa to the reniform, which it does not obscure. Below that point it is marked by black scales and is irregular and outwardly bent on the veins. Transverse posterior line geminate, outwardly bent over the cell, moderately incurved below; the two parts nearly evenly developed in most cases, but sometimes the outer line best emphasized by black scales. Sometimes the lines are even; sometimes the outer line is quite strongly dentate on the veins. There is a vague, irregular, subterminal line which is paler than the ground color, and in consequence best marked in the dark specimens. There is a series of terminal lunules, sometimes preceded by a pale lunulate line. The basal black streak is traceable in all the specimens, but it is never prominent, and sometimes only a line of scales; usually it does not reach the transverse anterior line, and when it does is not distinctly joined with it. There is a black dagger mark extending from the subterminal line inward, and as a rule through the transverse posterior line to the median shade. Another black mark extends inwardly from the subterminal line between veins 5 and 6, and this does not in any of the specimens before me extend to the transverse posterior line. The ordinary spots are large; the orbicular round or nearly so, usually paler than the ground color, but it may be marked with yellowish; the reniform is large, more or less constricted in the center, and marked with reddish yellow. There is a vague reddish or yellowish shading through the center of the wing, which is hardly localized, except in the ordinary spots. Secondaries smoky in both sexes; a little darker in the female. Beneath yellowish

or smoky, more or less powdery, and with a more or less obvious outer line and discal spot.

Expanse, 1.20 to 1.40 inches (30 to 35 mm.).

Habitat.—Massachusetts to Minnesota, to Texas; central New York, June and July; Washington, District of Columbia, in June; Texas, July and August.

This species is still paler than *ovata*, which it resembles by the peculiar reddish yellow shading in the wing and to which it is very closely allied. It is a small species, however, and slighter, though the range of size overlaps. The wings are narrower as a whole. In this species the transverse anterior line, while it may be somewhat drawn in at its middle, is as a whole oblique and never prominently filled with blackish scales. The basal streak which is so prominent in *ovata* is in this species almost entirely wanting. There is little variation in the examples before me, and it is only a question of more or less yellow and perhaps a little difference in size. Walker's description of the species fits this very well and fits nothing else known to me. Mr. Butler's suggestion that this is the same as Mr. Grote's *exilis* I believe to be correct. Where there are only two or three examples illustrating extremes, it may be possible to doubt that they belong to the same species, but with a goodly array of specimens no possible doubt can arise. The structural characters offer nothing to distinguish this from the other species of the group either in head, leg, or genital structures.

LARVA.

Stage VI.—Head pale whitish, mottled and reticulated with chocolate brown, darkest in a dash on each side of the median suture in front; width, 2.2 mm. Tubercles prominent, slightly conic, high, all single-haired to VI, which bears over four hairs. Ground whitish, powdered with chocolate brown, tubercles reddish at base. A brown line above wart III, defined by a pale shade above and broken only in the incisure, extends along joints 3 to 12 posteriorly, where it curves to join the dorsal line. It is most pronounced on joint 2. Dorsal line geminate, obscure, diffuse, single on joints 12–13, and stronger. Small, oblique dashes before warts I on joints 5–11; indistinct supra and substigmatal lines, curving up dorsally on joint 13; a subventral shade above wart VI; feet pale. Hairs white, not long. Warts alike.

Stage VII.—Head large, scarcely bilobed; shagreened, shiny, light brown, mottled and reticulated with brown, a blackish band from each lobe above, parallel to median suture meeting a brown v-shaped mark which borders the clypeus, passing on to the paired pieces above; a heavy brown mottling over the eye, passing backward; width, 3.3 mm. Body smooth, cylindrical, joint 12 slightly enlarged, light brown, shaded with blackish. A broad black subdorsal shade, broken at the incisures, defined above by whitish reaches from joint 2 to 12, where the shade curves sharply dorsad in the incisure 12–13, forming a black mark on

the dorsum of 13 and anal plate. A faint mottled geminate dorsal line, rather sharply defined on joints 11 and 12 in a shaded v mark. Rest of body somewhat mottled, but no distinct markings. Warts very small, pale, single-haired except VI, which bears several hairs. Several hairs on the leg plate. Skin with microscopic pile, absent on the tubercles. Setae short, dusky. Length, 25 mm.

Cocoon.—"Webbed up between leaves." (Riley.)

Pupa.—Slender, tapering, light brown, shining, abdominal segments sparsely finely punctured to the posterior border; wing cases shagreened. Cremaster low, rather wide, rounded, coarsely wrinkled, blackish; upper hook slender, projecting backward and bent downward, lower hooks stout, two on each side, divergent, shortly recurved at the tips. Length, 15 mm.

Food plant.—Oak.

ACRONYCTA CLARESCENS Guenée.

(Plates III, fig. 3, adult; XII, fig. 11, female adult; XVII, fig. 31, leg; XXI, fig. 27, male genitalia.)

Acronycta clarescens GUENÉE, Spec. Gen., Noct., 1852, I, p. 54.—WALKER, Cat. Brit.

Mus., Het., 1856, IX, p. 60.—BUTLER, Ent. Amer., 1887, III, p. 36, *hamamelis*.

Apateia haesitata GROTE, Bull. U. S. Geol. Surv., 1882, VI, p. 575.

Leptoreuma haesitata GROTE, Papilio, 1883, III, p. 112.

Ground color an even ash gray, sometimes with a faint suggestion of a yellowish shading. Head usually with a dusky line in front; collar with a dusky line at base and sometimes a smaller line just below the tip. Primaries with all the markings quite well distinguished. Basal line geminate, smoky, marked on the costa only. Transverse anterior line geminate, smoky or blackish, almost evenly oblique, a little out-curved between the veins in some specimens. The inner portion is usually a little better marked and sometimes black; the intervening space usually of the ground color; but toward the middle of its course it tends to become filled with smoky or blackish scales. Median shade line marked on the costa, but usually becoming less until it reappears in some specimens below the reniform. It is then very feebly marked and smoky, running parallel as a whole to the transverse posterior line. The transverse posterior line is geminate, the outer portion of the line black, the intervening space whitish, the inner line smoky and sometimes hardly traceable, the outer more or less broken, usually very narrow, but sometimes composed of lunules and quite distinct. There is a more or less evident pale subterminal line, beyond which the terminal space is darker and sometimes black marked. A series of terminal black lunules is preceded by a paler line, and the fringes beyond it are cut with smoky. There is a basal black dash which as a rule does not reach the transverse anterior line—in fact, in the over thirty specimens examined by me it does not reach the line in any case. There is a fairly evident dagger mark extending from the subterminal line in the submedian interspace, inwardly through the transverse posterior line; but this may disappear entirely in some specimens. A

shorter dagger mark extends inwardly from the subterminal line between veins 5 and 6, but does not in any case reach the transverse posterior line. In some specimens there are traces of a claviform. Ordinary spots fairly evident; the orbicular large, round or oval, generally paler but with a dark center; reniform upright, large, a little constricted at the middle; it may or may not be marked with yellowish, and in some cases there is a slight yellowish tinge through the cell. Secondaries smoky in both sexes, hardly darker in the females. Beneath yellowish, more or less powdery, with an outer line and discal spot variably marked.

Expanse, 1.20 to 1.60 inches (30 to 40 mm.).

Habitat.—Canada to Arizona and Texas; New Hampshire in May; Kittery Point, Maine, in June; Massachusetts in May; central New York in June.

Mr. Butler has referred this species to *hamamelis* Guenée; but he has evidently confused what Mr. Grote separated as *haesitata* with the true *hamamelis*. Guenée's description of *clarezens* applies perfectly to *haesitata*, and this author pointed out very clearly the difference between this species and his *hamamelis*. This species seems also to have been bred by some collectors from larvae which they did not distinguish from those of *hamamelis*, and the contention is, as a rule, that the species are the same; but there are a series of characters which always suffice to separate *clarezens* from any *hamamelis* that I have ever seen. In the first place this species is always a paler ashen gray. It is always more smoothly and evenly marked, and is never so completely obscured by the dusky powderings. The transverse anterior line is never completely filled with dark scales, as is the rule in *hamamelis*. There is an approach, however, to this in some specimens, where the line becomes emphasized in the middle of its course. In *hamamelis* I have not seen any specimen in which there was a dagger mark through the subterminal line in the submedian interspace, while except in one instance this dagger mark is evident everywhere in *clarezens*. In general structure there is no difference as compared with the other species; but the anterior femur is rather more dilated toward the base than is usual, and there is a rather abrupt narrowing toward the base; otherwise it agrees with the other species.

ACRONYCTA HAMAMELIS Guenée.

(Plates II, figs. 1, 2, 3, adults; XII, fig. 12, female adult; XVIII, fig. 9, palpus; XXI, fig. 28, male genitalia.)

Acronycta hamamelis GUENÉE, Spec. Gen., Noct., 1852, I, p. 52.—WALKER, Cat.

Brit. Mus., Het., 1856, IX, p. 59.—BUTLER, Ent. Amer., 1887, III, p. 36.

Leptoreuma hamamelis GROTE, Papilio, 1883, III, p. 112.

Hyboma hamamelis GROTE, Mitth. a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Ground color a dirty ash gray, more or less overlaid by black scales, which are prominently uplifted. Head quite smoky and almost always with a more or less evident black band crossing the front. In pale

specimens there is a black band between the antennae. Collar with a black band at base and another near the tip. Patagiae black powdered. The primaries have all the markings evident. The basal line is geminate, black, and usually reaches to the middle of the wing. The transverse anterior line is geminate, black, the two parts equally well marked, the intervening space more or less dusky. As a whole, it is very even, and slightly oblique from costa to inner margin. The median line is usually marked on the costa, and in the best cases extends obliquely to the reniform, below which it is again marked as a smoky shade line to the inner margin, running a little oblique inwardly and somewhat lunulate. The transverse posterior line is geminate, black, squarely bent over the cell and as squarely bent in below. The outer line is usually even and rather more distinct than the inner, which is usually lunulate, in strong contrast to the general rule. The intervening space is perhaps a little paler than the ground color, but not contrasting. The subterminal line is more or less evident, in all cases very irregular, pale, defined by blackish or smoky shadings, which are more prominent in the terminal space than before. There is a series of black terminal lunules preceded by a lunulate pale line; the fringes are cut with smoky. The basal space is more or less black filled, and there is visible an undefined black line from the base to the transverse anterior line, which is not prominent and does not indent the transverse anterior line in the least. There are no dagger marks beyond the transverse posterior line. In some specimens, usually where the base is dark, there is a very distinct dusky shading, somewhat triangular in outline, beginning in the submedian interspace just inside of the transverse posterior line and broadening to the outer margin, so that it includes all the space between veins 2 and 6. This is not present in all specimens however, and is, as stated, usually associated with forms in which there is a tendency to a dark basal space. The ordinary spots are evident and sometimes quite distinct. The orbicular is round, or nearly so, ringed with black scales, a little paler than the ground color, but with a large dusky center. The reniform is large, kidney shaped, rather indefinitely outlined by black scales, and more or less obscured in the center. The secondaries are smoky, with a more or less evident yellowish tinge. Beneath smoky or yellowish, powdery, both wings with an outer line and a discal spot.

Expanse, 1.25 to 1.55 inches (31 to 38 mm.).

Habitat.—Canada to Texas, west to South Dakota and the base of the Rocky Mountains; Maine, June and July; Minnesota in June; Missouri in March; Washington, District of Columbia, in June; central New York, July; Vermont in July.

This is a distinctly variable species in certain directions; nevertheless when once properly separated out, the variation is seen to consist rather in the relative distinctness of certain spaces than in any real change in the markings. The simplest form is one in which the entire ground color is evenly powdered with smoky or blackish. In this none

of the markings are prominent, and the elevated scales are distinctly visible. Another may become slightly paler throughout, except for the lines and other markings, and in such cases there will be more contrast and the maculation will be more distinct. The tendency is to the formation of a band over the transverse anterior line. The two parts of the line are unusually well separated and quite even, the space between them blackish. The lower part of the basal space also tends to become powdered, and sometimes the entire region is more or less shaded. In such cases the median space is usually contrasting, and we get another triangular shade extending from the outer part of the median space to the outer margin. This species never has a dagger mark running inwardly from above the anal angle, and it is therefore separable in all cases from *clarescens*. I have seen no specimen, out of nearly two hundred that I had for examination, which I could not readily refer to either *hamamelis* or *clarescens* without hesitation. Some faded specimens or rubbed examples of *hamamelis* may at first seem to resemble *clarescens*; but a very little study will show the difference between the two very distinctly. There is nothing that is at all characteristic or different from the rest of the series in structural characters; but as compared with *clarescens* the anterior femur is decidedly more slender. The species is a common one and has been often bred. I am not aware, however, that any number has been raised from a single batch of eggs, and any suggestion that a series of specimens were specifically identical merely because the larvae seemed to be so, can not be considered as proof of the fact asserted until it has been shown that there was no variation in the larvae.

LARVA.

GUENÉE, Spec. Gen. Noct., 1852, I, p. 52 (*brumosa*).—GOODELL, Can. Ent., 1877, IX, p. 61 (*hamamelis*).—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 169 (*brumosa*); Fifth Rept. U. S. Ent. Comm., 1890, p. 169 (*ovata*).

Stage I.—Whitish, translucent, setae all white except two on the cervical shield, single, pointed, no subprimaries; I and II in a square on joint 12. Tubercles large, white; no marks, but the food gives a greenish tint. Head round, whitish or slightly testaceous; width, 0.3 mm.

Stage II.—Head sharply bilobed, white; width, 0.4 mm. Body colorless, the food green. Tubercles white, high, with central seta and crown of about four shorter but equally thick ones. Warts IV and V single haired, not high; VI of two small setae.

Stage III.—Head, 0.7 mm.; whitish, body faintly greenish; warts slender, long, smooth, conic, concolorous, with central seta and small diffuse crown; all white, I-III; IV smaller, V single haired, VI with several long hairs. No secondary setae except possibly subventrally on joint 12-13.

Stage IV.—Head, 1.1 mm.; whitish, tubercles on the epicranium yellow and a brown dot below the upper tubercle. Body greenish, tubercles

yellow with some dots around I and II. Hairs white, single, with small bristly crown of secondary hairs.

Stage V.—Head, 1.8 mm. As before.

Stage VI.—Head, 2.5 mm. wide; pale whitish, granular, a small brown reticular streak on each lobe above. Tubercles large, single haired with a trace of the crown of short hairs. Tubercles yellow, as also a dorsal, subdorsal and lateral row of spots. Ground color sordid, faintly reddish tinted.

Stage VII.—Brown, a blotched dusky blackish dorsal stripe, cut by pale areas around warts I and II; these areas reddish brown, concolorous with the body. Sides slightly mottled. Tubercles and setae white, spiracles black. Otherwise as in *ovata*.

Food plants.—Oak, chestnut, birch.

ACRONYCTA INCRETA Morrison.

(Plate XII, fig. 13, female adult.)

Acronycta increta MORRISON, Proc. Bost. Soc., N. H., 1874, XVII, p. 131.

Lepitoreuma increta GROTE, Papilio, 1883, III, p. 112.

Ground color very dark smoky gray with a slight yellowish shading. Head without distinct markings; collar usually dark at base; patagiae black powdered. Primaries with all the markings distinct. Basal line black, geminate, reaching to the inception of vein 1. Transverse anterior line black, geminate, very evenly oblique, the space between the two defining lines more or less black filled. The median line is marked on the costa and again below the reniform, but it is usually obscure and not distinctly traceable. The transverse posterior line is geminate, black, squarely bent outwardly, and almost as squarely bent in on the submedian interspace. There is a very obscure subterminal line, which is best marked in the pale specimens, and emphasized by the slightly darker terminal space. There is a series of terminal dots or lunules from which black rays are sent inwardly, more or less defining a lunulate terminal pale line. There is a broken and irregular black line at base, which reaches the transverse anterior line, but does not always reach the root of the wing. There are no dagger marks. The ordinary spots are of moderate size and not well defined. The orbicular is round, of the ground color or a little paler, with a dusky center. The reniform is large, upright, slightly drawn in at the outer margin. The secondaries are smoky, a little paler in the males. Beneath smoky, more or less powdery, with a dusky outer line which is much the best marked on the secondaries and a more or less evident discal lunule.

Expanse, 1.16 to 1.28 inches (29 to 32 mm.).

Habitat.—New York; New Jersey; Texas; New Mexico.

This species resembles *hamamelis*, but is distinctly smaller throughout, decidedly narrower winged, and as a whole much darker. Of the

eight specimens before me seven were collected by Mr. Doll, who says that he finds the pupae very early in spring. The species is not by any means a common one, and is but rarely represented in collections. It may be that it is sometimes taken and discarded as an undersized *hamamelis*. One specimen has a very dark smoky ground color, with a faint greenish tint that is quite characteristic, but other specimens are much like the average run of *hamamelis*, except for the size and narrow wings. There is nothing characteristic in the structural details.

ACRONYCTA RETARDATA Walker.

(Plates II, fig. 5, adult; XII, fig. 14, female adult; XXI, fig. 29, male genitalia.)

Microcoelia retardata WALKER, Can. Nat. & Geol., 1861, VI, p. 38.—GROTE, Can. Ent., 1877, IX, p. 26 = *dissecta*.

Acronycta dissecta GROTE and ROBINSON, Trans. Am. Ent. Soc., 1870, III, p. 178, pl. II, fig. 81.

Lepitorea dissecta GROTE, Papilio, 1883, III, p. 113.—SMITH, Bull. U. S. Nat. Mus., No. 44, 1893, p. 45, pr. syn.

Ground color whitish gray. Collar with a dusky line at base. Primaries with all the markings evident. Basal line geminate, reaching nearly to the middle of the wing. Transverse anterior line geminate, black, outwardly oblique and a little curved. A black mark on the costal vein seems to bring the inner part of the line to the extreme base of the wing. The median line is well marked on the costa, extending obliquely to the reniform and rather vaguely marked below, though running close along the transverse posterior line to the outer margin. The transverse posterior line is geminate, both lines lunulate, smoky to black, the intervening space whitish, on the whole best marked opposite the anal angle. It is rather evenly and not too strongly bisinuate. There is a vaguely marked subterminal line, indicated rather by differences in shading than in any other way. A series of black dots is at the base of the fringes, beyond which they are cut with brownish. There is an incomplete and usually undefined line from the base to the transverse anterior line. Opposite the cell the space to the transverse posterior line is darkened, and in some specimens there is a vague suggestion of a dagger mark. Sometimes the shading beyond the transverse posterior line is rather prominent opposite the cell. The ordinary spots are large, incompletely defined, and not contrasting; the orbicular of the ground color, ringed with black scales, and with a smoky central dot; the reniform large, a little kidney shaped, of the ground color, usually with a dusky central lunule. Secondaries white to smoky, darker in the females. Beneath smoky; the secondaries paler, more powdery. An outer line and a discal spot are usually present, but always most distinct on the secondaries.

Expanse, 1.08 to 1.20 inches (27 to 30 mm.).

Habitat.—Canada to Virginia; west to the Mississippi Valley; Massachusetts in July; central New York in June and July.

This is the smallest species of the series, and as compared with the others the wings are a little more triangular and broader for their length. It is also the palest species, and, as a rule, the median space is much the palest part of the wing; the basal space being darker, and the dark shadings along the the transverse posterior line obscuring that part of the wing. The variation is all in the direction of suffusion, and I have seen examples that are dark greenish smoky, with the ordinary lines and spots of the usual whitish gray color, and, therefore, strongly contrasting. While the sexual characters are on the whole referable to this group, there is a distinct tendency toward structures like that found in *noctivaga* in the next group. The clasper is more hook-like and evenly developed than in the other species referred here. In other respects the structural characters correspond to those with which the species is associated.

LARVA.

Stage II.—Head bilobed; width, 0.4 mm. Larva all whitish, no marks; warts concolorous. Several hairs from each wart alike, not in a crown of shorter ones; stiff and not long except from joint 2; white, some of the dorsal ones dark.

Stage III.—Resting with the head turned on one side on the under-side of the leaf. Head bilobed, high, pale yellowish, dotted with a more opaque color; width, 0.7 mm. Body greenish, paler subventrally; warts round, knob-like, I to III, large, pale yellow; IV to VI, small, greenish. Hairs few, coarse, white; some of the dorsal ones blackish. Segments slightly annulate, faintly concolorously streaked transversely; a broken white dorsal line.

Stage IV.—Head pale brown, mottled on the vertex; width, 1.2 mm. Body with a vinous brown streak below warts I and II, reaching wart III. Segments folded, annulate, more whitish on the folds. Warts I to III reddish. A white dorsal line; hairs pale.

Stage V.—Resting on the upper side of the leaf. Head slightly bilobed, whitish, mottled with brown dots; width, 1.8 mm. Body whitish, with four wine-red transverse stripes on each segment, crossing the dorsum to wart III, distinct between warts II and III, faint dorsally, the second stripe converted into a double rounded spot between the warts of row I. Warts I to III, pale orange, the rest concolorous with the body; wart II smaller than I, IV and V small. Hair rather long, except from warts I and II, where they are shorter and dark.

Stage VI.—Head whitish, mottled with pale brown, a row of darker dots close to the sutures of clypeus and median suture; width, 2.5 mm. Dorsum to the spiracles shaded with purplish and containing the transverse bands, lateral region, venter and feet yellowish waxen white. Dorsal segments with five dark vinous red bands, reaching wart III. First nearly cut dorsally and not reaching so far down the sides as the

others; second broken by tubercles I, the dorsal segments formed into a pair of rounded spots, third broken by wart II, its dorsal segment faint, but continuous; fourth narrow, faint dorsally; fifth in the incisure, as long as the first band. Warts I and II, and also III in a less degree, short, erect, smooth cylinders, bearing a crown of stiff black hairs; IV to VI small and with few soft whitish hairs. No secondary hairs. Skin points minute, rather sparse, a little larger in the round ad-dorsal dot formed of the second band.

Cocoon.—Small, not very thick, composed of silk and bits of wood, or leaves bitten up.

Pupa.—Smooth, brown, tapering, the abdominal segments coarsely and densely punctured nearly or quite to the shagreened posterior incisure; wing cases not grooved and only slightly wrinkled. Cre-master a low, wide prominence, usually broad and sessile, not differentiated in color or sculpturing from the rest of the pupa. Above on each side one, below two short, thick, black spines, projecting obliquely outward, conic, their tips not recurved. Length, 8 mm.

Food plant.—Maple.

Group AURICOMA.

All the species of this group have the vestiture more or less elevated or roughened, and the primaries so powdered that the maculationship is obscured. There are no distinct black daggers or dashes except in *xyliniformis*, which is the best marked species of the group and the only one in which the transverse maculation is at all clearly defined. As a rule the tendency is to a longitudinal suffusion or strigate type of maculation. There seem to be two or three series represented, derived from different points in the *lobeliae* group, but difficult to define. All of them, however, come from one of the types in which the vestiture is roughened.

Illita and *luteicoma* are obvious derivatives of the *brumosa* type or of some form between it and *pruni*, from which also *xyliniformis* and its allies can be drawn in a different direction. All these forms are long winged and tend to a lanceolate type, the median lines becoming strongly dentate.

Noctivaga, *sperata*, *emaculata*, *impressa*, and *distans* are smaller species, very similar in type of maculation, with short, obtuse, trigonate primaries, and an evident tendency to the *connecta-alni* type of maculation.

Luteicoma and *illita* are long and rather narrow-winged species, the outer margin of primaries being oblique, rounded, and with the apices a little marked. The ground color is ash gray, and the maculation is only a little darker. All the transverse lines and the ordinary spots are traceable, though broken; but there are no longitudinal streaks, dashes, or shades, and no tendencies to a strigate type of maculation.

Illita is from the Rocky Mountain region, with the primaries much darker and the secondaries much lighter than in the Eastern *luteicoma*.

In the latter there is a distinct luteous shading, especially well marked in the secondaries, of which there is no trace in the former.

Sperata, *emaculata*, *distans*, *impressa*, and *noctivaga* have short, stumpy, trigonate primaries. All of them have a distinct, round orbicular, a very large, smudgy reniform, all the transverse lines distinct, and a more or less obvious median shade line.

Sperata, which is of a very pale ash gray, has no other markings, and even what there is does not contrast. It is an inconspicuous, powdery form, and recognizable thereby.

Emaculata is quite as powdery, but very much darker, so the black lines do not distinctly contrast. It has added a black, shaded streak at base, a black claviform, and a dusky shade near the anal angle.

Distans is much paler gray in ground color, hence the black lines and markings contrast more decidedly. The markings are as in the previous species, but the shadings below the submedian vein are more diffuse and prominent, and usually darken the wing from base to anal angle. There is often a break, however, between the claviform and the transverse posterior line in this dusky shade. As a whole the primaries are narrower and more pointed, and on analysis the resemblance to *albi* becomes strongly evident.

Impressa is broader winged and has the apices of primaries less marked. It is a clearer gray form, with all the markings distinctly written, and there is no continuous dark shading through the lower half of primaries. In the female the transverse anterior line is always distinct, while in *distans* it is almost always broken and obscured. *Distans* and *impressa* are very closely allied, and I would scarcely have cared to separate them on imaginal characters had not Dr. Dyar noted a difference in the larvae, which gave additional value to the points above noted. With extremes at hand, no difficulties can arise, nor if there is a good series of each form for comparison; but with a small number of variable specimens it may not be easy to decide as to the species.

Noctivaga is sharply defined by its mottled black and white appearance. The ground color is white, or nearly so, and all the lines, spots, shades, and dashes are black and diffuse. The secondaries are dark smoky, and altogether this form is hardly to be mistaken.

All the other species are more or less strigate in their type of maculation, and this is particularly true of *barnesii*, *perdita*, and *edolata*, in which the primaries appear blackish. *Barnesii* and *perdita* have the primaries evidently trigonate, though with a long, evenly curved outer margin and acute apex. *Barnesii* is paler in ground color, but all the transverse maculation has disappeared, while of the ordinary spots the reniform is sometimes traceable as a smoky lunule. The wing as a whole seems darker inferiorly, owing to a prominent black shade, which extends through the submedian interspace from base to anal angle.

Perdita has the primaries more uniformly blackish, but both the

ordinary spots are traceable, and the transverse posterior line may be made out as a somewhat paler, bisinuate shade.

Edolata has the primaries narrower and more nearly equal. The transverse posterior line is easily traceable and is very strongly dentate. The strigate marking is fully developed here and besides the black line in the submedian interspace there is another through and extending outwardly beyond the cell.

Extricata and *xyliniformis* are ashen gray species in which the strigate type is not so strongly developed as to obscure everything else, and where the transverse maculation is at least more obvious.

Extricata is somewhat larger, and darker bluish gray. The transverse anterior line is not well marked in most specimens, sometimes absent, and the transverse posterior line is strongly denticulate. There is a distinct tendency to an angulated, median shade line, which, indeed, is sometimes distinct and complete. A long basal dash, a streak crossing the transverse posterior line opposite anal angle, and a black streak below the ordinary spots in the cell emphasize the streaky appearance.

Xyliniformis is a painfully variable species; not because it can be confounded with anything else, but because, with a few specimens from well-separated localities, it allows itself to be so prettily divided into two series. It is ash gray in color, sometimes so densely black powdered that all the markings are obscured and sometimes so sparsely that it seems much lighter in ground color, and all the maculation is evident. Large, dark, and powdery specimens sometimes resemble *extricata*, but always differ by the absence of a longitudinal black basal line. The dash opposite the anal angle is almost always distinct, and usually crosses the transverse posterior line, though it rarely forms a well defined *psi*. The ordinary spots are usually distinct and always traceable.

Oblinita and *lanceolaria* agree in the very pale gray primaries, which are narrow, long, and sublanceolate. The head is a little more sunken than usual, and there is a distinct tendency to a short tongue, more marked in *lanceolaria* than in its ally.

Oblinita is rather smaller in average expanse, much more powdery and streaky in appearance, with the median lines so far as traceable very strongly dentate.

Lanceolaria is much more evenly colored, and has a very smooth bluish tinge over the white ground. The transverse posterior line, which is the only one obvious in my specimens, is very even, hardly contrasting, and accompanied by a paler shade inwardly.

Insolita is unknown to me, but is associated in wing form with *oblinita* by Mr. Grote. It is also given the more sunken head and other characters of the series, differing by the black primaries.

The general structure of the male clasper may be compared to a thumb and forefinger held so as to form an acute angle, the finger or

longer process up. The variation is in the proportion of these parts to each other, the tendency in our species being to the disappearance of the thumb and to the formation of a single, long curved hook similar to that in the first or *americana* group.

In the stumpy-winged series *sperata* is, on the whole, the most typical, with the thumb well developed, stout, and pointed at tip; the finger of moderate length, more slender, and easily curved to the pointed tip.

Emaculata strengthens the thumb and shortens it a little, while the finger is much lengthened, becomes much stouter, and is nearly straight to an abruptly pointed tip. *Distans* and *impressa* intensify this structure, the thumb being perhaps a little longer and the finger a little shorter.

Noctivaga, on the other hand, loses the thumb almost completely, the finger remaining much as in *sperata*.

Of the strongly strigate species, *barnesii* is like *sperata*, with the thumb greatly strengthened, but the proportions not much changed in other respects. *Perdita* is similar, but here the finger is also strengthened, though it becomes shorter. In *edolata* the thumb is much reduced, forming, indeed, a mere beak or spur, while the finger is very long, slender, and curved. This type is also found in all the other species of the group, the tendency to lose the thumb becoming absolute in *oblinita*, which then may be confused with the group *americana* at first sight. Unfortunately, I have had no male of *lanceolata*.

Of the European specimens referable to this group, I know *auricoma*, *rumicis*, *euphorbiae*, *myrica*, and *menyanthidis*, all belonging in a general way to the stumpy-winged form.

Euphorbiae in sexual structure is almost identical with *sperata*, and the species resemble each other very closely.

Myrica bears the same relation to *euphorbiae* in genital structure that *noctivaga* does to *sperata*, and here also the European and American species are very close structurally, while totally different in superficial appearance. *Myrica* is a very dark, evenly powdered, ashen gray, on which the ordinary markings are easily traceable, though they are not prominent.

Auricoma and *rumicis* represent the form found in *impressa*, our species standing almost midway between the two European forms in structure and resembling both superficially.

We have nothing resembling *menyanthidis*, in which both finger and thumb are long, slender, and curved, the thumb distinctly longer and a little up curved. Here we have a very distinct tendency to the *alni* type, which is not much contradicted in superficial appearance if we eliminate the peculiar black shading of the latter. There is nothing in the European species known to me which resembles our narrow-winged species. *Abcondita*, of which I have only a single specimen, resembles *euphorbiae* and will probably have similar sexual characters.

Ligustri has sexual structures totally unlike anything else in the genus and should be excluded from it even on superficial characters.

Megacephala is also unique and utterly unlike anything represented in the American fauna. There is nothing to contradict its reference to *Acronycta*, however, though I am at a loss as to how the structure could have been derived from anything known to me.

ACRONYCTA ILLITA, new species.

Plates XI, fig. 12, female adult; XVIII, fig. 22, leg; XXII, fig. 1, male genitalia.)

Ground color a dirty ashen gray, very powdery. Head and thorax without distinct markings. Primaries with all the markings obscured. Basal line geminate, black marked on the costa only. Transverse anterior line geminate, smoky or blackish, as a whole oblique, more or less outcurved between the veins. The median shade line is marked by an oblique dash on the costa only. Transverse posterior line geminate, lunulate, the inner line hardly defined; the outer broken, composed of smoky or black lunules, the intervening space a little paler. Subterminal line pale, rather vaguely defined, broken, followed by a series of black lunulate marks. There is a series of black terminal dots, before which the terminal space is a little paler. A few black scales indicate a basal, longitudinal line, and there is a feebly marked line above the anal angle, extending from the transverse posterior line to the outer margin. The ordinary spots are very obscure, of moderate size, the orbicular a little oval, centered with dusky; the reniform large, incomplete, more or less kidney-shaped, dusky, with a very pale central crescent. The space between the ordinary spots is paler than the rest of the wing. Secondaries soiled whitish, the veins a little dusky. Beneath white powdered, with a more or less obvious discal spot, but in the specimens before me without an exterior transverse line.

Expanse, 1.76 to 1.88 inches (44 to 47 mm.).

Habitat.—Denver; Glenwood Springs, Colorado, July.

Four specimens, not in the best of condition, are at hand. Three of them are males, the fourth is a female, with one pair of wings only. The species looks, at first sight, like a very dark *luteicoma* and resembles that species most nearly. I believe it to be distinct, however, and the very dark-powdered primaries, with secondaries in which there is no trace of yellow, give the creature a very distinctive appearance. The head is well developed, the front convex, but hardly bulging, the palpi closely applied to the front, and reaching the middle. The legs are well proportioned. The anterior leg of the male has the femur rather slender, the tibia large in proportion, the epiphysis inserted at about the middle and scarcely reaching to the tip. The harpes are moderate, and narrow slightly to the tip, where they are rather evenly rounded. The clasper is slender and strongly curved toward the tip, the inferior process very short and blunt. It is more than probable that this species is not rare in its range.

ACRONYCTA LUTEICOMA Grote and Robinson.

(Plates I, fig. 5, adult; VI, fig. 16, larva; XV, fig. 18, head; XVIII, fig. 23, leg; XXII, fig. 2, male genitalia.)

Acronycta luteicoma GROTE and ROBINSON, Trans. Am. Ent. Soc., 1870, III, 179, pl. II, fig. 83.

Pharetra luteicoma GROTE, Mitth. a. d. Roem. Mus., Hildesh., No. 3, p. 7.

Ground color a dirty, powdery ash gray, with a more or less well-marked yellow tint. The collar is usually a little dark at tip, and the patagia often have a dusky margin. Primaries, with all the markings traceable, though not prominent. Basal line geminate, black or blackish, usually reaching to the middle of the wing. Transverse anterior line geminate, outwardly oblique, outcurved between the veins. The median shade when best marked extends obliquely from the costa across the reniform, then makes an acute angle, and extends obliquely inward to the middle of the internal margin. Between this and its entire absence all intergrading forms are found. Transverse posterior line geminate, the inner line incompletely defined, the outer smoky or blackish, lunulate, the included space whitish and also lunulated. As a whole, the line is somewhat S-shaped. The subterminal line consists of a series of more or less connected white spots, outwardly margined by blackish lunules or dashes which do not reach the outer margin. There is a series of black terminal dots. There is no trace of a basal black line. In some specimens there is a blackish shading just below the submedian vein, between the transverse anterior line and the median shade. The ordinary spots are of good size, the orbicular irregular, round or oval, defined with black scales and with a dusky center, the reniform large, kidney-shaped, outlined by black scales and shaded with dusky. The secondaries vary from soiled whitish with a yellowish tinge to smoky yellow, those of the female being as a whole the darker. Beneath whitish powdery, sometimes with a vaguely defined outer line and more usually with a discal spot.

Expanse, 1.50 to 2 inches (38 to 50 mm.).

Habitat.—Canada, southward to Georgia and Texas, west to the Central States. Maine in June; central New York in June; District of Columbia, April and May; central Illinois in August; Texas in February; ? California.

In my catalogue I have also recorded the species from Colorado, and Portland, Oregon. It is more than likely that these localities refer to the preceding species; but I do not have the specimens at the present time to refer to. Dr. Dyar records the larva from California, but points out a difference which may really indicate a good species.

This is the largest and narrowest winged species in this group, which has no tendency to a lanceolate type. The primaries are subequal and the outer margin is roundly oblique, leaving the apex just a little acute. Two forms are distinguishable, depending upon the amount of yellow suffusion. In the one case the secondaries are almost white in

the male and have only a slight yellow suffusion in the female. In the second series the males are as dark as the females of the first, while the females are distinctly darker. Unfortunately both forms have been bred from the same lot of caterpillars, so that this does not point to even a good variety. The difference indeed is not great, and is not noticeable, except with a good series of specimens, where the massing of the two forms increases the apparent difference. In head structure this species is like the preceding, but the legs are decidedly stouter, the femur particularly being very heavy, while the tibia is stouter and shorter in proportion. The epiphysis is situated nearer to the tip, which it easily reaches. The harpes are much as in the preceding species; the clasper is long, moderately slender, not much curved; the inferior process is distinct, acute, and somewhat beak-like. This is one of the common species.

LARVA.

THAXTER, *Papilio*, 1883, III, p. 16.

Stage I.—Head blackish testaceous, whitish above the mouth; width, 0.4 mm. Body greenish, with black warts bearing long, stiff hairs. Cervical shield and anal plate blackish. On joints 5, 8-9, and 12 a series of diffuse, brown, dorsal patches. Warts without subprimary ones, three hairs from Ia + Ib, on thorax, and from I on abdomen; otherwise single-haired.

Stage II.—Head bilobed, brown-black, shining, labrum white, and a white line on each side of the clypeus; width, 0.6 mm. Body greenish white, the warts large, black, smaller on joint 11. Hair bristly, black, sparse on joint 11, some overhanging the head.

Stage III.—Head bilobed, flat in front, black and shining; mouth reddish; width, 0.9 mm. Body enlarged dorsally at joint 12, and apparently so at joint 5, as this part is held highest. Body whitish, almost white in places, especially subventrally on joints 10 and 12. Warts normal, black, IV very small. Hair bristly, black, weak on joint 11, thick and tufted dorsally on joint 5.

Stage IV.—Head bilobed, rounded, shining black, clypeus bordered with white, mouth pale brown; width, 1.4 mm. Body black, a subdorsal row of pale yellow spots, forming a band on joints 10-12; a narrow line below it; a similar band subventrally. Hair thick, bristly, black and white, with tufts of shorter soft hairs from warts I to III on joint 5, and two smaller divergent subdorsal ones on joint 12. A narrow white subdorsal line. In another example there were also white tufts from wart II on joint 4 and warts I and II on joint 6.

Stage V.—Head high, shining black; mouth and two bands, converging above, on each side of the clypeus, white; width, 2 to 2.2 mm. Body as before, with some long white hairs, the tufts on joint 5 brown or black; a smaller white tuft on joint 6; short divergent black pencils on joint 12. In Californian examples the subdorsal and subventral bands become strongly shaded with red, while they are pale in Eastern examples at this stage.

Stage VI.—Head whitish behind, mottled with brown and shaded with black in a diffuse band from the ocelli upward and on each side of the clypeus; mouth parts and under side of head largely black, shining; width, 3.3 mm. Body cylindrical, tapering slightly, joint 12 a little enlarged. Wart I as large as the others, IV minute. Body strigosely mottled with black and white, the black predominating and becoming continuous centrally on the segments and adjoining the narrow, broken, yellow dorsal line. Broad subdorsal and substigmatal lines, the former broken and obsolete anteriorly, yellowish white, pale red in the middle. Warts pale, with fleshy tint. Long hairs, pale, slender; those from warts I and II shorter and more spiny, the warts nearly in line transversely; a few long black hairs at the extremities. Thick tufts of plumed hairs, black-brown from warts I and II on joint 5; divergent black pencils from the closely approximate warts I and II on joint 12; dense shorter white tufts from I and II on joints 3 and 4, III on 5, I to III on 6, a few hairs from III on 9 or 9 and 10, moderate from III on 12, a few hairs from wart III on 13.

Stage VII.—Head whitish brown, a black line at the edge of the clypeus and a patch before the eyes. Body marked as before, but the narrow yellowish dorsal line runs through a series of velvety brown patches; the pale bands may be yellow or red. Warts all pale; spiracles white with black rims. Wart I bears some stiff bristles; long hairs from the extremities; lateral hairs soft, barbed, mixed with stiff bristles. Tufts all fine, light pinkish brown, like the color of new leather; those from warts I and II on joints 5 and 12 a little darker in shade. There are small tufts from warts III on joints 7 to 10. Venter and feet pale. In another example the white and black tufts persisted in the last stage. Another larva had but six stages with the following widths of head: 0.35, 0.6, 1.0, 1.9, 3.0, and 4.8 mm.

Cocoon.—Formed between leaves, composed entirely of silk, firm.

Pupa.—Cylindrical, the posterior fixed abdominal segments abruptly tapering; posterior margins of the segments with smooth, shining, slightly elevated rims. All coarsely wrinkled, the abdominal segments in front thickly covered with large conical elevations; cremaster tapering, concolorous, with a bunch of dense, numerous, stiff bristles projecting backward. Color, blackish brown. Length, 18 mm.

Food plants.—Birch, apple, walnut, oak, willow, poplar, elm, choke cherry, cherry, linden, ash.

ACRONYCTA SPERATA Grote.

(Plates II, fig. 6, adult; VIII, figs. 31, 32, larva; XXII, fig. 3, male genitalia.)

Acronycta sperata GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 81, pl. II, fig. 1.

Arctomyseis sperata GROTE, Papilio, 1883, III, p. 113.

Phaethra sperata GROTE, Mitth. a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Ground color a dirty, powdery ash gray. Head and thorax without definite markings. Primaries, with all the markings, smoky and rather obscurely defined. Basal line geminate, marked on the costa only.

Transverse anterior line geminate, slightly outcurved as a whole, and a little outcurved between the veins. The median shade line is distinct in most of the specimens and almost upright, crossing the wing near its middle, and a little bent outwardly on the median vein. Beyond it the median space is usually darker than toward the base. Transverse posterior line geminate, the inner line vague, the included space a little paler; the outer line more or less lunulated, often broken entirely, a little sinuate, and nearly parallel with the outer margin. There is a broken, pale subterminal line, beyond which the terminal space is shaded with smoky spots which do not reach the outer margin. There is a broken terminal line, and the fringes are cut with smoky. There are no streaks or dashes. The ordinary spots are distinct, darker, and rather contrasting. The orbicular is smaller, moderate, black-ringed; the reniform is large, kidney-shaped, incompletely outlined, but dusky filled. The secondaries are white in the male; outwardly a little soiled in the female. Beneath whitish, more or less powdered, the secondaries sometimes with a discal spot and traces of an outer line.

Expanse, 1.20 to 1.40 inches (30 to 35 mm.).

Habitat.—Canada to District of Columbia; west to Illinois; Missouri; Colorado (?); Massachusetts in May and June; central New York, May and June; Illinois in May.

In my catalogue I have recorded the species from the Northern States, May to August; but the specimens now before me do not show so great a range.

The species is quite easily recognizable by the pale, dirty gray primaries, in which all the markings are obscure, and only the ordinary spots stand out in dusky relief, contrasting with the clear white secondaries of the male, which are only a little soiled in the female. The front of the head is flat, the palpi reaching scarcely to the middle of the front. The anterior leg of the male has the femur rather dilated at middle, abruptly narrowed to the tip. The tibia is stout and proportionately rather short, while the tarsi are long and slender. The epiphysis is situated at the middle of the tibia or a little above, and does not extend to the tip.

The only variation that occurs in the species, so far as it is represented in the specimens before me, is that sometimes the wing beyond the median shade is darker than it is toward the base, and sometimes there is no apparent difference. The harpes of the male are broad and rather short, a little acutely rounded at the tip. The clasper has the inferior process almost as long as the superior. The superior process is rather stout, reaching nearly to the tip of the harpes, and only a little curved; the inferior process is almost as long, acute at the tip, and a little curved.

LARVA.

PACKARD, Fifth Rept. U. S. Comm., 1890, p. 628 (*Apatela* sp.).

Stage VII.—Head slightly bilobed, shining red brown, the sidepieces of clypeus yellowish; width, 2.8 mm. Body slightly enlarged at joint

12, wart IV small. Pinkish or creamy brown, more or less mottled with blackish shades, especially in a broken dorsal band, segmentarily furcate, between warts II and III and around the spiracles. A red substigmatal band, sometimes scarcely defined from the general reddish color. Hairs bristly, light red, brighter on joint 5; a few long ones at the extremities, and tufts of short, fine, feathery whitish hairs from warts I to III, on joints 6 to 12, more or less abundant. Another example was heavily shaded with black, the hair still red, the red substigmatal line and a series of subdorsal patches retaining the usual color. Head brown black.

Cocoon.—Spun between leaves partly bitten up into little patches, elliptical, thin, single, composed of pale silk.

Pupa.—Dark brown, a little blackish dorsally; fixed abdominal segments tapering; segments coarsely pointed, granular above; quite smooth in a narrow posterior rim. Thorax and cases wrinkly. Oremaster rather long, narrow, conic, smooth, terminating in a dense, round tuft of bristles.

Food plants.—Poplar, alder.

ACRONYCTA NOCTIVAGA Grote.

(Plates I, fig. 11, adult; VIII, figs. 27, 28, larva; XVIII, fig. 21, leg; XXII, fig. 6, male genitalia.)

Acronycta noctivaga GROTE, Proc. Ent. Soc. Phila., 1864, II, p. 437, pl. ix, fig. 3.—BETHUNE, Can. Ent., 1869, I, p. 71.

Apatela noctivaga PACKARD, Forest Insects, 1890, p. 460.

Pharetra noctivaga GROTE, Mitth. a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Acronycta longa WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 60.—GROTE and ROBINSON, Trans. Am. Ent. Soc., 1868, II, p. 77, pr. syn.—BUTLER, Ent. Amer., 1887, III, p. 36, pr. syn.

Ground color white or nearly so, overlaid by black scales, and mottled so as to give the insect a somewhat marbled appearance. Head irregularly mottled with black, usually with a distinct line across the front. Collar with the upper half black. Thorax with patagiae black marked, and the disk strongly black powdered. The wings have the ordinary markings fairly evident, but confused by the irregular black suffusion. The basal line is geminate and black, included space white. Transverse anterior line geminate, black, outwardly oblique, strongly outcurved between the veins, the included space white. The entire basal space is black powdered, but below the middle it is entirely suffused by blackish scales, so that there seems a contrast between the upper and lower part. The median shade line is diffuse, starting obliquely from the costa across the reniform, and below this running parallel to the transverse posterior line. The transverse posterior line is geminate, black, the inner line lunulate, the outer merged into the black subterminal space, the included space white, evenly sinuate, with two strong outward teeth on veins 3 and 4. The subterminal line is white, broken, defined by the black subterminal space and by a series

of interspacial black spots in the terminal space. There is a series of black terminal spots, preceded by a white terminal line, the fringes being cut with black. The ordinary spots are distinct, darker than the rest of the wing. The orbicular is small or moderate in size, round, black ringed, and usually with a dark center, which, as a rule, fills the entire space. The reniform is large, indefinitely outlined, kidney-shaped, and filled with black. Beyond the transverse anterior line a black patch extends to the median shade just above the submedian vein. Just above the anal angle a black patch extends from the transverse posterior line to the outer margin. Secondaries smoky, paler in the male, more yellowish in the female, with a slight brassy reflection. Beneath yellowish, powdery, with a more or less broken outer line and discal spot.

Expanse, 1.32 to 1.50 inches (33 to 37 mm.).

Habitat.—Canada, Jun to August; Massachusetts and New York, May and June; Washington, District of Columbia, in May; central Illinois, July 17; New Mexico; Portland, Oregon, April and May; Colorado.

The species is widely distributed and probably occurs over nearly the entire United States. A specimen before me, not in the best condition, from New Mexico, indicates that possibly there may be a similar representative species from that region. It is easy to recognize this insect by the very strong contrast between the white ground color and the black lines and blotches, which give it a striking appearance. There is little variation except in the extent of the black blotching. The front of the head is slightly convex, the head itself a little retracted; the palpi distinct and reaching to about the middle of the front. The anterior leg of the male has the femur well developed, rather evenly enlarged toward the base; the tibia stout, with the epiphysis short, inserted below the middle and reaching to the tip. The harpes are moderate, obliquely rounded at tip; the clasper, arising from an oblique ridge, is single, pointed at the tip, and a little curved. There is a very slight indication of an inferior process, but practically we have a single curved hook.

LARVA.

THAXTER, *Papilio*, 1883, III, p. 15.—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 460.

Stage I.—"Head brown; body rather stout, not tapering, greenish white; dorsal portion of joints 2, 5, 8, 9, and 12 red, the rest more or less tinged with red, sparsely clothed with long blackish hairs." (Thaxter.)

Stage II.—"Head dirty red, greenish anteriorly; body dirty greenish; segments distinct; dorsal patches dull reddish on superior portion, the other segments, except 10 and 11, suffused with red, somewhat thickly covered with tufts of stout black hairs." (Thaxter.)

Stage III.—"Head dark blackish; joint 12 enlarged; much darker than before, the red color becoming dark wine color, somewhat thickly

mottled and suffused over the dorsal portion of all the segments except 10 and 11. Sublateral and ventral portion light green, except on segments 2 and 4, which are tinged with red. A whitish lateral line. Warts black, hairs stout, black; those on joint 11 shorter than the others." (Thaxter.)

Stage IV.—"Head blackish, with a yellow V-shaped mark; body dull black above, yellowish beneath; a yellow lateral (subventral) line. The yellowish dorsal (subdorsal) patches on joint 11 on which the hairs are short. Joints 3-5 and 12 hunched up." (Thaxter.)

Stage V.—"Black above, deeper anteriorly. A distinct yellow band beginning on joint 5, running just below the stigmata, which are white, contrasting. Feet yellow, prolegs black; dorsal patches on joint 12 brighter; otherwise as before." (Thaxter.)

Stage VI.—Subventral "band orange colored; a broken yellowish stripe on the base of legs; two (sub) dorsal orange spots on joint 11 and sometimes a pair on joint 10." (Thaxter.)

Stage VII.—Head slightly bilobed, shining brown-black, sutures of clypeus, labrum, and antennae whitish; width, 3.3 mm. Body dull black, obscurely shaded and mottled. A broad obscure, diffuse, red substigmatal band (V) and a faint spot on joint 11 in front of wart I. Warts large, hair bristly and blackish from warts I to III, softer from IV to VI; wart IV very small; tufts of fine feathery hairs from warts I to III on joints 5 to 10 and 12, dark gray, in some examples so few as to be hardly noticeable.

Cocoon.—"Between leaves." (Thaxter.)

Food plants.—Poplar; also various low plants.

ACRONYCTA EMACULATA, new species.

(Plates XIII, fig. 2, male adult; XXII, fig. 9, male genitalia.)

Ground color a bluish ash gray, which is almost entirely overlaid by smoky scales, particularly in the female. The head and thorax are strongly powdered with smoky and black, without forming distinct markings. Primaries with all the markings traceable, but hardly prominent. Basal line geminate, black. Transverse anterior line geminate, the outer line black, the inner smoky, almost upright, as a whole a little outcurved between the veins. Median shade almost upright, a little oblique from the costa through the reniform, and then close to the transverse posterior line to the inner margin. The transverse posterior line is geminate; the inner line smoky, the outer black and a little dentate on the veins, included space of the palest ground color. As a whole the line is rather squarely bent over the cell, and strongly incurved below. Beyond this curve is a dusky shading, and the subterminal space as a whole is a little darker than the rest of the wing. Subterminal line whitish, broken, irregularly followed by black marks in the interspaces. There is a series of terminal black marks, and the fringes are cut with dusky beyond them. There is a somewhat inde-

fined basal black streak, below which the space is blackish. An oblique black mark extends from the transverse anterior line to the median shade just above vein 1. The ordinary spots are not well marked, though visible. The orbicular is round, moderate in size, ringed with black scales, and with a smoky center. The reniform is large, kidney-shaped, smoky. The secondaries are soiled whitish in the male, smoky in the female.

Expanse, 1.32 to 1.40 inches (33 to 35 mm.).

Habitat.—Calgary, Canada; Easton, Washington.

I have only two specimens of this species. The male, a very good specimen from Calgary, received from Mr. Dod; the female, evidently an electric-light capture, because one secondary is scorched, taken by Mr. Koebele and belonging to the U. S. National Museum, and these are the types. The female is very much darker than the male and the markings are hardly relieved. The male might pass as a very dark *impressa*, but the female shows more resemblance to *sperata*. In fact, the male itself would be more readily considered a variety of *sperata* than of *impressa*, though when the markings are closely compared the resemblance is to *impressa*. In the male characters this resemblance is intensified, because there is practically no difference in the genitalia, nor, indeed, in the leg structure. Nevertheless, I believe this to be a good species from the characters above given.

ACRONYCTA IMPRESSA Walker.

(Plates I, fig. 12, adult; VIII, figs. 33, 34, larva; XIII, figs. 4, 5, male and female adult; XIV, fig. 9, thorax; XVIII, fig. 19, leg; XXII, figs. 10, 11, male genitalia.)

Acronycta impressa WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 61.—GROTE, III. Essay, 1882, p. 38=*brumosa* Grote.—BUTLER, Ent. Amer., 1887, III, p. 35, an sp. dist. *brumosa* Guénée.

Phaetrea impressa GROTE, Mitth. a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Acronycta fuscata WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 62.—GROTE, III. Essay, 1882, p. 39=*brumosa* Grote.—BUTLER, Ent. Amer., 1887, III, p. 35=*impressa*.

Acronycta brumosa GROTE, in lists and coll.—SPEYER, Stett. Ent. Zeit., 1875, XXXVI, p. 109.—BUTLER, Ent. Amer., 1887, III, p. 35=*impressa*.

Apatela brumosa † PACKARD, Forest Insects, 1890, p. 169.

Acronycta verrillii GROTE and ROBINSON, Trans. Am. Ent. Soc., 1870, III, p. 178, pl. II, fig. 82.—MORRISON, Can. Ent., 1875, VII, p. 79=*innotata*; Ann. Lye. Nat. Hist., N. Y., 1875, XI, p. 92=*brumosa*; Psyche, 1875, I, p. 42=*brumosa*.

Ground color a somewhat dirty ashen gray, more or less black powdered. Head with a dusky line on the front, and usually another on the vertex. Collar tipped with black or smoky, although this is inconstant. Patagiae more or less black margined, and the disk also irregularly powdered. The primaries have the ordinary markings distinct. Basal line geminate, black; transverse anterior line geminate, smoky or blackish, more or less interrupted, outcurved in the interspaces, as a whole a very little oblique. The median line is more or less obscured

when best marked, a little oblique from the costa, darkening the reniform and below it running rather close to and parallel with the transverse posterior line. Transverse posterior line geminate, the inner line smoky and rarely complete, the outer line black, irregular, more strongly dentate on veins 3 and 4. As a whole it is somewhat S-shaped. There is an outward tooth in the submedian interspace in most of the specimens. Subterminal line interrupted, irregular, pale, marked by black scales in the interspaces. There is a series of terminal spots, beyond which the fringes are cut with black. There is a more or less evident black streak, which is generally interrupted at the base, and below this the basal space is darkened by black powderings. A more or less obvious smoky shading extends above vein one to the median line, though the tendency in this species is to lose its shading. The inward curve of the transverse posterior line above the anal angle is followed by a dusky shading which usually extends only to the subterminal line, but sometimes reaches the outer margin. As a whole the subterminal space is somewhat smoky filled. The ordinary spots are distinct; the orbicular small, round, black ringed, with a central dusky dot; the reniform large, kidney-shaped, somewhat incompletely outlined and with a smoky center. Secondaries yellowish white in the male, more smoky in the female. Beneath whitish, more or less powdery, in the female with a distinctly smoky tinge. Discal spot obvious on the secondaries, less distinct and sometimes wanting on the primaries; rarely with a traceable exterior line, except on the secondaries.

Expanse, 1.20 to 1.50 inches (30 to 37 mm.).

Habitat.—United States, west to the Rocky Mountains, Canada, May to August; central New York, July and August; Minnesota in June; central Illinois in July; New Jersey, July 17; Washington, District of Columbia, in May; Glenwood Springs, Colorado, in August.

The synonymy of this species as above given is, I believe, correct. Except in the case of Mr. Grote's species I have not seen the type; but Mr. Butler has definitely referred *impressa* and *fasciata* as being the same, while Mr. Grote has referred *fasciata* as the species identified by him as *brumosa*. The discussion concerning this species will be found under the next heading.

LARVA.

LINTNER, Twenty-sixth Rept. N. Y. State Mus., 1874, p. 159 (*oblinita*).—COQUILLETT, *Papilio*, 1881, I, p. 56 (*brumosa*).—DIMMOCK, *Psyche*, 1885, IV, p. 274.—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 169.

Stage VII.—Head shining black, without marks; width, 2.8 mm. Body velvety black, a broad diffuse, faint reddish substigmatal stripe (V and VI). Warts pale, sometimes whitish on the central segments, hair short, in small bunches from the warts, dorsal space appearing black from the absence of hair. On joints 3 to 5 and 12-13 the hairs are somewhat spiny and light reddish brown; elsewhere soft and pale yellowish. A few long ones at the extremities; wart IV very small.

Cocoon.—Spun tightly among leaves; composed of silk.

Pupa.—Brown-black, cases heavily wrinkled, abdominal segments roughened with irregular confluent granules, not points, the rounded posterior segmental bands smooth. Anal segments rapidly tapering. Cremaster wide, flattened, concave below and with a dense brush of little straight spines over the end.

Food plants.—Willow, plum, hazel, currant, blackberry.

ACRONYCTA DISTANS Grote.

(Plates XIII, figs. 6, 7, male and female adults; XVIII, fig. 20, leg; XXII, figs. 12, 13, male genitalia.)

Apateia distans GROTE, Can. Ent., 1879, XI, p. 58.

A detailed description of this species would be in all essential points a reproduction of what was written under the head of *impressa*, the two look so much alike. *Distans*, as compared with *impressa*, is, on the whole, a trifle smaller. The wings, especially in the male, are narrower and the apices of the primaries are distinctly more pointed. The latter is particularly true of the female, but is also traceable in the male. The markings, on the whole, are less distinct, more suffused by black scales, and there is a dusky or blackish longitudinal shading, which extends from the base below the middle of the wing to the outer margin without a distinct break. This is perhaps the most obvious character of the species; but it is a somewhat variable one, and occasionally a break occurs just inside of the transverse posterior line, and then the resemblance to *impressa* becomes very close. On the whole the species has the secondaries a little paler than in the previous case, but otherwise the two resemble each other perfectly. I doubt whether I would have considered this a distinct species had not Dr. Dyar called my attention to the fact that there seemed to be a larval difference. When the forms are separated in series a difference may be marked; but a single specimen may be troublesome to place in some cases. The species is perhaps better defined in the female than in the male. In the sexual characters there is very little difference; in both cases the harpes are rather evenly rounded at the tip and the clasper is very well developed and large. The inferior process is long, somewhat excavated on the inner side, with a rounded tip; the superior process is stout, long, nearly equal to the tip, where it ends in an abrupt, short point. In *impressa* this upper process is nearly straight and somewhat irregular; in *distans* it is more even and distinctly curved, though not strongly so. The differences, however, are comparative, and I would not be inclined to give them much weight. There is more difference in the anterior legs of the male. These in *distans* are distinctly longer than in *impressa*, not only comparatively but absolutely, though *distans* is the smaller species. The tibia in *impressa* is distinctly stouter and the epiphysis is inserted nearer to the base, besides being also broader. I have not been able to discover any other characters. I have not seen

Mr. Grote's type; but his description evidently refers to a specimen in which the longitudinal shading through the inferior portion of the wing is well marked. So far as distribution is concerned and the dates of appearance, these seem to be the same in the two species.

These are perhaps the most closely allied of any of the species in the genus, and they are mixed in collections generally. It is very probable that all previous authors have confused the two; but Mr. Grote's description, being defined, must be applied to the form agreeing with it.

LARVA.

SAUNDERS, Ins. Inj. Fruits, 1881, p. 313 (*brumosa*); Rept. Ent. Soc. Ont., 1883, p. 12 (*brumosa*).—PACKARD, Fifth Rept. U. S. Ent. Comm., 1890, p. 498 (species 43, birch).

Stage VI.—Head shining black; width, 2 mm. Body black, pale in the incisures; a substigmatal yellowish band, diffuse below. Hairs rather stiff throughout, a few long ones at the extremities; all pale yellowish except some black ones from warts I and II on joints 5 and 12.

Stage VII.—Head shining black, no marks; width, 2.5 mm. Body black, paler in the incisures, with the substigmatal band as before. Hair short, in small bunches from the warts, dorsal space appearing somewhat broadly black from the absence of hairs. Hair pale yellow, soft, a few bristly ones from tubercle I and some black ones on joints 5 and 12.

Cocoon.—Spun tightly among leaves; composed of silk.

Pupa.—Like that of *A. impressa* exactly.

Food plants.—Poplar, willow, birch, alder.

ACRONYCTA BARNESII, new species.

(Plates XIII, fig. 10, male adult; XXII, fig. 15, male genitalia.)

Ground color dark ashen-gray, very strongly powdered with black. Head without distinct markings, though there is a tendency to become black on the vertex. The patagiae are black margined, and the disc also tends to become more or less black lined. The primaries have all the ordinary markings obscured and tend to become strigate. The transverse anterior line may be traced, in some specimens, across the entire wing. It is black, geminate, the outer portion being the more evident. As a rule it consists of a pair of oblique streaks from the costa toward the middle of the wing. The median shade is marked in the same way, as a single streak from the costa toward the faintly indicated reniform. The transverse posterior line is barely indicated in some specimens; but usually wanting altogether. There is no subterminal line; but a vague paler shading may be traced, parallel with the outer margins, in some specimens. There is a series of black terminal spots, beyond which the fringes are prominently cut with black, and from these spots a series of rays extend inward; that above vein 5

being the longest and most prominent; the others lessening toward the apex. There is a broad black streak, extending from the base to beyond the middle of the wing in the submedian interspace. There is another, which almost fills the space between veins 1 and 2, and extends from the median vein to the outer margin. The other interspaces are less prominently black filled; but sometimes the powdering obscures these rays, and the whole wing gets an indefinite mottled appearance. The ordinary spots are wanting or very faintly indicated; the orbicular is not present in any specimen before me; the reniform is small, somewhat lunulate, and incompletely outlined in all but two of the nine examples under examination. Secondaries white in the male, smoky in the female. In both cases with a darker terminal line. Beneath white in the male, smoky in the female; powdery, with a more or less marked discal spot and sometimes a trace of an outer line.

Expanse, 1.50 to 1.84 inches (37 to 46 mm.).

Habitat.—Colorado: Denver; Garfield County, 7,000 feet; Glenwood Springs, June and July.

All the specimens before me were collected by Mr. David Bruce or by Dr. William Barnes. There are six males and three females, the latter being the larger throughout. Types are in the U. S. National Museum, Rutgers College, and with Dr. Barnes and Mr. E. L. Graef. The only variation that occurs is in the amount of the black powdering through the wings; otherwise it is very constant. The species has been confused with *edolata*, than which it has broader, more trigonate wings and a paler ground color. The head is moderate in size, the front just a little bulging; the palpi well developed and reaching to the middle. The legs are rather long in the male, with the femur evenly developed, not particularly stout in the middle; the tibia is proportionate, with the epiphysis inserted above the middle and not reaching to the tip. The harpes are rather short and broad, quite evenly rounded at the tip. The clasper has the inferior process well developed, rather long and somewhat beak-like; the upper process of moderate length, more slender and well curved; it is not more than one and one-half times as long as the inferior process.

ACRONYCTA PERDITA Grote.

(Plates III, fig. 6, adult; XVIII, fig. 16, leg; XXII, fig. 16, male genitalia.)

*Acronycta perdit*a GROTE, Can. Ent., 1874, VI, p. 154.

Ground color a very dark bluish gray, the wings strongly suffused with black. Head blackish on the vertex. Collar, centrally black, the sides being gray. The patagiae are black margined, while the disc has a black line on each side and sometimes also in the center. The primaries, although thoroughly suffused with black, still admit of tracing all the ordinary markings. The basal line is very feebly indicated by a pair of black dots on the costa. The transverse anterior line is geminate, strongly bent outwardly between the veins; as a whole nearly

upright. It is not complete in any of the specimens before me, but is always obvious on the costa at any rate. The median shade is traceable from the costa through the reniform as a somewhat diffuse black shade. The transverse posterior line is usually well marked, strongly dentate on the veins, particularly on 3 and 4; it is geminate, the outer line lunulate, the inner more even and broken; it is rarely complete. The subterminal line is broken, pale, consisting of rather a series of shades than a real line. The terminal space is marked by a series of black spots, separated by the paler veins. There is a series of black terminal dots, beyond which the fringes are cut with black. The ordinary spots are traceable. The orbicular is round or nearly so, small, defined by black scales. The reniform is large, indefinite, dusky. As a whole the lower portion of the wing is darker than the upper because of a black shade which extends from the base through the median space below vein 2. It may or may not be cut by the transverse posterior line, and beyond it this shade reaches to the outer margin, extending upward to vein 3. A somewhat triangular patch extends from the transverse posterior line to the outer margin opposite the cell. Above this the space between the transverse posterior and the subterminal line is black. The veins are generally a little paler, so that the wings have a rayed appearance. Secondaries white in the male, with a discal spot and an outer, smoky margin. In the female they are smoky. Beneath, white in the male, smoky in the female; both wings with a discal spot, but with only a faint trace of an outer line.

Expanse, 1.40 to 1.68 inches (35 to 42 mm.).

Habitat.—Sierra Nevada, California, in June; Easton, Washington.

This species varies little in the series before me, except in size. The females are as a whole larger than the males, but the difference is not great. There is some difference in the amount of black in the wings, and this determines the distinctness with which the markings appear. This type seems to be an intensification of the characters found in *barnesii*, but with the transverse lines much better marked. The legs of the male are longer; the femur is graceful, the thickest portion toward the base; the tibia is proportionately longer, with the epiphysis set at the middle and not reaching to the tip. The harpes of the male are evenly rounded at the tip. The clasper has the upper and lower process of nearly equal length; both being curved, but the lower is acute at tip and somewhat beak-like, while the upper is cylindrical, blunt at tip and rather more claw-like. The species is a distinct one in all its characters.

ACRONYCTA EDOLATA Grote.

(Plates IV, fig. 1, adult; XVIII, fig. 17, leg; XXII, fig. 17, male genitalia.)

Apatela edolata GROTE, Papilio, 1881, I, p. 153.

Mastiphanes edolata GROTE, Ill. Essay, 1882, p. 49, pl. I, fig. 4.

Ground color a very dark bluish gray, strongly overlaid by black scales. Head blackish above; collar blackish in the center, leaving

the sides gray; patagiae black margined, the disk with black lines at the side, and a smoky line through the middle. The primaries have all the markings obscured by the black streakings, but somewhat traceable. The basal line consists of an oblique black streak across the costal space. The median shade is scarcely more. The transverse posterior line may be traced across the wing as a series of strongly dentate whitish points, followed by black, defining spots. There is nothing that can be called a subterminal line; but there is a pale shading, beyond which a series of black rays extend through the terminal space. Some of these rays cross the shading and extend inward to the transverse posterior line. Between veins 1 and 2, and 2 and 3, this line is actually crossed, and connection is made with the dusky shading which extends to the base below the median vein. The veins themselves are a little white marked. Secondaries white in the male, a little dusky outwardly; hardly darker in the female, but with a broader dusky margin. Beneath powdery white, a little darker in the female, with a more or less obvious discal spot; but no outer line in any of the specimens before me.

Expanse, 1.72 to 1.88 inches (43 to 47 mm.).

Habitat.—Arizona.

This is a narrow winged species in which the primaries tend a little to become lanceolate. The ordinary markings are all much obscured, the dentate transverse posterior line being the only thing that is at all traceable, and this is very characteristic. The ordinary spots are not traceable in any specimen before me. The Colorado locality given in my catalogue is probably an error, due to the fact that specimens of *barnesii* were confused with this species. The head is of good size; the front a little convex, but not bulging; the palpi reach to the middle of the front. The anterior legs of the male are fairly well developed; the tibia rather stout and long in proportion to the femur, with the epiphysis inserted a little below the middle and reaching to the tip. The harpes of the male are moderate, rather evenly rounded at the tip. The clasper is stout, the inferior projection short and beak-like, the upper process forming a long curved hook, which gradually narrows to the pointed tip. The upper process is more than twice as long as the lower.

ACRONYCTA EXTRICATA Grote.

(Plates XIII, fig. 9, female adult; XVIII, fig. 15, leg; XXII, fig. 18, male genitalia.)

Apatela extricata GROTE, Bull. U. S. Geol. Surv., 1882, VI, p. 575.

Mastiphanes extricata GROTE, Papilio, 1883, III, p. 113.

Ground color dark bluish gray, powdery, with more or less evident smoky shadings. Head with vertex smoky; collar smoky or rusty brown above. The patagiae with narrow smoky margins and the disk with a smoky line on each side. Primaries with the transverse markings obscured in most specimens. Basal line marked by an oblique black dash on the costa. Transverse anterior line fragmentary, in

most cases only a strongly dentate brown shading; but in some instances a part of the line is marked with black. The median shade is usually pretty well marked and smoky brown. It is outwardly oblique from the costa through the reniform, then bends inwardly and runs nearly to the middle of the inner margin. The transverse posterior line is strongly dentate, obscurely geminate, the outer portion of the line black, the intervening space very pale, while the inner defining line is smoky if at all traceable. There is an obvious subterminal line. There is a series of terminal dashes between the veins, which extend inwardly to the transverse posterior line between veins 4 and 5, and 5 and 6. Other dashes extend inward above and below vein 1. There is a black basal streak, which extends well to the middle of the wing and nearly meets one of the inward dashes below vein 2. The ordinary spots are obscure, imperfectly outlined; the orbicular a little elongate; the reniform small, incompletely defined, outwardly smoky. Beyond the median shade the space between the veins is more or less marked by short black dashes. Secondaries white, a little soiled toward the apex in the female. Beneath white, powdery, usually without trace of any outer line or discal spot, although in some specimens the spot at least is indicated.

Expanse, 1.72 to 1.80 inches (43 to 45 mm.).

Habitat.—Texas, in March, May, and August.

This species is rather well marked and not easily mistaken for anything else. The wing seems strigate, an appearance which is enhanced by the narrow primaries and the strongly dentate transverse posterior line. In most of the specimens the median line is distinct and angulated, and in some examples it is very prominent. Occasionally it is traceable only with some difficulty, and in that case the species may be separated from *xyliniformis*, which it resembles, by its larger size, more strigate appearance, by the strongly dentate transverse posterior line, and by the basal black streak. The legs are long and stout, the anterior femur of the male dilated toward base; the tibia unusually stout, with the epiphysis attached above the middle and reaching to the tip. The tarsi are complete, short, and stout. The harpes of the male are a little oblique at tip, quite evenly rounded. The lower, beak-like process of the clasper is very stout and rather short; the upper, hook-like process is quite long, stout, and moderately curved. The species has not been found except in Texas thus far, and does not seem to be a common form there.

ACRONYCTA XYLINIFORMIS Guenée.

(Plates IV, figs. 5, 10, 12, 15, adults; VIII, fig. 35, larva; XV, figs. 14, 20, head; XVIII, fig. 14, leg; XXII, fig. 19, male genitalia.)

Acronycta xylinoides GUENÉE, Spec. Gen., Noct., 1852, I, p. 56.—GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 81, note 11.

Acronycta xyliniformis GUENÉE, Spec. Gen., Noct., 1852, III, p. 400.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 60.

Apatela xyliniformis DIMMOCK, Psyche, 1885, IV, p. 274.

Arctomyseis xyliniformis GROTE, Mitth. a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Acronycta longa GUENÉE, Spec. Gen., Noct., 1852, I, p. 54.—BETHUNE, Can. Ent., 1869, I, p. 71.—BUTLER, Ent. Amer., 1887, III, p. 36 = *brumosa* Guenée.

Apatela spinigera † GROTE, in lists and coll.—THAXTER, Psyche, 1878, II, p. 121.—GROTE, Bull. U. S. Geol. Surv., 1883, VI, p. 572.—DIMMOCK, Psyche, 1885, IV, p. 274, larva.

Apatela pallidicoma GROTE, Bull. U. S. Geol. Surv., 1878, IV, p. 169.

Phaertra pallidicoma GROTE, Mitth. a. d. Roem. Mus., Hildesh., No. 3, 1896, p. 7.

Ground color ashen gray, more or less black powdered. Head and thorax without definite markings, though the patagiae are sometimes a little dusky. Primaries with the markings fairly well defined. Basal line obscurely marked on the costa, and in most cases wanting. Transverse anterior line geminate, a little oblique, strongly outcurved between the veins, smoky, rarely entirely complete, and more frequently marked only by an oblique costal dash, everything below that being barely indicated or entirely wanting. The median shade is marked by an oblique streak from the costa to the reniform, and is sometimes traceable as a smoky shading obliquely inward from that point; as a rule, however, it is not traceable. The transverse posterior line is obsoletely geminate, the inner line very faintly marked, the intervening space whitish, the outer line black, lunulate, and a little dentate on the veins. Beyond this the subterminal space is somewhat darker, and occasionally relieves a vague shading that may be looked upon as a pale subterminal line. There is a series of black dots, beyond which the fringes are cut with black, and from which smoky or blackish shadings sometimes extend inwardly. There is no black longitudinal line or streak at base, though sometimes a few black scales indicate such a mark. There is a distinct dagger mark crossing the transverse posterior line in the submedian interspace. The ordinary spots are fairly well defined; the orbicular small, round, with a dusky center or entirely dusky; reniform large, incompletely outlined, smoky or blackish, kidney shaped. Secondaries white in the male, more or less smoky in the female. Beneath white or smoky, powdery, with a more or less obvious discal spot, which is often wanting, and sometimes with a trace of an outer line.

Expanse, 1.40 to 1.80 inches (35 to 45 mm.).

Habitat.—Canada to Florida, west to the Rocky Mountains; Florida in March; Texas in March and August; central New York in July; central Illinois in July; Washington, District of Columbia, May and July.

This is an exceedingly variable species in size, ground color, and in the distinctness of the markings. It has received several names, Guenée describing it twice, for I have no doubt, from the description, that *longa* was indicated for a form of this species. Mr. Grote has named one form *pallidicoma*, and has identified another as *spinigera* in collections. All these forms are referable to one variable type, which is rather easily identified by the fact that there is no distinct basal streak. This associates it with the narrow-winged forms like *oblinita* and *lan-*

ceolaria, neither of which it resembles enough to be mistaken. It seemed at first as if two species might be separated out; but I was absolutely unable to find any characters that were at all permanent. The head is distinct; the front a little convex, but hardly bulging; the palpi distinct, scarcely reaching the middle of the front. The anterior legs of the male are rather slender and graceful, the femur only a little thickened, the tibia well developed, the epiphysis inserted above the middle and reaching nearly to the tip. The tarsi are rather long. The harpes of the male narrow rather abruptly. The clasper is distinct, the inferior process very short and abruptly pointed, the upper long, rather stout, usually obtuse at tip, and a little curved.

LARVA.

RILEY, Fifth Rept. Ins. Mo., 1873 (*xyliniformis*).—THAXTER, *Psyche*, 1878, II, p. 121 (*spinigera*); Papilio, 1883, III, p. 17.

Stage II.—Head bilobed, shining whitish, with brown shades below the apices of the lobes; width, 0.5 mm. Body whitish, heavily shaded with dark brown in a subdorsal (I) and lateral (III) bands which join on joints 5, 8-9, and 12. Warts large, concolorous, with large bunches of stiff brownish hairs. Skin smooth.

Stage III.—Head as before; width, 0.6 mm. Body more heavily banded with brown, which is darker and blackish, leaving contrasting pale areas around wart II on joints 6, 7, 10, and 11; venter pale. Hair abundant, stiff, blackish.

Stage IV.—Head blackish, a paler spot below the apex of each lobe and on the side pieces of the clypeus, and over eye; width, 1 mm. Body as before, the dark marks more spreading and mottled. In pale examples the body is gray, finely blackish peppered, on a whitish ground, the white spaces of previous stage nearly obscured. Hair bristly, short, blackish, and whitish, a few long ones at the extremities.

Stage V.—Head brownish, with the side pieces of clypeus, a patch below apex of each lobe, and an irregular patch over the eye pale; width, 1.4 mm. Body gray, mottled, the warts black; faint paler marks around wart II on the central segments. Hair black and white, stiff.

Stage VI.—Head brownish black, paler on the sides and below the tops of the lobes, side pieces of clypeus whitish, forming an inverted V mark; width, 2.3 mm to 2.5 mm. Body gray, mottled, a darker dorsal shade; a series of whitish patches over warts I and II on joints 6 to 11. Warts dark, except in the pale patches; hair bristly, with sharp points, except the few long ones at the ends of the body and a few fine short hairs from warts I to III on joints 6 to 12, which are smooth, not barbed.

Stage VII.—Head black, with pale V mark and labrum, or dull reddish shaded with brown, the V mark yellowish; width, 3.5 mm. Body varies from blackish to gray, finely strigose and peppered, a dorsal

darker shade, faintly broken into segmentary furcate patches. A broad diffuse, red substigmatal band, most distinct in the paler form. Warts nearly in line transversely, IV nearly obsolete, yellowish, a more or less distinct yellowish patch covering warts I and II on joints 6 to 12. Hairs stiff and spiny, sharp pointed, with a few long, slender, black ones at the extremities. The spines are pale with black tip, a few black, and, in the darker forms, those on joints 3 to 5 are deep red at the base. From warts I to III on joints 6 to 10 are small tufts of dense, fluffy, barbed, conspicuous, white hairs, but variable, in some examples being so few as to be not noticeable at once.

Pupa.—Posterior abdominal segments, rapidly tapering; coarsely roughened with irregular dark points, the posterior margins of the segments smooth, raised, hoop-like. Thorax finely wrinkled, but comparatively smooth. Cremaster a slight tapering prolongation, shallowly furcate, granular at the apex, with two short, stout, thick, conical spurs, one above the other, at the apex of each furcation. Length, 17 mm.

Food plants.—Birch, blackberry.

ACRONYCTA OBLINITA Smith and Abbot.

(Plates IV, figs. 6, 13, 14, adults; VIII, figs. 29, 30, larva; XIV, figs. 4, 10, body; XVIII, fig. 13, leg; XXII, fig. 20, male genitalia.)

Phalaena oblinita SMITH and ABBOT, Ins. Ga., 1797, II, p. 187, pl. XCIV.

Acronycta oblinita GUENÉE, Spec. Gen., Noct., 1852, I, p. 49.—WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 58.

Eulonche oblinita GROTE, Papilio, 1883, III, p. 113; List N. A. Eupterotidae, etc., 1897, p. 15.

Apatele oblinita FERNALD, Stand. Nat. Hist., 1885, II, p. 452.—PACKARD, Forest Insects, 1890, p. 567, fig. 191.

Acronycta salicis HARRIS, Ent. Corresp., 1869, p. 314, fig. 44.

Ground color a very pale gray, almost white. Head and thorax without perceptible markings; but always more or less black powdered. Primaries powdery, with the markings all traceable; but tending to become strigate. Basal line geminate, powdery, marked on the costa only. Transverse anterior line geminate, very poorly defined, with very strong outcurves in the interspaces. The median line is marked by an oblique shade from the costa to the center of the reniform. The transverse posterior line is lunulate, strongly dentate on the veins, blackish, with whitish included shades, so that in some specimens the line seems to be white or nearly so, when the black lunules are not so well marked. There is a series of prominent black terminal dots. In some specimens there is a feebly marked black basal streak; but this is never complete, and is more usually wanting. There are no dagger marks. The ordinary spots are very obscure and scarcely defined. The orbicular is oval, ringed with black scales and of the ground color. The reniform is moderate in size, dusky, incompletely outlined, but marked with black spots. Secondaries white, in both sexes without markings except a broken terminal line. Beneath white, powdery,

usually without trace of outer line or discal spot. There is a tendency, however, to a discal spot in the secondaries, and to a less marked extent on the primaries also.

Expanse, 1.60 to 2 inches (40 to 50 mm.).

Habitat.—Nova Scotia to Florida, west to the Rocky Mountains; May to August, in the more northern range; March to July, Washington, District of Columbia; Riley County, Kansas, in May.

This is perhaps the most common of the species of this genus, and the early stages have been described again and again in economic publications. There is very little variation. The specimens may be somewhat paler or somewhat darker, depending upon the amount of black powdering; but it can be scarcely mistaken for anything else, because of the narrow, sublanceolate primaries with the strigate maculations, and the pure white secondaries. The head is retracted, small in size, while the tongue is decidedly weaker than usual in the genus. The palpi are short, and scarcely reach to the front in most of the specimens. The anterior leg of the male is proportionately developed. The tibia is stout, long in proportion to the femur, with the epiphysis small and attached above the middle. The harpes of the male are rather broad, but taper to a rather abrupt point. The clasper consists of a single, long corneous process, pointed at the tip and a little curved. The lower part of the process is very feebly marked, and is indeed practically absent. The structure thus resembles that of the *americana* group, but for the fact that this starts from an oblique chitinous ridge, and from nearly the middle of the harpes, instead of starting directly from the membrane of the side piece near the lower margin. Strictly speaking, *oblinita* shows several interesting points of difference, and stands almost midway between the normal species belonging to group *auricoma* and *Arsilonche*. If the insect is to be removed from *Aeronycta* it should find a place in the latter genus; but taking all considerations together, I think it is best left where it is; for the present at least.

LARVA.

SMITH and ABBOT, Lep. Ins. Ga., 1797, II, pl. xciv.—GUENÉE, Spec. Gen., Noct., 1852, I, p. 49.—HARRIS, Ent. Corr., 1869, p. 314, fig. 44 (*salicis*).—PACKARD, Guide Stud. Ins., 1869, p. 304.—RILEY, Amer. Ent., 1871, II, p. 341, fig. 210; Third Mo. Rept., 1871, p. 70, figs. 29, 30.—SAUNDERS, Can. Ent., 1871, III, p. 226, fig.—GENTRY, Proc. Ac. Nat. Sci., Phila., 1875, p. 24.—GOODELL, Can. Ent., 1878, X, p. 66.—MARTEN, Tr. Dept. Agr., Ill., 1880, p. 18, 131.—GROTE, Papilio II, p. 99.—SAUNDERS, Ins. Inj. Fruits, 1883, p. 325, fig. 337.—PACKARD, Fifth Rept., U. S. Ent. Comm., 1890, p. 567.

Stage II.—Head black or brownish black; width, 0.5 mm. Body whitish, with a diffuse brown-black shade subdorsally and laterally, heaviest on joints 5, 8-9, and 12, leaving little white patches on the other segments. Venter shaded with brown. Hairs numerous, stiff, dusky black.

Stage III.—Head black; width, 0.7 mm. Body as before, but the

brown shading is more extensive, covering the body except subdorsally on 6, 7, 10, and 11 in ring spots around warts II, in little streaks in the incisures and subventrally in a broad band which is narrowed at wart V and forms a series of intersegmental lunate patches. These marks are white. Hair black and white, spiny.

Stage IV.—Head black, labrum pale; width, 1 mm. Body brown-black, slightly mottled with whitish, the subdorsal patches nearly absent, but the substigmatal band distinct as before. Hair mostly whitish, only a few dusky, stiff, bristly.

Stage V.—Head black; width 1.3 mm. Body as before.

Stage VI.—Head, 2.4 mm. Body brown-black, a little speckled with white, especially subdorsally; a broad substigmatal band of intersegmental lunate spots white. Warts black.

Stage VII.—Head scarcely bilobed, black; width, 3.7 mm. Body velvety black, mottled with yellow dots, which segregate into a series of irregularly shaped patches subdorsally on the posterior part of the segments and in the incisures. A broad, yellow stigmatal band, deeply incised at the spiracles and narrowly cut by wart V into a series of lunate patches on joints 2 to 12. Spiracles white. Warts black; hair short, bristly, a few long ones at the extremities and a very few fine short feathery hairs from warts I to III on joints 5 to 10. These feathery hairs may be absent and are never conspicuous. From this more generalized form there is a wide variation; the warts may be deep red, or situated in a series of broad, transverse red bands, reaching across to the spiracles on each segment. The yellow marks may be very much increased, the substigmatal band broadened and continuous, the subdorsal spots forming a continuous mottled stripe.

Cocoon.—Spun tightly among leaves; composed of silk.

Pupa.—Cylindrical, terminal abdominal segments rapidly tapering. Segments coarsely tubercular granular, except the smooth, raised posterior margin. Cases shagreened and grooved, nearly smooth. Color brown, not blackish. Cremaster flattened, broad, concave below, slightly tubercular, with a more distinct tubercle or short spine on each outer corner. Tuft of spines rather narrow, but fine; sparse, as if partly absent, not concealing the end of the cremaster.

Food plants.—Buttonbush, willow, alder, strawberry, raspberry, etc.

ACRONYCTA LANCEOLARIA Grote.

Apatela lanceolaria GROTE, Proc. Ac. Nat. Sci. Phila., 1875, p. 418.

Eulonche lanceolaria GROTE, Ill. Essay, 1882, p. 50, pl. 1, fig. 7; *Papilio*, 1883, III, p. 113.

Ground color white or nearly so, very densely powdered with black, so that the insect obtains a bluish gray appearance. Head and thorax without distinct markings, but with a tendency to a dusky line on the patagiae. Primaries with all the markings obscured. The basal and transverse anterior lines are very feebly marked on the costa and sometimes entirely wanting. There is a bare indication of the median shade

line in the shape of an oblique dusky streak on the costa. The transverse posterior line is fairly well indicated. It is single, blackish, a little lunulate, almost continuous, and is preceded by a pale shading. There is a vague blackish streak extending inward from the outer margin through the transverse posterior line in the submedian interspace. An oblique dusky shading begins opposite the cell and extends to just below the apex. This shading is made up principally of blackish streakings in the interspaces, which are longest between veins 3 and 4 and 4 and 5, and become rapidly shorter above. The orbicular is very faintly discernible as an undefined whitish mark. The reniform consists of an imperfect blackish lunule, a little marked by a paler shade. The secondaries are white. Beneath white, black powdered, without markings in the specimens before me.

Expanse, 1.80 to 2 inches (45 to 50 mm.).

Habitat.—Massachusetts, May, June, and August.

This insect can not be mistaken for anything else. The long, narrow, pointed wings, in which all the markings are washed out, are unmistakable. As compared with *oblinita*, its nearest ally, it is yet longer winged, as a whole larger in size, the ordinary markings almost entirely washed out, and only the transverse posterior line at all evident. Another point of interest is the absence of the terminal dots, which in *oblinita* are very prominent. Three specimens only are under examination, and all of these are, unfortunately, females. The head is retracted; the tongue often softer than in *oblinita*. The palpi are very small and weak, hardly reaching to the front.

LARVA.

Stage V.—"Head medium, smooth, flattened, greenish yellow, front black; two yellow lines above the clypeus, following its outline, meeting at the apex; a faint, horizontal, yellow mark below the clypeus. General color of upper surface pale yellowish green, stigmatal line yellow and raised. A tuft of diverging yellow hairs arises from each tubercle. Spiracles small, brown, oval. Under surface pale green, thickly mottled with brown. Feet black; legs pale green with a few white hairs. Length, 22 mm." (A. H. Kirkland, manuscript.)

Stage VI.—[Green] "Dorsal line black. Tubercles light green. Only white hairs found on the stigmatal row of tubercles. Feet and outside of prolegs black. The hairs on the sides of the body are longer than those elsewhere. Spiracles large, oval, surrounded by black. Length, 25 mm." (A. H. Kirkland.) Width of head, 3.6 mm.

Cocoon.—Spun between leaves, composed of tough, nearly white silk, rather thin but opaque. Shape, elongate elliptical, single.

Pupa.—Cylindrical, of nearly even width to the end of the movable segments, then rather sharply tapering. Thorax and cases wrinkly; dorsal abdominal segments with coarse, erect, blunt spine-like granules, except on a narrow, posterior, smooth, raised rim on each segment;

venter smoother, the segments hardly wrinkled, but with some fine punctures; posterior rim faint. Cremaster broad but short, hollowed below and grooved above, with a few deep coarse punctures before tip; a terminal bunch of numerous short bristles. Dark mahogany brown, not blackish. Length, 19.5; width, 6.5 mm.

Food Plants.—Willow, *Comptonia*, *Gaillardia*.

ACRONYCTA INSOLITA Grote.

Acronycta insolita GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 82.

Eulonche insolita GROTE, Papilio, 1883, III, p. 113.

"Resembles *A. obliterata* in the lanceolate primary wings, which are even longer and more produced apically. Blackish; orbits of the eyes white. Primaries uniformly blackish, the dark tone obscuring all ornamentation except the transverse posterior and subterminal lines, which are oblique and appear as rather broad interspaceal lunulated or squared gray marks, which, in the as usual flexed transverse posterior line are marked by black outward points, the fragments of the transverse terminal line itself, the gray marks being the preceding shade. Hind wings white beneath, with the costal region dusted with blackish scales. Palpi with the second joint outwardly black; fore tibiae with blackish longer hair. Abdomen whitish above, darker beneath, rather long. The unusually dark color and pointed wings, together with the peculiar appearance of the transverse lines, should make this species very recognizable. This last section of the genus reminds us of *Leucania*. My specimen of *A. insolita* expands 1.60 inches. Coll. Am. Ent. Soc."

This species is credited to "Pennsylvania" and later to the "Middle States." I marked it in my catalogue as in the British Museum, but have no notes nor remembrance of the insect. I have seen nothing in any collection accessible to me of any form agreeing with the above description; the only one of the genus with which I am not personally acquainted.

ACRONYCTA DENTATA Grote.

(Plate XIII, fig. 11, female adult.)

Apatela dentata GROTE, Can. Ent., 1875, VII, p. 222.

Male.—"This is allied to *tritona* and *grisca*, but is a smaller species wanting all the black dashes. The ground color is blackish shaded over with whitish. The lines black, single, denticulate. The claviform is indicated by a slight black mark. Orbicular obsolete. Reniform whitish, rounded, with its outer edge black-lined and shaded. Transverse anterior line running in a little on median vein. Transverse posterior line inaugurated a little above the reniform, running well outwardly, denticulate throughout its length. Subterminal line hardly apparent; a blackish shade over median nervules on the gray terminal space. Fringes gray, preceded by blackish interspaceal markings. Hind wings fuscous, lighter toward the base, with indistinct line.

Beneath much paler, irrorate, without discal marks and with a common shaded line. Expanse, 32 mm. Quebec. Mr. Bowles."

The above is Mr. Grote's description and fairly characterizes the species. It is also credited generally to the "Eastern and Northern States," and I have it from the Adirondack Mountains in July. I have also seen a specimen from northern New Hampshire, but the creature is apparently rare.

ACRONYCTA PYRALIS Smith.

(Plate XIII, fig. 12, male adult.)

Acronycta pyralis SMITH, Ent. News, 1895, VI, pl. xv, fig. 1; Ent. News, 1896, VII, p. 26.

Ground color a very dark powdery gray; head and thorax without distinct markings, but the tip of the collar grayish and the patagiae indefinitely black margined. The primaries have all the ordinary maculation evident, but not sharply defined. Basal line single, black, and marked on the costa only. Transverse anterior line nearly upright, outcurved between the veins, black, preceded by a few pale scales. Transverse posterior line widely outcurved over the cell and a little incurved below, usually remote from the center of the wing; black in color, lunate between the veins and followed by a paler gray shade. Subterminal line obscure, and marked only by an irregular and incomplete preceding dark shade. There is a series of blackish terminal lunules and a very evident, blackish, somewhat diffuse shade across the median space close to and parallel with the transverse posterior line, somewhat obscuring the reniform. Orbicular large, oval, obscurely defined by black scales, with or without a dark central spot. Reniform broad, upright, a little incurved; outwardly a little paler than the ground color, but inferiorly obscured by the median shade. Secondaries smoky, with an indefinite extra-median line and pale fringes. Beneath, smoky and powdery; both wings with an outer line.

Expanse, 1.24 to 1.36 inches (31 to 34 mm.).

Habitat.—Calgary, July 13.

Two specimens, both females, were sent me by Mr. Dod under the number 31, and this is said to represent his stock. The species is the darkest of all those known to me, resembling *lithospila* in this respect, but quite different in markings.

This species is allied to *dentata* with which it is congeneric. It can not remain in *Acronycta*; but I am at a loss to place it as yet, and prefer to leave it here for the present.

ARSILONCHE Lederer.

Arsilonche LEDERER, Noctuiden Europas, 1857, p. 70.

Moderately stout species, with fine hairy vestiture, rather narrow, somewhat pointed primaries which bear no trace of transverse maculation.

Head moderate in size, distinct but not prominent, more retracted in the female, front convex but not prominent. Eyes full, well separated, naked and without lashes. Ocelli distinct. Antennae simple in both sexes, but a little thicker and with the joints somewhat marked in the male. Palpi rather feebly developed, yet reaching well to the front, though not to its middle in the female. Tongue weak, not useful for feeding.

Thorax stout, convex, clothed with long, fine hair, which forms no tufts, and in well-preserved specimens scarcely outlines the collar and patagiae. Legs of the usual noctuid type, well developed, unarmed except for the usual tibial spurs.

Abdomen conic, in both sexes exceeding the anal angle of the secondaries, clothed with fine hair which forms no tufts.

Primaries narrow, moderate in length, the outer margin oblique, apex somewhat pointed. In venation normally noctuidous. Secondaries trigonate, proportionate, vein 5 weak and from the cross-vein well removed from 4.

This genus differs from *Acronyeta* only in the weak tongue and fine hairy vestiture, characters in which *oblivita* and *lanceolaria* are only a little less distinguished.

There is, however, an entire absence of the usual *Acronyctid* appearance and maculation, which must be given some weight, and the superficial resemblance to *Leucania* is so great that the species has been twice redescribed in that genus.

In sexual characters the species agrees with the *auricoma* group of *Acronyeta*.

Our only species, which is the same as the European, is:

ARSILONCHE ALBOVENOSA Goeze.

(Plates X, fig. 7, female adult; XVII, fig. 2, legs; XXII, fig. 21, male genitalia.)

Noctua albovenosa GOEZE, Ent. Beitr., 1781, III, 3, p. 251.

Arsilonche albovenosa MORRISON, Proc. Ac. Nat. Sci., Phila., 1875, p. 428.—HARVEY, Can. Ent., 1876, VIII, p. 35.—GROTE, Can. Ent., 1883, XV, p. 30.

Leucania henrici GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 10.

Ablepharon henrici GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 112, pl. I, fig. 15.—MORRISON, Proc. Ac. Nat. Sci., Phila., 1875, p. 428, pr. syn.—GROTE, Can. Ent., 1883, XV, p. 30, an sp. dist. pr.

Leucania evanidum GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 10.

Ablepharon evanidum GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 112, pl. I, fig. 16.—MORRISON, Proc. Ac. Nat. Sci., Phila., 1875, p. 428, pr. syn.

Ablepharon fumosum MORRISON, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 275.

Arsilonche fumosum MORRISON, Proc. Ac. Nat. Sci., Phila., 1875, p. 428.

Ground color a very pale luteous gray, fading to almost white. Thorax with disk and patagiae more or less shaded with luteous or gray. Primaries with all the veins whitish, often margined with slate gray, the intervening space of the ground color. A more prominent slate-gray streak runs through the submedian interspace from the base, where it is

most distinct, to the outer margin, where it is almost faded out to the ground color. A second streak starts narrowly in the median cell and widens outwardly, becoming somewhat diffuse before the outer margin. At the apex the space between the veins is also darker, slate gray. The fringes and all the margins are white or nearly so. There is no transverse maculation and no trace of the ordinary spots; but in well-preserved specimens there is a series of small, slate-gray, interspaceal dots. Secondaries white, sometimes a trifle soiled toward the outer margin, where there is sometimes a faint dusky shade at the base of the fringes. Beneath white, the disk of primaries sometimes a little smoky, sometimes the costal region of both wings yellowish.

Expanse, 1.35 to 1.70 inches (34 to 42 mm.).

Habitat.—British America and United States generally; Canada, May and June; Massachusetts, in April; central New York, in June and July; Kansas and California, in January.

This widely distributed species is easily recognizable by its strigate, gray maculation on a whitish ground, resembling the species of *Leucania* in this particular. The variation is almost entirely due to the condition of the insect and its relative freshness. In recent specimens all the described streakings are fully marked and we have the typical *albovenosa*; after they have become a little faded by flight the gray changes to a luteous and we have *evanidum*.

Mr. Morrison's *fumosum* is an abnormally dark form in which almost the entire insect becomes slate gray. It is perhaps a question whether the name should be retained, but as it is not strictly a synonym I list it as an aberration, as which it has been already recognized.

The harpes of the male are oblong, a little rounded at tip, at the lower angle of which are a couple of little pegs. The clasper is a long, slender, curved hook resting on an oblique chitinous base which is inferiorly continuous with the clasper.

This species is not rare.

LARVA.

THAXTER, *Psyche*, 1877, I, p. 188.—COQUILLET, *Can. Ent.*, 1880, XII, p. 45.—

HENRY EDWARDS, *Ent. Amer.*, 1888, III, p. 171.—SNYDER, *Ent. News*, 1894, V, p. 277.

Stage IV.—Head bilobed, shining black, translucent whitish mottlings at the side, a patch at vertex of each lobe and a broken inverted V-mark bordering the clypeus; width, 1.2 mm. Body a little flattened. Warts large, black, with rather short bristly black hairs mixed with pale; warts nearly in line transversely. A black dorsal shade band filling in between the warts on joints 5 to 12; a mottled, transversely streaked lateral band and traces of brown subventrally. Cervical shield and anal plate black.

Stage V.—Head as before, but the white spaces smaller; width, 1.8 mm. Body largely mottled and streaked with black, a pale subdorsal line;

orange red blotches between the warts subdorsally and substigmatally. Hair short, stiff, black and white.

Stage VI.—Head bilobed, black, clypeus yellowish, the black pigment spotted, leaving a number of white streaks on the sides, a streak over the apex and a clypeal V-mark; lower half of clypeus and antennae white; width, about 2.7 mm. Body black, a white subdorsal line blotched with red between warts I and II; lateral area mottled with white; a white substigmatal band, passing over wart V, with orange blotches above it on the small wart IV. Warts large, I to III and VI dark, IV and V reddish. The black dorsum is broken by little white dots close to the incisures. Hairs as before. Later the white marks become yellow.

Stage VII.—Head shining black, side pieces of clypeus white or red, forming a V mark, a white streak on vertex of each lobe and a network of confluent white lines on the sides; width, 4 mm. Body black, the warts light orange red, obscurely connected by this color. Traces of dorsal, distinct subdorsal line, broken and mottled, the whole side area thickly covered with little streaks and dots of yellow; a straight, even, narrow yellow stigmatal band, crossing the orange wart IV. Subventral area and venter heavily yellow dotted; a geminate pale medio-ventral band. Hair black and white, bristly, mixed with softer hairs which predominate subventrally. No secondary hairs.

Cocoon.—Spun tightly among leaves; composed of silk.

Pupa.—Black, except in the joinings of the parts, where it is reddish; coarsely roughened. Anal segments rapidly tapering; the segments have a distinct smooth raised posterior rim and are coarsely granular in front, the granules rounded, subconfluent. Wing cases coarsely shagreened. Cremaster a tapering continuation of the last segment, not differentiated, but bearing a thick terminal tuft of fine straight spines.

Food plants.—Grass, smartweed, willow.

MEROLONCHE Grote.

Merolonche GROTE, Ill. Essay, 1882, p. 50.

Very robust, shaggy species, with loose, divergent vestiture, retracted head, weak tongue, and shortly pectinated male antennae.

Head small, retracted, front narrow, a little conically protuberant, though this varies in the species. Eyes small, naked, without hairy lashes. Palpi small, hardly exceeding the front, clothed with rather stiff, diverging hair. Tongue weak, useless for feeding. Antennae shortly pectinated in the male, simple in the female.

Thorax well developed, robust, convex; patagiae and collar well marked, the vestiture thick, rather loose, and composed of somewhat flattened hair. No tufts are formed, but there is a bunching of the vestiture posteriorly. Legs rather short and stout, proportioned, as

usual in the Noctuids, but comparatively smaller and with shorter tarsal joints, of which that at base is somewhat enlarged, especially on the forelegs.

Abdomen robust, conic in the male and only a little exceeding the hind angle of the secondaries; much heavier and more cylindrical in the female, and quite considerably exceeding the anal angle of the secondaries. No tuftings except the usual loose bunching at the sides of the segments in the male.

Primaries rather short and narrow, trigonate, outer margin oblique, apex a little produced. Venation in both wings of the normal Noctuid type and not in any way different from *Acronyeta*.

This genus is well distinguished from its allies, not only in the general habitus but in the shortly pectinated antennae of the male. In this character it resembles *Harrisimenna*, while totally distinct in all other respects.

There are three rather unsatisfactory species, of which *spinea* and *lupini* were described by Mr. Grote, and *ursina* is here first named.

Of *spinea* I have seen the types only; of *lupini* I have had numerous specimens which, while greatly varying in certain directions, never quite reached the former type.

Spinea has a very evident angulated median shade line; the other median lines are obscured and the ordinary spots are wanting or but feebly indicated.

Lupini is a much better marked species, with the median lines and ordinary spots well developed and the median shade line obscure or at least not prominent. This is a somewhat variable quantity, however, and the sharply defined orbicular and somewhat smudgy reniform are much more constant factors. Both species are Californian.

Ursina is a smaller species, more hairy in appearance, the primaries very evenly sprinkled with white and black scales, so as to give a powdery ashy gray appearance in which all the markings are sunken, though traceable. The species is altogether slighter, especially in the female, in which the abdomen is neither so long nor so clumsy. It occurs in the mountainous regions of Colorado.

The sexual characters of the male are essentially those of group *auricoma*, the harpes oblong, somewhat acutely rounded at the tip, the clasper essentially a long, curved hook set on an oblique ridge, which may or may not form an inferior process.

In tabular form the species divide as follows:

ANALYTICAL KEY TO SPECIES OF MEROLONCHE.

- | | |
|--|-----------------|
| Median shade line distinct, angulated, forming the most prominent feature of the primaries; ordinary spots obsolete..... | <i>spinea</i> . |
| Median shade line subordinate or wanting; ordinary spots present. | |
| Less powdery; all the ordinary markings fairly evident; with a vague yellowish tinge | <i>lupini</i> . |
| Densely powdered, obscuring the ordinary markings; total impression a bluish ash gray | <i>ursina</i> . |

MEROLONCHE LUPINI Grote.

(Plates III, fig. 2, adult; X, fig. 4, female adult; XV, fig. 8, male antenna; XVII, fig. 1, legs; XXII, fig. 23, male genitalia.)

Apatela lupini GROTE, Bull. Buff. Soc. Nat. Sci., 1873, I, p. 79; Ibid., 1876, III, p. 78.
Merolonche lupini GROTE, Ill. Essay, 1882, p. 50; Papilio, 1883, III, p. 112.

General color a somewhat yellowish ashen gray. Collar and patagiae more or less black marked, but without very definite lines or bands. Primaries powdery, but rather smooth, and with all the markings well written. Basal line geminate, evident on the costa, vague below that point. Transverse anterior line geminate, the inner narrow, outwardly bent and outcurved between the veins; the outer diffuse and more evenly oblique. Transverse posterior line distinct, denticulate, a little sinuate, but as a whole parallel with the outer margin. As a rule it is continuous, but it is sometimes broken into lunules and is then preceded by a white shade. Median shade line evident in all specimens, but most distinct in the female; narrow, diffuse, irregular, obviously angulated on the median vein, and reaching the internal margin close to the outer part of the transverse anterior line. Subterminal line pale, diffuse, marked outwardly by a series of more or less connected dusky spots. A series of black terminal dots, beyond which the fringes are cut with black. Orbicular small or moderate in size, round, concolorous, outlined in blackish. Reniform moderate in size, imperfectly defined, and somewhat obscured by the median shade which crosses it and forms the inward angle just below. Secondaries smoky, with a discal lunule, and crossed by two vague dusky shades between and beyond which the wing is paler. Beneath, primaries dusky with a broad gray outer margin; secondaries gray, with a large black discal lunule and an incomplete dusky band.

Expanse, 1.50 to 1.75 inches (37 to 44 mm.).

Habitat.—Mendocino County, California.

Specimens of this species are usually in unsatisfactory condition because of their tendency to grease, and the yellowish tinge that is usual is probably not natural. The species is fairly well marked, but it is quite certain that another smaller and more powdery species which may be my *ursina* has been confused with it. The true species is quite evenly gray and scarcely "hoary." The only variation in the seven specimens before me is in the relative distinctness of the median shade line.

MEROLONCHE SPINEA Grote.

(Plate X, figs. 2, 3, male and female adults.)

Apatela spinea GROTE, Bull. Buff. Soc. Nat. Sci., 1876, III, p. 78.

Acronycta spinea HENRY EDWARDS, Pac. Coast Lep., No. 27, 1878, p. 3.

Merolonche spinea GROTE, Ill. Essay, 1882, p. 50; Papilio, 1883, III, p. 112.

Female.—"This species resembles *lupini* in structure and size, and may not be eventually considered a good species. It differs by the

transverse posterior line being narrower, more continuous, less scalloped; opposite the cell, between veins 6 and 4, it is drawn in, forming as usual a point on the intermediate vein 5. Else, while whiter, much like its ally, the submedian dash well marked, the fringes checkered. Hind wings blackish, with white fringes; tegulae black lined."

The above is Mr. Grote's original description, but none of the characters hold. Nevertheless, judging from the extremely scanty material, the species seems distinct by the absence of the ordinary spots and the prominence of the narrow, rather sharply defined median shade line. The species, if species it is, seems much less abundant than its congeners, hence it is impossible to speak of the range of variation. I have seen the types only, from which the pictures have been made by the courtesy of the officials of the American Museum of Natural History. "California," is given as the *habitat*.

MEROLONCHE URSINA, new species.

(Plates X, figs. 5, 6, male and female adults; XXII, fig. 22, male genitalia.)

Dull ashen gray, very strongly powdered with blackish hair-like scales, which give the insect a peculiar shaggy appearance. Head and thorax without obvious markings, though the patagiae seem a little dark margined and the posterior mass of thoracic vestiture is smoky. Primaries with the markings obscure, fragmentary, and not at all defined. Basal line not traceable. Transverse anterior line geminate, broken, as a whole nearly upright, with three rather even, though small, outcurves. Transverse posterior line well removed toward the outer margin, with which its course is nearly parallel and only a little sinuate, consisting of a series of black lunules preceded by a whitish shading. Subterminal line pale, consisting of a vague shading more or less marked by dusky spots in the interspaces, sometimes not at all traceable. There is a series of blackish terminal lunules, beyond which the fringe is cut with dusky. Orbicular small, round or oval, concolorous, black-ringed. Reniform small, kidney-shaped, imperfectly defined by two black lunules. Secondaries whitish, powdery, more smoky in the female. Beneath, gray, powdery, with an indefinite outer line and discal spot on all wings.

Expanse, 1.40 to 1.60 inches (35 to 40 mm.).

Habitat.—Colorado.

Several specimens of both sexes have been at hand, most of them collected by Mr. David Bruce in the mountainous districts toward Glenwood, whence Dr. William Barnes has also received it. As compared with *lupini* the species has smaller, narrower, and more pointed primaries and a larger, more quadrate thorax, with proportionately smaller abdomen. The vestiture is more divergent and more hairy, and the insect as a whole has a bluish tinge. None of the markings are evident and there is only a vague indication in some specimens of a median shade. The secondaries are also paler, and altogether the species gives quite a different impression from *lupini*. I have in the

past labeled specimens, with a query, as *spinea*, which I did not know positively until now.

I have three specimens from the Sierra Nevada Mountains in California which are probably referable to this species, but their condition is not such that I would care to say this positively. They are certainly neither *spinea* nor *lupini*, and I am not yet ready to admit another species.

HARRISIMEMNA Grote.

Harrisimemna GROTE, Trans. Am. Ent. Soc., 1873, IV, p. 293.

A somewhat slight-bodied form with long, prominently tufted abdomen, strongly tufted thorax, large trigonate wings, and a somewhat retracted head.

Head moderate in size, distinct, but not prominent, front slightly convex, but not bulging. Eyes large, narrowly separated, naked, without lashes. Ocelli distinct and not concealed. Tongue moderate, suitable for feeding, but not strong. Palpi short and weak, hardly reaching to the end of the projecting scales of the front. Antennae very shortly pectinated in the male, simple in the female.

Thorax rather small, quadrate, convex, thickly clothed with scales and scaly hair, which form an enormous bushy, posterior tuft; collar and patagiae distinct. Legs slender, short for the insect, but of normally noctuid proportion to each other. Unarmed except for the usual spurs, which are of very moderate size.

Abdomen cylindrical, much exceeding the anal angle of the secondaries in both sexes, much stouter in the female. In both sexes with a series of dorsal tufts, of which that on the fourth segment is enormously exaggerated.

Primaries trigonate, the apices somewhat drawn out in the male, rectangular in the female. In the former inner and outer margin are almost of a length, while the costa is at least one-half longer; in the latter the outer margin is distinctly shorter than the inner, and the costa is hardly one-third longer than the latter. The venation is normally noctuidous.

Secondaries proportionate, vein 5 much weaker than the others and arising from the cross vein well removed from 4, but nearer to it than to 6.

The only species thus far known is:

HARRISIMEMNA TRISIGNATA Walker.

(Plates XV, fig. 6, male antenna; XVI, fig. 6, venation; XVII, fig. 4, legs; XIX, fig. 9, male genitalia.)

Grammophora trisignata WALKER, Cat. Brit. Mus., Het., 1856, IX, p. 29.

Harrisimemna trisignata GROTE, Trans. Am. Ent. Soc., 1873, IV, p. 293; Ill. Essay, 1882, p. 49, pl. I, fig. 3.

Notodonta sexguttata HARRIS, Ent. Corresp., 1869, p. 174, figs. 24, 25.—GROTE, Trans. Am. Ent. Soc., 1873, IV, p. 293, pr. syn.

Ground color of head and primaries white, with either a creamy or bluish tinge, varying in the specimens. Palpi black marked. Head

with a broad black band above the middle, a short, narrow one below the antennae, and another somewhat broader between the feelers. Collar white at base, crossed by a broad black band, the upper portion red-brown, the edges tipped with white scales. Thorax red-brown, the edges of the patagia white tipped. Abdominal tuftings at base white, with black tips, the prominent tufts brown. Primaries white with the ornamentation black and contrasting, but a little confused by irregular black powderings, which sometimes darken the inferior portion of the median space. The most prominent features are three almost round, red-brown patches situated as follows: One near the base, filling the space between the basal and transverse anterior lines and the costa and median vein; another close to the apex, filling the space between the transverse posterior and subterminal lines, the costa, and vein 6; the third just above the hind angle extending from the transverse posterior line almost to the exterior margin and between veins 2 and 3. Basal line geminate, prominent, black, terminating in a larger black patch in the submedian interspace. Transverse anterior line geminate, almost upright, outcurved in the interspaces; the inner line well defined, the outer often diffuse and powdery. Transverse posterior line geminate, very irregularly dentate, outwardly angulate so as to form two prominent teeth on veins 3 and 4. Both lines are distinct, but the inner tends to become diffuse. There is no obvious subterminal line, but there is a series of disconnected spots and shades which may represent it. A series of black terminal lunules is preceded by narrow white crescents. Fringes white, cut with blackish. The median shade line is prominently marked on the costa, but is obscured below that point by the black powderings. Orbicular moderate, round, concolorous, black-ringed and with a black center. Reniform large, kidney-shaped, black-ringed, with a dusky central lunule. Secondaries in the male white, with blackish apical powderings and a series of smoky terminal lunules; in the female deep smoky brown with contrasting white fringes. Beneath, whitish in the male, apices of both wings smoky and both with an imperfect extra discal dark line; in the female, primaries smoky, with contrasting white fringes which are cut with brown; secondaries whitish with two smoky transverse lines, a broad smoky margin, and a dark discal lunule.

Expanse, 1.20 to 1.55 inches (30 to 35 mm.).

Habitat.—Canada to Texas, west to Wisconsin and Missouri; Canada in July; Massachusetts in June; Long Island, New York, in July.

This is one of the most distinct of the North American noctuids and certainly by all odds the most aberrant and striking of those here treated. The three round brown patches on each wing give the insect an absolutely unique appearance. The only observable variation is in the amount of the black powdering.

LARVA.

MELSHEIMER, Harris's Corresp., 1869, p. 114.—HARRIS, Ent. Corr., 1869, p. 174, fig. 25.—PACKARD, Guide, 1869, p. 304.—GOODHUE, Can. Ent., 1886, XVIII, p. 58.—DYAR, Ent. News, 1895, VI, p. 340.

Stage V.—Width of head, 1.7 mm.; shaped as in the next stage.

Stage VI.—Width of head, 2.2 mm. Slightly bilobed, clypeus very high, a long conical tubercle before the apex of each lobe, pointing obliquely forward, bearing the upper epicranial seta on its upper aspect before the tip; setae short, stiff.

Stage VII.—Head slightly bilobed, higher than wide, smooth and rounded, no tubercles; width, 3.3 mm. Black with a reddish shade in the sutures, shining. Body compressed, higher than wide; feet, especially the abdominal, very long. Joints 5–7 slender and arched, 12 very strongly humped, tubercles I and II in an elevated square, the lower part of the segment small, so that joint 13 with the anal feet is placed nearly directly beneath it. Tubercles large, chitinous on the humped parts, elsewhere small, reduced to single setae, except VI, which bears many, and II on thorax, which bears two, setae. Hair stiff, long, especially on the humped parts, white. Cervical shield attached to the head by a firm membrane, the anterior dorsal pair of hairs being attached at the tip to the labrum of the head case of the preceding stage, forming a string of cast heads. Color black, shading into red-brown on the anterior side on the hump on joint 12 and thoracic feet. Sides of joints 7 to 10 streaked and washed with whitish flesh-color, joining over the back centrally. The larvae are solitary, wagging the string of cast heads from side to side when disturbed.

Cocoon.—A hole of the diameter of the body of the larva bored in wood "one-fourth inch horizontally, then down about 2 inches like a woodpecker's hole in miniature, the opening covered with thin parchment-like silk very near the color of the bark. The chips are wadded up into balls about the size of B shot" (Goodhue).

Food plants.—Winterberry, lilac.

LIST OF THE GENERA AND SPECIES.

PANTHEINAE.

PANTHEA Hübner.

1. *furcilla* Packard.
 2. *gigantea* French.
 3. *portlandia* Grote.
 4. *acronyctoides* Walker.
- leucomelana* Morrison.

DEMAS Stephens.

1. *propinquilinea* Grote.

DEMAS Stephens—Continued.

2. *flavicornis* Smith.
3. *palata* Grote.

CHARADRA Walker.

1. *deridens* Guenée.
- circulifera* Walker.
- contigua* Walker.
2. *dispulsa* Morrison.
3. *decora* Morrison.

ACRONYCTINI.

ACRONYCTA Ochsenheimer.

Group AMERICANA.

1. rubricoma Guenée.
2. americana Harris.
aceris † Smith and Abbot.
acericola Guenée.
hastulifera † larva Guenée.
obscura Henry Edwards.
3. hastulifera Smith and Abbot.
acericola † larva Guenée.
4. hesperida Smith.
5. daetylina Grote.
6. felina Grote.
7. frigida Smith.
lepusculina † Edwards.
felina † French.
8. pacifica Smith.
9. insita Walker.
var. canadensis Smith.
10. cretata Smith.
11. leporina Linnaeus.
vulpina Grote.
sancta Henry Edwards.
12. populi Riley.
13. lepusculina Guenée.
14. cinderella Smith.
15. transversata Smith.
16. tota Grote.

Group LOBELIAE.

17. innotata Guenée.
gracii Grote.
18. betulae Riley.
19. morula Grote and Robinson.
ulmi Harris.
20. occidentalis Grote and Robinson.
psi † Guenée.
interrupta Guenée.
21. laetifica Smith.
22. lobeliae Guenée.
23. fureifera Guenée.
24. hasta Guenée.
telum Guenée.
25. manitoba Smith.
26. thoracica Grote.
27. strigulata Smith.
28. radeliffei Harvey.
29. quadrata Grote.
30. spinigera Guenée.
harveyana Grote.
31. pruni Harris.
clarescens † Grote.

Group LOBELIAE—Continued.

32. brumosa Guenée.
impleta Walker.
subochrea Grote.
33. superans Guenée.
34. lithospila Grote.
35. tritona Hübner.
36. connecta Guenée.
37. funeralis Grote and Robinson.
americana † Harris.
38. fragilis Guenée.
spectans Walker.
39. minella Dyar.
40. paupercula Grote.
41. viunula Grote.
42. revellata Smith.
43. grisea Walker.
pudorata Morrison.
44. mansueta Smith.
45. faleula Grote.
46. parallela Grote.

Group PERSUASA.

47. afflicta Grote.
48. persuasa Harvey.
49. liturata Smith.
50. marmorata Smith.

Group HAMAMELIS.

51. albarufa Grote.
walkeri Andrews.
52. ovata Grote.
53. modica Walker.
exilis Grote.
54. clarescens Guenée.
haesitata Grote.
55. hamamelis Guenée.
56. increta Morrison.
57. retardata Walker.
dissecta Grote and Robinson.

Group AURICOMA.

58. illita Smith.
59. luteicoma Grote and Robinson.
60. sperata Grote.
61. noctivaga Grote.
longa † Walker.
62. emaculata Smith.
63. impressa Walker.
fasciata Walker.
brumosa † Grote.
verillii Grote and Robinson.

ACRONYCTINI—Continued.

ACRONYCTA Ochsenheimer—Continued.

Group AURICOMA—Continued.

64. *distans* Grote.
65. *barnesi* Smith.
66. *perdita* Grote.
67. *edolata* Grote.
68. *extricata* Grote.
69. *xyliniformis* Guenée.
longa Guenée.
spinigera †Grote.
pallidicoma Grote.
70. *oblinita* Smith and Abbot.
salicis Harris.
71. *lanceolaria* Grote.
72. *insolita* Grote.
73. *dentata* Grote.
74. *pyralis* Smith.

ARSILONCHE Lederer.

1. *albovenosa* Goetze.
henrici Grote.
evanidum Grote.
ab. fumosum Morrison.

MEROLONCHE Grote.

1. *spinea* Grote.
2. *lupini* Grote.
3. *ursina* Smith.

HARRISIMEMNA Grote.

1. *tresignata* Walker.
sexguttata Harris.

EXPLANATION OF PLATES.

PLATE I.

Illustrations of species of *Acronycta*:

- Fig. 1. *Acronycta lepusculina* Guenée.
 2. *Acronycta americana* Harris.
 3. *Acronycta dactylina* Grote.
 4. *Acronycta rubricoma* Guenée.
 5. *Acronycta luteicoma* Grote and Robinson.
 6. *Acronycta superans* Guenée.
 11. *Acronycta noctivaga* Grote.
 12. *Acronycta impressa* Walker.
 13. *Acronycta lithospila* Grote.
 14. *Acronycta hasta* Guenée.
 15. *Acronycta afflicta* Grote.

The numbers 7 to 10, inclusive, are wanting on the plate. Fig. 14 is hardly characteristic and represents an abnormal type.

This and the plates following, to and including Plate VII, were prepared for the U. S. Department of Agriculture as stated in the Introduction.

PLATE II.

Illustrations of species of *Acronycta*:

- Fig. 1. *Acronycta hamamelis* Guenée; normal type.
 2. *Acronycta hamamelis* Guenée; suffused form.
 3. *Acronycta hamamelis* Guenée; pale form.
 4. *Acronycta modica* Walker.
 5. *Acronycta retardata* Walker.
 6. *Acronycta sperata* Grote.
 7. *Acronycta psi* Linnaeus (European).
 8. *Acronycta occidentalis* Grote and Robinson.

Fig. 9. *Acronyeta tritona* Hübner.

10. *Acronyeta morula* Grote and Robinson.

11. *Acronyeta lobeliae* Guenée.

12. *Acronyeta hastulifera* Smith and Abbot; female.

13. *Acronyeta furcifera* Guenée; male.

14. *Acronyeta furcifera* Guenée; female.

15. *Acronyeta furcifera* Guenée; female.

16. *Acronyeta connecta* Grote.

17. *Acronyeta innotata* Guenée; normal.

18. *Acronyeta innotata* Guenée; rare form.

19. *Acronyeta betulae* Riley.

Fig. 14 represents an unusually small pale form; fig. 15 is nearer the usual type.

PLATE III.

Illustrations of species of *Acronyeta* and *Merolonche*:

Fig. 1. *Acronyeta quadrata* Grote.

2. *Merolonche lupini* Grote.

3. *Acronyeta clarescens* Guenée.

4. *Acronyeta grisea* Walker.

5. *Acronyeta hastulifera* Smith and Abbott; male.

6. *Acronyeta perdita* Grote.

7. *Acronyeta funeralis* Grote and Robinson.

8. *Acronyeta thoracica* Grote.

9. *Acronyeta parallela* Grote.

10. *Acronyeta albarufa* Grote.

11. *Acronyeta persuasa* Harvey.

12. *Acronyeta lactifica* Smith.

Fig. 10 is bad in all points, and reference should be had to Plate XII, fig. 9, for a more accurate figure.

PLATE IV.

Illustrations of species of *Acronyeta*:

Fig. 1. *Acronyeta edolata* Grote.

2. *Acronyeta hasta* Guenée.

3. *Acronyeta insita* Walker; male.

4. *Acronyeta pruni* Harris.

5. *Acronyeta xyliniformis* Guenée; female.

6. *Acronyeta oblonga* Smith and Abbot; male.

7. *Acronyeta ovata* Grote.

8. *Acronyeta ovata* Grote.

9. *Acronyeta modica* Walker.

10. *Acronyeta xyliniformis* Guenée; male.

11. *Acronyeta vinnula* Grote.

12. *Acronyeta xyliniformis* Guenée.

13. *Acronyeta oblonga* Smith and Abbot; female.

14. *Acronyeta oblonga* Smith and Abbot; male.

15. *Acronyeta xyliniformis* Guenée; female.

Fig. 14 represents an unusually small form, the usual size being better shown at 6. Figs. 5, 10, 12, and 15 fairly represent the variation in the species named.

PLATE V.

Larvae of *Acronyeta*:

Fig. 1. *Acronyeta afflicta*; larva above.

2. *Acronyeta afflicta*; larva in characteristic position on a leaf.

3. *Acronyeta ovata*; larva at rest on leaf.

- Fig. 4. *Acronycta betulae*; immature larva.
5. *Acronycta betulae*; full-grown larva.
6. *Acronycta modica*; larva above.
7. *Acronycta occidentalis*; larva above.
8. *Acronycta occidentalis*; larva from side.
9. *Acronycta radcliffei*; larva above; its head much enlarged at 9a.

Fig. 9 is bad in all respects, and was made from a discolored specimen stiffened by a fungus growth.

PLATE VI.

Larvae of *Acronycta*:

- Fig. 10. *Acronycta fureifera*; larva above.
11. *Acronycta radcliffei*; larva from side.
12. *Acronycta hastulifera*; larva above.
13. *Acronycta hastulifera*; larva from side.
14. *Acronycta rubricoma*; larva; green form, with yellow, almost complete, tufts.
15. *Acronycta rubricoma*; larva; yellow form with black tufts partly lost.
16. *Acronycta luteicoma*; larva above.
17. *Acronycta americana*; larva from side.

PLATE VII.

Larvae of *Acronycta*:

- Fig. 18. *Acronycta dactylina*; larva above.
19. *Acronycta dactylina*; larva from side.
20. *Acronycta morula*; larva above.
21. *Acronycta morula*; larva from side.
22. *Acronycta pruni*; larva above.
23. *Acronycta pruni*; larva from side.
24. *Acronycta lobeliae*; larva above.
25. *Acronycta populi*; larva in characteristic position on leaf.

PLATE VIII.

Larvae of *Acronycta*:

- Fig. 26. *Acronycta leporina*; larva in characteristic position on leaf.
27. *Acronycta noctivaga*; larva above.
28. *Acronycta noctivaga*; larva from side.
29. *Acronycta oblonga*; larva above; pale form with red hair.
30. *Acronycta oblonga*; larva from side; black form with pale hair.
31. *Acronycta sperata*; larva from side.
32. *Acronycta sperata*; larva above.
33. *Acronycta impressa*; larva above.
34. *Acronycta impressa*; larva from side.
35. *Acronycta xyliniformis*; larva from side and from above.
36. *Demas propinquilinea*; larva on leaf from side.
37. *Panthea furcilla*; larva from side on pine.

From figures drawn and colored by Miss L. Sullivan under the direction of Dr. C. V. Riley.

PLATE IX.

Illustrations of Pantheids:

- Fig. 1. *Panthea furcilla* Packard; female.
2. *Panthea gigantea* French; male.
3. *Panthea gigantea* French; female.
4. *Panthea portlandia* Grote; female.

- Fig. 5. *Panthea acronyctoides* Walker; male.
6. *Panthea acronyctoides* Walker; female, from an imperfect specimen.
7. *Demas propinquinella* Grote; male.
8. *Demas propinquinella* Grote; female.
9. *Demas flavicornis* Smith; male.
10. *Demas flavicornis* Smith; female.
11. *Charadra dispulsa* Morrison; male.
12. *Charadra deridens* Guenée; female.

Reproduced from slightly enlarged photographs. All of the prints from which these plates of adult insects were made have been touched up with a brush to cure imperfections and to secure somewhat stronger contrasts.

PLATE X.

Illustrations of *Acronycta* and allied genera:

- Fig. 1. *Demas palata* Grote; male.
2. *Merolonche spinea* Grote; from the male type.
3. *Merolonche spinea* Grote; from the female type.
4. *Merolonche lupini* Grote; from the female type.
5. *Merolonche ursina* Smith; male.
6. *Merolonche ursina* Smith; female.
7. *Arsilonche albovenosa* Goeze; female.
8. *Acronycta insita* Walker; male.
9. *Acronycta hesperida* Smith; from the female type.
10. *Acronycta transversata* Smith; from the male type.
11. *Acronycta tota* Grote; female.

Somewhat larger than natural size and reproduced from enlarged photographs.

PLATE XI.

Illustrations of species of *Acronycta*:

- Fig. 1. *Acronycta leporina* Linnaeus; male.
2. *Acronycta leporina* Linnaeus; female, from American specimens.
3. *Acronycta cretata* Smith; from a male type.
4. *Acronycta cretata* Smith; from a female type.
5. *Acronycta pacifica* Smith; from the male type.
6. *Acronycta frigida* Smith; from the male type.
7. *Acronycta populi* Riley; from a female type.
8. *Acronycta lepusculina* Guenée; female.
9. *Acronycta felina* Grote; female.
10. *Acronycta frigida* Smith; from a female type.
11. *Acronycta cinderella* Smith; from the male type.
12. *Acronycta illita* Smith; from the female type.

All are somewhat greater than natural size and are reproduced from enlarged photographs.

PLATE XII.

Illustrations of species of *Acronycta*:

- Fig. 1. *Acronycta manitoba* Smith; from a female type.
2. *Acronycta paupercula* Grote; male.
3. *Acronycta fragilis* Guenée; female.
4. *Acronycta radcliffei* Harvey; male.
5. *Acronycta spinigera* Guenée; female.
6. *Acronycta strigulata* Smith; from a female type.
7. *Acronycta mansueta* Smith; from a male type.
8. *Acronycta falcata* Grote; female.

- Fig. 9. *Acronycta albarufa* Grote; female.
 10. *Acronycta ovata* Grote; female.
 11. *Acronycta clarescens* Guenée; female.
 12. *Acronycta hamamelis* Guenée; female.
 13. *Acronycta increta* Morrison; female.
 14. *Acronycta retardata* Walker; variety of female.

All are somewhat greater than natural size and are reproduced from enlarged photographs.

PLATE XIII.

Illustrations of species of *Acronycta*:

- Fig. 1. *Acronycta brumosa* Guenée; female.
 2. *Acronycta emaculata* Smith; from the male type.
 3. *Acronycta marmorata* Smith; from the male type.
 4. *Acronycta impressa* Walker; male.
 5. *Acronycta impressa* Walker; female.
 6. *Acronycta distans* Grote; male.
 7. *Acronycta distans* Grote; female.
 8. *Acronycta liturata* Smith; from a female type.
 9. *Acronycta extricata* Grote; female.
 10. *Acronycta barnesii* Smith; from a male type.
 11. *Acronycta dentata* Grote; female.
 12. *Acronycta pyralis* Smith; male.

All are somewhat greater than natural size and are reproduced from enlarged photographs.

PLATE XIV.

Body structures of *Acronycta* and allied genera:

- Fig. 1. *Panthea portlandia*; head and thorax from above.
 2. *Charadra dispulsa*; head and thorax from above.
 3. *Acronycta americana*; head and thorax from above.
 4. *Acronycta obliterata*; head and thorax from above.
 5. *Panthea portlandia*; head and thorax from side.
 6. *Acronycta americana*; thorax from side.
 7. *Acronycta morula*; thorax from side.
 8. *Acronycta retardata*; thorax from side.
 9. *Acronycta impressa*; thorax from side.
 10. *Acronycta obliterata*; thorax from side.
 11. *Acronycta americana*; ovipositor of female.
 12. *Acronycta ovata*; ovipositor of female.
 13. *Acronycta morula*; male genitalia seen from side (upper figure) and from beneath (lower figure).

All figures from drawings by Dr. J. B. Smith, except 11, 12, and 3, which are from sketches made by Mr. Theodore Pergande.

PLATE XV.

Head structures of *Acronycta* and allies:

- Fig. 1. *Charadra deridens*; antenna of male at tip.
 2. *Charadra deridens*; antenna of male toward base.
 3. *Charadra dispulsa*; antenna of male at tip.
 4. *Charadra dispulsa*; antenna of male near base.
 5. *Panthea portlandia*; antenna of male near middle.
 6. *Harrisimemna trisignata*; antenna of male toward tip.
 7. *Raphia frater*; antenna of male near middle.
 8. *Meroloneche lupini*; antenna of male near middle; the details of structure are omitted on all save three joints.

Fig. 9. *Acronycta tritona*; base of maxilla, showing the maxillary palpus.

10. *Acronycta rubricoma*; head from above.
11. *Acronycta americana*; head from above.
12. *Acronycta morula*; head from above.
13. *Acronycta auricoma*; head from above.
14. *Acronycta xyliniformis*; head from above.
15. *Acronycta americana*; head from side.
16. *Acronycta rubricoma*; head from side.
17. *Acronycta morula*; head from side.
18. *Acronycta luteicoma*; head from side.
19. *Acronycta auricoma*; head from side.
20. *Acronycta xyliniformis*; head from side.
21. *Panthea portlandia*; head from front.
22. *Charadra deridens*; head from front.
23. *Acronycta americana*; head from front.

All from drawings by Dr. J. B. Smith; and, except the heads, made with camera lucida.

PLATE XVI.

Venation of *Acronycta* and its allies:

- Fig. 1. Venation of primaries of *Panthea portlandia* toward the apex, and origin of veins 2 to 5 of secondaries.
2. Venation of *Demas flavicornis*, female.
 3. *Demas flavicornis*, showing origin of veins 6 to 11 on primaries with accessory cell absent.
 4. Variations in the shape of accessory cell and the origin of veins 6 to 10 in *Demas* and *Panthea*.
 5. *Charadra dispulsa*, venation of primaries toward apex, and origin of veins 2 to 5 of secondaries.
 6. Venation of *Harrisimemna trisignata*, female.
 7. Venation of *Raphia frater*, female.
 8. Venation of *Acronycta dactylina*, male.
 9. *Acronycta betulae*; showing origin of veins 6 to 10 of primaries.
 10. *Acronycta lithospila*; showing origin of veins 6 to 10 of primaries.
 11. *Acronycta albarufa*; showing origin of veins 6 to 10 of primaries.

All from camera lucida sketches by Dr. J. B. Smith.

PLATE XVII.

Leg structures in *Acronycta* and allies:

- Fig. 1. All legs of *Merolonche lupini*.
2. All legs of *Arsilonche albocerosa*.
 3. All legs of *Acronycta dactylina*.
 4. All legs of *Harrisimemna trisignata*.
 5. All legs of *Charadra deridens*.
 6. All legs of *Panthea portlandia*.
 7. All legs of *Raphia frater*.
 8. All legs of *Demas flavicornis*.
 9. Anterior leg of male *Acronycta rubricoma*.
 10. Anterior femur and tibia of *Acronycta americana*, male.
 11. Anterior leg of male *Acronycta dactylina*.
 12. Anterior leg of male *Acronycta hastulifera*.
 13. Anterior leg of male *Acronycta insita*.
 14. Anterior leg of male *Acronycta leporina*.
 15. Anterior leg of male *Acronycta cretata*.

Fig. 16. Anterior femur and tibia of *Acronycta populi*, male; *cinderella*, *transversata*, and *pacifica* are similar.

17. Anterior leg of male *Acronycta tota*.

18. Anterior leg of male *Acronycta innotata*.

19. Anterior tibia and tarsus of *Acronycta betulae*.

20. Anterior leg of male *Acronycta morula*; *occidentalis* is similar.

21. Anterior leg of male *Acronycta laetifica*.

22. Anterior leg of male *Acronycta lobeliae*.

23. Anterior leg of male *Acronycta vinnula*.

24. Anterior leg of male *Acronycta manitoba*.

25. Anterior leg of male *Acronycta grisea*; *revellata* is practically the same.

26. Anterior leg of male *Acronycta spinigera*.

27. Anterior leg of male *Acronycta pruni*; *radcliffei* is practically the same.

28. Anterior leg of male *Acronycta quadrata* and *tritona*.

29. Anterior leg of male *Acronycta persuasa*.

30. Anterior leg of male *Acronycta brumosa*.

31. Anterior leg of male *Acronycta clarescens*.

32. Anterior leg of male *Acronycta albarufa*; *orata*, and *hamamelis* are practically like it.

All the drawings were made by Dr. J. B. Smith with a camera lucida and to the same scale, so that the figures are comparable.

PLATE XVIII.

Miscellaneous structures in *Acronycta*:

Fig. 1. Showing position of tubercles on abdominal segments in larvae of lower Tineides.

2. Showing position of tubercles on abdominal segments in larvae of Sphingides.

3. Showing position of tubercles on abdominal segments in larvae of Bombyces.

4. Labial palpus of *Acronycta americana*.

5. Labial palpus of *Acronycta rubricoma*.

6. Labial palpus of *Acronycta betulae*.

7. Labial palpus of *Acronycta connecta*.

8. Labial palpus of *Acronycta pruni*.

9. Labial palpus of *Acronycta hamamelis*.

10. Labial palpus of *Acronycta persuasa*.

11. Labial palpus of *Acronycta oblongata*.

12. Tarsal claw in *Acronycta rubricoma*; and this is the type found more or less marked in nearly all the species.

13. Anterior leg of male *Acronycta oblongata*.

14. Anterior leg of male *Acronycta xyliniformis*.

15. Anterior leg of male *Acronycta extricata*.

16. Anterior leg of male *Acronycta perditia*.

17. Anterior leg of male *Acronycta edolata* and *barnesii*.

18. Anterior leg of male (in group) *Acronycta persuasa*.

19. Anterior leg of male *Acronycta impressa*.

20. Anterior leg of male *Acronycta distans*.

21. Anterior leg of male *Acronycta noctivaga*, *sperata*, and *emaculata*.

22. Anterior leg of male *Acronycta illita*.

23. Anterior leg of male *Acronycta luteicoma*.

24. Anterior leg of male *Acronycta superans*.

25. Anterior leg of male *Acronycta modica*.

26. Anterior leg of male *Acronycta strigulata*.

27. Anterior leg of male *Acronycta funeralis* and *connecta*.

28. Anterior leg of male *Acronycta parallela*.

Fig. 29. Anterior leg of male *Acronycta paupercula*.

30. Anterior leg of male *Acronycta furcifera* and *hasta*.

Sketches for 1, 2, 3, were supplied by Dr. H. G. Dyar; all others are by Dr. J. B. Smith.

PLATE XIX.

Male genital structures in *Acronycta* and allies:

- Fig. 1. Harpe and clasper of *Panthea portlandia*.
 2. Harpe and clasper of *Panthea furcilla*.
 3. Harpe and clasper of *Panthea gigantea*.
 4. Harpe and clasper of *Panthea acronyctoides*.
 5. Harpe and clasper of *Demas propinquinella*.
 6. Harpe and clasper of *Demas flavicornis*.
 7. Harpe and clasper of *Charadra dispulsa*.
 8. Harpe and clasper of *Charadra deridens*.
 9. Harpe and clasper of *Harrisimemna tri-signata*.
 10. Harpe and clasper of *Acronycta rubricoma*.
 11. Harpe and clasper of *Acronycta americana*.
 12. Harpe and clasper of *Acronycta aceris* (European).
 13. Harpe and clasper of *Acronycta dactylina*.
 14. Harpe and clasper of *Acronycta hastulifera*.
 15. Harpe and clasper of *Acronycta hesperida*.
 16. Harpe and clasper of *Acronycta insita*.
 17. Harpe and clasper of *Acronycta leporina* (European).
 18. Harpe and clasper of *Acronycta cretata*.
 19. Harpe and clasper of *Acronycta leporina* (American).
 20. Harpe and clasper of *Acronycta populi*.
 21. Harpe and clasper of *Acronycta lepusculina*.
 22. Harpe and clasper of *Acronycta felina*.
 23. Harpe and clasper of *Acronycta tota*.

All the figures are from sketches made by Dr. J. B. Smith to the same scale with camera lucida.

PLATE XX.

Male genital structures in *Acronycta*:

- Fig. 1. Harpe and clasper of *Acronycta cinderella*.
 2. Harpe and clasper of *Acronycta pacifica*.
 3. Harpe and clasper of *Acronycta transversata*.
 4. Harpe and clasper of *Acronycta frigida*.
 5. Harpe and clasper of *Acronycta innotata*.
 6. Harpe and clasper of *Acronycta betulac*.
 7. Harpe and clasper of *Acronycta morula*.
 8. Harpe and clasper of *Acronycta occidentalis*.
 9. Harpe and clasper of *Acronycta lactifica*.
 10. Harpe and clasper of *Acronycta lobeliae*.
 11. Harpe and clasper of *Acronycta lobeliae*; small specimen.
 12. Harpe and clasper of *Acronycta furcifera*.
 13. Harpe and clasper of *Acronycta hasta*.
 14. Harpe and clasper of *Acronycta manitoba*.
 15. Harpe and clasper of *Acronycta thoracica*.
 16. Harpe and clasper of *Acronycta strigulata*.
 17. Harpe and clasper of *Acronycta radcliffei*.
 18. Harpe and clasper of *Acronycta quadrata*.
 19. Harpe and clasper of *Acronycta spinigera*.
 20. Harpe and clasper of *Acronycta pruni*.

Fig. 21. Harpe and clasper of *Acronycta brumosa*.

All the figures are from camera lucida sketches drawn to the same scale by Dr. J. B. Smith.

PLATE XXI.

Male genital structures in *Acronycta*:

- Fig. 1. Harpe and clasper of *Acronycta superans*.
 2. Harpe and clasper of *Acronycta lithospila*.
 3. Harpe and clasper of *Acronycta tritona*.
 4. Harpe and clasper of *Acronycta connecta*.
 5. Harpe and clasper of *Acronycta funeralis*.
 6. Harpe and clasper of *Acronycta alni* (European).
 7. Harpe and clasper of *Acronycta fragilis*.
 8. Harpe and clasper of *Acronycta paupercula*.
 9. Harpe and clasper of *Acronycta vinnula*.
 10. Harpe and clasper of *Acronycta recellata*.
 11. Harpe and clasper of *Acronycta grisea*.
 12. Harpe and clasper of *Acronycta strigosa* (European).
 13. Harpe and clasper of *Acronycta mansueta*.
 14. Harpe and clasper of *Acronycta falcata*.
 15. Harpe and clasper of *Acronycta parallela*.
 16. Harpe and clasper of *Acronycta cuspidata* (European).
 17. Harpe and clasper of *Acronycta tridens* (European).
 18. Harpe and clasper of *Acronycta psi* (European).
 19. Harpe and clasper of *Acronycta afflicta*.
 20. Harpe and clasper of *Acronycta persuasa*.
 21. Harpe and clasper of *Acronycta liturata*.
 22. Harpe and clasper of *Acronycta marmorata*.
 23. Harpe and clasper of *Acronycta megacephala* (European).
 24. Harpe and clasper of *Acronycta albarufa*.
 25. Harpe and clasper of *Acronycta ovata*.
 26. Harpe and clasper of *Acronycta modica*.
 27. Harpe and clasper of *Acronycta clarescens*.
 28. Harpe and clasper of *Acronycta hamamelis*.
 29. Harpe and clasper of *Acronycta retardata*.

All the figures are from camera lucida sketches drawn to the same scale by Dr. J. B. Smith.

PLATE XXII.

Male genital structures in *Acronycta* and allies:

- Fig. 1. Harpe and clasper of *Acronycta illita*.
 2. Harpe and clasper of *Acronycta luteicoma*.
 3. Harpe and clasper of *Acronycta sperata*.
 4. Harpe and clasper of *Acronycta euphorbiae* (European).
 5. Harpe and clasper of *Acronycta myrica* (European).
 6. Harpe and clasper of *Acronycta noctivaga*.
 7. Harpe and clasper of *Acronycta menyanthidis* (European).
 8. Harpe and clasper of *Acronycta rumicis* (European).
 9. Harpe and clasper of *Acronycta emaculata*.
 10. Harpe and clasper of *Acronycta impressa*, variety.
 11. Harpe and clasper of *Acronycta impressa*, normal.
 12. Harpe and clasper of *Acronycta distans*, normal.
 13. Harpe and clasper of *Acronycta distans*, variety.
 14. Harpe and clasper of *Acronycta auricoma* (European).

- Fig. 15. Harpe and clasper of *Acronycta barnesii*.
16. Harpe and clasper of *Acronycta perdita*.
17. Harpe and clasper of *Acronycta edolata*.
18. Harpe and clasper of *Acronycta extricata*.
19. Harpe and clasper of *Acronycta xyliniformis*.
20. Harpe and clasper of *Acronycta oblinita*.
21. Harpe and clasper of *Arsilonche albovenosa*.
22. Harpe and clasper of *Merolonche ursina*.
23. Harpe and clasper of *Merolonche lupini*.

All the figures are from camera lucida sketches drawn to the same scale by Dr. J. B. Smith.



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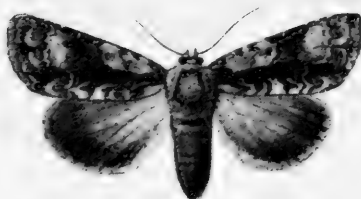
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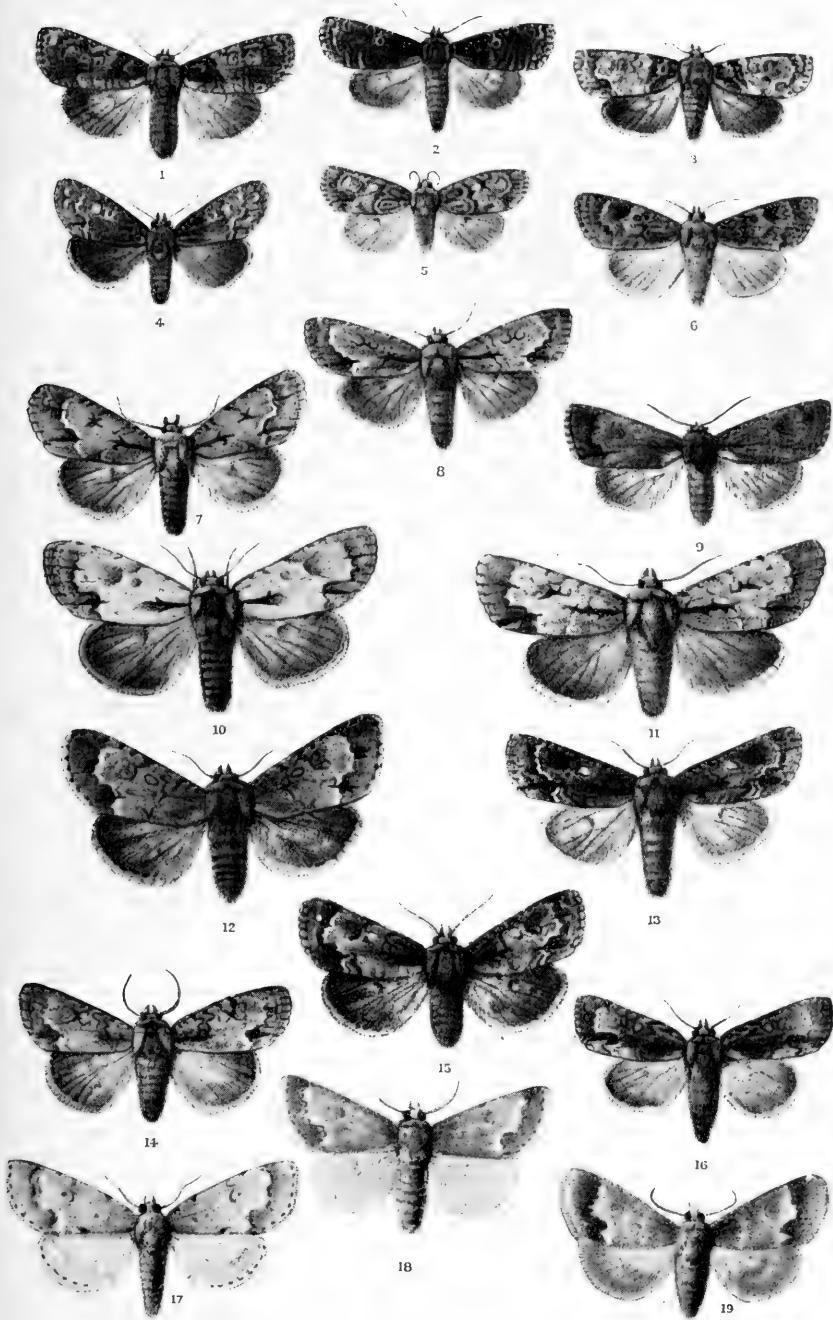
14



15

THE GENUS ACRONYCTA.

FOR EXPLANATION OF PLATE SEE PAGE 185.



THE GENUS ACRONYCTA.

FOR EXPLANATION OF PLATE SEE PAGES 185, 186.



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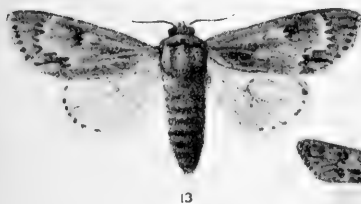
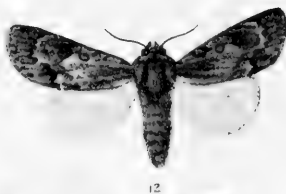
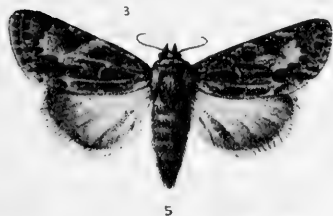
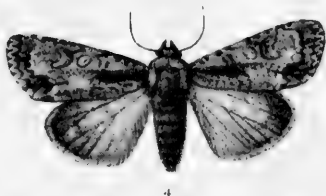
11



12

THE GENUS ACRONYCTA.

FOR EXPLANATION OF PLATE SEE PAGE 186.



THE GENUS *ACRONYCTA*.

FOR EXPLANATION OF PLATE SEE PAGE 186.





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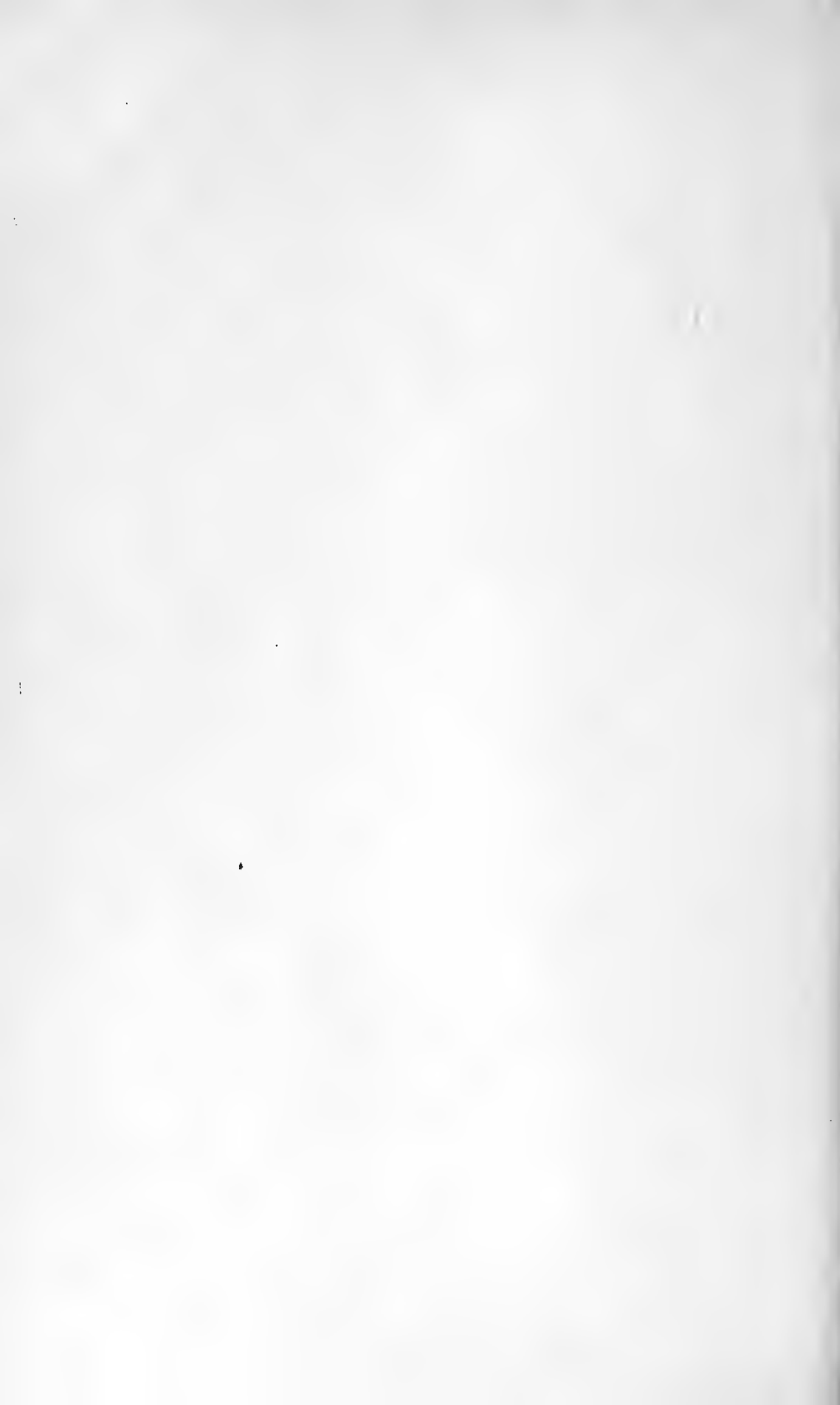
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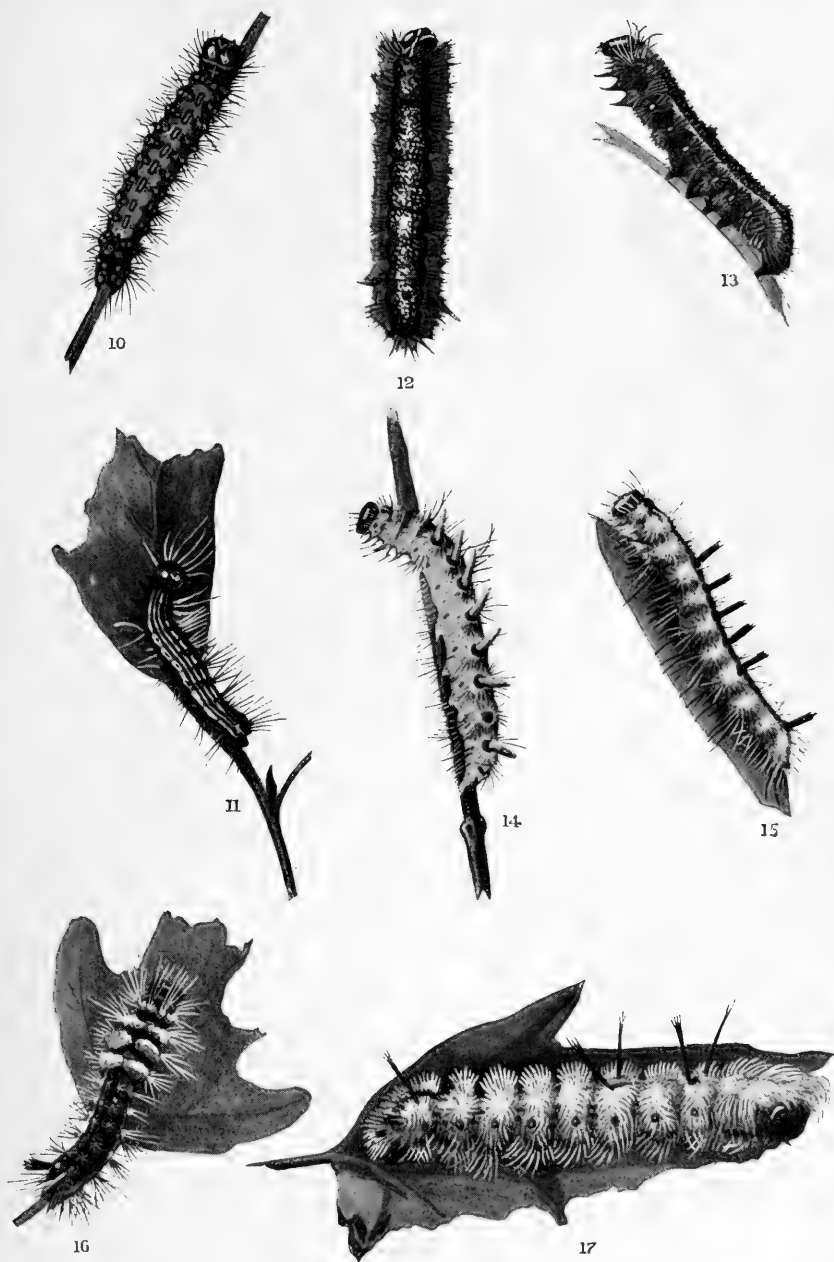


9

THE GENUS ACRONYCTA.

FOR EXPLANATION OF PLATE SEE PAGES 186, 187.

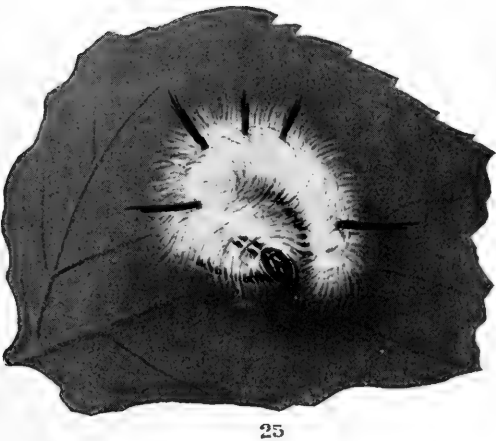
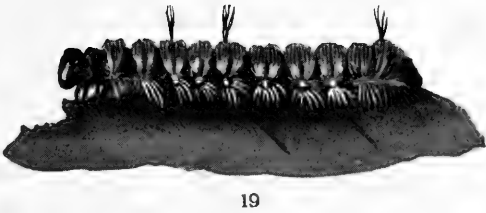




THE GENUS *ACRONYCTA*.

FOR EXPLANATION OF PLATE SEE PAGE 187.



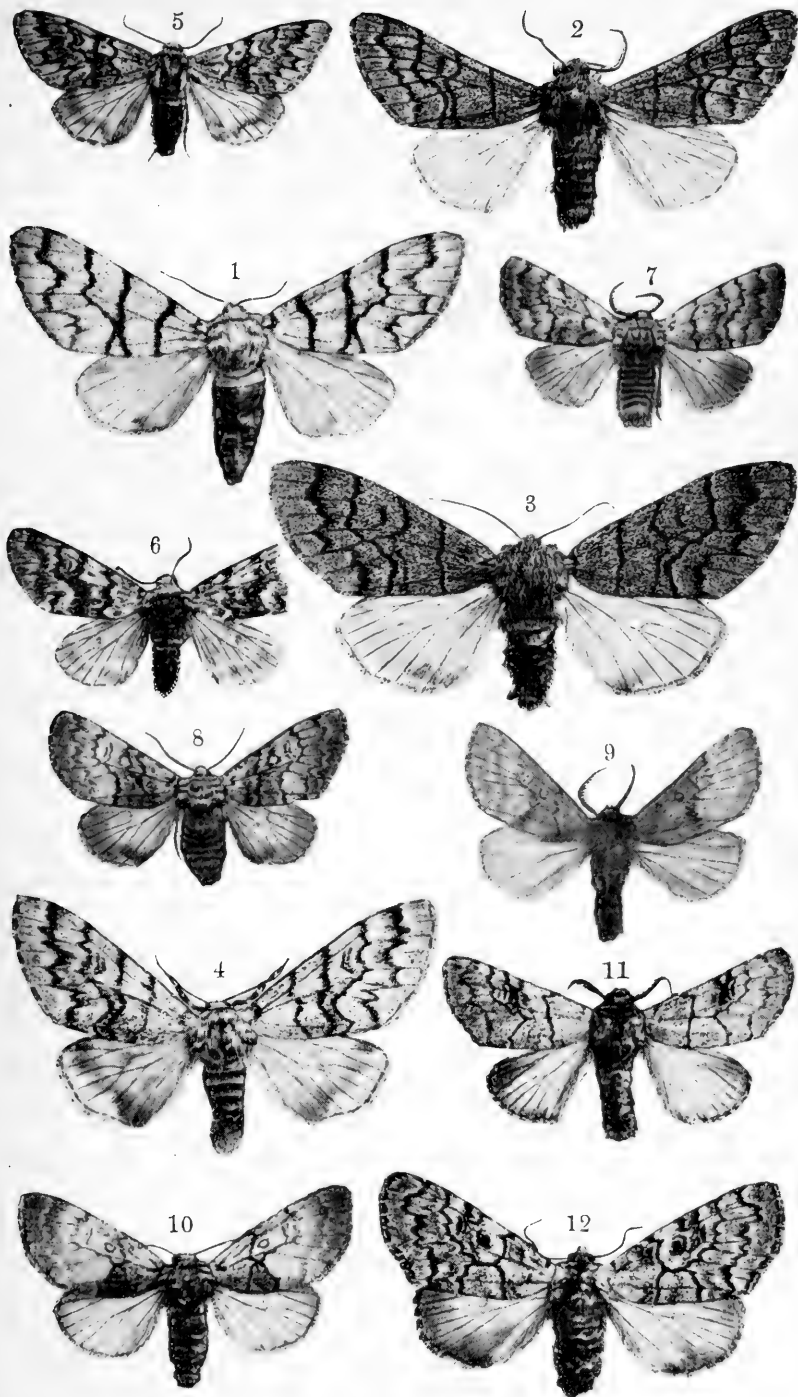


THE GENUS ACRONYCTA.
FOR EXPLANATION OF PLATE SEE PAGE 187.



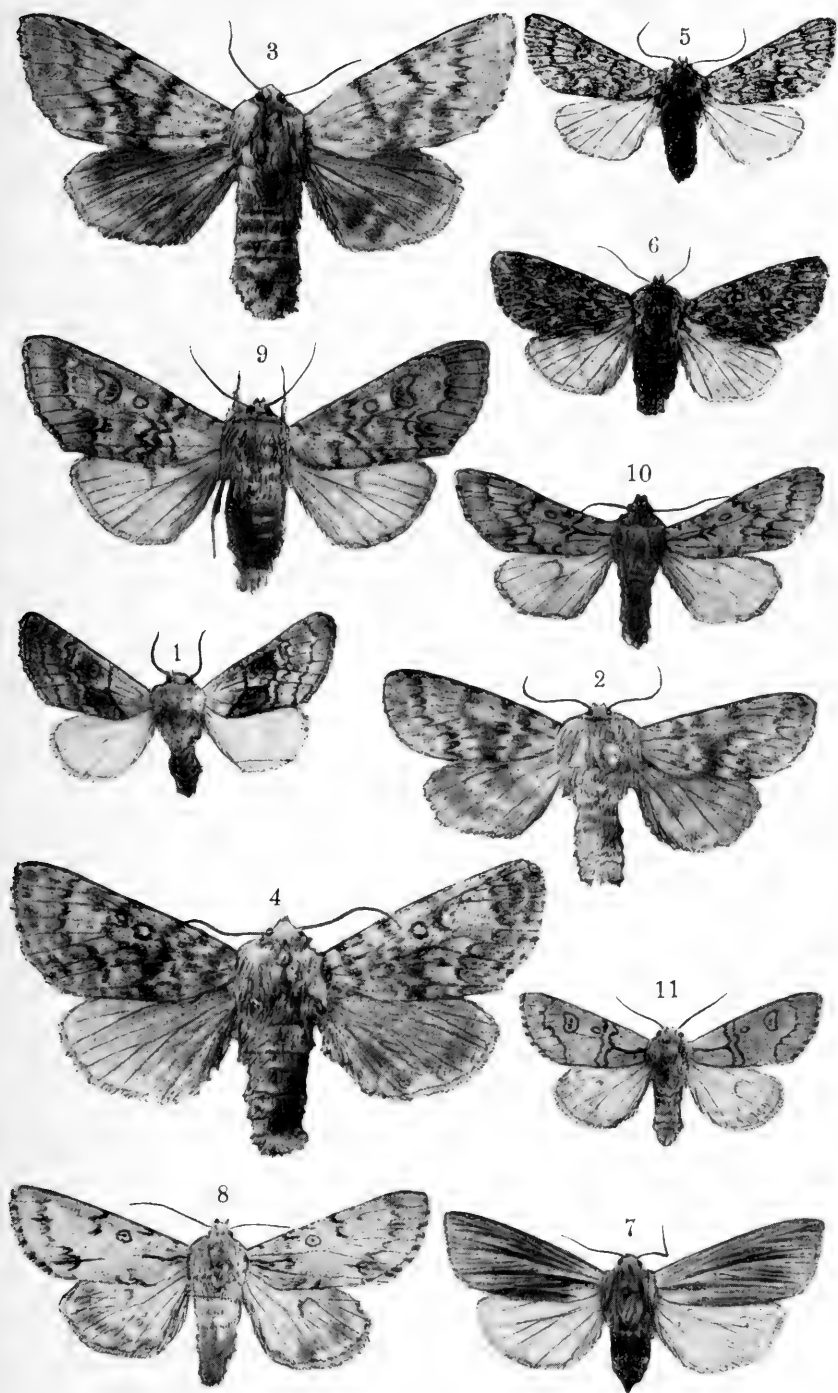
THE GENUS ACRONYCTA.

FOR EXPLANATION OF PLATE SEE PAGE 187.



ILLUSTRATIONS OF PANTHEIDS.

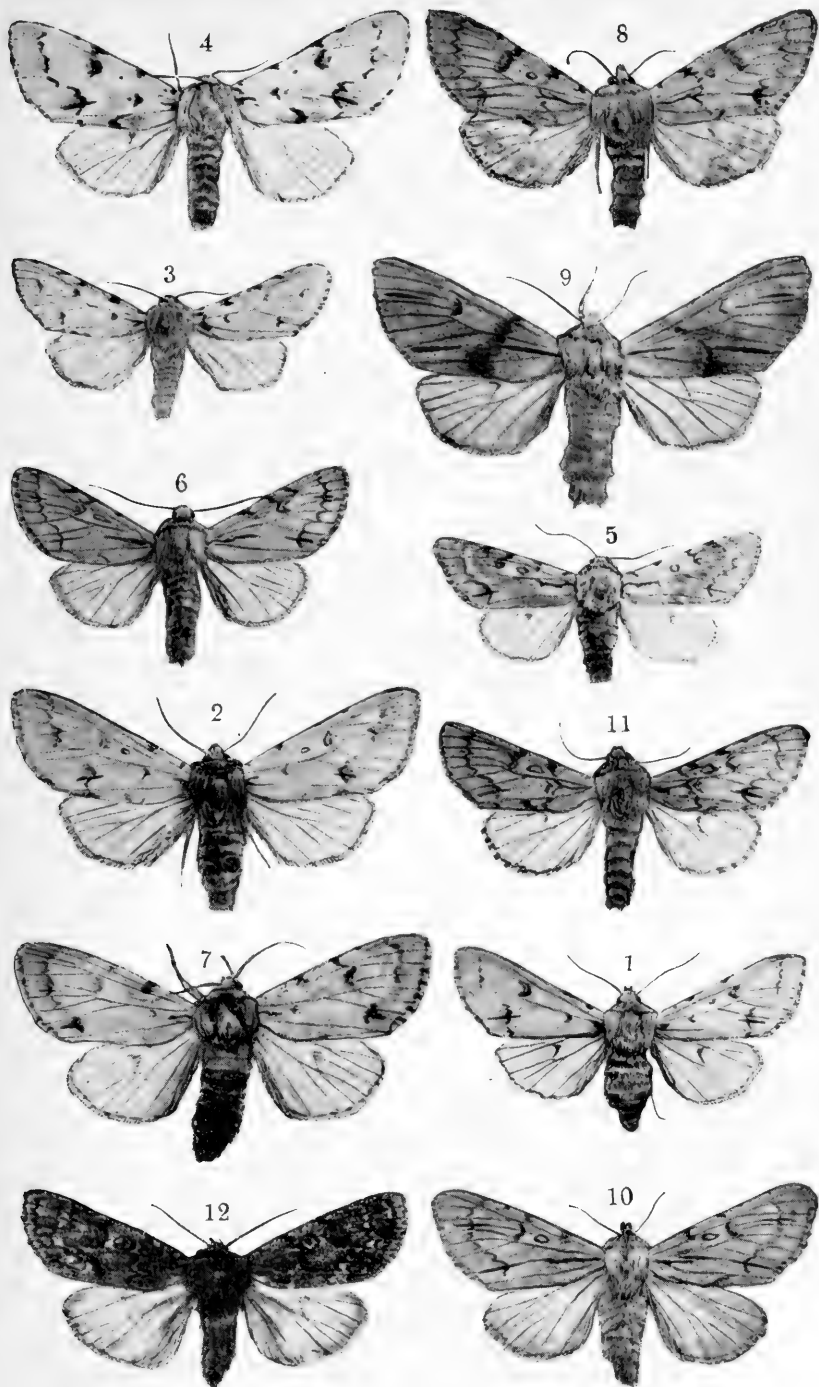
FOR EXPLANATION OF PLATE SEE PAGES 187, 188.



THE GENUS *ACRONYCTA* AND ITS ALLIES.

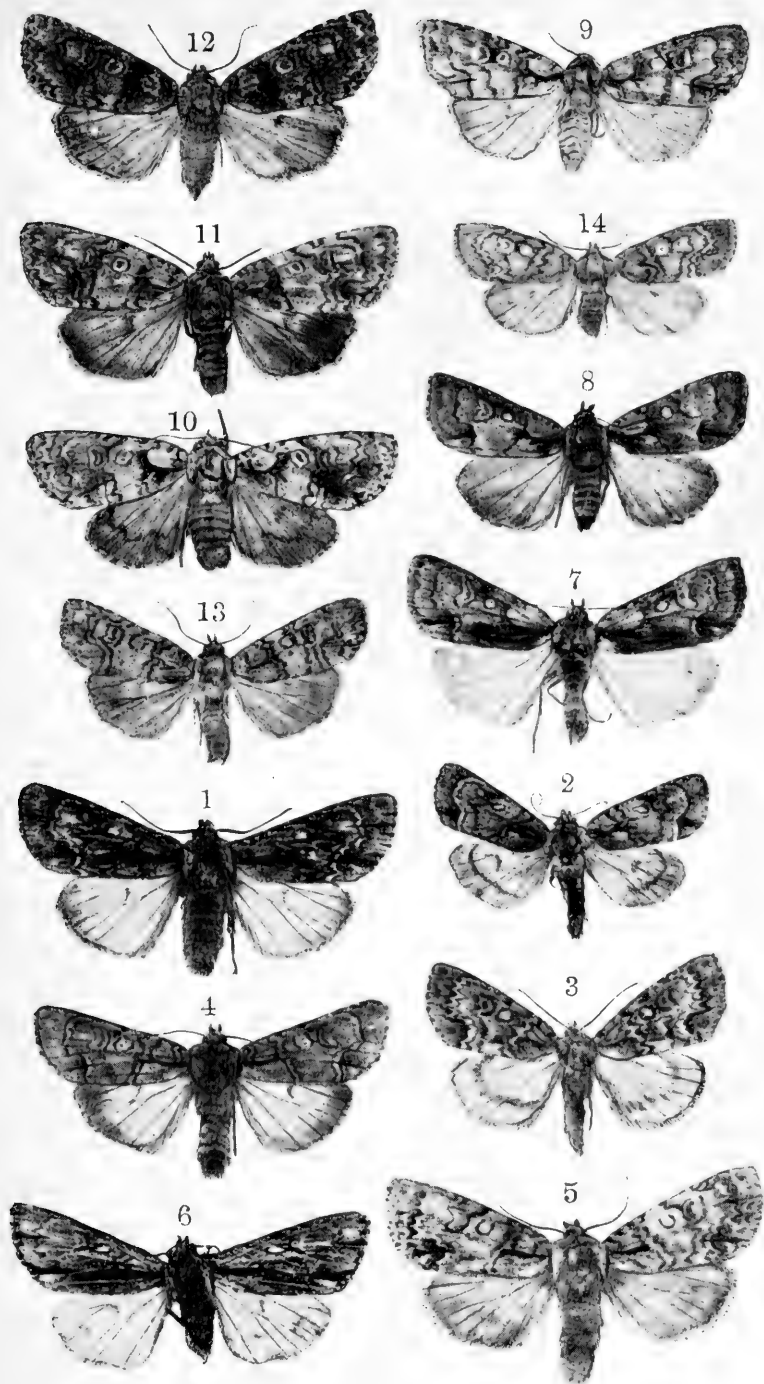
FOR EXPLANATION OF PLATE SEE PAGE 188.





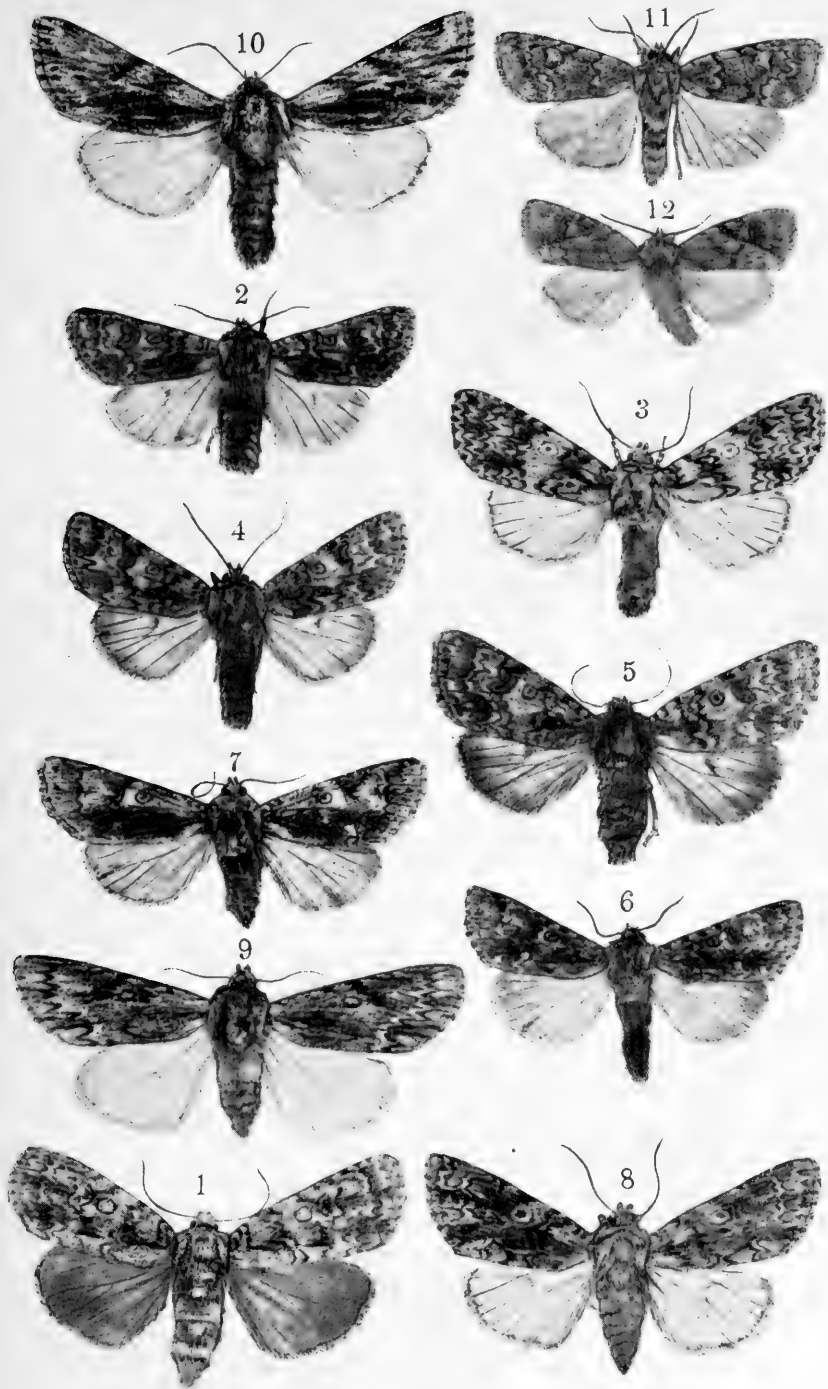
THE GENUS *ACRONYCTA*.

FOR EXPLANATION OF PLATE SEE PAGE 188.



THE GENUS *ACRONYCTA*.

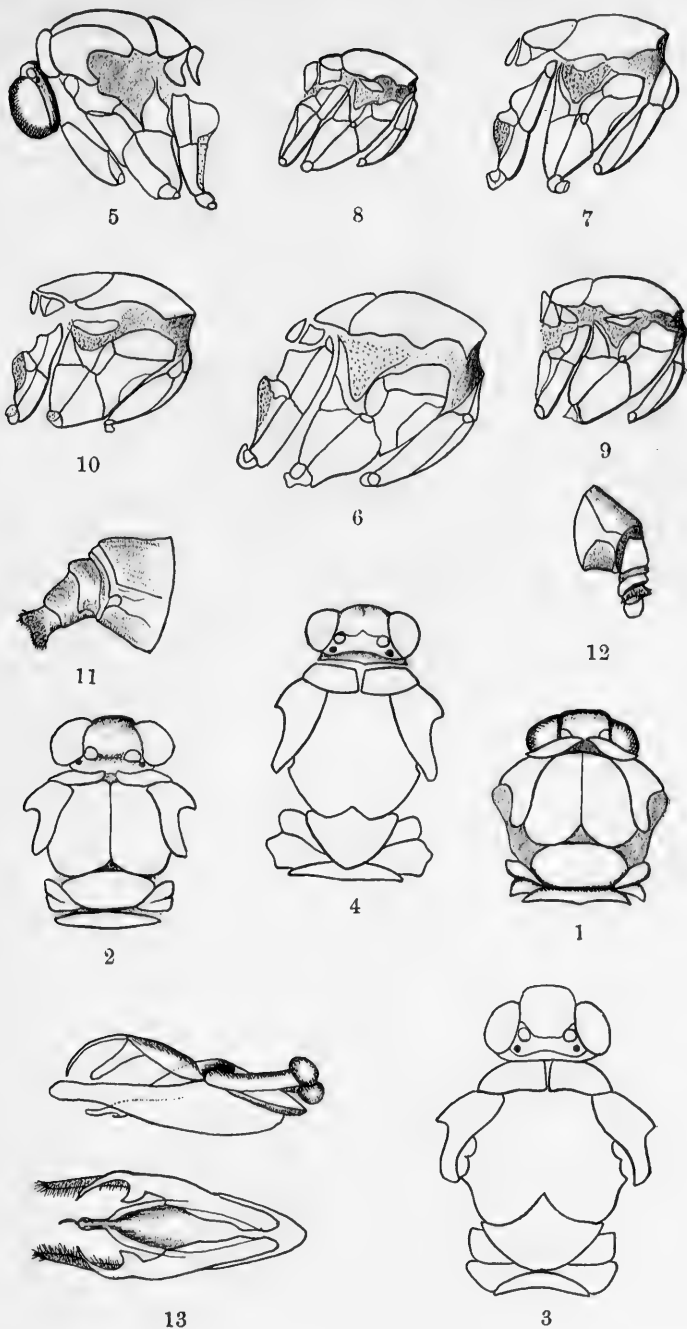
FOR EXPLANATION OF PLATE SEE PAGES 188, 189.



THE GENUS *ACRONYCTA*.

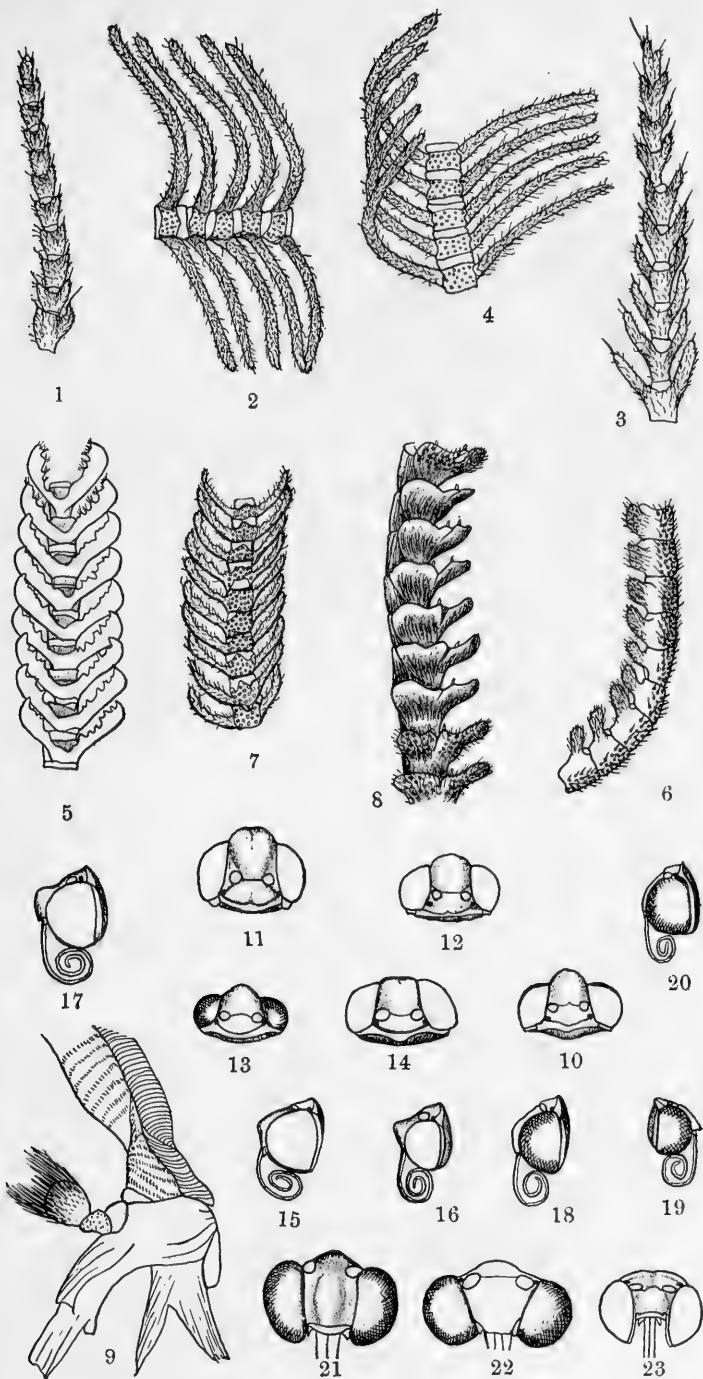
FOR EXPLANATION OF PLATE SEE PAGE 189.





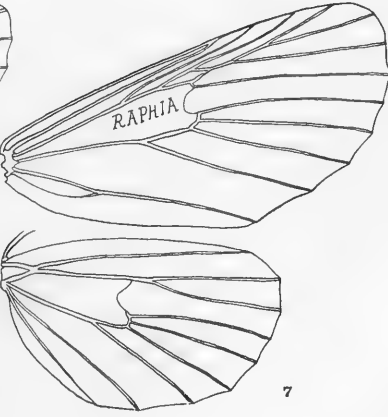
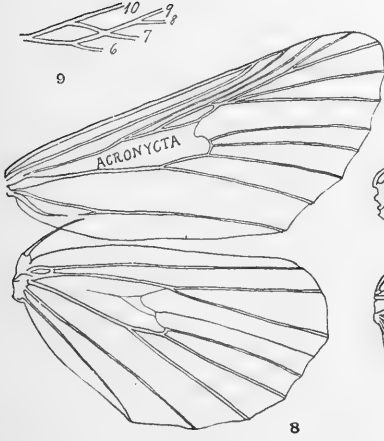
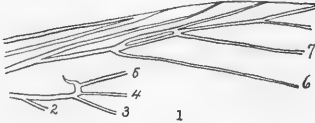
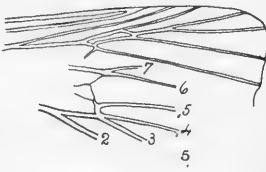
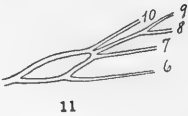
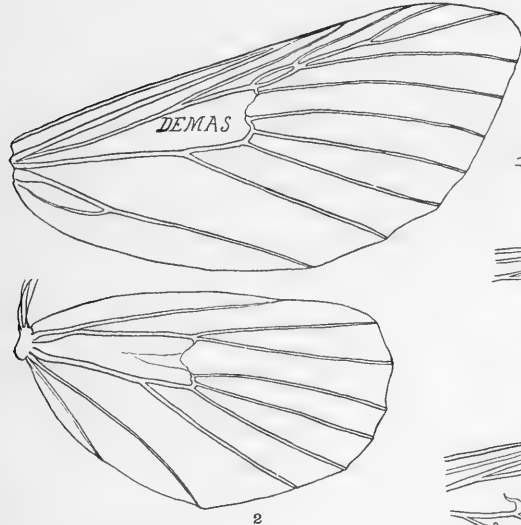
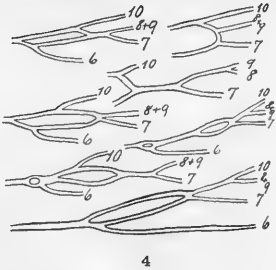
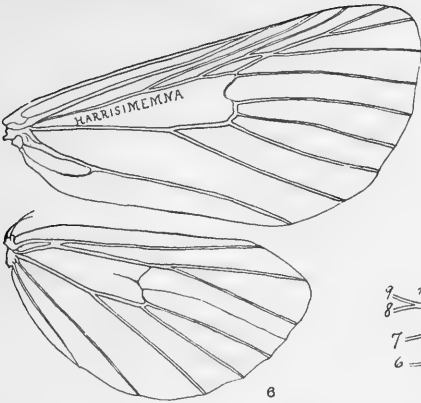
BODY STRUCTURES OF ACRONYCTA.

FOR EXPLANATION OF PLATE SEE PAGE 189.



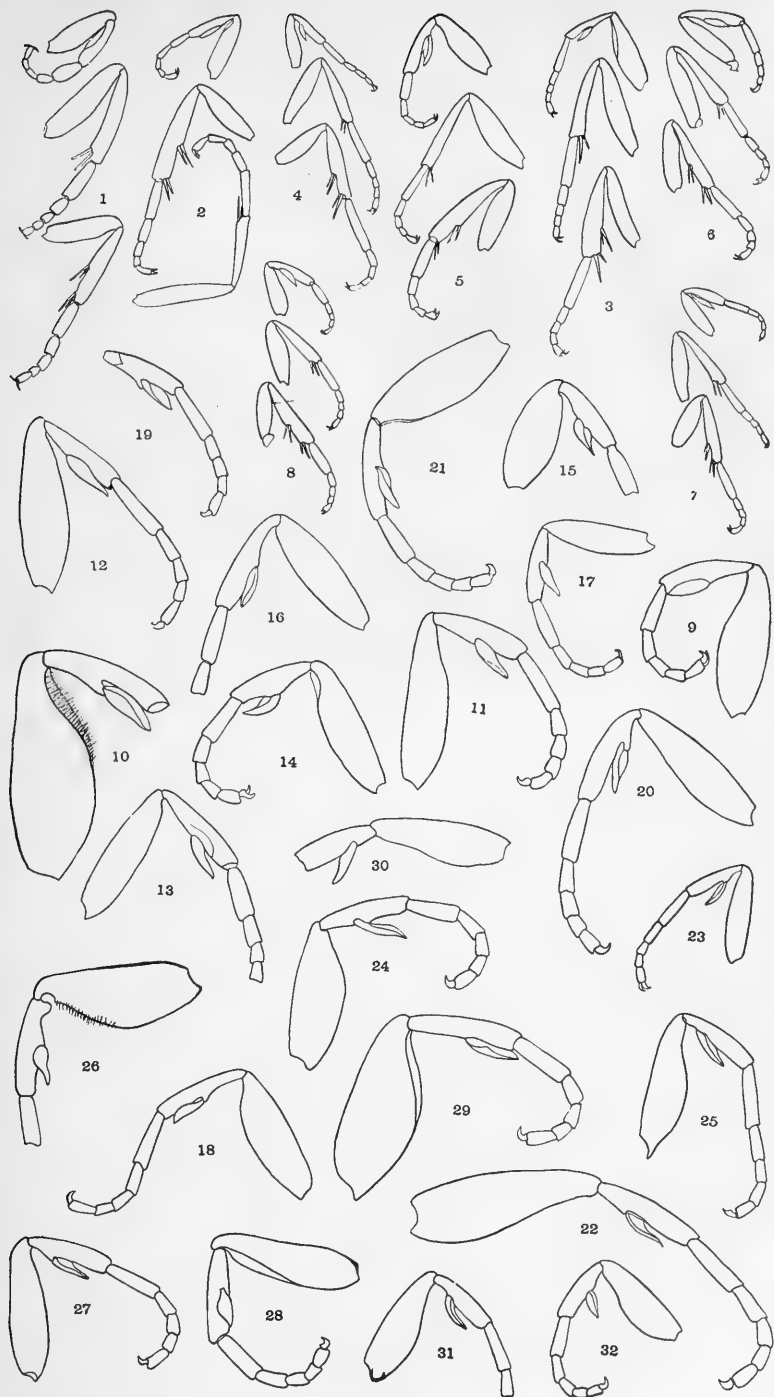
HEAD STRUCTURES OF ACRONYCTA.

FOR EXPLANATION OF PLATE SEE PAGES 189, 190.



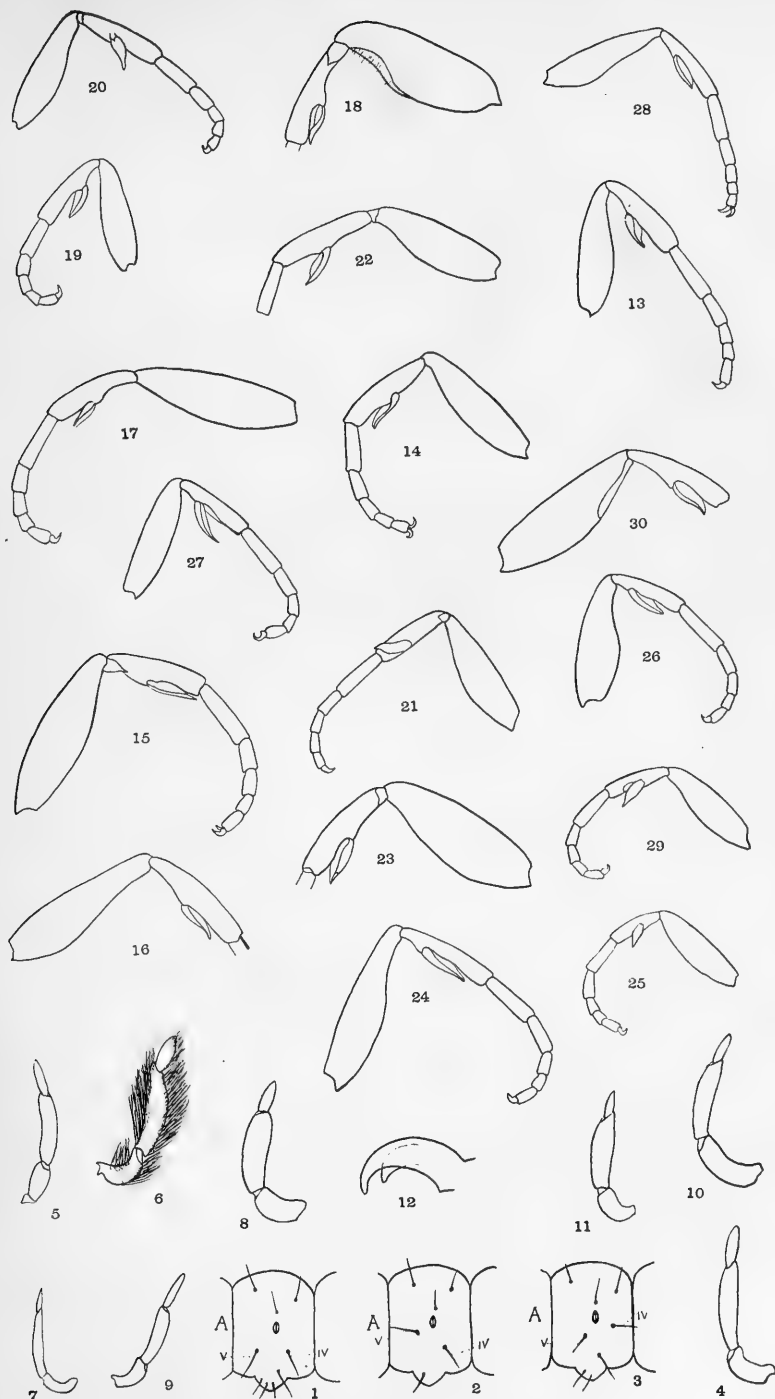
VENATION OF ACRONYCTA.

FOR EXPLANATION OF PLATE SEE PAGE 190.



LEG STRUCTURE OF ACRONYCTA.

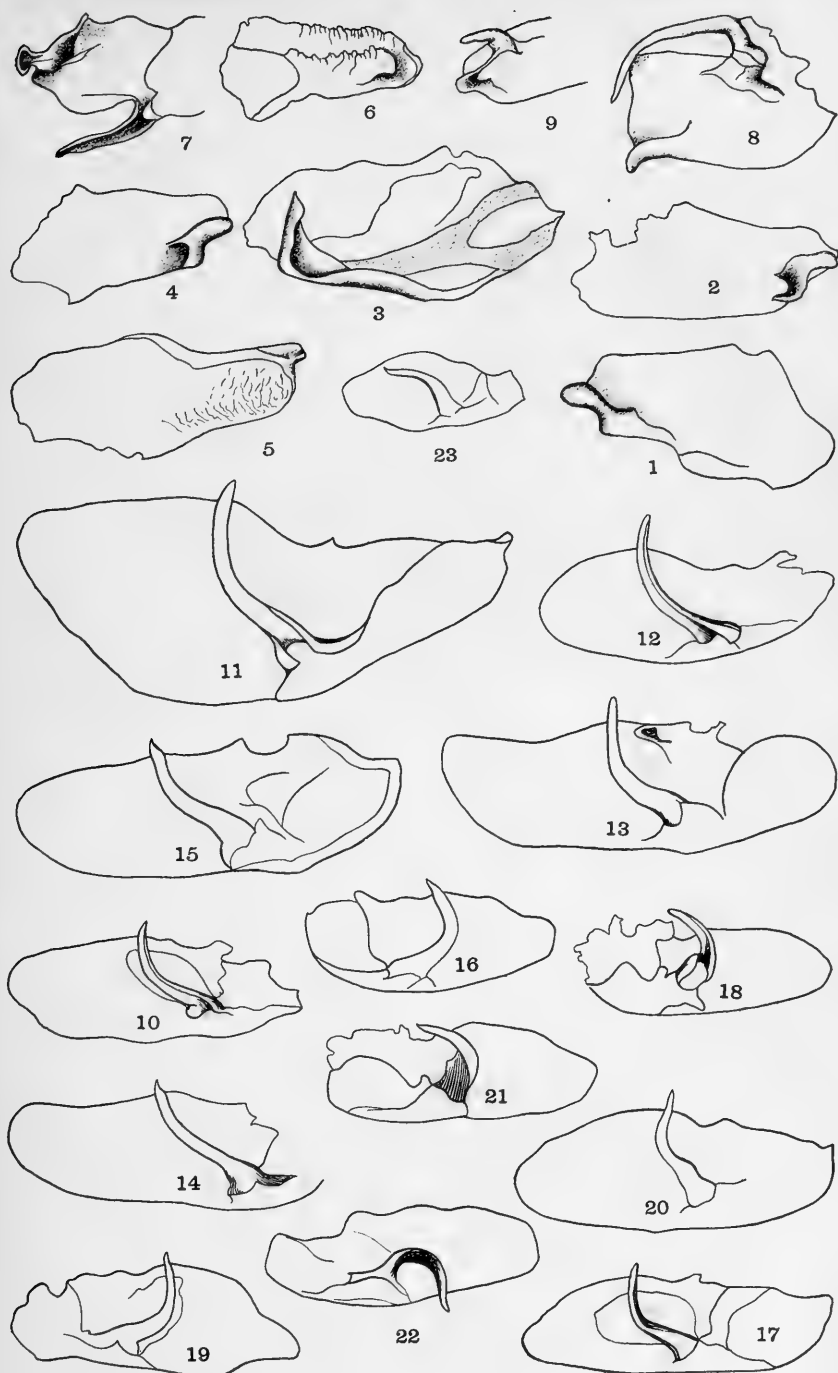
FOR EXPLANATION OF PLATE SEE PAGES 190, 191.



LEG AND OTHER STRUCTURES OF ACRONYCTA.

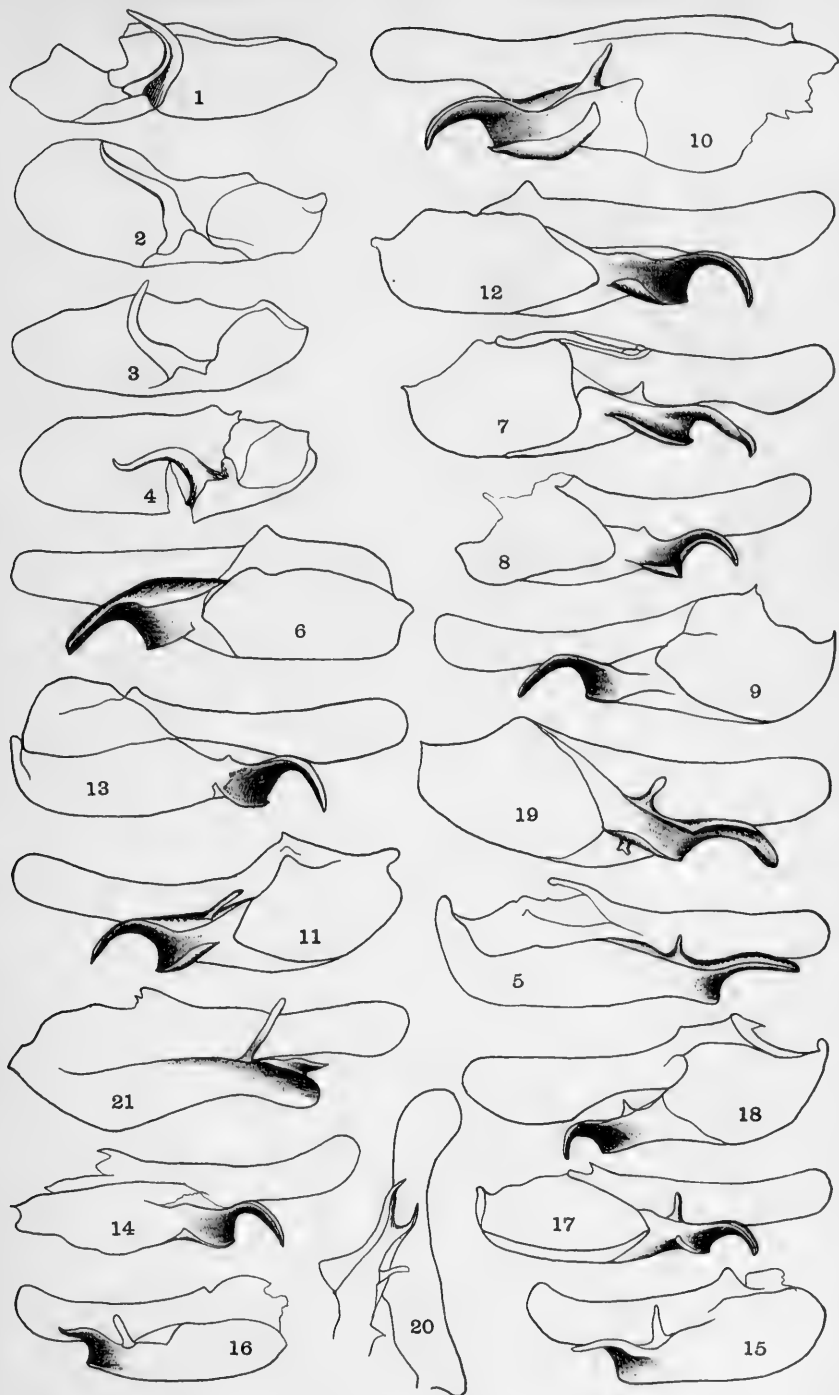
FOR EXPLANATION OF PLATE SEE PAGES 191, 192.





GENITAL STRUCTURES IN ACRONYCTA.

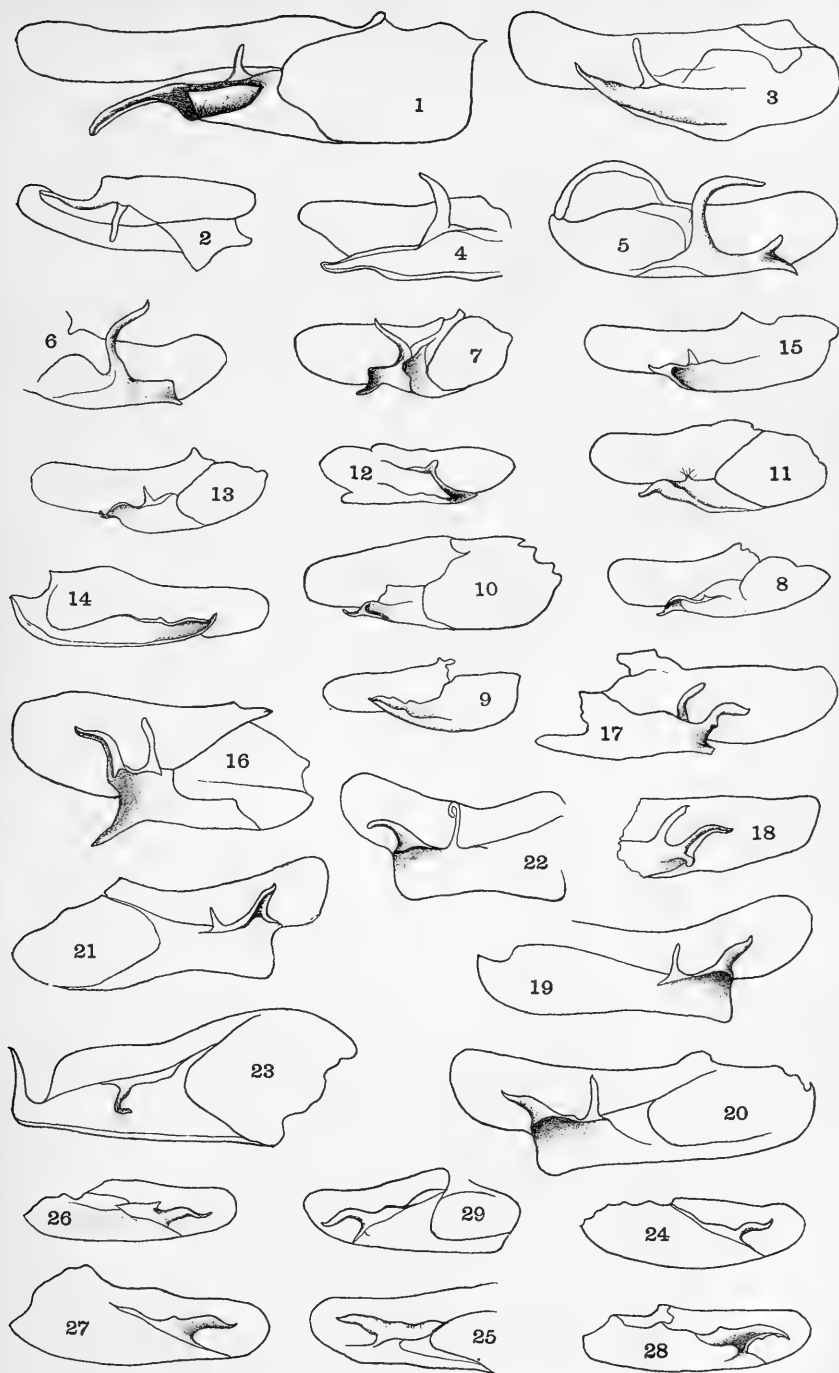
FOR EXPLANATION OF PLATE SEE PAGE 192.



GENITAL STRUCTURES IN ACRONYCTA.

FOR EXPLANATION OF PLATE SEE PAGES 192, 193.

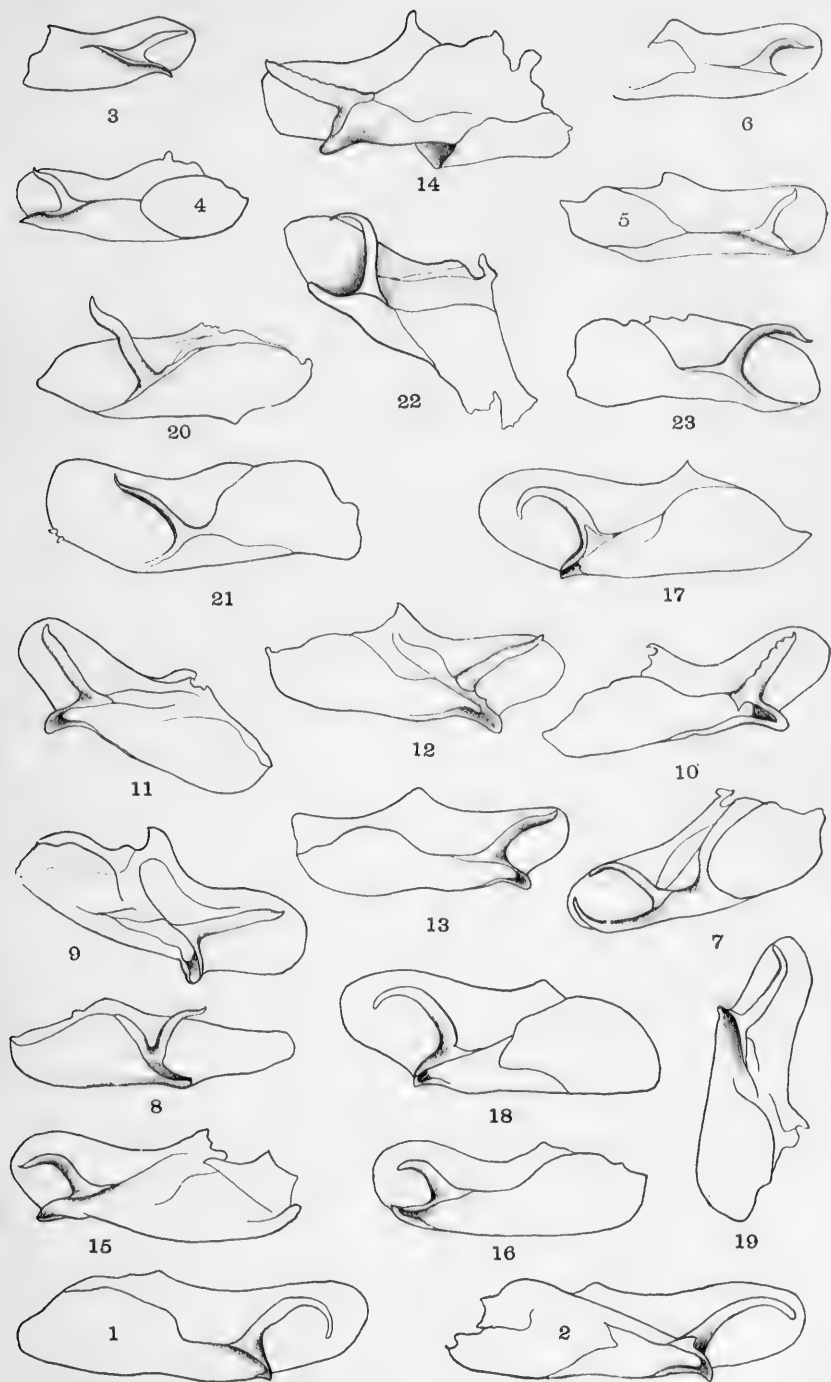




GENITAL STRUCTURES IN ACRONYCTA.

FOR EXPLANATION OF PLATE SEE PAGE 193.





GENITAL STRUCTURES IN ACRONYCTA.

FOR EXPLANATION OF PLATE SEE PAGES 193, 194.

DESCRIPTIONS OF THE SPECIES OF CYCADEOIDEA, OR
FOSSIL CYCADEAN TRUNKS, THUS FAR DETERMINED
FROM THE LOWER CRETACEOUS RIM OF THE BLACK
HILLS.¹

By LESTER F. WARD,

Associate Curator, Section of Palaeobotany.

Within the past five years there have come into my hands for determination 155 specimens of cycadean trunks, counting the perfect trunks and the fragments or parts of trunks in all states of completeness and of preservation, but exclusive of such duplicate fragments as are known to belong to the same individual. Of these, 25 specimens belong to the U. S. National Museum; 2 to the State School of Mines, South Dakota; 2 to the Woman's College of Baltimore; and 126 to Yale University. Out of all this material I have distinguished 21 species, all but one of which are new to science. The following are the species, systematically arranged:

1. *Cycadeoidea dacotensis* (McBride) Ward emend.
2. *colossalis*, new species.
3. *wellsii*, new species.
4. *minnekahtensis*, new species.
5. *pulcherrima*, new species.
6. *cicatricula*, new species.
7. *turrita*, new species.
8. *mcbridei*, new species.
9. *marshiana*, new species.
10. *furcata*, new species.
11. *colei*, new species.
12. *paynei*, new species.
13. *aspera*, new species.
14. *insolita*, new species.
15. *occidentalis*, new species.
16. *jennyana*, new species.
17. *ingens*, new species.
18. *formosa*, new species.
19. *stillwelli*, new species.
20. *excelsa*, new species.
21. *nana*, new species.

¹ Published with the permission of the Director of the U. S. Geological Survey.

The following is a systematic description of these species:

Genus CYCADEOIDEA Buckland.

1827. *Cycadeoidea* BUCKLAND, Proc. Geol. Soc., London, I, No. 8, pp. 80-81 (session of June 6, 1827).

1828. *Cycadeoidea* BUCKLAND, Trans. Geol. Soc., London, 2d ser., II, pp. 375-401, pls. XLVI-XLIX (volume dated 1829, but memoir probably issued separately in 1828).

CYCADEOIDEA DACOTENSIS (McBride) Ward, emend.

1893. *Bennettites dacotensis* MCBRIDE, in part, American Geologist, XII, p. 249, pl. XI, fig. 1 (non f. 2).

1894. *Cycadeoidea dacotensis* (MCBRIDE) WARD, in part, Proc. Biol. Soc., Washington, IX, p. 86.

Trunks large (30 to 50 cm. high, 30 to 50 cm. in diameter, 100 to 150 cm. in girth), short-cylindrical, contracted below, dome-shaped above, symmetrical, sometimes laterally compressed and elliptical in cross section, probably subsequent to entombment; bearing a number of short secondary axes or undeveloped branches in the form of rounded protuberances, or, in case of decay, of corresponding saucer-shaped depressions; apex presenting a flattened surface with a central elevation studded with polygonal bract scars and bases arranged in rows which sometimes proceed in helicoid form from the center outward; rock substance of a dark brown or reddish color, firmly silicified, hard and heavy, sometimes weighing over 100 kg., fine grained; organs of the armor slightly ascending except near the base, the angle increasing toward the summit where they become vertical; leaf scars where not interrupted forming two series of spiral rows which proceed in different directions and intersect one another, those from right to left nearly horizontal below and curving upward until they form an angle of 45° with the vertical axis, the opposite series less distinct forming a small angle (5° to 10°) with the axis; scars subrhombic and nearly uniform in shape, larger below, diminishing upward, the distance between the lateral angles varying from 16 to 26 mm., and that between the vertical angles from 10 to 16 mm., empty from decay of the petioles, at least to considerable depth, sometimes to a depth of more than 5 cm.; interspaces between the scars very thick, though variable, sometimes 16 mm., presenting an undulate or wrinkled surface with indications of deeper lines of separation of the walls; spadices large and somewhat elliptical in outline, the longer axis nearly horizontal, 8 to 10 cm. long, the shorter nearly vertical and 5 to 7 cm.; involueral bract scars numerous, arranged in concentric ellipses around the central organs in many somewhat distinct rows, increasing in size from the center outward, subrhombic, triangular, or polygonal in shape, 2 to 20 mm. in diameter, apparently passing insensibly into the normal leaf scars, empty like them forming deep cavities or punctations; essential organs of the buds, flowers, or

fruits sometimes wanting, their place occupied by a deep circular cavity, more frequently represented by a dark and firm substance, which in some of the smaller ones projects beyond the general surface; armor 5 to 7 cm. thick, separated from the ligneous axis by a definite line; cortical parenchyma 5 cm. thick, fibrous zone 4 cm. thick with three or more rings of wood, or sometimes presenting a number of thin concentric laminae of alternating black and brown substance, apparently representing as many rings of wood, and inclosing the homogeneous medulla 5 to 15 cm. in diameter, conforming in cross section to the trunk.

Only one of the specimens belonging to the U. S. National Museum is referable with certainty to this species. This is the fine trunk, No. 1, of the collection of six purchased of Mr. Cole. That this is specifically identical with Professor McBride's specimen represented by fig. 1 of his plate there is no room to doubt. It is, however, difficult to reconcile it with his description, in view of the fact that in that description he has included two specimens belonging to entirely different species, his fig. 2 showing none of the external characters of fig. 1, or of the specimen in hand, but clearly belonging to the same specific group as several of the fragments collected by Professor Jenney and myself from the Minnekahta locality in 1893, as will be shown below. As Professor McBride in his description includes characters that could scarcely have been exposed in the perfect trunk represented by his fig. 1, it seems clear that he derives such from the specimen fig. 2, which was probably a fragment showing these characters in the fractures. It was therefore a question whether to retain the name or not. I conclude to do so for so much of Professor McBride's description as applies to his fig. 1.

The Museum specimen is somewhat larger than the one in the University of Iowa, standing over 44 cm. high, having a girth of 122 cm., and weighing 90.27 kg. It is one of the most perfect and beautiful cycadean trunks that have thus far been brought to light.

Thirteen of the specimens in the Yale collection are referred to this species. These are Nos. 1, 3, 5, 6, 13, 30, 39, 43, 54, 62, 63, 95, and 106. Of these Nos. 3, 5, and 54 are nearly perfect trunks, and one of these, No. 54, is larger than the one in the U. S. National Museum.

CYCADOIEDEA COLOSSALIS, new species.

Trunks colossal, subconical or subcylindrical, more or less laterally compressed, dark colored, hard and heavy, weighing from 100 to over 300 kg., 38 to 79 cm. high, 40 to 66 cm. in major, 26 to 46 cm. in minor diameter, 100 to 180 cm. in girth, bearing numerous relatively small branches not projecting far beyond the general surface; terminal bud low, set in a circular platform of small polygonal scars filled by the bases of the leaves or bracts; organs of the armor and secondary axes horizontal at the middle portion of the trunk, somewhat descending at the lower portion and ascending at the upper portion; phyllotaxy much obscured

by the intrusion of other organs, but spiral rows ascending from left to right at an angle varying from 75° below to 45° above plainly traceable; leaf scars subrhombic to nearly rhombic, very small relatively to size of trunk, 13 to 16 mm. between lateral, and 8 to 12 mm. between vertical angles, empty to a depth of 13 to 50 mm., the bottoms of the cavities apparently occupied by portions of the leaf bases; interstices between the scars very variable, but, except at the summit, generally large, sometimes 25 mm., nearly even on the surface but finely marked with mostly horizontal but variously curved or crooked ridges or wrinkles, with occasional indications of planes of separation into two, three, or even five plates; walls much thinner in the upper portion, often broken down in the specimens, displaying the striate inner surface of the scars diminishing in size below; reproductive organs abundant at all parts of the trunk, large, well developed, and conspicuous, often rising somewhat above the surface, forming gentle swellings or more abrupt protuberances, elliptical in shape, the major axis nearly horizontal, 5 to 10 cm. long, the minor axis 3 to 5 cm., usually with a solid center, sometimes with a small central cavity surrounded by firm substance, the whole inclosed within concentric elliptical rings or rows of involueral bract scars which increase in size from the center outward, are empty, and have the form of the leaf scars, into which they occasionally seem to graduate; armor 5 to 10 cm. thick, attached to the woody axis by a uniform layer of bark 6 mm. thick; cortical parenchyma 4 to 6 cm. thick; fibrovascular zone also 4 to 6 cm., separated into two distinct rings of wood, each consisting of a loose spongy substance inclosed in a firm plate or thin hard layer, the outer ring 35 mm. and the inner 25 mm. in thickness, through all of which the medullary rays pass forming a sort of columnar structure; medulla more or less elliptical in cross section, 11 to 13 cm. by 15 to 20 cm. in diameter, decayed leaving a cavity at the base in one specimen, and in another having a concentric structure consisting of four zones or rings of soft porous material scarcely differing except in coloration.

The large perfect specimen, No. 6 of the Cole collection, is the largest cycadean trunk known in the world. Prior to its discovery the great *C. reichenbachiana* (Göppert) Capellini & Solms-Laubach from Galicia which is at the Mineralogical and Geological Museum in Dresden, and which I have not seen, had taken the lead. Prof. H. B. Geinitz was so kind as to send me an excellent photograph of that specimen, and on this I find the dimensions marked. It is 50 cm. high, 51 cm. in major, and 44 cm. in minor, diameter, and 157 cm. in girth. It is therefore not so tall as the American specimen by 29 cm., has a major diameter 25 cm. less, and a minor diameter 2 cm. less, showing that it is less flattened, but the circumference is 23 cm. less. [The photograph sent me by Professor Geinitz was taken from the specimen in position as mounted on a support in the Dresden Museum. Judging from it alone I should say that the trunk is here inverted, but to be certain it would

be necessary to examine it. It is clear that in the present position the leaf scars have a decided downward direction, which is rare but not unknown (e. g., *C. uhleri*). Moreover, the scars, which are subtriangular, have now their sharp angle upward, which, if the specimen is right side up, would indicate that the keel of the petioles was on the upper side, a condition which I have only met with in two other species, *C. aspera* and *C. insolita* described below. Göppert's figure¹ shows the specimen in the same position, that is, probably inverted.]

Eight of the specimens in the Yale collection belong to this species, namely, Nos. 2, 7, 9, 10, 17, 37, 40, and 55, of which Nos. 2 and 10 are perfect trunks, but are both much shorter in proportion to their size than the great National Museum type. They are also less laterally compressed. They may have been somewhat vertically compressed. No. 37, though incomplete, is a fine specimen, weighing nearly 150 kg., and has a height of 71 cm. No. 55, though it has lost considerable at the summit, still weighs 110.68 kg. No. 40, which represents less than half of the original trunk, is also a fine fragment. The rest are smaller and more imperfect.

CYCADEOIDEA WELLSII, new species.

Trunks large, ellipsoidal, subcylindrical, or somewhat barrel-shaped, more or less laterally compressed, rounded at the summit, bearing numerous small secondary axes in the form of protuberances, light reddish brown or drab colored, fine grained, hard and rather heavy, sometimes weighing nearly 100 kg., 40 to 55 cm. high, 30 to 45 cm. in diameter, and more than 1 meter in girth; terminal bud not prominent; organs of the armor about horizontal except near the summit; phyllotaxy much disturbed and not traceable; leaf scars rather small, subrhombic or nearly rhombic, often trapeziform or very irregular in shape, average distance between the lateral angles 20 mm. and between the vertical ones 12 mm., none of the angles rounded, all except the small ones at the apex empty to considerable depth; ramentaceous interspaces exceptionally thick, sometimes 2 cm., presenting a smooth but gently undulating surface, lowest in the middle part rising to the scar which forms a sharp edge, producing the general effect of being molded in plastic clay; reproductive organs very large, abundant, and conspicuous, greatly distorting the arrangement of the leaf scars as well as their form, often nearly circular in cross section, 4 to 5 cm. in diameter, showing the remains of the central organs surrounded by concentric circles of large, empty, and deep involueral bract scars which are semilunar or somewhat triangular in shape, and may reach 7 mm. in length; armor about 7 cm. thick, cortical parenchyma 4 cm., fibrous zone 4 cm. showing two rings, the inner projecting at the base, concentrically laminated and inclosing the much decayed medulla about 12 cm. in diameter.

¹Jubiläums-Denkschr. d. Schles. Ges. f. nat. Cult., 1853, pl. VIII, fig. 4.

There are two specimens of this species in the Yale collection, namely, Nos. 21 and 59, the former of which is a fine, nearly perfect trunk, large and handsome, weighing 92.76 kg. I was at first inclined to regard them as belonging to *C. minnekahtensis* on account of the general resemblance of the external surface; but this obviously can not be done, because these trunks are unbranched and symmetrical in form. In this respect they approach *C. dacotensis* and *C. colossalis*, but here the surface differs completely. No forms intermediate in either of these respects occur in either collection, and there is no escape from regarding these two trunks as constituting a new species.

I have named the species for Mr. Henry F. Wells, who obtained these and nearly all the rest of the Yale collection, and from whom Professor Marsh purchased them. He may therefore be regarded as the collector, which, under the approved rules for naming species, requires the use of the genitive form.

CYCADEOIDEA MINNEKAHTENSIS, new species.

Trunks gigantic, much branched and irregular in form, the type and only perfect specimen known weighing 219.09 kg., 74 cm. high, 50 cm. in diameter exclusive of branches, 79 cm. across at maximum spread of branches, 150 cm. in girth, light brown or chestnut colored, smooth on the outer surface presenting the appearance of having been molded in plastic clay, moderately heavy; branches very large forming conical protuberances projecting from the middle portion of the trunk giving it a winged appearance, other branches proceeding from other parts, especially below, composite, that is, the main branches or primary axes having lesser or secondary branches; prominent terminal buds, sometimes themselves compound, on all the branches, often very perfect with a sort of neck; organs of the armor declined over most of the surface; phyllotaxy obscure and not traceable; leaf scars subrhombic to nearly rhombic, averaging 22 mm. wide by 10 mm. high, the unusual vertical narrowness perhaps due to compression, very variable, however, in all respects, those on the lesser branches smaller, usually empty and striate within; ramentaceous interstices usually thick, 5 to 15 mm., firm and fine-grained, smooth and polished but somewhat undulating, the edges of the scars sharp, always without signs of subdivision; reproductive organs numerous, simulating the small branches, the central part preserved but heterogeneous, showing scars and markings of the essential organs, varying from 12 to 50 mm. in diameter, surrounded by small involucre bract scars; armor about 6 cm. thick, separated from the underlying tissues by a thin porous layer; cortical parenchyma about 5 cm. thick; fibrovascular zone 8 cm. thick without visible subdivision into rings; medulla not clearly shown, and internal structure generally more or less conjectural.

The remarkably fine but weird and anomalous specimen upon which the above description is almost wholly based was found by our party lying partly buried in the ground, in the same place where the other trunks

had been gathered. It was overgrown with lichens in many places, and had been regarded so uncouth as not to be worth transporting to Hot Springs. I arranged with Messrs. Payne and Cole to have it shipped to Washington, and it arrived in due time in safety. It holds the fourth rank as to size and weight, but differs from all others in so many respects that a comparison with any is difficult. Specifically it approaches most closely to *C. pulcherrima*, but lacks all the symmetry and definiteness of that form. It is only in the fact that both are very branching, especially around the middle part of the trunk, that they have an external resemblance.

The specimen shows a fine terminal bud at the apex of the principal trunk and several others on the other branches. Except near the summits of the several branches the leaf scars and other organs of the armor are decidedly descending, but on the main branch or trunk, some distance above all the lateral branches, there is a sharp line separating the descending from the ascending scars above. This feature I have only seen elsewhere in *C. goucheriana* from Maryland.

The only other specimen in the collection that could with any propriety be included under this specific head is the small trunk picked up at the same time and place and numbered 19. This may represent a very young state of this species with all the characters in miniature and devoid of reproductive organs. It is branched much in the same way, longitudinally compressed, lacks a little of the base and part of one side below, but for purposes of description is practically complete. The entire trunk was only 18 or 20 cm. high, 14 or 15 cm. in its longer and 7 or 8 cm. in its shorter diameter, with a maximum girth of 36 cm. Its present weight is 1.81 kg. The dimensions are therefore less than one-fourth, and the weight is less than one-twelfth of the large trunk. It might even have been wholly subterranean as in the living *Zamia integrifolia*.

Among the fragments in the Yale collection I found eight that belong to these species, and as the National Museum type is nearly perfect, these add somewhat to our knowledge of the inner parts of the trunk. These specimens are numbered 14, 22, 24, 32, 41, 71-72, 83, and 86. They consist chiefly of branches torn away from large trunks, and several of them may have belonged to the same trunk. Some of them may be found to fit together, but as they were lying about in different rooms and even on different floors of the Peabody Museum, it was impossible for me to correlate them. Certain ones, as No. 14, consist of a mere gnarl of branches, and most of them are proliferous or composite, the branches often having fine, sometimes compound, terminal buds.

CYCADEOIDEA PULCHERRIMA, new species.

Trunks large (38 cm. high, 4 cm. in diameter, and 130 cm. in girth in the only complete specimen known), short ellipsoidal or subspherical, of a light ash color and moderately heavy, bearing numerous large, short branches at and below the center all round, forming conical protuber-

ances, some of which are 8 to 10 cm. long and 12 to 18 cm. in diameter at the base, rarely compound, that is, the branches themselves bearing other smaller ones, or two or more arising side by side; branches and all other organs radiate, that is, proceeding in the direction from the center of the trunk, those of the equatorial zone horizontal, or making a right angle with the axis, those below descending, and those above ascending; leaf scars arranged in definite rows intersecting one another, somewhat spiral, but so placed as to simulate meridians and parallels of latitude, the former series, however, rising from left to right and making an angle which varies with the curvature from 5° to 10° with the vertical axis, the other series, rising from right to left, varying from horizontal to an angle of 45° ; scars varying in shape from subrhombic to nearly true rhombs and in size from 10 by 19 cm. or smaller near the summit to 16 by 22 cm. measured between vertical and lateral angles, which are usually quite sharp, the sides straight, and the whole very definite and symmetrical, usually empty to considerable depth, but partially filled by the remains of the leaf bases, which occasionally show punctations representing the vascular bundles; ramentum walls 2 to 5 mm. thick, wrinkled on their outer edges, often with a distinct median groove, sometimes reduced to thin lamellae with sharp edges, striate within the scars in the direction of the petioles; reproductive organs not abundant, the more typical ones mostly in the equatorial zone among the branches which they sometimes resemble, being large with a solid central axis surrounded by relatively large bract scars, nearly circular with a diameter of 5 cm., other smaller ones scattered among the leaf scars only slightly disturbing their arrangement, often abortive and reduced to collections of pits in the angles of the walls; armor 6 to 8 cm. thick, irregularly attached to the ligneous axis, which consists of a parenchymatous zone 3 cm. thick, inclosing a fibrous zone 25 to 35 mm. thick and divided into two to four exogenous rings; medulla 10 cm. in diameter at the base, enlarging upward to more than twice that size, porous in structure, its outer surface marked with longitudinal ridges which are interrupted and alternating, forming the bases of the medullary rays.

The trunk upon which the above description is almost exclusively based is the one which was called No. 3 of the collection obtained from Mr. Cole and is certainly, in my judgment, artistically the most beautiful cycadean trunk known. I say this deliberately, after having seen the greater part of all thus far discovered in all countries, and where I have not actually seen the specimens themselves I have, in almost all cases, seen artistic models, or at least excellent photographs or drawings. The specific name is therefore fully justified.

The characters of the internal structure and the medulla are derived from the large decayed area at the base on one side, which well exposes them, leaving the other side still perfect. The total weight of this specimen is 85.73 kg.

Only one imperfect specimen, namely, No. 78, of the Yale collection could be referred to this species, and this not without some doubt.

CYCADEOIDEA CICATRICULA, new species.

Trunks small and short, subconical, more or less laterally compressed, smooth and symmetrical, unbranched, light yellowish-brown on the weathered surfaces, fine-grained and flinty within, about 20 cm. high, 18 by 22 cm. in diameter, with a girth of about 60 cm., and weighing 13 or 14 kg.; organs of the armor nearly horizontal; leaf scars arranged in two definite series of spiral rows, those from left to right forming an angle near the base of about 70° with the axis but curving inward in their upward course so that the angle progressively diminishes to about 30° at the summit; those from right to left only slightly curving and making an angle of about 45° ; scars very small, almost exactly rhombic, uniform and definite with all the angles sharp, distance between lateral angles 9 to 12 mm., and between vertical ones 6 to 8 mm.; leaf bases present filling the scars to near the top presenting a roughened spongy tissue; ramentaceous walls very thin, varying from the thickness of tin foil to 2 mm., presenting a beautiful and regular network of whitened lines over the entire outer surface of the trunk, with a faint commissure or elongated openings between the contiguous plates of the thicker ones; reproductive organs not abundant nor well developed, the most typical 3 cm. in diameter, variable in shape and character, consisting of protuberances with a depression at the top or ridges with bract scars on the sides, others anomalous consisting of small projections or elevations, probably abortive, none of them greatly disturbing the form or arrangement of the leaf scars; armor 3 cm. thick, separated from the wood by a definite line or crack; cortical parenchyma 2 cm.; secondary wood 3 cm., consisting of an outer ring 2 cm. thick and an inner one 1 cm. with a fissure between; medulla elliptical, 5 by 7 cm. in diameter, consisting of a homogeneous substance resembling fine yellow sandstone, clearly marked off from the inner ring of wood.

This species is one of the best defined of all, notwithstanding that it is based upon a single specimen, namely, No. 118 of the Yale collection. This is an almost perfect trunk, and is only obscured by sand and gravel cemented in the scars so that very little can be seen of the summits of the leaf bases. It was collected by Mr. H. F. Wells three-fourths of a mile north of Black's ranch, about 3 miles north of Blackhawk, South Dakota. Its only affinities are with *C. pulcherrima*, with which it shares the rhombic scars and their definitely arranged rows.

CYCADEOIDEA TURRITA, new species.

Trunks of moderate size, profusely and irregularly branched, the primary branches often bearing secondary ones, the branches symmetrical, abruptly contracted at the base into cylindrical, turret-shaped projec-

tions, dome-shaped at the summit, with a terminal bud at the apex composed of small polygonal organs, usually light reddish, soft, friable, and of low specific gravity, but sometimes darker, harder, and heavier, 20 to 40 cm. high, 25 to 50 cm. in diameter, the branches 10 to 20 cm. long, 10 to 30 cm. in diameter, 30 to 90 cm. in girth; leaf bases slightly ascending; leaf scars very irregularly distributed over the surface except of the branches, here sometimes arranged in two sets of spiral rows which intersect each other at about the same angle (60°) with the axis of the branch, subrhombic, the upper and lower angles reduced to mere curves, 23 mm. wide, 12 mm. high; leaf bases almost always present, usually projecting, porous; vascular bundles often distinct, set well apart in a row some distance from the margin with a few others near the center, appearing either as small pits or black dots; ramentum walls thin, 1 to 2 mm., usually with a groove or commissure, sometimes thickening at the angles and affected with elongated pits and other openings, some of these latter passing into abortive flower buds, which constitute all that is known of the reproductive organs of the species; armor 5 cm. thick; woody axis only known in certain branches, thin, 2 to 3 cm., and not visibly divided; medulla in one specimen 9 cm. in diameter, black and homogeneous.

Twelve of the specimens of the Yale collection have been referred to this species, namely, Nos. 15, 45, 49, 51, 65, 66, 67, 70, 74, 75, 82, and 85, and still much remains uncertain as to the characters. They nearly all agree in the most striking feature, the possession of peculiar turret-like branches, but owing to the fragile nature of the rock and the sprangling habit of the species all the specimens were badly broken to pieces and nothing remains but *dissecta membra*. Some of these plants evidently consisted entirely of branches and possessed no trunk proper which could be regarded as bearing these branches, but usually there was a large shapeless mass at the base from which they proceeded in all directions. Such was the case in Nos. 45, 51, 66, and 67, some of which must be nearly complete. Nos. 45 and 75 belong to the harder and heavier sort, and possibly may not belong to this species. They might be referred to *C. minnekahmensis* or *C. marshiana* but for differences in the leaf scars and petioles, which agree with this species. No. 74 is very anomalous and is only placed here to avoid making new species out of deficient material. The turret, if such it was, is reduced by erosion to a pointed cone without character. The specimen is worn to and into the medulla on one side, but the opposite side is well preserved. The leaf scars are typical, but there is a number of large projecting axes looking like horns, and the specimen, laid on the worn side, has the shape and semblance of a gigantic "horned toad." All the other specimens are much alike, and No. 82 is taken as the type for most of the characters.

So far as the rock substance, color, and external organs are concerned, this species is very close to *C. mebridei*, but that species is always simple and consists of one large short trunk, constituting a broad dis-

tion which all the numerous specimens of both species do not tend in any way to obliterate. In its branching habit it approaches *C. minnekahensis* and *C. marshiana*, but the external characters persistently keep it separate from either. In color it somewhat resembles the former, but this is all that can be said.

CYCADEOIDEA McBRIDEI, new species.

1893. *Bennettites dacotensis* McBRIDE, in part, American Geologist, XII, p. 249, pl. XI, fig. 2; Bull. Lab. Nat., Hist. State Univ. of Iowa, II, No. 4, pp. 391, 392, pl. XII, fig. 2.

1894. *Cycadeoidea dacotensis* (McBRIDE) WARD, in part, Proc. Biol. Soc., Washington, IX, p. 86.

Trunks large and very short (25 to 40 cm. high, 25 to 75 cm. in diameter with a girth of 80 to 250 cm.), more or less laterally or longitudinally compressed, well silicified but somewhat porous or spongy and therefore only moderately heavy, reddish brown in color, occasionally bearing small secondary axes which only slightly project; organs of the armor variable but usually radial in direction; leaf scars arranged in spiral rows intersecting each other at various angles, usually forming an angle with the axis in either direction of from 40° to 55° ; scars subrhombic or lozenge-shaped, the distance between the lateral angles varying from 22 mm. to 35 mm., that between the vertical angles varying from 13 mm. to 16 mm., nearly always filled with the well-preserved bases of the leaves which have disarticulated at natural joints, leaving a smooth surface either convex or concave, or occasionally nearly flat, presenting a spongy appearance; vascular bundles of the leaves usually distinct in the form of pits or of dots of darker color arranged in one row all round the margin a short distance from it and with a few additional ones near the center; ramentaceous interspaces thin for the size of the trunks (1 to 4 mm.), compound, that is, consisting of two or more plates of firmer material separated by intervals of loose porous tissue, very uniform in character and little distorted, the porous tissue often worn to some distance leaving fissures divided by thin projecting walls; reproductive organs sometimes abundant and conspicuous, but usually rather scarce and poorly defined, some quite large with a cavitous funnel-shaped or crater-shaped center, others simulating leaf scars except that they are surrounded by a loose porous tissue in which angular pits occasionally occur, still others resembling small branches, making it difficult in some cases to decide to which class to refer them, one which has been cut through the center longitudinally showing a heterogeneous mass of internal organs resting on a conical receptacle 25 mm. below its somewhat projecting summit; armor 4 to 8 cm. thick, separated from the cortical parenchyma by a layer of true bark 6 mm. in thickness of soft texture, its inner surface (exposed in one specimen) covered with small pits or punctations and definitely marked by elliptical scars about 9 mm. long and 5 mm. wide which are aligned horizontally around the trunk the longer axis being in this direction, the

upper side of the scars usually so indistinct as to make them appear kidney-shaped, the lower side and ends consisting of a dark raised ring or welt with a groove all round it and exterior to it, the central portion occupied by a number of punctations more or less concentrically arranged; woody axis 9 to 12 cm. thick, of which the parenchyma occupies somewhat more than half and is very porous except where traversed by the medullary rays of firmer consistency; fibrous zone divided into an outer soft and an inner harder ring, the inner wall of the latter conspicuously marked by the scars of the medullary rays; medulla in the larger specimens 15 cm. in diameter, but usually elliptical and about 8 by 11 cm. of a uniform porous consistency.

I name this species for Professor McBride because he was the first to deal with it, although he confounded it with *C. dacotensis*, and parts of his description apply to the one and parts to the other species. Still his figures are clear and leave no doubt that his fig. 2 belongs here. In his description of that figure he says that it belongs to "another individual," which of course would have been otherwise evident, and parts of his description show that either this or other material in his hands consisted of fragments showing the interior of the trunks, which could not have been exposed in the "large, perfect individual." Most of his description of the internal parts must have been based on such fragments, and the following words appear to apply entirely to the present species: "Leaves not known; their bases as perceived are fusiform or lozenge-shape in cross section, one-half inch by one inch in dimensions, and show the remains of numerous equally developed fibro-vascular bundles."

His specimens seem to have come from exactly the same locality as those purchased from Mr. Cole, which I subsequently visited in company with Professor and Mrs. Jenney, with Messrs. Cole and Payne as our guides. There was found the large branching specimen, *C. minnekahtensis*, and there, too, I picked up twelve fragments of different sizes and shapes. These were numbered in continuation of the Black Hills collection, of which there are seven nearly perfect trunks, and therefore included Nos. 8 to 19. Of these six certainly belong to the present species, namely, Nos. 8, 9, 10, 13, 14, and 16. Two of these fragments, Nos. 10 and 14, are found on comparison to fit together and therefore of course to belong to the same trunk. When placed in their proper position they constitute the greater part of it, but a large segment is missing from one side. Among these specimens, all differently broken, a much larger number of characters are exposed than could be seen in any number of perfect trunks. Wherever two or more display the same parts they are in substantial agreement, and it is therefore assumed that such features as are only visible in some one specimen would be found in the rest if the proper parts could be exposed. The beautiful markings on the inner surface of the liber zone, as above described, are to be seen only in specimen No. 16. That all trunks of the species were of the short conical shape indicated by Nos. 10 and 14 when placed in

their natural position can not of course be demonstrated, but the other specimens do not negative this view.

Professor McBride remarks that "the present species is near *Bennettites gibsonianus* Carr., from which it may be distinguished by greater size and by the fact that in our species the fibro-vascular bundles of the leaf-stems are of uniform size and distribution, and do not form a horseshoe shape in cross section, as is said to be the case in the English species." In this last one would suppose he was confounding the undivided vascular bundle as it appears in the axis, and especially in its passage through the cortical layer¹ before it divides, with the form assumed by the numerous strands that enter the petiole and appear as small dots on a cross section of the latter.² Neither in the American Geologist nor in the Bulletin of the Laboratory of the State University of Iowa do these strands show clearly in fig. 2, still I think I can detect them, but in nearly all our specimens these bundles are very clearly shown, and they do agree remarkably well with those of Carruthers's figure.² Still I should hesitate to refer the American forms to *C. gibsoni* on this character alone, and having myself examined the British specimen I do not think it is very close in other respects.³

The absence of perfect trunks of this species in the U. S. National Museum collection is not due to its rarity in the Black Hills, as I was satisfied after examining the large number of fragments picked up by myself, but to the frailty of the species. There is in fossil cycads certainly a close connection between the mineral constitution and the original nature of the tissues, and both vary with the species, much as different kinds of wood differ in their qualities of hardness, durability, tenacity, etc., in our living forests. Accordingly the substance of the rock in this species is always soft, porous, and light, easily worn by attrition, and therefore frail. Moreover there is a tendency to early decay of the medulla and woody axis, which caused many of the trunks to become hollow before they were entombed. This made compression and general destruction easy and accounts for the difficulty in securing good specimens.

In view of these facts I was not surprised to find a large number of specimens of this species in the Yale collection. There are no less than 13 which I have so referred, although several of these are very abnormal and doubtful. The ones so classed are Nos. 8, 19, 23, 26, 27, 29, 38, 42, 46, 53, 73, 76, and 110. No one of these is absolutely complete, and the greater part of them are mere fragments. In the majority of cases the specific determination is clear at a glance, and this is true even of the smaller fragments. No. 19 is a typical and nearly complete trunk, weighing 51.46 kg., and No. 23 is by far the most perfect specimen of the species known to me. It weighs nearly 59 kg., but there is a vast cavity at the summit. No. 76 is also nearly complete and a fine

¹ Carruthers, Trans. Linn. Soc., XXVI, pl. LVII, fig. 3.

² Idem., pl. LVIII, fig. 2.

³ Sixteenth Ann. Rept. U. S. Geol. Surv., Pt. 1, p. 487.

example, weighing 23.59 kg. There are three dwarf specimens, Nos. 26, 29, 42, and 53, which, though nearly perfect, must be immature trunks if they belong here. They differ too much from each other to constitute a specific group, and I have been obliged to treat them as young, dwarf, or aberrant forms of this species. Nos. 26, 29, and 42 have each a good terminal bud, the only such seen in the species. No. 53 is very small, only 11 cm. high, weighing only 1.57 kg., short-conical, and very symmetrical. It represents the species in miniature, and is doubtless undeveloped.

Only one of the specimens of the Yale collection from the Blackhawk region belongs to this species, namely, No. 110, which consists of nearly half of a large trunk, showing the much worn outer surface, with deep holes, which are often united a short distance within by the decay of the walls so as to produce communicating chambers. The opposite side exposes a large hollow or trough, consisting of the inner wall of the woody zone. It also shows the attachment of the armor and the underlying axis in an exceptional manner.

CYCADEOIDEA MARSHIANA, new species.

Trunks very large, profusely branched, the primary branches often bearing secondary ones, the whole individual frequently consisting of branches, sometimes with a sort of common base, the branches irregular in size, form, and direction, making shapeless or grotesque objects; summits of the branches rounded, bearing small polygonal scars with depressed or cavitous centers separated by deep channels as if from the disappearance of the walls, or filled with the bases of the apical leaves often set in a circular, smooth flattened area and having a small conical protuberance or terminal bud at the center; rock substance hard, heavy, and dark colored, general external appearance rough and massive; forms very variable in size and difficult to measure, the largest attaining 91 cm. in its greatest dimension, the lateral generally greater than the vertical dimensions when standing on the base, the former often 50 to 60 cm., the latter 30 to 40 cm., branches 15 to 30 cm. long, 10 to 40 cm. in diameter, and often over a meter in girth; organs of the armor ascending on all the branches; phyllotaxy usually so disturbed as not to be traceable, but consisting of at least one series of spiral rows of scars passing from right to left at an angle of about 75° with the axis of the branch; leaf scars of medium size or small for the size of the trunks, normally subrhombic, but varying from triangular, or with a mere groove to represent the upper angle, to nearly rhombic, 15 to 30 mm. wide, 7 to 15 mm. high, averaging 12 by 25 mm. for the body of the trunk and 10 by 18 mm. for the branches, usually empty to considerable depth, sometimes filled with the leaf bases, which either present a smooth concave surface or a rough projecting surface formed in part by rows of pointed elevations consisting of the exposed extremities of the vascular bundles lying on the sides of a central con-

ical protuberance the apex of which is formed in part of the more interior strands; ramentaceous interstices usually thick, 5 to 15 mm., hard, roughened, wrinkled, or grooved, often highest next to the scars, sometimes thinner with only a median line; reproductive organs generally abundant on the body of the trunk and larger branches, large, 7 cm. long in a circumferential direction, 5 cm. high, conspicuous, either projecting or cavitous and crater-shaped from the decay of the essential organs, surrounded by concentric rows of large bract scars, sometimes more rare and smaller; armor 4 to 7 cm. thick, but difficult to observe except on the branches where it has little significance, cortical parenchyma 3 to 4 cm., fibrous zone 2 to 4 cm. with two rings; medulla sometimes seen at the compound base, 12 cm. in diameter, often decayed leaving a large cavity, its surface exposed in one specimen showing the scars of the medullary rays in the form of elongated ridges increasing in thickness upward and terminating in a sharp point.

This magnificent species was first clearly made known to me in the Yale collection, where it is represented by four, and probably six, specimens. These are Nos. 4, 11, 33, 44, 47, and 79. The doubtful ones are Nos. 33 and 79. These are single branches of much larger trunks and their characters are somewhat aberrant. Of the other five there is no doubt, as they agree in all their characters. No. 11 is taken as the type. It is larger than any of the rest and the next largest specimen in the Yale collection, weighing 221.35 kg., and therefore holding the third rank in this respect among the cycads of the world. It has the form of a huge animal, has five primary branches, and, when placed in the position in which it probably grew, four of these, with the mass to which they are attached, constitute a sort of fore part, with head, thorax, and fore limbs, while the other represents the hinder part and is aligned in the opposite direction. Between these parts is a constriction dividing the two systems. It is very complete, so much so that it has furnished few of the internal characters.

Nos. 4 and 47 are also large trunks, weighing respectively 52.62 and 34.93 kg., and the other fragments supplement the more perfect specimens, so as to make a pretty full description of the species possible.

I have named the species in honor of Prof. Othniel Charles Marsh, to whose energy and munificence this great collection is wholly due.

When engaged in examining and describing these specimens in the Yale collection I supposed that none existed in the United States National Museum, but on revising all my previous descriptions in the light of the new material I discovered that I was mistaken and that specimen No. 15 belongs to this species. I had referred it with doubt to *C. colossalis*, and under that head had made the following remark: "The only other specimen in the collection of the United States National Museum that I can refer to this species is the fragment No. 15, collected by myself in 1893 on the same spot where the others were found. This is a very irregular block or segment, broken from near the top of

a great trunk. It is similar in mineral character to No. 6, and the leaf scars and other organs agree well with the upper parts of that specimen. The fractures are downward, but follow the plane of the petioles, which are here erect. In No. 15, however, two large and nearly equal branches, whose axes were nearly at right angles to each other, are represented. Viewed from the broken sides the two axes are clearly seen in contact, having a gnarly appearance, such as is normally produced at the junction or crotch between two branches."

This branching character, as I was well aware, does not belong to the large perfect specimen, but having no others, I thought it possible that some of the small secondary axes might in other cases become primary branches. But after seeing so many other specimens of *C. colossalis*, all agreeing in this respect, and also a large number of the present species also all agreeing and exhibiting no tendency to vary in the direction of the other species, it became obvious that the branching forms all belonged to one species and the simple ones to another. The specimen No. 15 clearly belongs to the branching species, and now it is easy to see other specific differences.

CYCADEOIDEA FURCATA, new species.

Trunks large, forking above, or sometimes with a third branch, simple below, laterally compressed, eccentric, light colored, soft and of low specific gravity, 35 to 45 cm. high, 25 to 30 by 35 to 40 cm. in diameter, 90 to 110 cm. in girth; organs of the armor mainly horizontal; leaf scars sub-rhombic or somewhat triangular, the vertical angles generally rounded, the lateral acute, variable in size, averaging 15 by 25 mm., those on the branches smaller, or sometimes nearly as large, empty; ramentaceous walls variable, usually thin, 1 to 5 mm., much thicker in the angles, firm in texture, grooved or divided into two or three plates; reproductive organs few, large, elliptical, 4 to 7 by 7 to 10 cm. in diameter, either set in depressions or somewhat elevated, surrounded by bract scars, either cavitous in the center or solid, the larger ones simulating small branches; armor 4 to 7 cm. thick; cortical parenchyma 7 cm., clearly distinguishable from the darker zone of wood 6 cm. in thickness; medulla elliptical, 9 to 11 cm. in diameter.

This species is thus far represented by only two specimens, namely, Nos. 18 and 60 of the Yale collection, the latter of which is in such a complete state of preservation that little can be known of its internal structure. It is distinguished from all other trunks known to me by a true dichotomy, consisting of a simple trunk with two nearly equal erect branches and a natural junction or crotch at their joint of separation. The axis is far to one side and the trunk is flattened on that side, the entire true base being lateral and the trunk standing on a false base belonging to the armor, but naturally flattened in transverse direction. These peculiarities were doubtless the result of the position in which the trunk originally grew among rocks. Besides this striking charac-

teristic, the light color and soft constitution of the rock, as well as the form and arrangement of the scars, ramentum walls, reproductive organs, etc., distinguish this from all other cycadean trunks. It is a fine specimen and weighs 49.9 kg.

No. 18 consists of two nearly equal branches and one somewhat smaller, arranged in a triangular cluster. Two of them are flat on one side from growing against rocks. The trunk proper can scarcely be said to be represented. The two larger branches are each about 30 cm. in diameter and 23 cm. long, with rounded summits, forming something analogous to terminal buds. Fractures about the lower portion yield elements of internal structure, but they relate to the branches only. The external surface is beautifully preserved. This specimen weighs 66.22 kg.

CYCADEOIDEA COLEI, new species.

Trunks rather large, ellipsoidal, 34 to 48 cm. high, elliptical or nearly circular in cross section, 30 to 39 cm. in diameter and 90 to 118 cm. in circumference at the thickest part, simple, the apex studded with polygonal small scars and presenting a smooth disk with a central elevation; rock substance dark brown in color and moderately heavy; organs of the armor except the very lowest manifestly ascending; leaf scars arranged in two series of more or less distinct spiral rows, those passing from left to right forming an angle of 75° and those from right to left of 45° to the vertical axis; scars subrhombic, varying from almost rhombic to nearly triangular with rounded angles, large, averaging 22 mm. wide and 13 mm. high, but ratio of width to height variable, empty to a depth of 2 to 5 cm.; ramentaceous walls usually thick, but very variable, doubly grooved or wrinkled, cracked or fissured, often pitted by the scars of small bristles or perulae; fruiting axes numerous, small, most or sometimes all of their surface occupied by bract scars, central portion correspondingly small, generally cavitous from the disappearance of the essential organs, which appear to have often been immature or abortive; armor about 6 to 7 cm. thick; cortical parenchyma 3 cm. thick; fibrous zone 2 cm., consisting of two rings of wood; medulla about 9 cm. in diameter.

This is a very handsome species of which the type specimen was purchased of Mr. F. H. Cole, for whom the species is named. That specimen weighs 63 kg.

The Yale collection contains nine specimens that I was obliged to refer to this species. These are Nos. 12, 20, 25, 28, 48, 52, 57, 68, and 80. Of these Nos. 25 and 80 are small and either dwarfed or immature, and Nos. 28 and 52 are small fragments. The rest are fairly typical and furnish good characters. No. 48, though small, weighing only 29.49 kg., is perhaps the most typical. No. 57, though not complete, weighs 56.24 kg., and was doubtless originally quite the equal of the United States National Museum type. No. 12 has an unusual number of fruiting axes.

CYCADEOIDEA PAYNEI, new species.

Trunks medium sized, laterally compressed, usually enlarging from the base upward to near the summit but sometimes subcylindrical, 30 cm. to 55 cm. high, 65 cm. to 85 cm. in average girth, 20 by 25 cm. to 25 by 35 cm. in diameter, light or darkish brown in color, not specially firm or heavy, bearing few or not any secondary axes; organs of the armor horizontal; phyllotaxy rather obscure, but scars arranged in imperfect spiral rows, chiefly subrhombic, but varying to rhombic or triangular, much distorted in the specimens in hand, but where clearly shown 10 to 16 mm. high and 16 to 31 mm. wide, empty to some depth, their bottoms filled with the partially decayed remains of the petioles; ramentaceous interstices rather thin but variable, usually with a more or less distinct commissure; reproductive organs or their remains numerous and conspicuous, often projecting considerably beyond the general surface in the form of protuberances or terete spongy cylinders, often decayed leaving large cavities, more or less crater-shaped or funnel-shaped, the interior sometimes definitely grooved or marked, surrounded by numerous, sometimes large triangular involucreal bract scars; armor varying in thickness from 2 cm. to 7 cm., attached by an irregular line or thin layer of bark to the cortical parenchyma which is 1 to 2 cm. thick and incloses a fibrous zone of about the same thickness, which is divided into two or three rings; medulla less compressed than the outer parts, 6 to 10 cm. in diameter.

The only specimens that certainly belong to this species are Nos. 4 and 5 of the collection purchased from Mr. Cole. The description of the internal parts is chiefly based on No. 5, which is the smallest of that collection and has been cut longitudinally through the axis, one of the halves cut transversely 12 cm. above the base, and the surfaces polished. These sections furnish clear views of the organs of the armor and of the relations of the armor to the underlying parts. The specific identity of the two specimens is based on the external characters, which substantially agree. No. 4 weighs 33.11 kg., and No. 5, 22.22 kg. I name the species for the ranchman, Mr. Payne, who originally discovered the cycads of that region and from whom Mr. Cole obtained them. He it was, moreover, who finally guided us to the locality after Mr. Cole had vainly sought to take us to it the previous day, missing the way, notwithstanding that he had been at the spot.

In the Yale collection there are three specimens, Nos. 58, 69, and 77, which I have doubtfully referred to this species, although some of the characters are different from those above described. Nos. 58 and 69 are vertically instead of laterally compressed. If this is due entirely to pressure of the superincumbent mass after entombment, it has no systematic value and depends upon the position occupied by the specimen; but eminent authorities have insisted that it is a condition of growth. I am inclined to think that this may be true in some cases, but that the former explanation is the chief one.

No. 77 of the Yale collection is smaller above than below, and if it belongs to *C. paynei* this is not a constant character. There is, moreover, a peculiarity in No. 77 which distinguishes it from all other cycadean trunks known to me, and which could not well be described as a specific character. I therefore set it forth here as an individual trait, due perhaps entirely to the particular time at which the trunk was entombed and the conditions under which its mineralization took place. The specimen shows a large number of fruits on its surface, which are filled and protrude in greater or less degrees. Many of them consist of protuberances or gentle swellings presenting a uniform granular surface. These apparent granules are about 1 mm. in diameter, and have the character of vein quartz or chalcedony, sometimes with a blueish cast, as if partially opalized. They are very uniform in size and appearance, and look much like little seeds. In some of the fruits, however, they are so exposed as to show what lies below the immediate surface, and here they have the form of the terminal portions of small rods or the silicified cores of tubes. The fact that they occupy the whole central portion of the organ precludes the possibility of their being the bases of involucre bracts, and, besides, they are not angular nor semilunar, but cylindrical. They must, therefore, represent some of the growths from the receptacle of the spadix, and the only such growths thus far found in fossil cycads are the seminiferous peduncles and the interseminal scales or chaff. I incline to regard them as the representatives of the former of these organs, but they are probably not the organs themselves silicified, but simply the homogeneous and structureless siliceous rods or cores that have filled the tubes caused by the decay of these organs.

The Yale specimens are all smaller than either of the National Museum types, No. 77 weighing 21.09 kg., No. 69, 20.86 kg., and No. 58, which is dwarf, abnormal, and perhaps immature, 5.33 kg.

CYCADEOIDEA ASPERA, new species.

Trunks small, subconical, simple, very rough on the surface, light brown varying to whitish, dark with white streaks within, moderately heavy, about 20 cm. high, nearly the same in diameter, and 70 cm. in circumference; organs of the armor somewhat declined throughout; phyllotaxy not traceable; leaf scars anomalous in having the upper angle much sharper than the lower, the reverse of the usual case and only elsewhere observed in *C. insolita*, lower angle reduced to a groove, a curve, or a straight line, lateral angles always sharp; scars small, 12 to 25 mm. wide, 10 to 15 mm. high, subrhombic; leaf bases present usually projecting 5 to 10 mm. above the walls, presenting a light brown, very spongy and porous surface, without evidence that any of the pores represent the scars of vascular strands; ramentaceous interstices thin, 1 to 5 mm., dark reddish brown, sunk to varying depths among the projecting leaf bases and other organs, scaly and laminated with crooked and twisted plates; reproductive organs as

numerous as the leaf scars, projecting much beyond the petioles, sometimes 3 cm. high, solid or variously broken and jagged, occasionally somewhat cavitous, scarcely showing any involueral scales, but in addition to all the other organs described are small angular bracts, mostly broken down, presenting sharp edges and projections over the surface, intermediate in character between scales and leaves, properly to be classed as bristles or perulae; all the different projecting organs giving the trunk a ragged and horrescent appearance; armor, including projections, 6 cm. thick, the vascular strands traceable far into the woody zone and inner limit not definite; parenchymatous layer 15 mm. thick penetrated by the whitened leaf bundles; secondary wood 2 cm. thick, consisting of two nearly equal rings, the outer white, the inner black or dark blue in the only specimen known; medulla 6 cm. in diameter, dark, fine-grained and homogeneous.

This species is based on the single specimen, No. 104, of the Yale collection from the Blackhawk locality, which is somewhat less than half of a trunk that divided along a vertical plane from top to bottom almost as smooth and even as if sawn through by a gang saw, exposing the interior in an admirable manner. Its only affinities are with *C. paynei*, and the specimen, though smaller, has a remarkable resemblance to No. 5 of the U. S. National Museum, which was cut through on the same plane as this specimen. The resemblance is, however, more apparent than real, and the descending leaves, and especially the inverted scars, clearly exclude it from that species. Add to this that no specimens of *C. paynei* have been found elsewhere than in the original Minnekahta locality, and the improbability of this belonging to that species is very great. It is too perfect a specimen to class as undeterminable, and there seems no course left than to treat it as constituting a new species.

CYCADEOIDEA INSOLITA, new species.

Trunks medium sized, unbranched, somewhat elliptical in cross section, subcylindrical or subconical; rock substance light colored, moderately hard and heavy; height of trunks 30 to 40 cm., diameter 30 to 35 cm., girth about 1 meter; organs of the armor nearly horizontal; leaf scars irregularly distributed over the surface, very variable in size and shape, rhombic or subrhombic, in the latter case having the more acute angle above and the more obtuse one below, that is, the opposite of the normal condition, 15 to 25 mm. wide, 8 to 15 mm. high, sometimes empty to some depth, but in some such cases the summits of the leaf bases showing the vascular bundles in the form of little rods or pins projecting upward and forming a row all around the leaf bases close to the margin with others near the center, about 18 to each leaf; leaf bases sometimes projecting in the form of small cones, in which cases the bundles can be seen either as black dots or as little protuberances around the sides of the cones; ramentum walls thin but variable, 1 to 4 mm., firm and sharp on the edges of the scars, grooved along the

middle; reproductive organs abundant, disturbing the phyllotaxy, tending to congregate and blend together, presenting a rough surface, usually projecting, rather small and with few bract scars; armor 4 to 6 cm. thick, cortical parenchyma 2 to 3 cm., fibrous zone 15 to 30 mm. with two or three rings, the outer either preserved and showing fine-grained structure or much decayed, in either case conspicuously partitioned off by the medullary rays, the others also showing woody wedges; medulla 8 by 12 cm. in diameter at the base, enlarging upward, hard and homogeneous in structure.

This species is founded on two specimens in the Yale collection, Nos. 50 and 64, chiefly the latter, No. 50 being only a small fragment. The characters can not be forced into any other species, especially the inverted leaf scars and the peculiar habit of the vascular bundles in the petioles. In No. 33, which is a branch of a trunk of the type of No. 11, and has been referred to *C. marshiana*, this latter peculiarity is nearly repeated, but this happens in no other specimen of that species.

No. 64 is the lower part of a trunk irregularly broken across the top and down one side to near the middle. The apex is therefore unknown. It is this specimen that has furnished all the external characters, but No. 50 shows precisely the same characters, so far as it goes, and adds somewhat to the knowledge of the internal parts. No. 64 weighs 24.95 kg. and No. 50, 3.29 kg.

CYCADEOIDEA OCCIDENTALIS, new species.

Trunks medium sized, conical or ellipsoidal, simple or with a few small secondary axes, well silicified, moderately hard and heavy, reddish brown without, dark or nearly black within; organs of the armor generally ascending; phyllotaxy not traceable in any of the specimens; leaf scars subrhombic, variable in size, 16 to 25 mm. long, 10 to 16 mm. high, usually filled by the leaf bases; bundles not visible; ramentaceous interspaces thin, less than 2 mm., roughened without, white within, contrasting strongly with the black petiolar substance in longitudinal section; reproductive organs rare, slightly protruding, usually having remains of the organs preserved, occasionally decayed so as to leave openings, obscure from without, distinct in sections longitudinal to them, penetrating to a depth of 6 cm.; the substance above the fruit light colored; fruit dark, elliptical or ovate, nearly homogeneous and showing no structure, subtended by strong involucreal bracts and crowded by a mat of chaff probably consisting of the summits of the interseminal scales, seeds not detectable; armor 5 to 8 cm. thick, irregularly joined to the woody axis, the outer or parenchymatous portion of which to a thickness of 3 cm. is more or less decayed in most of the specimens, the fibrous zone divided into two rings each about 15 mm. thick, the innermost very firm and fine-grained, its inner wall (exposed in two specimens) regularly marked by the scars of the

medullary rays, the scars consisting of conspicuous elongated depressions arranged in longitudinal rows at equal distances (1 cm.) from one another; the scars nearly the same distance one above another but alternating so as to form diagonal rows crossing the vertical ones at an angle of nearly 45° ; inner face of the second ring of wood (exposed over a small area in one specimen) nearly smooth but faintly striate in a horizontal direction, marked with smaller, more distant scars; medulla (represented only in one small disk-shaped specimen from near the top of a trunk, and here thoroughly crystallized) scarcely known.

Four of the fragments picked up by me belong to this species. They are Nos. 11, 12, 17, and 18. No. 11 is a large block weighing over 7 kg., showing considerable of the external surface, which is not very clear. Portions of it have been detached and cut in several directions to show the internal structure. Most of such characters above given are derived from this source. No. 12 is a very small piece, consisting entirely of the fibrous zone of wood, of which it shows the inner wall with the scars identical in character with those of No. 11, of which it is probably only a detached fragment. No. 17 is a crescent-shaped fragment from a small trunk and weighs 2.27 kg. It appears to have come from near the top of the trunk. No. 18 is a thin, horizontal zone or disk from near the top of a small trunk. The internal portion is much crystallized.

CYCADEOIDEA JENNEYANA Ward.

1894. *Cycadeoidea jenneyana* WARD, Proc. Biol. Soc., Washington, April 9, 1894, IX, p. 87.

Trunks large and tall, attaining a height of 130 cm., cylindrical, little compressed, 30 to 50 cm. in diameter, the girth reaching over a meter and a half, firmly silicified, more or less chalcedonized or opalized within, very hard and heavy, light brown or reddish externally, white or reddish, sometimes black within; organs of the armor horizontal except near the summit; leaf scars arranged in intersecting spiral rows, those passing from left to right making an angle of about 40° and those from right to left of about 50° with the vertical axis; scars subrhombic to subtriangular with mostly rounded angles, sometimes kite-shaped, large, 20 to 30 mm. wide, 12 to 25 mm. high, partially or wholly filled with the remains of the leafstalks; vascular bundles in the petioles arranged in an imperfect row all round near the margin with other straight rows, or somewhat scattered in the interior, numerous (forty were counted in one cross section), circular, elliptical, crescent-shaped, or kidney-shaped in section; ramentaceous interspaces very thick but somewhat variable (6 to 13 mm.), sometimes roughened or irregularly affected by small pits representing bract scars, a line of which may run through the center dividing the walls, or by cracks which divide them into plates or small partitions; reproductive organs numerous, large, and well developed, often protruding, sometimes cavitous, scattered over all parts of the surface, axillary to

the leaf scars, whose shape and order they distort, elliptical in outline, 25 to 40 mm. in a horizontal and 18 to 26 mm. in a vertical direction, surrounded by concentrically arranged semilunar or somewhat triangular bract scars which are sometimes continued in a horizontal direction, converging and blending with the rows dividing the walls, the central portion when exposed at the margin of a fracture taking the form of an elongated cylindrical spadix or fruit, which, seen in cross section, proves to be made up of four large organs which seem to contain two axes, and seen in longitudinal section, to constitute a convex receptacle from which arise seminiferous peduncles (or filaments) and interseminal (or interstaminate) scales, the seeds (or anthers) having disappeared leaving a region of amorphous decayed tissue occupied by the matted prolongations of the chaff; armor 8 to 9 cm. thick; liber zone very indistinct; cortical parenchyma 3 to 4 cm. thick; fibrovascular zone about 2 cm., without visible subdivision into rings; medulla slightly elliptical, the major diameter 16 to 17 cm., the minor 13 to 14 cm., black and cherty in all the specimens, showing no structure, giving off rays which may be seen traversing the woody cylinder.

The above description is based mainly on two large trunks, or parts of the same trunk, which, through the intervention of Professor Jenney, were generously loaned to the Smithsonian Institution by Dr. V. T. McGillicuddy, director of the State School of Mines of South Dakota in Rapid City, where they had been deposited. There are many reasons for believing that these two pieces belong together, and, with a small missing intermediary piece, constituted a tall, cylindrical trunk. One of the pieces, about 40 cm. long, represents the true base, and the other, 58 cm. long, the true summit. The former is scarcely worn at all, while the latter is deeply eroded all round as the result of having been long exposed to adverse influences, probably by having lain in the bottom of a gulch. It is therefore considerably smaller than the normal diminution upward would require. The difference applies, however, wholly to the exterior, and the medulla and woody cylinder are no smaller than would be the case in an entire trunk at different heights. After a careful examination I have arrived at the conclusion that if they are parts of one trunk it would only indicate the loss of about 30 cm., which would give a total height for the trunk of about 130 cm.

Only two other tall, cylindrical species of Cycadeoidea are known to me, namely, the *C. excelsa*, described below, and the *C. gigantea* of Seward from the Purbeck beds of Portland.¹ Specifically, of course, *C. jenneyana* is very distinct from both of these, but in its straight, erect habit it somewhat resembles *C. gigantea*. It is much less compressed laterally, and if my conclusions are correct as to the amount missing between the two sections, it was taller by 11 or 12 cm. Mr.

¹A. C. Seward, on *Cycadeoidea gigantea*, a new Cycadean stem from the Purbeck beds of Portland. Quart. Journ. Geol. Soc. London, February, 1897, LIII, pp. 22-39, pls. 1-v.

Seward does not state the weight of his specimen, but if the material at all resembles that of all other cycads from those quarries its specific gravity is low and the weight would be small in relation to the bulk. He states the girth of the specimen at 107 cm., while that of *C. jenneyana* is very nearly 130 cm. More exactly, the lower piece, measured at the middle, is 129.54 cm., while the upper piece, both at the lower end and at the middle, measures 107 cm. The difference, as explained above, is chiefly due to erosion of the surface of the latter. The lower piece weighs 95.26 kg. and the upper, 86.18 kg., a total of 181.44 kg. The entire trunk must therefore have weighed nearly 250 kg., which would have given it the third rank, from this point of view, among the fossil cycads of the world.

The question whether there are any other specimens in our collection that belong to the same species is a more difficult one. In 1893 I visited the spot where the large trunks were originally found. I was accompanied by Professor and Mrs. Jenney, and we took with us as our guide Mr. Gilbert Getchell, of Rapid City, who said he helped load the specimens into the wagon in 1876, in company with Mr. Leedy, who had discovered them some time earlier, but who was no longer in those parts. Mr. Getchell showed us the locality, on the ranch of a Mr. Black, 2½ miles north of Blackhawk. No other fragments were found by any of our party, although we all searched diligently for several hours and collected a large amount of silicified wood. We were told at the ranch that a man named McBride (not Professor McBride, of course) had been in the region and had gathered and taken away all the specimens he could find.

Later in the summer, when I was in California, Professor Jenney learned the whereabouts of Mr. McBride, who was then in Deadwood, and purchased two fragments of cycads from him that he said came from that locality. He also purchased two other fragments from a man named Stillwell, in Deadwood, also as he was informed, from the same place. All these he sent to Washington, and they constitute a part of the cycad collections in my hands.

Upon careful examination of all four of these fragments I conclude that there is nothing to negative the supposition that three of them belong to the same species as the large trunks, and I have accordingly included them under *Cycadeoidea jenneyana*. They were numbered in the collection as: McBride Fragments, Nos. 1 and 2, and Stillwell Fragment, No. 1.

These fragments are irregular and not well preserved, but they evidently came from large trunks, and all the characters that they show agree substantially with those of this species. As they come from the same locality, and as a portion of the great trunk is missing, I have examined them carefully to see whether they might possibly belong to that trunk, but I find no evidence of this. These fragments weigh, respectively, 12.25, 11.34, and 7.26 kg.

A few days after visiting this locality on Black's ranch I was in Hot Springs, and purchased a number of fragments of cycads from a dealer named Homer Moore. Two of these, which fitted together, forming a block weighing a little more than 7 kg., evidently belonged to a very large trunk, and these show a number of characters which agree with those of *C. jenneyana*. In fact they very closely resemble the Stillwell Fragment, No. 1, so that whatever is done with the one must be done also with the other. Mr. Moore thought that these specimens came from the Minnekahta region, but was uncertain as to their source. They certainly differ specifically from any of the material from that region, and agree substantially with most of that from Black's ranch. I shall therefore include them under *C. jenneyana*.

I had in hand two small slabs belonging to the Woman's College of Baltimore, purchased in Germany by Dr. John F. Goucher, president of that college, and sent over, along with the Bibbin's collection, from Maryland. Dr. Goucher informed me that when he purchased these fragments he was told that they came from the Black Hills in America. I can well believe this, as, so far as they go, they are substantially identical with the material from Black's ranch, and I am obliged to refer them to the present species. They contain none of the woody cylinder, but are confined to the armor, of which they show a thickness of 3 to 5 cm. The exterior is obscure and closely resembles the Stillwell Fragment, No. 1, and the Homer Moore Fragment, but the inner face is cut and polished in a direction transverse to the leaf bases, which are beautifully shown, and also in the opposite direction, showing the organs in longitudinal section. Fruiting axes are also thus exposed, and much of the above description relating to the structure of these organs is derived from a study of these sections. I have no doubt that the other specimens, when similarly cut, as they will be eventually, will furnish the same characters. In fact, they can now be less distinctly seen on a number of fractured surfaces.

These specimens bear the labels of the Museum of the Woman's College, Nos. 1501 and 2128. The former weighs 532 grams and the latter 489 grams. They are exactly alike in all essential respects and may well have belonged to the same trunk.

In the Yale collection there are 24 specimens that appear to belong to this species. These are Nos. 81, 87, 88, 90, 91, 93, 96, 97, 98, 101, 102, 108, 109, 111, 112, 113, 114, 115, 116, 120, 121, 124, 125, and 126. It will be observed that all but the first two of these came with the two last invoices, and are from the Blackhawk region, the same from which the original type of the State School of Mines was obtained. The two reported from the Minnekahta region, Nos. 81 and 87, also belong to this species beyond a doubt. No. 81 consists of eight small fragments, which all fit together and form an irregular segment from a large trunk similar to those belonging to the State School of Mines of South Dakota. Indeed, they might have belonged to the supposed

missing portion of the tall trunk which those two pieces are believed to have so nearly constituted. The eight fragments together weigh 9.5 kg.

No. 87 also consists of a number (five) of small fragments that can be built up into a segment of a trunk, and altogether weigh 7.6 kg., but these do not so closely resemble the type specimens. Still, the characters they possess are those of this species. Professor Marsh thought that these specimens came from the Blackhawk locality, but Mr. Stillwell, from whom they were purchased, states that they were obtained 3 miles southwest of Minnekahta station. This agrees closely with the original locality. I am disposed to believe that there has been some mistake, and that these particular specimens are, after all, from the Blackhawk region.

Of the other 22 from the Blackhawk region Nos. 91, 113, 120, and 124 are somewhat doubtful. No. 91 has a large terminal bud, 8 cm. high, elliptical in cross section, and 15 by 20 cm. in diameter, studded with polygonal bract scars, 5 to 8 mm. in diameter, filled with the bases of the bracts or small leaves matted together and exposed on the sides of the terminal bud which have suffered from erosion. I have not included this bud in the description of the species on account of doubts as to the true affinities of this specimen, which, if it belongs here, is the only one in which the bud is preserved. The surface is so badly worn that all the reliable characters are obscured except that in general shape the specimen agrees with others of this species. The scars are large and the walls thick, which further confirm this supposition. No. 113 is also badly worn and metamorphosed, but probably belongs to this species. It is a fine trunk, nearly complete, 55 cm. high, and weighs 91.17 kg. No. 120 is an interesting specimen, and shows a great number of large fruits which stand out, having resisted the deep erosion of the surface. No. 124 is a mass of quartz and only a fragment, but in all probability came from a trunk of *C. jenneyana*.

The rest of the specimens, though mostly fragments and segments from large trunks, are not doubtful, as they show surface characters in all cases which are distinctive. Several, however, are fine trunks. No. 101, though in three sections perfectly fitting together, is an almost perfect trunk, laterally compressed, 97 cm. high, and weighs 183.71 kg., which is a little more than one kilogram heavier than both pieces of the type specimen from the State School of Mines of South Dakota. Unfortunately the surface is badly worn and the most important characters are obscured. No. 102 is the lower part (36 cm.) of the largest trunk of the species thus far known. It is nearly circular in cross section, has a diameter of 47 cm. and a girth of 156 cm. Its surface is also in a fair state of preservation. No. 121 is a similar but much smaller basal portion. No. 115 is anomalous in many respects and might have been included among the doubtful cases. Though in two pieces it is nearly complete and weighs 87.77 kg., having a height of 60 cm. and a girth of 106 cm. Some of the leaf bases are horizontal, while others

are strongly declined. The latter are all on one side below the middle, and in the case of certain abnormally small but strongly projecting leaf bases there is the additional peculiarity that they are converted into impure opal or blue quartz. No. 116 is also a fine, nearly complete trunk 49 cm. high, 42 by 36 cm. in diameter, 120 cm. in girth, and weighs 85.73 kg.

CYCADEOIDEA INGENS, new species.

Trunks large or colossal, ellipsoidal in form, thickest at the middle part, diminishing and more or less rounded off at both base and summit, slightly elliptical or nearly circular in cross section, unbranched or with a few small secondary axes in the form of protuberances, usually of a dark color, hard consistency, and high specific gravity, attaining a maximum height of 85 cm., girth of 170 cm., and weight of over 300 kg.; organs of the armor slightly declined near the base, horizontal in the middle portion, ascending above, and erect at the apex, producing a large terminal bud consisting of the bases of somewhat flattened leaf-like bracts or scales; leaf scars arranged in two sets of rows passing spirally round the trunk, intersecting each other, and forming each a different angle with the axis, those passing from left to right forming an angle of about 35° to 45° , while those passing from right to left form an angle of 50° to 60° ; scars large, 35 to 50 cm. wide, 20 to 35 cm. high, peculiar in shape, the lateral angles drawn out into sharp points by the incurving of the sides, the vertical consisting of mere curves, varying from this to simple gibbosity; leaf bases always present filling the scars and often projecting, presenting either plane or slightly convex surfaces; vascular bundles in one row closely set together and very near the margin and an irregular ring at the center inclosing an empty space; ramentaceous interspaces thin, 3 to 10 mm., scaly or laminated, sunk below the leaf bases forming grooves on the surface of the trunk, often white in color contrasting with other parts; reproductive organs abundant especially in the upper part of the trunks, very different from the leaf bases, usually large, elliptical, 5 to 6 cm. wide by 3 to 4 cm. high, sometimes solid and projecting, but usually with an opening at the top or cavitous and crater-like, surrounded by numerous bract scars filled with the bases of the bracts which are usually narrowly triangular or nearly flat; armor 5 to 10 cm. thick, more or less clearly marked off from the underlying tissues; cortical parenchyma 3 to 4 cm. thick; zone of secondary wood 4 cm.; medulla 10 to 20 cm. in diameter.

A perfectly well characterized species, differing entirely from any of those based on specimens from the Minnekahta region. It is also very distinct from *C. jenneyana*, which is the leading form of the Blackhawk region. Still this species is also common there, and is represented in the collection by eight specimens, namely, Nos. 92, 94, 99, 100, 103, 117, 122, and 123. No. 100 is taken as the type and is the next largest cycadean trunk known in the world, weighing 303.91 kg. It slightly exceeds in height the U. S. National Museum type of *C. colossalis*.

having a maximum length of 85 cm. Its diameters are, respectively, 62 cm. and 49 cm., and it has a girth of 170 cm. But like all other specimens of this species it diminishes in size toward each end and is somewhat barrel-shaped.* Nos. 103 and 117 represent the lower part of two other large trunks, and the summit is represented only in No. 100. No. 94 comes next in point of interest in affording most of our knowledge of the internal structure of the species, including the markings on the medulla. No. 123 is also instructive from this point of view. The rest are fragments, but all add to the complete conception of the species.

The form of the leaf scars is imitated very closely by two other species, one of which, *C. formosa*, is represented by only one specimen, No. 89. The other is *C. stillwelli*, and this is made very clear by the new material added by the specimens last sent from the Blackhawk region by Mr. Wells, especially No. 105. In both these cases, however, the scars are much smaller, and this is particularly the case with *C. stillwelli*.

CYCADEOIDEA FORMOSA, new species.

Trunks of moderate size, short-conical, unbranched, dark brown, nearly black within, of average specific gravity, about 25 cm. high, nearly 30 cm. in diameter and having a girth of somewhat less than a meter; organs of the armor, even the lowest, somewhat ascending with a uniform angle; leaf scars arranged in two series of spiral rows, those of both series making an angle with the axis of about 50°; scars large for the size of the trunk, peculiar in shape, the lateral angles very sharp, the vertical ones very obtuse and rounded, the bounding sides usually curving downward and upward on the right and left causing the scars to be drawn out laterally corresponding to wings of the petioles, lower side more pronounced than the upper in such a manner that a line joining the lateral angles divides the scar into unequal areas, varying to simply gibbous by the absence of the above described curves; distance between lateral angles 25 to 30 mm., that between highest and lowest points 16 to 20 mm.; leaf bases always present, usually projecting somewhat, sometimes nearly 1 cm., outlines definite, conforming to shape of scars, exposed ends presenting surfaces that are exactly square or tangential to the trunk, never convex nor concave, smooth but not polished, covered by a diaphragm representing a natural plane of disarticulation, this layer, however, sometimes removed, in which case small projecting points are irregularly scattered over the surface of the leaf base; outer row of leaf bundles very close to the margin, faintly visible at the ends, more clearly as striae on the eroded sides of projecting leaf bases; ramentum walls thin, 1 to 3 mm., thickening at the angles, sunk below the petioles and usually separated from them by a crack, dull colored, loose in structure and somewhat pitted, having the appearance of cracks filled with mud or extraneous matter; reproductive organs numerous and well marked, occurring at all points,

but tending to an arrangement in vertical rows one above another with a trend different from that of either of the rows of leaf scars, projecting beyond the leaf bases to which they bear no resemblance, rounded or elliptical, 3 to 6 cm. in diameter, never cavitous, usually exhibiting concentrically arranged scars, the circular central portion inclosed in a tube surrounded by involueral bract scars occupied by the bases of the bracts which project in miniature imitation of the leaf bases, the central portion sometimes occupied by small cylindrical bodies or rods 1 mm. in diameter and 1 to 5 mm. long, consisting of nearly pure quartz; armor 5 cm. thick, definitely separated from the axis by a porous liber zone of appreciable thickness; cortical parenchyma 15 mm. thick; secondary wood 4 cm. thick consisting of two distinct rings of about equal thickness separated by a peculiar scalloped line, apparently caused by the convex edges of woody wedges 5 mm. thick separated by thin medullary rays; medulla 9 cm. in diameter, somewhat heterogeneous or chambered in structure.

This species is represented by the single specimen No. 89 of the Yale collection. It has close affinities on the one hand with *C. ingens* and on the other with *C. stillwelli*, while all these are related to *C. mebridei*, but it is impossible to refer it to any of these species.

CYCADEOIDEA STILLWELLI, new species.

Trunks small, cylindrical, or more or less laterally compressed, 30 to 40 cm. high, 15 to 25 cm. in diameter, 40 to 70 cm. in girth, reddish or light colored externally, cherty, flinty, or more or less agatized within, simple, or bearing a few small branches in the form of projections or protuberances, short conical at the summit, with a natural depression at the apex, studded with small polygonal scars and a gentle swelling at the center; organs of the armor nearly horizontal; leaf scars arranged in two series of spiral rows, those from left to right making an angle of 40° to 50° , those from right to left of 30° to 50° with the axis of the trunk; leaf scars normally almost exactly rhombic or diamond-shaped, but with a tendency on the one hand to the rounding of the vertical angles and on the other to the incurving of the sides so as to exaggerate the acuteness of the lateral ones, this sometimes very marked; scars small, 20 to 25 mm. wide, 15 to 20 mm. high, occasionally almost as high as wide, the lateral diagonals about horizontal and the vertical ones perpendicular to them, or vertical; leaf bases always present, filling the scars, often projecting, sometimes considerably, the petioles disarticulating at several different points by means of a diaphragm which forms a thin layer over the exposed summits, the occasional absence of which leaves a rough spongy or porous structure; vascular bundles arranged in two rows, one near the margin and parallel to it, the other forming an elliptical ring at the center 3 by 4 mm. in diameter, both rows usually appearing in the form of denticulate ridges; ramentaceous walls very thin, 1 to 2 mm., often sharp at the surface,

generally sunk below the leaf bases forming grooves or deep chambers between them, the surface therefore consisting chiefly of the latter, in the more abnormal forms of scar describing a double curvature and having somewhat the shape of a "line of beauty," in penmanship or one of the parts of a Buddhist cross or "swastica," sometimes, however, projecting so as to leave a groove around the outer edge of the convex summits of the leaf bases; reproductive organs few, more numerous on the narrower sides of the trunk, disposed somewhat in rows or chains, generally parallel to the axis but sometimes running round the trunk, more or less contiguous, consisting of protuberances, some rising above the highest leaf bases, closed, or more commonly open at the top, sometimes crater-like but generally truncated, presenting an irregular surface with numerous pits or pores at the center surrounded by bract scars which are sometimes empty, but usually occupied by the bases of narrowly triangular or flattish bracts projecting and squarely truncated with thin interspaces in miniature imitation of the leaf bases; armor much thicker on the narrower than on the broader sides of the trunk, 3 to 6 cm. thick in the former and 2 to 3 cm. in the latter case, clearly and definitely marked off from the woody axis by a cambium line; cortical parenchyma 15 to 20 mm. thick; secondary wood zone 10 to 20 mm., very fine-grained and clearly marked off from the last; medulla somewhat elliptical, 5 to 8 cm. in diameter, marked on its external surface by rows of small rhombic projections of a dark color terminating in small longitudinal ridges representing the origin of the medullary rays.

The small, cylindrical section of a trunk acquired through Professor Jenney's intervention from Mr. L. W. Stillwell, of Deadwood, exhibited so many good characters, all different from those of any other specimen in the U. S. National Museum collection that before I had seen the Yale collection, in fact long before it was made, I had described it as a new species and named it for Mr. Stillwell. It was reported to have been found in the Blackhawk region, and there is every reason to believe that such was the case.

The Yale collection contains six specimens of this species, each of which adds something to our knowledge of it. These are Nos. 16, 36, 56, 105, 107, and 119. The first three of these purport to come from the Minnekahta region, while the others are certainly from the Blackhawk region. The first of these is somewhat smaller than the type, and has near its summit two small branches. The leaf scars are normal and confirm my suspicion that the peculiar form which they have in the original specimen is due to lateral compression. It weighs nearly 5 kg. No. 36 represents the upper part of a trunk of exactly the same diameter as the Stillwell specimen, but with the outer parts all worn away. The summit, however, is perfect. The transverse fracture has supplied a number of otherwise missing or imperfect characters. This specimen weighs 8.17 kg. No. 56 is larger and entire from base to summit, but broken in two near the middle. It is very elliptical in cross section from

lateral compression, badly worn like the others, and has a slab scaled off from one side, exposing the outer surface of the medulla and corresponding inner wall of the woody zone. This specimen is 39 cm. high, 15 by 20 cm. in diameter, and has a girth of 54 cm. Its ellipticity is, however, exaggerated by the greater erosion of the flat sides. It weighs 12.7 kg.

No. 105 is only a section, weighing 12.8 kg., with base and summit wanting, also a piece from one side, part of which was saved, but the part that remains shows the outer surface in the most perfect state of preservation, and much of the above description of the phyllotaxy, leaf scars, petioles, vascular bundles, ramentum walls, etc., is derived from it. No. 107 is also an exceedingly interesting specimen, weighing 9.07 kg., and is especially valuable as showing the true base. It is obliquely broken through from the top to near the bottom, but one side shows the spiral rows of leaf scars. No. 119, although larger, weighing 14.29 kg., is not as well preserved, but also shows the base, which is slightly concave.

Upon the whole, this species may be regarded as one of the best characterized of all that have been based on cycadean trunks alone:

CYCADEOIDEA EXCELSA, new species.

Trunks tall, compressed-cylindrical (only specimen known 91 cm. high and truncated), with an enlarged base, 112 cm. in circumference at the base, 80 to 90 cm. at all other points, light ash-colored without, whitish or bluish within, soft externally, fine-grained inside and moderately hard, with the specific gravity rather low, unbranched but more or less irregular, crooked, zigzag, and inclined; organs of the armor horizontal, or at right angles to the axis; leaf scars disposed in two series of spiral intersecting rows, those from left to right making an angle of 20° , those from right to left of 50° with the axis; scars imperfectly rhombic or rectangular, the diagonals 16 to 25 mm., the lateral angles nearly alike, the vertical ones usually unlike, the upper consisting of a deep but obtuse sinus, the lower also obtuse but relatively shallow, sometimes reduced to a gentle concave curve formed by the two lower sides; leaf bases generally preserved to within 2 cm. of the surface, disarticulated at a natural joint, its surface even and concave but roughened and affected by many small dots of a dark color, irregularly arranged, perhaps representing gum ducts, and some large pits which may have contained leaf bundles; ramentaceous walls thin and frail, 1 to 2 mm., of a light color within contrasting with the darker leaf bases, thickened at the angles and more or less compound, with a few small pits representing scars of bracts or perulae; reproductive organs numerous, usually solid, harder than the remaining parts, hence often projecting from the eroded surfaces, of different sizes, the smaller ones probably abortive and occupying angular spaces among the leaves, the walls dividing and surrounding them, circular in

section, with or without bract scars, the larger ones lying in interrupted rows running in the same direction as those of the scars which they crowd and distort, elliptical in section, the longer diameter being along the line of the rows, 25 mm. by 38 mm. in diameter, usually solid except their roughened extremities, sometimes open or crater-like at the summit, a few solid and cylindrical (one of which has been detached and will be sliced for microscopic sections); armor 4 to 7 cm. thick, separated from the axis by an even line; parenchymatous zone 2 cm. thick; fibrous zone 3 cm., divided into three rings, one of which exhibits a somewhat open structure in places crossed by thin medullary rays and inclosed between walls or sheaths of harder material; medulla 13 cm. in diameter and nearly circular, solid, fine-grained, and homogeneous in structure.

The fine specimen upon which the above description is wholly based was purchased by me from Mr. Homer Moore in Hot Springs, South Dakota, on August 22, 1895, together with the two fragments above described, belonging to *C. jennyana*. It consists of four pieces which belong together and form a very remarkable trunk, differing greatly from any other from the Black Hills or from any other section.

I inquired carefully into the history of these specimens and learned that some years before they had been found by a railroad employee named A. B. Noble, who was no longer in that region, some two miles below Hot Springs in a canyon or ravine which makes into Fall River from the northeast. No further details could be gathered, but as it is 4 miles to Evans's quarry, where the true Dakota group is exposed, it is certain that the horizon must be in the Lower Cretaceous, and it is probably substantially the same as that of all the other trunks.

The four pieces or sections which have been numbered from 1 to 4, beginning with the basal one, may be briefly described as follows:

1. No. 1, which is considerably the largest in all respects, represents the true base, and swells out below to a diameter of over 40 cm. and a girth of nearly 112 cm. It is slightly elliptical, the minor axis of a cross section being only 33 cm., but part of this difference is due to the erosion of the armor on the broader sides.

2. No. 2 is a shorter and smaller piece, but fits perfectly upon the upper fracture of No. 1, which is somewhat oblique. On one side a large elliptical area has decayed, forming a depression which reaches to the bottom of the leaf stalks. This depression is about equally divided between Nos. 1 and 2.

3. No. 3 is a much shorter piece, the upper fracture of which is very oblique, so as to make it almost wedge-shaped. The upper surface of No. 2 and the lower surface of No. 3 do not form a perfect joint. A thin slice, or a number of such pieces, have apparently sealed off and are wanting. There is, however, abundant evidence of the general agreement of the two sections, and one decayed area extends across the break and reappears on No. 3.

4. No. 4, which is the uppermost section, fits perfectly upon No. 3.

The fracture across the top is oblique in the opposite direction from that of the lower end, thus increasing the cuneiformity of both sections. When superposed upon each other these two upper sections form a sort of crook or bend in the trunk, so that the center of gravity falls considerably on one side and the upper piece falls off unless supported.

The trunk has evidently long lain on one side or the other as determined by the above-mentioned crook or bend and been subject to much erosion on the two exposed sides, while the other two sides have correspondingly escaped. The result is that the leaf scars are deeply worn over much of the surface, while along the protected sides they are preserved or only irregularly broken down, leaving what look like jagged projections.

The weight of the several pieces is as follows:

	Kilograms.
No. 1	50.80
No. 2	21.32
No. 3	17.02
No. 4	18.37
Total	107.51

Nothing at all approaching this species was found in the Yale collection.

CYCADEOIDEA NANA, new species.

Trunks very small, symmetrical, short-conical, laterally subcompressed, 12 cm. high, 15 by 17 cm. in diameter, 49 cm. in girth, dark colored, well silicified, of medium hardness and specific gravity, unbranched, summit not depressed, terminal bud projecting from apex; leaf bases ascending even the lowest ones, scars arranged in two series of spiral rows, those from left to right making an angle of 80° and those from right to left of 50° with the axis, very small, subrhombic, averaging 10 mm. wide by 6 mm. high, smaller near the summit, empty to considerable depth; ramentaceous interstices 1 to 3 mm. thick, firm in texture, usually consisting of three layers which may be regarded as a lining to each of the adjacent scars with a thicker membrane between; reproductive organs few, poorly defined, slightly projecting with irregular markings on their outer surfaces, probably for the most part immature or abortive; armor 3 to 5 cm. thick; axis 8 cm. in diameter, somewhat clearly marked off from the armor but without clear boundaries between the cortical parenchyma and fibrous zone or between the latter and the medulla, so far as the single known specimen shows without cutting.

This species differs from all others in a number of characters besides its small size. The only specimen is No. 84 of the Yale collection, a small, almost perfect trunk weighing only 2.95 kg. At first glance it recalled the *C. pygmaea* of England from the Lias of Lyme Regis, figured by Lindley and Hutton,¹ but on confronting the specimen with

¹ Fossil Flora of Great Britain, II, pl. CXLIII.

that figure the differences are obvious. Except for its small size it might be compared to *C. marylandica* from the Iron Ore Clays of Maryland, and of all the specimens of that species it most resembles the fragment which Professor Fontaine designated as No. 2,¹ and which I have described as Johns Hopkins Cycads, No. 3.² That specimen, however, has a large secondary axis, which with better material might take it out of that species.

Of all the forms from the Black Hills it most resembles in the character of the scars, etc., some of the smaller branches of *C. marshiana*, in which these are considerably reduced in size. I have, therefore, had a faint suspicion, which I would not leave the subject without expressing, that it might be one of these secondary axes or knots, as it were, wrenched from the larger trunk and found in an isolated position. I have, with this thought in my mind, examined a great many such cases, but I can find none in which the fracture at the point of separation at all resembled the base of this specimen, they all showing the break to have been due to some extraneous cause, whereas the base of this specimen is perfectly natural, not torn nor cracked, and shows the medulla at the center. Nevertheless, there is something a little anomalous in the way the armor surrounds the axis.

The above arrangement of the species of Cycadeoidea from the Black Hills is not wholly without method. It is true that there is no lineal arrangement that can be regarded as satisfactory, and yet there are decided affinities among the species. These affinities, however, are shown in particular characters, and the same species may have some characters almost in common with two or more other species that are otherwise very different. This is specially the case with branching species in which other characters resemble those of unbranched species. For example, *C. turrita*, except in its branching habit, is closely allied to *C. mebridei*, which never branches; *C. marshiana*, but for its branching, would be nearly related to *C. colossalis*; and *C. wellsii* may be almost regarded as an unbranched form of *C. minnekahtensis*.

In view of these and many other more subtle peculiarities, I have sought, since the arrangement must be lineal, to compromise in such a manner as to bring those species most akin as near together as possible, but it is clear that any arrangement would widely separate species that are similar in one respect or another.

C. dacotensis and *C. colossalis* are obviously very closely allied species. *C. wellsii* can scarcely be said to form a transition from *C. colossalis* to *C. minnekahtensis*, but it resembles the former at least in the one fact of being simple. *C. pulcherrima* is somewhat close to *C. minnekahtensis*. *C. cicatricula* can not be said to form a transition from *C. pulcherrima* to *C. turrita*, but it has considerable affinity to the former. *C. turrita*

¹ Potomac or Younger Mesozoic Flora, Monogr. U. S. Geol. Surv., 1890, XV, p. 192.

² Proc. Biol. Soc. Washington, March 13, 1897, XI, p. 11.

is related to *C. minnekahtensis* and *C. pulcherrima*, and from it to *C. mcbridei*, as already remarked, the distance would be very small but for the branching habit of the former.

Between *C. mcbridei* and *C. marshiana*, however, there is scarcely any bond, and it might have been as well to place the latter immediately after *C. colossalis*. We virtually begin a new series here and pass naturally through *C. furcata* to *C. colei* and *C. paynei*. *C. aspera* closely resembles the last of these in external aspect, but the two anomalous characters noted clearly distinguish it from all others. It fits in here, however, and *C. insolita* and *C. occidentalis* belong to this same general group.

C. jenneyana, *C. ingens*, *C. formosa*, *C. stillwelli*, and *C. excelsa* may also be said to form a group. The first and the last two constitute the only cylindrical forms known in America. The shape of the scars in *C. ingens*, *C. formosa*, and *C. stillwelli* unite these three from that important point of view, while those of *C. jenneyana* and *C. ingens* tend to approach each other. *C. excelsa* has little in common with any other species, and *C. nana* almost nothing. These two are therefore properly made to close the series.

ON SOME NEW PARASITIC INSECTS OF THE SUBFAMILY ENCYRTINAE.

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There follow descriptions of ten new genera and thirty-four new species of Encyrtine insects, the new genera being described at this time to secure their insertion in Mr. William H. Ashmead's about-to-be-published Revision of the Encyrtinae.

ASTEROPAEUS, new genus.

Female.—This is intermediate in some respects between *Chrysoplatycerus* Ashmead and *Anicetus* Howard. Body short, stout; abdomen nearly circular, concave above, shorter than thorax; scutellum rounded at tip, with no tuft of bristles; scapulae meeting at inner basal angle; frons moderately broad, ocelli forming a slightly acute-angled triangle; facial impression bounded by an arched carina superiorly; antennae rather short, scape and flagellum flattened and very broad, funicle joints extremely short, the whole funicle equaling only the first joint of the club in length; eyes smooth; wings clouded, hyaline at tip; marginal vein thick, short, shorter than stigmal, subequal in length to post-marginal.

ASTEROPAEUS PRIMUS, new species.

Female.—Length, 0.86 mm.; expanse, 2 mm.; greatest width of fore-wing, 0.37 mm. General color dark orange; mesoscutum suffused with purple or at least giving purplish reflections; facial carina also purplish; abdomen metallic green, somewhat yellowish in middle; antennae with superior margin and tip of club black; all legs honey yellow, hind tibiae somewhat dusky without. Head and mesoscutellum finely shagreened; mesoscutum and abdomen lustrous; antennae and thorax with rather prominent dark-colored hairs; wings with a thin patch of pronounced dark bristles below submarginal vein, remaining discal cilia whitish.

One female reared from a *Ceroplastes*, upon a leguminous tree, collected at Guaymas, Mexico, September 24, 1894, by Prof. C. H. Tyler Townsend.

Type.—No. 5021, U.S.N.M.

TETRACNEMOIDEA, new genus.

Female.—A small, rather stout-bodied form, with the abdomen compressed from the sides; epistoma plainly carinate; eyes well separated; ocelli forming an obtuse-angled triangle; thorax with the axillae not differentiated by a suture; scutellum rounded at tip; wings with a punctiform marginal vein, post-marginal and stigmal very short; antennae inserted near mouth, scape slender, cylindrical, flagellum about twice as long as scape, club slightly enlarged, oval; pedicel twice as long as funicle joint, first funicle joint slightly longer than wide, others increasing somewhat in width, but remaining subequal in length.

Male.—This is one of the forms with branched antennae, and resembles the female except in this respect: Joints 1 to 4 of the funicle each bears a rather long, hairy branch; joints 5 and 6 without branch; joints 1 to 4 subequal in length, 1 rather shorter than others; joint 5 less than half as long as 4, 6 a little longer; club as long as 5 and 6 together.

TETRACNEMOIDEA AUSTRALIAENSIS, new species.

Female.—Length, 0.97 mm.; expanse, 2.15 mm.; greatest width of forewing, 0.39 mm. General color black, with slight greenish, metallic reflections on thorax; antennae dark brown; legs honey yellow, hind femora brownish above; wings hyaline. Head and thorax rather delicately reticulate, faintly lustrous; pleura and abdomen smooth, shining.

Male.—Resembles female except in generic and sexual characters and the following: Hind legs brown throughout, middle tibiae sometimes slightly darkened.

Described from ten females, four males, reared at Sidney, Australia, March, 1892, from a *Dactylopius* on *Pittsporum*, by Mr. A. Koebele.

Type.—No. 5022, U.S.N.M.

PARAPSILOPHRYS, new genus.

Resembles *Psilophrys* in the peculiar antennae, but differs mainly in sculpture, in the possession of a faint marginal cilia to the forewings, and in the extremely long ovipositor. Also comes close to *Tineophoc-tonus*, differing principally in antennae and venation.

Female.—Body long, rather slender; abdomen as long as head and thorax together; antennae long, slender, inserted just above mouth border; scape reaching above vertex, slender, cylindrical; pedicel three times as long as thick; first funicle joint longer than pedicel, remaining joints decreasing slightly in length to sixth, which is only about twice

as long as broad; club as long as two preceding joints together, only slightly enlarged; head with frons strongly convex, scrobes extending only to base of eyes, strongly indicated semicircular; ocelli forming a right-angled triangle, occipital margin acute; scutellum slightly rounded at tip, almost pointed, axillae just meeting at tip; wings with faint marginal cilia, marginal vein almost lacking, stigmal short but longer than post-marginal, abdomen somewhat compressed from sides, ovipositor extruded to about the length of the abdomen; head and mesonotum finely and closely punctate.

Male.—Abdomen short, subtriangular, much shorter than thorax; antennae long and slender like those of the female, except that they are not quite so long, proportion of joints relatively about the same; in other respects resembles female.

PARAPSILOPHRYS GELECHIAE, new species.

Female.—Length, 3 mm.; expanse, 4.2 mm.; greatest width of forewing, 0.77 mm. General color, metallic blue-green, somewhat bronzy on mesoscutellum; antennae with metallic bulla, brown scape and underside of pedicel, and black flagellum; all legs honey yellow, except hind tibiae and tarsi, which are nearly black externally, and hind coxae which are metallic; tegulae light honey yellow; head and mesoscutum with close fine punctation, mesoscutellum with deeper punctation, mesopleura delicately but plainly shagreened; wings hyaline, veins dark brown, especially at stigma.

Male.—Length, 2.4 mm.; expanse, 3.8 mm. General color, metallic green with bluish reflections from abdomen only; antennae honey yellow throughout; in other respects resembles female, except that hind tibiae are yellow at tips.

Described from two females, one male, reared June 17, 1893, from cocoons of a *Gelechia* on cottonwood, received from Mr. E. G. Lamber-son, Jetsam, Wyoming.

Type.—No. 5023, U.S.N.M.

BLEPYRUS, new genus.

Female.—Comes closest to *Pentelicus* Howard. Body stout, head lenticular when seen from above, occipital margin very acute; face not prolonged, scrobes not deep, rounded at top, ocelli forming a slightly obtuse-angled triangle, lateral ocelli almost touching eye margin, frons not broad, rather deeply confluent punctured, almost rugoso-punctate or with close thimble-like punctures; eyes large, broadly oval, hairy; antennae inserted at mouth-border, scape slender, cylindrical, short, not reaching beyond middle of face; flagellum short, scarcely longer than scape, pedicel nearly twice as long as broad, funicle very short, joints almost annular, club very large, obliquely flattened and longer than pedicel and funicle together; mesonotum lustrous, only slightly sculptured; axillae not meeting at inner basal angle; wings with very short

marginal vein and very long stigmal and post-marginal, the post-marginal longer than the stigmal; legs stout, middle tibial spur very strong, nearly as long as first tarsal joint.

Supposed male.—What is presumably the male of this genus, since specimens were reared at the same time and place from the same host and since it bears certain structural resemblances, has the antennal scape very short, rather stout, inserted about the middle of the face, pedicel short, as broad as long, funicle joints stout, subequal in length, regularly clothed with hair, not very distinctly separated, club short, oval, not or slightly wider than the funicle and hardly as long as two preceding funicle joints together; the axillae meet at tip, the ocelli form a broadly obtuse-angled triangle, and the head and mesoscutum are similarly shagreened.

BLEPYRUS MEXICANUS, new species.

Female.—Length, 1.4 mm.; expanse, 3.5 mm.; greatest width of fore-wing, 0.6 mm. Very variable in size, these measurements being for the larger specimens. Frons with thimble-like punctures, mesoscutum and scutellum squamoso-punctate, axillae apparently obsolete, scutellum with a median impressed line at base, mesopleura faintly aciculate. Color black with strong purplish reflections on mesoscutum, scape of antennae dark at base, otherwise honey-yellow; pedicel dark above, club black, funicle dark above, front femora black, middle femora black, somewhat yellowish at tip; middle tibiae brown at base, hind femora with basal half black, remainder of legs honey-yellow.

Supposed male.—Length, 1.16 mm.; expanse, 3 mm.; greatest width of fore-wing, 0.57 mm. Head and mesoscutum transversely shagreened, with a few small scattered punctures; mesoscutellum finely punctate. Color metallic green with golden reflections, more pronounced on the head; tegulae brown, scape of antennae and all legs straw yellow, flagellum of antennae light brown.

Described from three females and three males reared from *Pseudococcus yuccae*, received from Prof. C. H. Tyler Townsend, Monterey, Mexico, October, 1894.

Type.—No. 5024, U.S.N.M.

BLEPYRUS MARSDENI, new species.

Female.—Length, 1.5 mm.; expanse, 3.5 mm.; greatest width of fore-wing, 0.57 mm. Mesopleura nearly smooth, very faintly aciculate, especially toward hind border; head deeply confluent punctured, mesonotum finely squamoso-punctate. General color black with evident bluish reflections on head and mesoscutum; mesoscutellum with faint coppery reflections; antennal scape honey-yellow, flagellum dark brown, all coxae black, front femora entirely black, middle and hind femora black at base, remainder of legs honey-yellow; wings subhyaline, very faintly dusky, veins light brown.

Described from three female specimens reared September, 1893, from

specimens of a *Rhizococcus* on *Citrus* trees and a *Dactylopius* on *Croton*, received from Hon. J. H. Marsden, commissioner of agriculture and forestry, Honolulu, Hawaiian Islands.

Type.—No. 5025, U.S.N.M.

BLEPYRUS TEXANUS, new species.

Female.—Length, 1.4 mm.; expanse, 3.5 mm.; greatest width of forewing, 0.57 mm. Head with close deep punctures, which are hardly confluent, and with a faint aciculation; mesoscutum finely squamoso-punctate, scutellum more strongly longitudinally striato-punctate, axillae closely united with scutellum so as to be very difficult to distinguish, mesopleura smooth, shining. General color black, head and mesoscutum with purplish reflections, antennae uniformly yellow, all femora black, yellowish at tips; hind femora with apical third honey-yellow, all tibiae and tarsi honey-yellow.

Described from two females reared from *Dactylopius virgatus*, received from Prof. C. H. Tyler Townsend, Brownsville, Texas.

Type.—No. 5026, U.S.N.M.

RHOPOIDEUS, new genus.

Female.—Body rather stout, compact. Head subquadrate when seen from above; eyes widely separated, naked; ocelli at angles of slightly obtuse-angled triangle; cheeks rather full, face deeply impressed; antennae inserted near mouth, scape slender, long, reaching nearly to middle ocellus; flagellum short, pedicel twice as long as broad; funicle 5-jointed, joints 1, 2, and 3 small and narrow, each rather broader than long, 4 and 5 broader and longer and as broad as long; club much broader, ovate, somewhat flattened, longer than entire funicle; mandibles rather long, sickle-shaped, acute, edentate. Thorax slightly arched; scapulae meeting at inner basal angle; mesoscutellum broad. Abdomen conical, depressed above, ovipositor distinctly extruded. Wings ample; marginal vein punctiform; post-marginal lacking, stigmal stout, slightly curved, entering the disk of the wing at angle less than 45°.

This genus resembles *Rhopus* Foerster, a probable synonym of *Metallon* Walker, as pointed out by Ashmead, but differs in antennae and ovipositor. Especial attention is called to the edentate mandibles.

RHOPOIDEUS CITRINUS, new species.

Female.—Length, 0.6 mm.; expanse, 1.4 mm.; greatest width of forewing, 0.18 mm. Head rather coarsely shagreened; mesonotum more finely transversely shagreened; mesopleura finely longitudinally aciculate; head and mesonotum with fine short, rather sparse white pile. General color light orange; eyes nearly black; ocelli carmine; antennae faintly dusky; ovipositor sheaths nearly black at tips; wings hyaline, veins distinct.

Eight females labeled 3821x, which refers to a tortricid found on

Prunus at Truckee, Nevada County, California, by Mr. A. Koebele in September, 1885. The notes show no rearing of any parasites from this material, and it is feared that there was a mistake in the labeling. No. 3831 refers to *Aspidiotus perniciosus*, a much more probable host.

Type.—No. 5027, U.S.N.M.

ATROPATES, new genus.

Female.—A rather stout-bodied form. Head seen from above sub-semicircular, somewhat concave posteriorly; vertex not very broad; ocelli at angles of right-angled triangle; eyes naked; frons prominent, face strongly declivous, making the head appear triangular from side; scrobes semicircular; mandibles short, 3-dentate. Antennae inserted at border of mouth; scape with a strong leaf-like expansion; pedicel rather slender, about twice as long as broad; the 6-jointed funicle increasing rapidly in width from joint 1 to joint 6, joints 1 to 3 subequal in length, 1 as broad as long, 3 twice as broad as long, 3 to 6 increasing somewhat in length, 6 about twice as broad as long; club flattened, obliquely truncate, as long as entire funicle, and at its middle nearly twice as wide as funicle joint 6. Mesonotum rather strongly convex; scapulae meeting at tips; mesoscutellum bare; metanotum bare. Abdomen ovate, flattened above. Fore wings clouded; marginal vein stout, longer than the slender stigmal; post-marginal shorter than stigmal.

Male.—Head narrower when seen from above, plano-concave, frons not prominent, scrobes circular, eyes more widely separated than in female. Antennae inserted below middle of face but well above mouth border; scape slender, cylindrical; flagellum filiform, pilose with hairs about as long as three times the width of the funicle; pedicel about twice as long as broad; funicle joint 1 five times as long as broad; relative length of funicle joints 1 to 6 about as follows: 10, 8, 8, 7, 9, 8; club nearly twice as long as last funicle joint, ovate. In other respects like female except that abdomen is triangular and fore wings are hyaline.

ATROPATES COLLINSI, new species.

Female.—Length, 1.5 mm.; expanse, 3 mm.; greatest width of fore-wings, 0.51 mm. Head smooth, glistening, with very fine sparse punctures; mesonotum lustrous, very faintly shagreened, with fine, sparse piliferous punctures; mesopleura longitudinally striate. General color honey yellow, mesopleura somewhat lighter; face and mesoscutum with faint purplish luster; eyes black, ocelli dark red; antennal club black, leaf-like expansion of scape edged with brown below, pedicel and funicle joints 1 and 2 dusky; lower face with a brown transverse band at clypeus; abdomen brown and strongly metallic at base and tip, ovipositor sheaths light yellow; hind tibiae somewhat dusky at outer basal third. Fore wings with a discoidal cloud, lighter at tips; marginal vein dark brown.

Male.—Length, 1.1 mm.; expanse, 2.8 mm.; greatest width of forewing, 0.5 mm. Head and mesonotum closely and finely shagreened. Color black with bronze reflections; antennae brown; middle and hind femora and tibiae brown, wings perfectly hyaline.

Eleven females and six males reared at Washington from females of *Pulvinaria innumerabilis* Rathvon received in 1889 and 1891 from Mr. Lewis Collins, Brooklyn, New York, H. Hentz & Co., Brooklyn, and Mr. L. H. West, Roslyn, New York. All of the parasites issued late in July. The species is named after Mr. Collins in recognition of his able work as secretary of the Tree Planting Society of Brooklyn, in the course of which he has made many valuable entomological observations.

Type.—No. 5028, U.S.N.M.

EURYRHOPALUS, new genus.

Female.—A stout-bodied form allied to the *Bothriothoracini*. Head lenticular seen from above; eyes very large, vertex very narrow; ocelli at angles of an extremely acute-angled triangle; face strongly declivous; mandibles stout, 3-dentate. Antennae inserted below middle of face; scape short, cylindrical; funicle joints very short, widening rapidly to the broad, compressed, obliquely truncate club which is nearly as long as entire funicle. Punctuation of head and mesonotum differing in character; mesonotum flat, scutellum not arched, mesoscutum with a slight posterior projection overlapping on the scutellum for two-thirds of its breadth, scapulae scarcely to be distinguished, their sutures in the scutellum obsolete (in certain lights they can be faintly traced). Stigmal vein of fore wing given off at juncture of submarginal with costa, long and slender; postmarginal as long as stigmal; hind wings with the costal cell extending to the hooklets. Abdomen short, flattened above, subtriangular.

EURYRHOPALUS SCHWARZI, new species.

Female.—Length, 1.7 mm.; expanse, 3.6 mm.; greatest width of forewing, 0.58 mm. The narrow vertex and face bear four parallel longitudinal rows of rather large punctures, the lateral rows at eye border, the two rows of each side diverging from the others below; cheeks finely longitudinally aciculate; mesonotum lustrous, very finely shagreened and with fine piliferous punctures; mesopleura opaque, very finely longitudinally aciculate. Color black, not metallic; tarsi yellowish; front tibiae brown. Fore wings with a small discoidal cloud, veins very distinct, dark brown.

One female, Biscayne Bay, Florida, May 16, Dr. E. A. Schwarz.

Type.—No. 5029, U.S.N.M.

BERECYNTUS, new genus.

Female.—Comes nearest to *Prionomitus* Mayr, from which, however, it differs in its lengthened face. Head seen from above semicircular,

vertex broad. Ocelli at angles of an obtuse-angled triangle; eyes sparsely hairy, broadly oval; cheeks longer than eyes; scrobes elongate; epistoma with a large, rounded, longitudinal carina; mandibles stout, long, 3-dentate, with a long, sharp, apical tooth. Antennae inserted slightly above mouth; scape long, slender, subcylindrical, slightly swollen near middle and reaching nearly to top of head; pedicel subcylindrical, nearly four times as long as broad; funicle joints short, increasing slightly in width from 1 to 6 and each about as long as broad; club about two-thirds as long as funicle, broader at base than sixth funicle joint, obliquely truncate from tip to near base. Mesonotum flat, scutellum slightly elevated, rounded at tip; scapulae narrow, not quite meeting at tips. Abdomen flat, broadly oval, pointed at tip. Marginal vein of fore wing very short, broader than long; postmarginal much shorter than the rather stout stigmal vein; costal cell of hind wings very narrow but extending nearly to hooklets.

BERECYNTUS, BAKERI, new species.

Female.—Length, 1.4 mm.; expanse, 3.4 mm.; greatest width of forewings, 0.63. Head and mesoscutum densely and shallowly punctate, with irregular, frequently hexagonal punctations, those of head rather finer than the others; mesoscutellum with close, shallow, very elongate punctation; mesopleura faintly longitudinally aciculate. Head, thorax, and abdomen lustrous. General color highly metallic green; mesoscutellum bronzy; flagellum of antennae black; all legs black except femorotibial knees and torsi, which are brown. Wings hyaline, veins dark brown.

One female collected in Colorado by Mr. C. F. Baker (Baker's No. 866).

Type.—No. 5030, U.S.N.M.

ASTYMACHUS, new genus.

Female.—Comes nearest to *Aphyeus*. An elongate, rather slender form. Head moderately broad, eyes naked, vertex broad, ocelli at angles of a slightly acute-angled triangle; mandibles short, tri-dentate, teeth subequal. Antennae inserted just below middle of face; scape short, not widened; pedicel longer than first funicle joint, triangular, somewhat longer than wide; funicle joints increasing somewhat in width from 1 to 6, each about as wide as long; club ovate, as long as funicle joints 4, 5, and 6 together. Mesonotum apparently not arched; scutellum transverse, naked; metanotum naked. Hind femora considerably swollen. Abdomen long-ovate, perfectly sessile, acute at tip; ovipositor extruded for about one fifth the length of the abdomen. Wings hyaline; marginal vein short but thick; post marginal lacking; stigmal short, but longer than marginal.

Male.—Resembles female except in antennae. Funicle joints and club clothed with short but rather thick pubescence; funicle joint 1 longer and narrower than other funicle joints, about as long as pedicel; club not quite so long as three preceding funicle joints.

ASTYMACHUS JAPONICUS, new species.

Female.—Length, exclusive of ovipositor, 1.16 mm.; expanse, 2 mm.; greatest width of forewing, 0.32 mm. All specimens are mounted in balsam, so that details of sculpture can not be made out. General color bright orange yellow; eyes black; ocelli dark red; antennae light brown; ovipositor-sheaths black; terminal joints of all tarsi dark brown.

Male.—Resembles female in all respects except in the generic characters pointed out above and in the primary sexual characters.

Many male and female specimens reared by Mr. Albert Koebele from a Lecanium-like coccid on *Bambusa*, Gifu, Japan (Koebele's No. 1259).

Type.—No. 5031, U.S.N.M.

HETERARTHRELLUS, new genus.

Female.—Has somewhat the facies of *Aphycus*, differing mainly in the antennae. Mandibles short, 3-dentate. Head short, vertex broad, eyes naked, face not prolonged, scrobes subcircular. Antennae inserted near mouth; scape long, reaching above top of head, subcylindrical; pedicel only half as long as first funicle joint; funicle joint 1 six times as long as broad, remaining funicle joints rapidly decreasing in length to 6, which is about as broad as long; club flattened, oval, slightly wider than funicle joint 6 and somewhat longer than funicle joints 5 and 6 together. Head and thorax opaque, closely microscopically punctate, scapulae barely meeting at tips; abdomen subopaque. Fore wings with a short marginal vein and a longer postmarginal and stigmal, which are subequal in length, the stigmal distinctly curved; submarginal very close to costa. Hind wings with a very narrow costal cell, which, however, extends nearly to hooklets.

Male.—Resembles female except in antennae, which are filiform with slightly enlarged club and furnished with long hairs not arranged in whorls. The pedicel is very short and the funicle joints subequal in length, the terminal ones perhaps a trifle shorter.

HETERARTHRELLUS AUSTRALIENSIS, new species.

Female.—Length, 1.28 mm.; expanse, 3.4 mm.; greatest width of forewing, 0.59 mm. Head and mesonotum very finely microscopically punctate, mesonotum and cheeks covered with dense short white pile; mesopleura and abdomen very finely shagreened, the latter with dense short white pile. Ocelli forming a slightly obtuse-angled triangle, well separated from both occipital and eye margins. General color black; head and mesopleura orange; antennal scape with a white spot below, near tip; propleura orange except tip, which is pallid; tegulae pallid with a brown spot at tip; all legs honey yellow; hind tibiae dusky. Wings hyaline, veins dark brown.

Male.—What is probably the male of this species, although reared from a different insect, is uniformly black except for an orange spot each side of face between eyes, orange pleura and tegulae and legs like

the female. A male reared from the same host, but which is mutilated, has the mesopleura dusky and the lower face orange.

One female and the last-mentioned male reared from pupae of *Seymnus flavifrons* Blackburn, Paramatta, New South Wales, by Mr. A. Koebele, and the other male and a mutilated female of probably this species from larvae of *Rhizobius debilis* Blackburn, at Adelaide, South Australia, also by Mr. Koebele.

Type.—No. 5032, U.S.N.M.

Genus APHYCUS Mayr.

Aphycus MAYR, Die Europäischen Encyrtiden, 1876, p. 21.

The following table contains the females of all known species of this genus of which this sex has been described. No table of males is given since males of but few species are known. Of the 16 species listed by Dalla Torre in his recent catalogue 11 are included in this table, together with 19 new species. Of the remaining 5 species listed by Dalla Torre, *A. amoenus* Howard and *A. immaculatus* Howard are known in the male sex only, *A. chrysopae* Ashmead belongs to *Isodromus*, and *A. niger* Ashmead and *A. unicolor* Ashmead belong to new genera which Mr. Ashmead will soon characterize.

ANALYTICAL KEY TO SPECIES.

- | | |
|---|---|
| Scape widened, with leaf-like expansion below | 2 |
| Scape not widened | 9 |
| 2. Mesoscutum with two curved transverse black lines. | |
| 1. <i>lichtensiae</i> Howard (Ceylon). | |
| Mesoscutum with no such lines | 3 |
| 3. Wings hyaline | 4 |
| Wings more or less dusky. | |
| Wings almost wholly dusky; mesonotum black. | |
| 2. <i>fuscipennis</i> , new species (Sonoma County, California). | |
| Wings with only a dusky patch below stigma; mesonotum orange. | |
| 3. <i>lccanii</i> , new species (Alameda and Los Angeles, California). | |
| 4. Club more or less black, with preceding joints white or yellow | 5 |
| Club entirely white or yellow. | |
| Scape entirely black; 4 or 5 funicle joints dusky. | |
| 4. <i>pulchellus</i> , new species (Ithaca, New York). | |
| Scape with white spot above; first funicle joint only dusky. | |
| 5. <i>dactylopii</i> , new species (Hong Kong, China). | |
| 5. Lateral ocelli almost or quite touching eye border | 6 |
| Lateral ocelli well separated from eye border. | |
| Lateral ocelli placed well forward of occipital margin. | |
| Ocelli forming an equilateral triangle; legs profusely spotted. | |
| 6. <i>punctipes</i> Dalman (Germany and Sweden). | |
| Ocelli forming a somewhat obtuse-angled triangle; legs not spotted. | |
| 7. <i>townsendi</i> , new species (Brownsville, Texas). | |
| Ocelli forming a somewhat acute-angled triangle; tibiae with two dots only; only two funicle joints dusky; general color, lemon yellow. | |
| 8. <i>cockerelli</i> , new species (Las Cruces, New Mexico). | |

Ocelli forming a decidedly acute-angled triangle; four funicle joints dusky; abdomen dark above, thorax somewhat infuscated.

9. *annulipes* (Ashmead) (Florida).

Lateral ocelli at occipital margin.

10. *nigritus*, new species (Los Angeles, California).

6. Mesopleura smooth..... 7
Mesopleura strongly longitudinally striate.

11. *johnsoni*, new species (Champaign, Illinois).

7. Mesonotum orange or yellow..... 8

Mesonotum black..... 12. *coquilletti*, new species (Los Angeles, California).

8. Scape with continuous white dorsal margin; tibiae very distinctly spotted.

13. *lounsburyi*, new species (Cape Town, South Africa).

Scape with dorsal margin partly black; tibiae indistinctly spotted.

Two funicle joints only brown.. 14. *pulvinariae* Howard (Davenport, Iowa).

Three funicle joints brown.

15. *maculipes* Howard (South Carolina and Ohio).

Four funicle joints brown.

16. *californicus*, new species (Alameda, California).

9. Wings with a large brown spot in the middle.

17. *apicalis* Dalman (Sweden and Germany).

Wings somewhat dusky, with a hyaline cross band beyond stigma.

18. *angelicus*, new species (Los Angeles, California).

Wings hyaline..... 10

10. Ocelli forming an acute angled triangle..... 11

Ocelli forming an obtuse-angled triangle.

19. *australiensis*, new species (Australia).

Ocelli forming a right-angled triangle.

Color yellow.. 20. *texanus*, new species (Texas, New Mexico, and Arizona).

Color black, with a whitish trans-facial band.

21. *oaxacae*, new species (Oaxaca, Mexico).

11. Club light brown, concolorous with rest of flagellum..... 12

Club black, contrasting with preceding joints..... 13

Club with dark brown base, apical half yellow.

Abdomen and metanotum bright orange yellow.

22. *flavus* Howard (Florida; Los Angeles, California).

Abdomen and metanotum black or blackish.

23. *hederaceus* Westwood (England and Germany).

12. Tip of scutellum with depressed hairless circular area.

24. *oregonensis*, new species (Oregon).

Tip of scutellum with no such area.

Scutellum and mesopleura black..... 25. *ceroplastis* Howard (New Mexico).

Scutellum and mesopleura yellow..... 26. *flaviceps*, new species (Illinois).

13. First 3 funicle joints nearly as wide as last 3.

27. *mexicanus*, new species (Mexico).

First 3 joints much reduced.

Uniformly light orange yellow..... 28. *alberti*, new species (Australia).

Uniformly brown above..... 29. *brunneus* Howard (New Jersey).

Black above, light yellow below..... 30. *eruptor* Howard (Florida).

APHYCUS FUSCIPENNIS, new species.

Female.—Length, 1.35 mm.; expanse, 2.8 mm. Scape with a strong ventral leaflike expansion. Vertex not broad; ocelli forming an acute-angled triangle. General color dull black; scape above, apex of pedicel and funicle joints 4, 5, and 6 white; head and face yellowish white,

except for a brown streak on lower cheek at each side of jaws; pro- and meso-pleura, tegulae, a narrow band of the mesoscutum bordering tegulae, and all legs yellowish white, except that each tibia has three narrow black bands and each femur two interrupted dark bands. Forewings dusky, with a white transverse band just beyond tip of stigmal vein.

Eight females reared in August by Mr. Albert Koebele from a *Lecanium* on *Arctostaphylos pungens*, which he had collected the previous May in Sonoma County, California.

Type.—No. 5033, U.S.N.M.

APHYCUS LECANII, new species.

Female.—Length, 0.72 mm.; expanse, 2.3 mm. Resembles preceding species, except that mesonotum and middle of abdomen above are bright orange, the middle femora are unspotted and the front femora have only a single black dot near knee, while the fore wings have a broad fuscous stripe below marginal vein and are more or less dusky at tip.

Male.—What is probably the male of this species is uniformly black, with hyaline wings, brown legs (lighter at knees); antennae brown, except funicle joints 5 and 6, which are dirty white.

Many specimens. Los Angeles County and Alameda County, California, A. Koebele. Reared from males of a *Lecanium* on *Pinus insignis* (June), from a *Lecanium* on *Heteromeles arbutifolia* (March and April), and from a *Lecanium* on *Quercus agrifolia*.

Type.—No. 5034, U.S.N.M.

APHYCUS PULCHELLUS, new species.

Female.—Length, 1.35 mm.; expanse, 3.2 mm. Vertex very broad; ocelli at angles of slightly obtuse-angled triangle, lateral ocelli well separated from eye-margin; head large and firm; abdomen elliptical; wings perfectly hyaline. General color dark orange; antennal scape black, slightly orange above near tip; pedicel black, lighter at tip; first funicle joint brown, second, third, and sometimes fourth light brown, remainder of funicle and club dirty yellow; metanotum and dorsum of abdomen and all legs pallid; wing-veins not brown, but apparently without color.

Nine females reared January 25 to 30, 1890, from a *Kermes* on *Quercus tinctoria*, collected October 14, 1889, by the writer, at Ithaca, New York. From the same *Kermes* were bred specimens of *Hamadryas bassettella*.

Type.—No. 5035, U.S.N.M.

APHYCUS DACTYLOPII, new species.

Female.—Length, 1.2 mm.; expanse, 2.5 mm. Resembles preceding species except as follows: Scape with a broad white band just before tip; pedicel with its apical half silvery white; first funicle joint black;

remainder of funicle and club silvery white. General color dark dull orange, brighter on head; notum with hind border of pronotum dark, sutures blackish and a black spot at center of mesoscutellum; mesopleura orange; abdomen with a central orange spot below.

One female reared from *Dactylopius vastator* Maskell, collected at Hong Kong, China, and reared by Mr. Maskell at Wellington, New Zealand, April 14, 1896.

Type.—No. 5036, U.S.N.M.

APHYCUS TOWNSENDI, new species.

Female.—Length, 1.37 mm.; expanse, 2.9 mm. Wings hyaline; vertex moderately broad; ocelli forming a slightly obtuse-angled triangle, the lateral ocelli placed well in advance of the occipital margin and well separated from the eye border. Wing veins dark brown; general color dark orange; head somewhat lighter; mesoscutum a dark shade at middle, mesoscutellum with a central dark shade, mesopleura orange; underside of abdomen mahogany, upperside of abdomen black; legs, including coxae, pallid; hinder part of head black; scape black with white spot at tip; funicle white; club black.

Three females, reared from a *Phenacoccus* on cotton by Mr. C. H. T. Townsend, Mesilla Park, New Mexico. (?)

Type.—No. 5037, U.S.N.M.

APHYCUS COCKERELLI, new species.

Female.—Length, 1.28 mm.; expanse, 2.8 mm. Vertex narrow; ocelli at angles of an acute-angled triangle; wings hyaline; veins light brown; general color light lemon yellow, scape with its expansion black, yellowish above; pedicel with a black dot at base; funicle joints 1 and 2 black, remainder of funicle lemon yellow, club black; pronotum, tegulae, mesopleura, and all legs, pallid, except that all tibiae bear two minute brown dots exteriorly near base; abdomen sometimes slightly dusky above.

Six females, reared from a *Lecanium* on osage orange, collected by Prof. T. D. A. Cockerell, at Las Cruces, New Mexico.

Type.—No. 5038, U.S.N.M.

APHYCUS NIGRITUS, new species.

Female.—Length, 0.93 mm.; expanse, 2.3 mm. Vertex rather narrow; ocelli at angles of somewhat acute-angled triangle, lateral ocelli touching occipital margin. General color black; vertex and face orange; border of scutellum yellowish; mesopleura orange; all legs dusky, hind legs lighter on inner surface; wing veins dark brown, nearly black; antennal scape black, white at apical third; pedicel and first funicle joint black; (remainder of antennae broken off).

One female, reared from *Dactylopius* on *Artemisia*, Los Angeles, California, Mr. D. W. Coquillett.

Type.—No. 5039, U.S.N.M.

APHYCUS JOHNSONI, new species.

Female.—Length, 1.16 mm.; expanse, 2.9 mm. Vertex rather narrow; ocelli forming a rather acute-angled triangle, lateral ocelli well separated from occipital margin, but close to eye margin; antennal scape with expansion black and dorsal margin white; pedicel with apical third silvery white, funicle joints 1 and 2 black, remainder of funicle yellow; club black; head bright orange; pronotum black with whitish border; mesonotum dark orange, somewhat suffused with a dusky shade; metanotum and abdomen black; tegulae and mesopleura pallid; mesopleura strongly longitudinally striate; front legs with three brown spots near tip; all tibiae with three transverse bands, the distal band on the hind tibiae less pronounced; middle femora unspotted, hind femora with a dusky shade exteriorly; wings hyaline, veins light brown.

One female, reared by Mr. W. G. Johnson, at Champaign, Illinois, April 29, 1896, from a small *Lecanium* on elm.

Type.—No. 5040, U.S.N.M.

APHYCUS COQUILLETTI, new species.

Female.—Length, 0.86 mm.; expanse, 1.9 mm. Vertex rather narrow; ocelli forming an acute-angled triangle, lateral ocelli separated from occipital margin, touching eye margin. Wings hyaline, veins very light brown, antennal scape white at base and tibiae black in middle; pedicel with a black spot above, but otherwise white; first four funicle joints light brown, fifth and sixth silvery white; club black; head yellow; cheeks below brownish; pronotum black, with whitish border, meso- and metanotum black; entire underside of body pallid, including coxae and all legs; middle and hind tibiae with two interrupted black bands.

Two females, Los Angeles, California, D. W. Coquillett.

Type.—No. 5041, U.S.N.M.

APHYCUS LOUNSBURYI, new species.

Female.—Length, 0.7 mm.; expanse, 1.6 mm. Vertex very narrow; ocelli nearly touching eye margin and forming an acute-angled triangle; mesopleura smooth. General color dark orange, scape with its expansion black in middle, dorsal portion continuously white and expansion white at tip of base; pedicel black above at base, remainder silvery white; first two funicle joints black, remainder lighter at tip; club black, lighter at tip; occiput and pronotum black; abdomen dark at sides above; under sides of body pallid; all tibiae with three pairs of dark spots.

Four females, reared by Mr. C. P. Lounsbury, Cape Town, South Africa, from *Lecanium oleae*.

Type.—No. 5042, U.S.N.M.

APHYCUS CALIFORNICUS, new species.

Female.—Length, 0.7 mm.; expanse, 1.6 mm. Mesopleura smooth; vertex narrow; lateral ocelli almost touching eye border and forming slightly acute-angled triangle; wings hyaline, veins brown. General color orange; abdomen dusky above; pronotum and occiput black; under side of body pallid, except that abdomen is dusky toward tip; antennal scape black, yellowish at tip; pedicel oblique at base, white at tip; first four funicle joints black, joints 5 and 6 yellow; club black; all legs pallid, except that middle and hind tibiae have two brown bands.

Two females, reared by Mr. A. Koebele from *Lecanium* on *Adenostoma fasciculatum* collected near Alameda, California, June, 1887.

Type.—No. 5043, U.S.N.M.

APHYCUS ANGELICUS, new species.

Female.—Length, 0.72 mm.; expanse, 1.6 mm. Scape somewhat swollen but without a leaf-like expansion. (All of the preceding species have possessed a strong ventral leaf-like expansion to the scape.) Vertex narrow; ocelli forming an acute-angled triangle; lateral ocelli near eye margin; wings somewhat dusky with a hyaline cross band beyond stigma. General color orange, somewhat dusky on mesonotum; scape, pedicel, and first four funicle joints black, remaining funicle joints and club silvery white; legs and underside of body pallid, legs not spotted; ovipositor slightly extruded.

Three females, from *Dactylopius* on passion flower, Los Angeles, California, summer of 1886, Mr. Albert Koebele.

Type.—No. 5044, U.S.N.M.

APHYCUS AUSTRALIAENSIS, new species.

Female.—Length, 1.4 mm.; expanse, 3.9 mm. Scape slender, not at all widened, very slightly swollen toward tip; vertex broad; ocelli forming an obtuse-angled triangle; wings hyaline, veins light brown. General color uniform dark yellow, somewhat brighter on face; antennae yellowish, club light, dusky toward tip; legs entirely unspotted; mesopleura finely shagreened and with a few striae on apical portion.

Two females, reared from a *Dactylopius* on *Eucalyptus*, Melbourne, Victoria, Australia, A. Koebele.

Type.—No. 5045, U.S.N.M.

APHYCUS TEXANUS, new species.

Female.—Length, 0.88 mm.; expanse, 1.6 mm. Closely resembles preceding species, except that it is very much smaller; the antennae are not brownish toward tips, the ocelli form a right-angled triangle, the lateral ones almost touching eye border, while the pleura are faintly aciculate, not striate.

Eight females, bred from *Dactylopius virgatus*, July, 1895, Brownsville, Texas, Prof. C. H. T. Townsend.

Type.—No. 5046, U.S.N.M.

APHYCUS OAXACAE, new species.

Female.—Length, 1.28 mm.; expanse, 2.7 mm. Antennal scape perfectly cylindrical; vertex broad; ocelli very large, forming a right-angled triangle; head with vertex orange, face and cheeks black, with the exception of a broad white band below eyes and crossing face; scape black, with a whitish central spot below; pedicel black, whitish at tip, funicle and club dark brown; mesoscutum black anteriorly, reddish brown posteriorly; scutellum and scapulae brown; abdomen black, with brownish borders; propleura dirty yellow; mesopleura dirty yellow at base, dusky beyond; legs pallid; all tibiae with three distinct dark bands; hind femora with two dark spots; wings hyaline, veins dark brown.

One female, Oaxaca, Mexico, Mr. A. Koebele.

Type.—No. 5047, U.S.N.M.

APHYCUS OREGONENSIS, new species.

Female.—Length, 1.2 mm.; expanse, 2.8 mm. Vertex rather narrow; ocelli large, forming an acute-angled triangle; well separated from eye and occipital borders; scape slightly swollen toward tip; wings hyaline, veins light; mesoscutellum with a central longitudinal hairless line and a circular hairless space at tip; mesopleura strongly longitudinally striate; color dark orange; cheeks with a darker lustrous area; abdomen black above, except at center; metanotum black internally, scape black in the middle, yellowish at either end; flagellum brown; mesonotum with a narrow black line at anterior border.

Six females, reared from *Pulvinaria* on Oregon flowering currant, February, 1890. The scales were received from Mr. F. S. Mattison, Aumsville, Marion County, Oregon.

Type.—No. 5048, U.S.N.M.

APHYCUS FLAVICEPS, new species.

Female.—Length, 0.77 mm.; expanse, 2.2 mm. Scape somewhat swollen toward tip; vertex narrow; ocelli forming a very acute-angled triangle; scutellum with a longitudinal hairless line but no circular hairless spot at tip; wings hyaline, veins colorless. General color orange; head light lemon yellow; scape black at tip, yellow at base; flagellum brown; abdomen black above; ventral surface of body light yellow; tibiae with three light brown bands.

Two females, reared by Mr. W. G. Johnson, Champaign, Illinois, from a *Lecanium* on an unknown plant.

Type.—No. 5049, U.S.N.M.

APHYCUS MEXICANUS, new species.

Female.—Length, 1.5 mm.; expanse, 3.2 mm. Scape long, cylindrical, reaching as high as top of head; vertex very narrow; ocelli form an acute-angled triangle; wings hyaline, veins light brown. General color orange; scape black below, yellowish above; pedicel black at base, yellowish at tip; first four funicle joints brown, fifth and sixth yellow; club black; abdomen black above; pleura light yellow, finely shagreened, with few longitudinal impressed lines; occiput black; pronotum black below, pallid behind, with two black shallow spots; tegulae pallid, with a brown spot at tip; metascutellum black; metascutum orange with black spot either side; metapraescutum with a brown spot either side and another brown spot either side of the scapulae; legs pallid, not spotted.

Many specimens reared from a *Ceroplastes* in the City of Mexico, by Prof. C. H. T. Townsend. Two specimens reared from *Ceroplastes cirripediformis* in Baton Rouge, Louisiana, in December, by Mr. H. A. Morgan.

Type.—No. 5050, U.S.N.M.

APHYCUS ALBERTI, new species.

Female.—Length, 0.81 mm.; expanse, .21 mm. Resembles preceding species, except that first three funicle joints are reduced in size, whereas in *mexicanus* they are subequal with the last three, in lacking the brown dots either side of scutellum, in having abdomen concolorous with the thorax. It is also a considerably smaller species.

Male.—Uniform black above; lower face reddish yellow; antennae brown; tegulae yellowish; pleura and under side of body honey-yellow; all legs honey-yellow.

One male, one female, reared from *Lecanium hesperidum*, at Sidney, New South Wales, Mr. A. Koebele.

Type.—No. 5051, U.S.N.M.

Genus CHRYSOPOPHAGUS.

Chrysopophagus ASHMEAD, Insect Life, VII, pp. 245, 246.

CHRYSOPOPHAGUS BANKSI, new species.

Female.—Length, 2.1 mm.; expanse, 3.8 mm. Resembles *C. compressicornis* Ashmead, except in the following particulars: Scutellum is brownish yellow, not orange; abdomen is brownish yellow, except at base, where it is dark and metallic; all legs are uniform dark honey-yellow; fore-wings are almost uniformly dusky, except at base; the flagellum of antenna is black; pronotum is dark honey-yellow; head is smooth or very faintly shagreened.

Described from three female specimens, two collected by Mr. Nathan Banks at College Station, Texas, August 31, 1890, and one collected by

Prof. T. D. A. Cockerell at Mesilla Park, New Mexico, June 24, 1896.

Type.—No. 3851, U.S.N.M.

Genus *ECTROMA* Westwood.

Ectroma WESTWOOD, Philosophical Magazine, 1833, 3d ser., III, p. 344, No. 30.

ECTROMA AMERICANUM, new species.

Female.—Length, 1.6 mm. Ocelli at angles of right-angled triangle; head smooth, shining, very faintly shagreened; mesoscutum shining, with close silvery pubescence; mesoscutellum with golden pubescence; first abdominal segment and sides of metanotum with silvery pubescence; general color, dull yellowish brown; mesoscutellum somewhat brighter colored; scape of antennae honey-yellow; pedicel and funicle black; club pure white; dorsum of abdomen dark brown and sides of mesonotum also dark; all legs uniform honey-yellow; rudiments of wings prominent, those of forewings as long as middle tarsi.

One female, collected by Prof. T. D. A. Cockerell at Mesilla, New Mexico, June 24, 1896.

Type.—No. 3852, U.S.N.M.

This is the first representative of this remarkable group to be found in America. Other species are known from Europe, Java, and Madeira.

Genus *PHAENODISCUS* Foerster.

Phaenodiscus FOERSTER, Hymenopterologische Studien, 1856, II, p. 144, No. 6.

PHAENODISCUS ARIZONENSIS, new species.

Female.—Length, 1.5 mm.; expanse, 3.3 mm. Comes closest to *P. aeneus* Dalman. Frons with large sparse punctures; face with still larger punctures; mesonotum transversely shagreened and with large regular piliferous punctures; wings deeply infuscated, except at tip; costa above submarginal vein much arched; stigmal, postmarginal and marginal veins subequal in length; general color dusky reddish brown, lighter on face and mesopleura, and much darker on abdomen and mesoscutum, the latter being somewhat metallic; all coxae nearly black, legs yellow-brown; scape of antennae, pedicel, and first three funicle joints light brown; funicle joints 4, 5, and 6 yellowish white.

Three females, Mr. H. G. Hubbard, Chiracahua Mountains, Arizona, May 31, 1897.

Type.—No. 3853, U.S.N.M.

ON THE COLEOPTEROUS INSECTS OF GALAPAGOS ISLANDS.

By MARTIN L. LINELL,¹

Aid, Division of Insects.

The general physical features of the Galapagos archipelago have been amply described by Darwin, Salvin, Hooker, and more recently by Alexander Agassiz,² and need not be repeated here. The extreme poverty of the insect life of these islands is especially alluded to by Mr. Agassiz and particularly illustrated by Dr. Samuel H. Scudder in his account of the Galapagos Orthoptera.³ The whole number of species of this order is 20, including 5 cosmopolitan species. The coleopterous fauna appears to be relatively equally poor, although, as must be expected from any locality, more numerous in species than the Orthoptera. Charles Darwin, while on the famous *Beagle* expedition, collected 29 species, of which Rev. F. W. Hope⁴ described one as new. The remainder were reported upon by George R. Waterhouse,⁵ who described 22 new species and 3 new genera. Of the remaining 6 species 2 were cosmopolitan and 4 were left as doubtfully identical with species previously known from the American continent. In 1852 the Swedish frigate *Eugenie* touched the islands, and from the Coleoptera obtained there Boheman in 1858 described 6 as new. From that time until 1889 no further mention was made of the Coleoptera of these islands. In that year Dr. L. O. Howard, in his Annotated Catalogue of the Insects Collected in 1887-88 by U. S. Fish Commission Steamer *Albatross*,⁶ lists 12 species determined by the writer, but the presumably new ones are not described. The *Albatross* again visited the islands in 1891, and 3 species were obtained. Later in the same year Dr. G. Baur, of Clark University, on a special trip to the islands, collected 21 species, which he presented to the U. S. National Museum, as the U. S. Fish Commission had done with the two lots previously mentioned. Although some

¹ Mr. Linell died May 3, 1897.—Editor.

⁴ Trans. Ent. Soc., London, 1837, p. 130.

² Bull. Mus. Comp. Zool., 1892, XXIII, p. 56.

⁵ Ann. Nat. Hist., 1845, XVI, p. 19.

³ Idem, 1893, XXV, p. 1.

⁶ Proc. U. S. Nat. Mus., XII, No. 771.

of the forms of the different collectings are identical, there are now represented in the Museum a total of 28 species. By careful examination of this material 8 forms prove to be identical with species collected by Darwin, but none of Boheman's species have been recognized. Of the remaining 20 species 5 are found to have an extended distribution in tropical America, 1 is cosmopolitan, and 14 are described as new in the following pages.

In view of the extreme interest attaching to the biology of these islands, it has been thought advisable to furnish a complete list of the 55 coleopterous species so far known to inhabit this archipelago. The percentage of apterous forms is very large, as will be seen by the list; and another peculiar feature is that they are generally of a smoother sculpture than their congeners of the continent. Of Waterhouse's species that have been rediscovered, a more explicit description is given, and for one of them a new genus is proposed. Two new Brazilian Coleoptera attracted attention in the course of the work of comparison and are characterized in footnotes.

Family CARABIDAE.

CALOSOMA GALAPAGEIUM Hope.

Calosoma galapageium HOPE, Trans. Ent. Soc. London, 1837, II, p. 130.

Form and size of *Cychnus stenostomus*, apterous, smooth, and very shining. Head black, impunctate; mandibles piceous; labrum and palpi ferruginous. Antennae ferruginous, slightly darker outward, finely rufo-pubescent from the fifth joint, reaching the elytra to one-fourth the length from the base. Thorax black, aeneous at the base, entirely impunctate, slightly wider than long, subcordate, somewhat wider at apex than at base; disk feebly convex, not depressed at the sides; median line distinctly impressed; basal foveae rounded, deep, approximate to the sides; base truncate; posterior angles prolonged and deflexed. Elytra at base slightly wider than the thorax at middle, ovate, one-half longer than broad, dark cupreous green; humeri rounded; disk slightly convex, feebly (at the sides and apex obsoletely) punctato-striate; intervals nearly flat, smooth; the third, seventh, and eleventh with feebly convex, elongate elevations, separated by rounded very shallow foveae, each fovea with a couple of punctures. Epipleura and ventral surface reddish brown, smooth. Legs ferruginous; tibiae sparsely and finely spinose, the intermediate ones strongly arcuate (male), expanded at apex, pubescent beneath and prolonged into a spine as long as the spurs; anterior tarsi (male) with the first three joints strongly dilated and densely spongy beneath, the first joint campanulate, the second widest, quadrate, the third strongly transverse, the fourth short, emarginate, two-thirds as broad as the third, with a few small spines and a trace of sponginess beneath, fifth joint narrow, cylindrical. Posterior coxae oval obtuse.

Length, 12.5 mm.; width, 5 mm.

One male, collected on Chatham island by Dr. G. Baur.

This is the smallest known species of *Calosoma* and has more the appearance of a *Cychrus*. Hope's description does not mention the sexual characters, and he gives the color as black above and beneath, with the elytral margin violaceous. It is not recorded on what particular island Darwin collected it.

***CALOSOMA HOWARDI, new species.**

Calosoma ? galapagoum LINELL (nec. HOPE), Annot. Cat. by L. O. Howard, Proc. U. S. Nat. Mus., 1889, XII, p. 191.

Ovate, bluish green above, slightly shining, winged. Head obsoletely sparsely punctate, slightly strigose at the eyes; labrum and mandibles black; palpi piceous. Antennae reaching to about one third the length of the elytra, piceous at base, the hairy joints brown. Thorax one-half broader than the head, one-half broader than long, subcordate, widest before the middle, imperceptibly sinuate behind; posterior angles not prolonged, subacute, forming an acute angle with the humeral margin of elytra; lateral margin narrowly reflexed; base broadly sinuate each side near the angles; disk feebly convex, not depressed at the sides, smooth or obsoletely finely strigose; median line distinctly impressed; the transverse basal impression obsolete, more or less punctate; basal foveae near the hind angles large, rounded, sparsely punctate. Elytra one-half longer than broad, subparallel or slightly wider behind (in the female); striae regular, feebly impressed at base, deeper behind, with small but deep punctures, submarginal striae more obsolete, marginal stria with muricate punctures; intervals of the disk slightly convex, obsoletely transversely rugose toward the sides; the third, seventh, and eleventh intervals interrupted by numerous small shallow foveae for their whole length. Ventral surface black, smooth; episterna of prothorax violaceous; sides of metasternum and first ventral with more or less numerous coarse punctures. Posterior trochanters oval, alike in the sexes. Legs black; tibiae finely spinose, the intermediate ones arcuate (slightly in the female), with coarse and dense yellow pubescence along the exterior groove below the middle.

Length, 16 to 21 mm.; width, 7.5 to 10.5 mm.

Male.—Anterior tarsi with three joints strongly dilated and spongy beneath. Intermediate tibiae strongly arcuate, the apex expanded, with a dense yellow pubescence beneath, and prolonged into a short obtuse spine.

Type.—No. 1311, U.S.N.M.

Two examples from Duncan island and 12 from Chatham island, collected by the *Albatross* expedition in 1888, and 78 from Charles island, collected by the *Albatross* expeditions in 1888 and 1891; also by Dr. G. Baur.

PTEROSTICHUS CALATHOIDES Waterhouse.

Feronia calathoides WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 21.

Poecilus calathoides GEMMINGER and HAROLD, Cat. Col., 1868, I, p. 300.

Elongately ovate, black, smooth, shining, very depressed above. Antennae, labrum, palpi, and legs piceo-rufous. Thorax subquadrate, sides arcuate and slightly convergent before the middle, parallel behind; posterior angles rectangular, not carinate; disk with the median line finely impressed and with a single long basal fovea each side, equidistant between the middle and the angles, entirely impunctate. Elytra at base scarcely broader than thorax, obliquely dilated for a short distance and then arcuately narrowed to apex; disk with 9 deeply impressed, impunctate striae; intervals convex, smooth, the second broader at base and with a short stria; the third stria with an impressed puncture toward the base, the second with one at the middle and another one toward apex, the eighth with the usual coarse punctures. Ventral surface smooth, piceous black. Prosternum rounded at apex; episterna of metathorax twice longer than broad. Male without fimbriae on the hind tibiae. Female with the elytra subopaque. Wings aborted.

Length, 11 mm.; width, 4.5 mm.

Two examples from Charles island, collected by the *Albatross* expedition in 1888, and 3 from Chatham island, collected by Dr. G. Baur. If Chaudoir's genera are accepted, the species would belong to the genus *Dysidius*. The island from which Darwin obtained it is not recorded.

PLATYNUS GALAPAGOENSIS Waterhouse.

Feronia galapagoensis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 21.

Poecilus galapagoensis GEMMINGER and HAROLD, Cat. Col., 1868, I, p. 302.

Apterous, elongate, depressed, very smooth, black above, ventral surface and legs rufo-piceous. Antennae ferruginous, with the three basal joints glabrous. Thorax broad, flat, slightly longer than broad, widest at middle, arcuately narrowed to apex, feebly convergent, nearly parallel behind the middle; side margins narrowly reflexed; posterior angles rectangular, obtuse at apex, flattened above; disk entirely impunctate, with a long basal fovea on each side nearer to the lateral margin than to the middle; median line finely impressed; transverse basal impression obsolete. Elytra elongately oval, with rounded humeri and finely impressed smooth striae, the second stria with a puncture behind the middle, the third with one toward the base; intervals flat, finely alutaceous; apices feebly sinuate, slightly prolonged. Episterna of metathorax somewhat longer than broad. Legs slender, moderately long; the anterior tarsi without grooves, the middle and posterior tarsi with lateral grooves.

Length, 11 mm.

One female, collected on Chatham island by Dr. G. Baur. On which island Darwin collected the species is not recorded.

SCARITES GALAPAGOENSIS, new species.

Elongate, parallel, convex, shining black, apterous. Mentum nearly twice broader than long, broadly concave, smooth, acutely carinate at middle, with a round fovea at base each side of the carina; the lobes strongly rounded at the sides with a fine obtuse submarginal carina; the tooth broad at base, abruptly narrowed and acute at apex, longer than the lobes, the margins carinate. Maxillae incurved at apex and acutely mucronate. Mandibles nearly as long as the head, arcuate and acute at apex, bicarinate above, scarcely striate. Antennae piceorufous, reaching to the hind angles of the thorax, the basal joint a little longer than the following three together, the second to fourth obconical, decreasing in length, the fifth to tenth broader, compressed, densely rufopubescent, slightly longer than broad; the terminal joint oval, compressed. Paragenae broad, concave, smooth, emarginate and dentate at apex, the inner margin rounded, not carinate. Eyes prominent, truncate behind, and inclosed by the globose tempora. Head smooth, deeply bisulcate in front. Epistoma slightly striate toward the sides, bidentate and emarginate at middle, with two small tubercles at the emargination; the lateral margin in front of the eyes rounded and less prominent than the eye. Labrum subequally tridentate with three coarse punctures, the median puncture bisetose, the lateral ones unisetose. Thorax in front scarcely wider than the head, narrowed and feebly rounded to the hind angles, nearly twice broader than long; disk convex, smooth, the median and anterior transverse lines distinct; anterior margin finely striate; posterior angles distinctly dentate; base pedunculate at middle, the oblique sides being distinctly sinuate; a rounded fovea at the base each side of the peduncle. Elytra as long as head and thorax including the mandibles, narrower than the thorax, slightly dilated at middle and strongly rounded to apex; humeri strongly dentate; disk convex, deeply striate, striae impunctate; intervals smooth, obtusely subcarinate, the third with one puncture toward apex and the usual apical puncture; basal margin and the ninth interval finely granulate, the latter with a series of punctures. Ventral surface smooth; the episterna of metathorax one-third longer than broad. Ventral segments without impressed basal line, the subterminal ones each with two punctures at middle, the terminal with four punctures at the margin; the last two segments, with the lateral margin and a connected spot, red, translucent. Legs moderately stout; the anterior tibiae prolonged at apex, tridentate in front, the upper tooth very small, the terminal one very long and slender, curvate, reaching to the third tarsal joint; no trace of denticles above the third tooth. Middle tibiae with one spine near apex and with a row of denticles, increasing in size from the knee downward. Posterior tibiae slender, without dense fimbriae. Tarsi slender. Claws long, arcuate. Length, 27 mm.; width, 9 mm.

Type.—No. 1312, U.S.N.M.

Two examples, collected on Chatham island by Dr. G. Baur. The species appears to be nearest allied to the Brazilian forms of the *cayennensis* group, but it is apterous, and if intercalated in the table of Chaudoir's monograph it would be placed near the Mediterranean species *S. laevigatus* Fabricius.¹

SELENOPHORUS GALAPAGOENSIS Waterhouse.

Selenophorus galapagoensis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 22.

Oblong oval, feebly convex, winged, above piceous, distinctly alutaceous, feebly shining; elytra slightly bronzed. Labrum ferruginous, feebly emarginate. Mandibles smooth, scrobes large. Antennae ferruginous, reaching to the humeral angles, the third joint one-half longer than the second. Thorax broader than long, rounded at the sides, widest before the middle, slightly narrowed to the base; posterior angles obtuse; apex feebly sinuate near the angles; base broadly emarginate at middle; disk impunctate, with the median line finely impressed, often abbreviated; transverse apical line effaced; basal foveae feeble. Elytra slightly broader than thorax, basal line slightly sinuate, forming an obtuse angle with the side margin; apices very feebly sinuate; disk with fine smooth striae, more deeply impressed at apex, the second, fifth, and seventh with series of small impressed punctures; the submarginal punctures coarser; subscutellar stria long. Epipleura of thorax and elytra ferruginous. Ventral surface rufopiceous, nearly smooth. Prosternum rounded at apex, not margined.

¹A very distinct species of *Distichus*, apparently undescribed, has been collected in Santarem, Brazil, by Mr. Herbert H. Smith. It is characterized as follows:

DISTICHUS SMITHI, new species.

Elongate, parallel, black, shining, smooth above and slightly depressed, winged. Mentum rugulose with distinct submarginal and median carina, the tooth very short, obtusely angulate at apex. Paragena slightly rugose, marginate externally, deeply emarginate at apex. Mandibles long, sinuate externally, strongly toothed, not striate above. Antennae ferruginous, submoniliform, reaching the hind angles of thorax. Head smooth; eyes prominent; epistoma with a few short striae at the sides; lateral margin in front of the eyes angulate, less prominent than the eye. Thorax one-half broader than long, widest in front, scarcely narrowed and feebly rounded to the hind angles; base distinctly pedunculate, finely rugose along the sides and in the rounded foveae; hind angles with a small tooth; disk smooth with median and apical lines deeply impressed, obsolete strigose along the apical margin. Elytra longer than head and thorax, finely toothed at the humeri, granulate along the basal and lateral margins; disk deeply striate; striae smooth; intervals convex, smooth, the third with six impressed punctures on the outer side. Ventral surface finely rugosely granulate, smooth along the median line. Abdominal segments with two punctures, the terminal segment with four; the basal line on the last three segments distinct. Anterior tibiae with four denticles above the third tooth; the middle tibiae with two spines, the upper one very small, not much different from the nearest of the denticles above. Posterior tibiae with five long hairs on the posterior margin, not densely fimbriate. Length, 23 mm.; width, 7 mm.

Type.—No. 1313, U.S.N.M.

Four examples, Santarem, Brazil.

Legs short, ferruginous. Posterior tarsi with second to fourth joints slightly longer than wide. Length, 8 mm.; width, 3.5 mm.

Five examples, collected on Charles island by the *Albatross* expedition in 1888. It is not stated on what island Darwin collected it. The species is a true *Selenophorus*.

FERONIA INSULARIS Boheman.

Feronia insularis BOHEMAN, Fregatten *Eugenie's* Resa, Zool., L, p. 14.

No particular island of habitat is mentioned for any of Boheman's species.

AMBLYGNATHUS OBSCURICORNIS Waterhouse.

Amblygnathus obscuricornis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 22.

It is not recorded on what island Darwin collected this insect.

NOTAPHUS GALAPAGOENSIS Waterhouse.

Notaphus galapagoensis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 23.

Collected on James island by Darwin.

Family DYTISCIDAE.

COPELATUS GALAPAGOENSIS Waterhouse.

Copelatus galapagoensis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 23.

No island recorded for Darwin's capture of this species.

Family HYDROPHILIDAE.

TROPISTERNUS LATERALIS Fabricius.

Hydrophilus lateralis FABRICIUS, Syst. Ent., p. 228.—WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 41.

It is not recorded on what island Darwin collected this species which is widely distributed in America.

PHILHYDRUS species.

Philhydrus species WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 41.

Waterhouse suspects this to be identical with a continental species. No particular island is indicated where Darwin collected it.

Family STAPHYLINIDAE.

CREOPHILUS species.

Creophilus, new species? WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 26.

Collected on Chatham island by Darwin.

This is probably *Creophilus villosus* Gravenhorst, introduced from North America.

Family COCCINELLIDAE.

SCYMNUS GALAPAGOENSIS Waterhouse.

Scymnus galapagoensis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 41.

Collected on James island by Darwin.

Family DERMESTIDAE.

DERMESTES CARNIVORUS Fabricius.

Dermestes carnivorus FABRICIUS, Syst. Ent., p. 55.

One example, collected on Chatham island by the *Albatross* expedition in 1891. The species is generally distributed over North and Central America.

DERMESTES VULPINUS Fabricius.

Dermestes vulpinus FABRICIUS, Spec. Ins., I, p. 61.—WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 26.

Collected on James island by Darwin. It is cosmopolitan.

Family ELATERIDAE.

PHYSORINUS GALAPAGOENSIS Waterhouse.

Physorinus galapagoensis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 25.

According to a note by Mr. G. C. Champion¹ this species belongs to *Anchastus*. What island Darwin collected it on is not recorded.

HETEROCREPIDIUS PUBERULUS Boheman.

Heterocrepidius puberulus BOHEMAN, Fregatten *Eugenie's* Resa, Zool., 1858, I, p. 66.

Family BOSTRYCHIDAE.

TETRAPRIOCERA LONGICORNIS Olivier.

Tetrapriocera longicornis OLIVIER, Ent., IV, 77, p. 15.

One example taken on Indefatigable island by the *Albatross* expedition in 1888. The species is distributed from southern Florida and West Indies to Central and South America.

AMPHICERUS PUNCTIPENNIS Le Conte.

Amphicerus punctipennis LE CONTE, Proc. Ac. Nat. Sci. Phila., 1858, p. 73.

Apat species WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 36.

One specimen, taken on southern Albemarle island by Dr. G. Baur, I consider a form of Le Conte's species, of which I have compared

¹ Biol. Centr.-Amer. Col., III, Pt. 1, p. 385.

specimens from the southwestern United States, Mexico, and Venezuela. It agrees with an example from Los Angeles, California, in having granulate tubercles on the disk of thorax and in wanting the usual elevations on the declivity of elytra. The only difference that might be considered specific is that the apical margin of the elytra is not raised and not recurved to connect with the convex submarginal interval, but this margin is variable in development in individuals from the same locality. Darwin collected his specimens on a dead mimosa tree on Chatham island.¹

Family CLERIDAE.

NECROBIA RUFIPES De Geer.

Corynetes rufipes De Geer, Mem., V, p. 165.—WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 26.

Collected on James island by Darwin. It is cosmopolitan.

Family PASSALIDAE.

NELEUS TLASCALA Percheron.

Neleus tlascala PERCHERON, Mon. des Passales, 1835, p. 45.

One example was collected on Chatham island by the *Albatross* expedition in 1891. The species is distributed from Lower California to Paraguay. It has ample wings.

¹ The following apparently undescribed species of this genus has been collected in Chapada, Brazil, by Mr. Herbert H. Smith:

AMPHICERUS FRONTALIS, new species.

Cylindrical, robust, piceous black, shining, glabrous above. Antennae ferruginous, second joint globose, the following five together as long as the club, gradually wider and more acute on the inner side; the club strongly compressed, eighth and ninth joints transverse, tenth a little longer than wide. Mandibles black, polished, with the scrobes flat, punctate, short and broad. Palpi rufous, densely ciliate. Head transversely rugose beneath, densely longitudinally strigose on the vertex; front shining and finely punctate on the sides, strigose near the eyes; on the middle a large, oval, opaque space, densely covered with small very acute tubercles. Labrum densely covered with yellow hairs. Clypeus dark ferruginous, separated from the front by a deep arcuate impression. Epistoma not separated. Eyes very large. Thorax quadrate with conical hind angles; the anterior declivity without hooks, rather finely granulate and rugose on the summit, each side with prominent acute tubercles; the inflexed sides densely rugosely punctate; disk with a large triangular smooth space at middle, and posteriorly reticulately punctate. Elytra rather finely punctate; humeri prominent, nearly smooth; posterior declivity more coarsely, rugosely punctate; suture scarcely elevated; apex distinctly margined. Ventral surface finely, densely punctulate, with yellowish sericeous pubescence; metasternum sparsely punctulate, nearly glabrous. Legs piceous, finely punctulate and pubescent. Length, 13 mm.; width, 4.5 mm.

Type.—No. 1314, U.S.N.M.

Family SCARABAEIDAE.

COPRIS LUGUBRIS Boheman.

Copris lugubris BOHEMAN, Fregatten *Eugenie's* Resa, Zool., 1858, I, p. 42.

ORYCTES GALAPAGOENSIS Waterhouse.

Oryctes galapagoensis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 26.

One female was collected on Chatham island by the *Albatross* expedition in 1888, and six males were taken by Dr. G. Baur on the same island. It is a light-brown shining insect, wider behind, resembling in form the South American *Bothynus ascanius* Kirby. The punctuation is sparse and fine and the sutural stria distinct. The ventral surface is moderately hairy. Wings are present, but seem to be somewhat aborted. The length of the female is 23 mm., of the males 16 to 19 mm. The generic characters are very different from *Oryctes* Illiger, all the species of which inhabit the Old World. It should form a new genus in the group *Pentodontides* of Lacordaire, and the following name is proposed for it:

PSEUDORYCTES, new genus.

Mentum large, elongate, convex, arcuately narrowed to apex. Mandibles prominent, with the exterior margin entire, strongly rounded. Antennae ten-jointed, club small in both sexes. Head transversely depressed between the eyes, the canthus angulate and prominent. Clypeal suture raised into an obtuse bisinuate ridge, more prominent at middle and at the side margin. Clypeus broader than long, subtriangular, sinuate toward apex (in the male slightly longer and more sinuate than in the female); apical margin reflexed, obsoletely emarginate. Thorax transverse, very convex, deeply emarginate at apex, strongly rounded at the sides, without any impressions in either sex; the posterior angles obtuse in the female, rounded in the male. Stridulating organs forming two longitudinal bands on the middle of propygidium, parallel in the female, convergent to apex in the male. The apical margin of this segment is feebly rounded in the female, in the male prolonged in an acute triangle. Pygidium convex and entirely glabrous in the male, in the female with a slight rounded impression at the middle and the margin ciliate. Prosternum with a conical protuberance behind the coxae. Legs moderately stout, the anterior tibiae quadridentate in the female, in the male tridentate, with the margin above the teeth flattened and rounded. Posterior tibiae with two oblique ridges, the apex moderately expanded, truncate and fimbriate. Posterior metatarsus triangular, scarcely longer than broad. Claws simple.

Type.—*Oryctes galapagoensis* Waterhouse.

Family CERAMBYCIDAE.

MALLODON MOLARIUM Bates.

Mallodon molarium BATES, Biol. Centr.-Amer. Col., 1879, V, p. 9.

The *Albatross* expedition in 1888 collected on Charles, Chatham, and Duncan islands seventeen examples of this large Prionid, which is distributed from Lower California through Mexico and Central America to Panama. The species is amply winged.

ACHRYSON GALAPAGOENSIS, new species.

Cylindrical, luteous, opaque, sparsely clothed with short pale pubescence. Head densely punctate, two spots on the front and one on the vertex, black. Antennae slender, in the male nearly twice the length of the body, in the female slightly passing the apex of elytra. Thorax globose, much more strongly so in the female, narrowly constricted at each end, with elongate black spots, six at apex and six at base; the dorsal spots sometimes connected to longitudinal stripes; in other specimens the spots are wanting, except the dorsal pair at base and the lateral pair at apex; apical margin truncate, basal margin slightly bisinuate; disk with a small smooth space at middle, the punctuation different in the sexes; the female is densely, rugosely punctate, the male has the black spots very finely and densely punctulate with sparse granules, the rufous parts slightly rugosely punctate. Scutellum semioval with dense yellowish hairs. Elytra conjointly rounded at apex, the male with distinct but not very long sutural spines, the female with only acute angles; disk densely rugosely punctate with black spots as follows: A basal spot each side in the depression inside the humerus, a circumscutellar spot and on each elytron six elongate spots, arranged in two transverse curved bands, one before and the other one behind the middle; the lateral spots of these bands are sometimes wanting but the central spots on each elytron are generally connected and prolonged toward apex. Metasternum, abdomen, and legs sparsely and finely muricately punctate. Wings ample. Length, 16 to 20 mm.

Type.—No. 1315, U.S.N.M.

Two males and two females, collected on Chatham island by Dr. G. Baur.

EBURIA LANIGERA, new species.

Female.—Elongate, somewhat depressed, brownish testaceous, densely clothed with long appressed grayish hairs. Antennae slightly longer than the body, with only slight traces of flying hairs; scape one-fourth shorter than third joint, feebly clavate, slightly compressed but not flattened, finely punctate; third to eleventh joints filiform, slightly decreasing in length. Thorax scarcely longer than broad, strongly

narrowed in front, sparsely rugosely punctate; lateral spines moderate, conical, acute; lateral tubercles in front small, flattened, black, not at all prominent; dorsal tubercles small, conical, black. Elytra depressed along the suture, each with two pairs of elevated, yellow, linear spots, surrounded by obscure color, the basal pair well separated, the exterior twice the interior four times longer than broad; the posterior pair of spots are approximate, the exterior one twice longer. There are traces of costae behind the posterior spots. The basal half of the elytra and the dark spots surrounding the posterior ivory spots are punctate but not granulate, the sides and apex are obsoletely punctulate. The elytral apices are emarginate with short subequal spines. Legs slender, the middle and posterior femora bispinose, the spines short, the interior ones slightly longer. The posterior femora reaching to apex of elytra. Length, 20 mm.

Type.—No. 1316, U.S.N.M.

One specimen, collected on Charles island by the *Albatross* expedition in 1888.

EBURIA BAURI, new species.

Male.—Elongate, slightly depressed, ferruginous, sparsely clothed with a short, recumbent pubescence. Antennae twice longer than the body, the four basal joints densely rugose and with long hairs on all sides; the outer joints fimbriate with long hairs, finely punctulate, canaliculately impressed, beginning from the apex of the fifth joint; scape feebly clavate, scarcely more than half as long as the third joint; the terminal joint one-third longer than tenth and curvate. Thorax transverse, densely rugose; lateral spines small, subconical; tubercles on the sides in front obtuse, not prominent; dorsal tubercles black, small, rounded. Elytra with two pairs of small yellow elevated spots, surrounded by black, all well separated; the basal pair largest, the inner one somewhat shorter; the discal pair very small, the inner one almost punctiform; punctuation moderately coarse at base, not different on the black marks, gradually finer toward apex, the intervals very finely rugosely granulate; apices acuminate and spinose at middle, without sutural spines. Legs moderately stout, femora not spinose, the posterior pair very far from reaching the apices of elytra. Length, 22 mm.

Type.—No. 1317, U.S.N.M. Two examples, collected on Chatham island by Dr. G. Baur.

Female.—Color as in the male. Antennae not rugose, somewhat longer than the body, the scape two-thirds the length of the third joint, distinctly flat on the anterior face; outer joints compressed. Head and thorax with longer pubescence and long, erect hairs intermixed. Thorax somewhat narrowed at apex, scarcely rugose, the spines and tubercles larger, all black. Elytra more convex, muricately punctate, gradually more finely toward apex; the ivory spots much larger, more distinctly surrounded with black, the inner one of the

basal pair much larger than the exterior one; apices truncate, with long spines, the sutural spine half as long as the exterior one. Middle and posterior femora with a long apical spine on the inner side. Length, 19 to 35 mm.

Type.—No. 1318, U.S.N.M.

Three specimens, collected on Chatham island by Dr. G. Baur.

EBURIA AMABILIS Boheman.

Eburia amabilis BOHEMAN, Fregatten *Eugenie's* Resa, Zool., 1858, I, p. 151.

Described by Boheman as having the thorax one-half longer than broad and the basal ivory spots of elytra connected at apex. The length is given as 13 mm.

ACANTHODERES GALAPAGOENSIS, new species.

Subtrigonal, moderately convex, brownish, covered with a fine ashy-gray pubescence and maculate with lighter and darker brown. Antennae passing the body by the last three joints, annulated with dark brown, the third to eleventh joints filiform, the third and fourth together as long as the four following joints together; the terminal joints sparsely ciliate in the male. Front sparsely punctate. Eyes coarsely granulate. Thorax with narrow median carina, dorsal tubercles obtusely conical, lateral tubercles large, acute; intervals and margins with sparse, coarse and deep punctures. Sides of scutellum brown. Elytra narrowed to apex, the suture and margins with brown spots; two dark-brown, strongly-angulate, transverse bands behind the middle; the centrobasal ridges feebly raised at the base, prolonged in an obtuse flexuous carina toward apex; the basal half sparsely covered with granules, each of which has a small puncture behind, the apical half nearly smooth; apices emarginate, the outer angle with a short spine. Prosternum regularly arcuate, feebly canaliculate. Mesosternum flat, without tubercles, vertical in front. Femora moderately clavate. Tibiae biannulate with brown, the anterior ones not dilated nor compressed. Anterior tarsi moderately dilated in the male, fringed with black hairs. Posterior metatarsus very long and slender, as long as the three following joints together. Length, 14 mm. (male) to 16 mm. (female).

Type.—No. 1319, U.S.N.M.

One male and one female, collected on Chatham island by Dr. G. Baur. The species resembles much the Brazilian *A. lateralis* Bates in form, structure, and coloration, but the fasciate elytra and the much longer posterior metatarsus will at once distinguish it.

Family CHRYSOMELIDÆ.

HALTICA GALAPAGOENSIS Waterhouse.

Haltica galapagoensis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 39.

Collected by Darwin on Charles island.

Family TENEBRIONIDÆ.

Genus STOMION.

Stomion WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 27.

A genus peculiar to this archipelago. It is allied to the Californian genus *Emmenastus* Motschulsky, but the intercoxal process of abdomen is broad and the tarsi are finely spinose beneath. They are apterous with the elytra connate. Several closely allied species occur.

STOMION CARINIPENNE, new species.

Oblong, opaque, black above, rufopiceous beneath, antennae and legs rufous. Thorax densely, rather coarsely, punctate, scarcely narrowed in front, sides nearly parallel. Elytra at base broader than thorax; striae deep, coarsely punctate; intervals obtusely carinate with scattered minute punctures. Length, 8 to 9 mm.

Type.—No. 1320, U.S.N.M.

Eight specimens from Charles island, collected by Dr. G. Baur.

STOMION GALAPAGOENSE Waterhouse.

Stomion galapagoense WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 29.

Oval, opaque, piceous black above, ventral surface, antennae and legs rufopiceous. Thorax less densely, not strongly, punctate, very short, distinctly narrowed to apex; sides rounded. Elytra at base not broader than thorax; striae deep, coarsely but not closely punctate; intervals convex but not carinate, obsolete transversely rugulose, sparsely minutely punctulate. Length, 8 to 10.5 mm.

Seven examples, collected on Chatham island (six by *Albatross* expedition, 1888, and one by Dr. G. Baur) have above-mentioned relative characters, and agree tolerably well with Waterhouse's description. The island where Darwin collected his specimens is not recorded.

STOMION PICEUM, new species.

Oval, opaque, piceous above, ventral surface, antennae and legs rufopiceous. Thorax densely, more strongly, punctate, very short, distinctly narrowed at apex; sides rounded. Elytra at base not broader than thorax; striae feebly impressed, finely punctate; intervals broad, feebly convex, distinctly punctate. Length, 8.5 to 11 mm.

Type.—No. 1321, U.S.N.M.

Sixteen specimens, collected on Chatham island, (twelve by *Albatross* expedition in 1888 and four by Dr. G. Baur) show some variation in sculpture, but are probably one species, distinct from the previous form, although very closely allied.

STOMION BAURI, new species.

Oblong, subcylindrical, somewhat shining, black above, ventral surface and legs piceous, antennae rufous. Thorax quadrate, strongly convex, not narrowed at apex, finely and moderately densely punctate; sides broadly rounded. Elytra at base scarcely broader than thorax; humeri acute; striae feebly impressed, very finely punctate; intervals feebly convex, obsoletely minutely punctate. Male with mentum densely rufo-villosé. Length, 7 to 8 mm.

Type.—No. 1322, U.S.N.M.

Three examples, collected on southern Albemarle island by Dr. G. Baur. The species is very distinct by its form.

STOMION HELOPIOIDES Waterhouse.

Stomion helopioides WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 30.

Described as having the thorax transverse, not narrowed in front, the elytral striae not strongly punctate and the intervals flat. Size, 6 to 7 mm. No island is recorded where Darwin collected this or the next species.

STOMION LAEVIGATUM Waterhouse.

Stomion laevigatum WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 30.

Described as having the elytra smooth.

Genus **AMMOPHORUS** Guérin de Méneville.

Ammophorus GUÉRIN, Voy. Coquille Ent., 1830, II, p. 94.

A genus allied to *Eulabis*, from California, differing in the cylindrical antennae with the last joint truncate: Species are known from Peru, Chile, Hawaiian Islands (?), and Galapagos Archipelago.

AMMOPHORUS GALAPAGOENSIS Waterhouse.

Ammophorus galapagoensis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 30.

Described as having the head and thorax longitudinally strigose, the latter with acute front angles and nearly straight hind angles; the elytra with eight sulci and equal intervals, the suture raised. It was collected on Chatham island by Darwin.

AMMOPHORUS BIFOVEATUS Waterhouse.

Ammophorus bifoveatus WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 31.

Described as having the thorax rather finely punctured, the sides suddenly and equally constricted before and behind with the angles

acute, the posterior ones prominent, the disk with two shallow grooves on the sides and numerous longitudinal rugae, two of which on the median line are more conspicuous and separated by a narrow ridge. The punctures of the elytral striae are closely placed. It was collected on James island by Darwin.

AMMOPHORUS CAROLI, new species.

Piceous black, feebly shining, antennae, mouth and ventral surface rufopiceous, legs rufous. Head and thorax coarsely and densely but not confluent punctate, the latter broader than long, distinctly narrowed behind; the sides irregularly rounded, only constricted at the base; anterior angles rectangular; posterior angles acute, laterally prominent; disk on each side with one discal and three marginal shallow foveae. Elytra not broader than thorax, regularly ovate; humeral tooth distinct; striae nine, deeply impressed, with large, rounded, deeply impressed punctures, separated by at least their own width; intervals equal, narrow, acute, except the one nearest the suture, which is broader and more obtuse; the sutural edges scarcely raised. Thorax beneath very coarsely, irregularly punctate. Abdomen less coarsely punctate, the last two segments finely and sparsely punctulate. Wings wanting (as probably in all species of this genus). Length, 5.5 mm

Type.—No. 1323, U.S.N.M.

One example, collected on Charles island by the *Albatross* expedition in 1888.

AMMOPHORUS OBSCURUS Waterhouse.

Ammophorus obscurus WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 32.

Described as black, obscure, with piceous antennae and legs; head and thorax rugosely punctate, the latter narrow with the angles prominent; the elytra have the suture flat and the punctures of the striae transverse. What island Darwin collected it on is not recorded.

A specimen collected on southern Albemarle island by Dr. G. Baur agrees nearly with this description, but may prove to be a different species. The head and thorax are distinctly alutaceous, the former finely punctate in front, more strongly behind, the punctures not confluent; the thorax is longitudinally strigose, but the punctures are small and well separated.

Genus **PEDONOECS** Waterhouse.

Pedonoees WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 33.

Tessaromma BOHEMAN, Fregatten *Eugenie's* Resa, Zool., 1858, I, p. 91.

Forms of the group *Blapstini*, closely allied to the Californian genus *Notibius* Le Conte, by the quadrangular intercoxal process and the apterous body.

PEDONOECS GALAPAGOENSIS Waterhouse.

Pedonoees galapagoensis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 35.

Described as having the thorax densely punctured and the elytral intervals simply convex and glabrous. No particular island of habitat is recorded.

PEDONOECS COSTATUS Waterhouse.

Pedonoees costatus WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 35.

Described as having the punctuation of thorax confluent, forming longitudinal narrow ridges and the elytral intervals alternately costate. It was collected on James island by Darwin.

PEDONOECS MORIO Boheman.

Tessaromma morio BOHEMAN, Fregatten *Eugenie's* Resa, Zool., 1858, I, p. 92.

According to the description, this has the thorax densely and finely punctate and the elytral intervals carinate.

PEDONOECS PUBESCENS Waterhouse.

Pedonoees pubescens WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 36.

According to the description, this species also has the thorax densely punctulate, but the elytral intervals convex and pubescent.

PEDONOECS BAURI, new species.

Elongate, parallel, depressed, subopaque, piceous; antennae ferruginous, slender, gradually, not strongly, clavate. Head and thorax distinctly alutaceous, sparsely and finely punctulate. Superior portion of eye rather large, rounded. Sides of front arcuate. Thorax broader than long, regularly but feebly convex, emarginate at apex; sides not ciliate, parallel from the base, rounded and slightly convergent anteriorly; the angles slightly prominent but obtuse; base finely margined, distinctly sinuate at the sides; basal foveae feeble. Elytra not broader than thorax; striae feebly impressed with distant deep rounded punctures; intervals convex, not carinate, alutaceous and sparsely punctulate, swollen and somewhat irregular on the posterior declivity, sparsely pubescent at the sides. Legs obscurely ferruginous; anterior tibiae slender, slightly compressed; tarsi not dilated. Last ventral segment flattened at middle, apex with a small rounded emargination. Length, 7.5 mm.

Type.—No. 1324, U.S.N.M.

One male specimen, collected on Chatham island by Dr. G. Baur. Differs from all the preceding species by the sparsely punctulate head and thorax.

GNATHOCERUS CORNUTUS Fabricius.

Trogosita cornuta FABRICIUS, Ent. Syst. Suppl., p. 51.

One example of this cosmopolitan species was collected on southern Albemarle island by Dr. G. Baur.

PHALERIA MANICATA Boheman.

Phaleria manicata BOHEMAN, Fregatten *Eugenie's* Resa, Zool., 1858, I, p. 92.

Family CISTELIDAE.

LOBOPODA GALAPAGOENSIS, new species.

Female.—Elongate, subfusiform, brownish piceous, feebly shining, sparsely pubescent. Head moderately finely, not densely, punctate; eyes large, moderately widely separated. Thorax nearly twice wider than long, rather finely, not densely, punctate, obsoletely canaliculate; sides scarcely sinuate, feebly convergent; anterior angles strongly rounded, posterior angles somewhat acute; base deeply bisinuate; basal foveae rounded, deep. Scutellum transverse, punctate, subtruncate at apex. Elytra long, wide at the base, narrowed from a little beyond the humeri, deeply striate; striae very closely crenately punctate; intervals nearly flat, sparsely muricately punctate; apices acute. Ventral surface darker piceous, sparsely punctulate. Legs slender, femora piceous, tibiae, tarsi, and antennae ferruginous. Penultimate joint of anterior and middle tarsi shortly lobed. Prosternum abruptly declivous behind. Mesosternum oblique and emarginate in front. Length, 10 mm.

Type.—No. 1325, U.S.N.M.

Two females, collected on Charles island by the *Albatross* expedition in 1888.

Family OEDEMERIDAE.

OXACIS GALAPAGOENSIS, new species.

Elongate, parallel, pale testaceous, feebly shining, sparsely and finely pubescent. Head short, finely punctate, with a fuscous stripe on the vertex. Antennae eleven-jointed, inserted close to the eyes, scarcely longer than half the body; second joint very short, last joint not constricted. Eyes grayish black, very large, rounded, feebly emarginate. Mandibles simple, very acute, the apical half black. Maxillary palpi with last joint one-half longer than the penultimate, widest at middle, the apical side a little longer than the inner and slightly rounded. Labial palpi with last joint feebly dilated, the apical margin rounded. Thorax as wide as long, widest near the apex, obliquely narrowed to the base, finely rugosely punctate, with a median stripe and a marginal spot each side, infusate. Elytra slightly narrowed to

apex, finely rugosely punctate, obsoletely costate; a broad band from humerus to apex and a short stripe near the scutellum infusate. Ventral surface finely rugose; the last segments infusate at the sides. Legs slender, pale. All tibiae with two spurs. Tarsi with penultimate joint slightly dilated and spongy beneath. Claws toothed at base. Length, 11 mm.

Type.—No. 1326, U.S.N.M.

Three examples, collected on Chatham island by Dr. G. Baur. The species resembles *Alloxacis dorsalis* Melsheimer, from eastern North America, but both mandibles are simple.

Family OTIORRHYNCHIDAE.

OTIORRHYNCHUS CUNEIFORMIS Waterhouse.

Otiorrhynchus cuneiformis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 38.

Collected on Charles island by Darwin.

Genus PANTOMORUS Schoenherr.

The following species agrees in most characters with *Pantomorus* as amended by Dr. Sharp,¹ and may be temporarily listed under that genus. The antennae are moderately slender, scape slightly passing the eye, second joint of funicle nearly twice as long as first, club subfusiform, acute at apex. Rostrum flat above, feebly emarginate at apex, as long as the head, with a deep median channel from its middle to the vertex. Mandibles with distinct scar, situated on a conical protuberance. Scrobes terminal, visible from above, very deep; arcuately deflexed at a distance from the eye; the acute ridge limiting them above continued straight to the upper margin of the eye. Thorax transversely globose, strongly constricted at apex, without ocular lobes or fimbriae; base less constricted, bisinuate, much more strongly in the male. Scutellum scarcely visible, vertical. Elytra with distinct but obtuse humeri, widest behind the middle; the base of each separately rounded, feebly in the female, more strongly in the male with the margin reflexed each side of the scutellum; disk very convex with ten entire striae of coarse punctures. Wings partially developed. Mentum large, concave. Front coxae very large, contiguous. Middle coxae narrowly separated. Epimera of mesothorax moderately large. Metasternum short, the episterna in front angulate each side. Intercostal process of abdomen very broad, the first suture angulate at middle, the second segment longer than third and fourth together. Legs long, especially in the male, the intermediate ones the shortest; femora incrassate at middle; anterior tibiae prolonged, strongly denticulate within, arcuate toward apex, strongly mucronate; intermediate tibiae simple in the female, slightly arcuate and denticulate in the male and

¹ Biol. Centr.-Amer. Coleopt., IV, Pt. 3, p. 153.

with a small mucro. Posterior and middle tibiae laminate at apex with large smooth articular surface; corbels of the posterior pair closed, fusiform, scaly. Tarsi moderately dilated, the first joint a little longer than the second, slightly incrassate in the male. Claws divergent.

PANTOMORUS GALAPAGOENSIS, new species.

Piceous black, feebly shining, sparsely clothed with grayish and brown appressed hairs, that are easily abraded. Rostrum rugosely punctured, more strigose at the sides. Head and thorax aciculate, finely punctate and somewhat scabrous, the latter much larger in the male. Sides of thorax beneath with denser hairs, the hairs scale-like in the female. Length, 10 to 12 mm.

Type.—No. 1327, U.S.N.M.

One male and four females from Chatham island (three collected by the *Albatross* expedition in 1888 and two by Dr. G. Baur).

ANCHONUS GALAPAGOENSIS Waterhouse.

Anchonus galapagoensis WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 39.

Collected on James island by Darwin.

Family SCOLYTIDÆ.

A single specimen, unfortunately without elytra, taken on Charles island by Dr. G. Baur. It belongs in the group *Hylurgi*, but has not been identified with certainty.

Family ANTHRIBIDÆ.

ORMISCUS VARIEGATUS Waterhouse.

Ormiscus variegatus WATERHOUSE, Ann. Nat. Hist., 1845, XVI, p. 37.

Collected on Charles island by Darwin.

THE BIRDS OF THE KURIL ISLANDS.

By LEONHARD STEJNEGER,

Curator, Division of Reptiles and Batrachians.

Zoologically speaking, the Kuril islands are a *terra incognita* as yet. During the last one hundred and fifty years various zoologists and collectors have touched at various localities in that interesting chain of volcanic islands, but no systematic collecting or exploring has ever been undertaken. Of all the animals inhabiting that bleak and foggy region the birds are best known, but the following list will best demonstrate how imperfect is our knowledge of even these. The trouble is that only in comparatively few cases have the exact islands and localities been furnished by the observers, and when I state that two faunas meet somewhere in the Kuril chain, viz, that of Yezo in the south and that of Kamchatka in the north, it will at once be seen how extremely unsatisfactory is a specimen or an observation labeled "Kuril islands" only, as most of them are. Very few people realize that this storm-beaten and dangerous archipelago is about 630 miles long, and that it is a very important link in the chain of islands which fence off the curious series of inland seas of Asia's Pacific coast.

Steller was the first naturalist to gather material on some of the Kurils, and most of his observations have been utilized by Pallas in his *Zoographia Rosso-Asiatica*. Steller only visited the northern islands, and most of Pallas's references, therefore, relate to these. Dr. Merck and Langsdorff also furnished some specimens and observations, but nothing of any importance was obtained until Wosnessenski's visit, 1845-46. This intrepid and careful collector wintered on Urup and collected in various of the larger islands. Numerous specimens were sent by him to the Academy of Sciences in St. Petersburg, but unfortunately his collections were never worked up systematically and collectively. What we know about them has to be gathered laboriously from various scattered references in the numerous writings of Brandt, Middendorff, and Schrenck. Since his day no important collections have been made in the Kurils except by Capt. H. J. Snow. During a winter's sojourn on

Iturup and innumerable cruises he has collected a great number of specimens and added most materially to our knowledge of the animals of the archipelago. The birds mostly found their way into the hands of Captain Blakiston and Mr. Pryer, who identified and reported upon most of them in their joint paper, *Birds of Japan*.¹ Many of these specimens are now in the Seebohm collection, now in the British Museum and in the U. S. National Museum, though some were in the Hakodate Museum, the fate of which is not known to me. Unfortunately, only a few of Captain Snow's specimens have any locality attached to them other than Kuril islands, and his own published observations only in rare cases remedy this defect.

The present writer was fortunate in visiting a few of the smaller rocks in the Middle Kurils during August, 1896. He was able to stay ashore only a few hours, and during these he had more important business than collecting birds. He secured a few specimens, however, which have helped to throw some light upon the ornithology of the region. He also visited the village of Shana on Iturup, but was not allowed to shoot any birds, and had to be satisfied with field-glass identifications.

On the map the Kuril islands appear as the natural stepping stones for the summer birds visiting Kamchatka on their regular trips to and from their winter quarters, but I have shown, years ago,² that many of Kamchatka's most characteristic migrants do not pass south by way of the Kurils and Japan. I made, however, an admission then which I now think had better not have been made, namely, that when the same species which summers in Kamchatka also is known to regularly breed in, travel through, or winter in Japan proper, it may be safely assumed that it migrates southward directly to Japan along a route following the Kuril chain of islands. That may be the case, or it may not; it certainly does not follow of a necessity.

Simply because *Motacilla lugens* breeds in Kamchatka, the Kurils, and Yezo we are not justified in concluding that the Kamchatkan individuals travel to their winter quarters over the Kurils. They may follow the route of *Chelidon tytleri*, *Anthus gustavi*, or *Carpodacus erythrinus grebnitskii* for all we know. I have elsewhere indicated the possibility of a very slight difference in the relative extent of black and white in the wings of the Kamchatkan birds and those breeding in the south,³ and I wish to again call attention to the extreme importance of a minute study of these seemingly trifling details for the solution of these and similar zoogeographical questions.

In this respect the ornithology of the Kuril islands becomes highly interesting and important, and it is greatly to be hoped that some day they may be systematically explored by competent zoologists. In order

¹ Trans. Asiatic Soc. Japan, 1882, X, pp. 84-186.

² Res. Orn. Expl. Command. Isls., Kamch., pp. 345, 346.

³ Proc. U. S. Nat. Mus., 1892, XV, p. 312.

to stimulate the good work and to lay a foundation upon which others may build I have, in the following pages, gathered together all the material and records accessible to me.

The numbers following the systematic names in the list are those of Blakiston and Pryer's Birds of Japan,¹ and the quotations throughout the text of these authors refer to pages in the same paper. Quotations from Pallas refer to his Zoographia.

1. URINATOR IMBER (Gunnerus). 184.

According to Pallas² Steller observed it in the Kuril islands [i. e., the northern islands] at the mouth of the rivers and in the bays of the sea. The species may have been *U. adamsii*, under which name Snow enumerates it.³

2. URINATOR ARCTICUS (Linnaeus). 18.

Blakiston and Pryer⁴ give this species as "observed at Iturup." As *U. pacificus* has been obtained at Hakodate both species may occur at Iturup at least during migrations.⁵

3. URINATOR LUMME (Gunnerus). 19.

Enumerated here on the authority of Pallas,⁶ who says that it is called Uacha by the [northern] Kurilians. Snow says that it is very common in early spring, when numbers are to be seen making their way northward along the islands. A few breed on Paramushir and Shumshu.⁷

4. URIA LOMVIA'ARRA (Pallas). 12.

Pallas gives⁸ the Kurilian name as "Hara" and says that it is very numerous about the [northern] Kuril islands, and Blakiston and Pryer notice specimens from the Kuril islands [southern, probably] in the Hakodate Museum. I myself observed the species on the Mushir Rocks August 22, and nesting very numerous on the two Ushishirs, August 24, 25. Snow says: "Plentiful all along the islands. These birds arrive about the end of April, and leave toward the end of September."⁹

5. URIA TROILE CALIFORNICA (Bryant). 11.

The specimens in the Hakodate Museum referred to *Uria troile* by Blakiston and Pryer¹⁰ are probably this species.

¹Trans. Asiatic Soc. Japan, 1882, X, pp. 84-186.

⁶Page 343.

²Page 341.

⁷Snow, Notes Kuril Isl., 1896, p. 31.

³Notes Kuril Isl., 1896, p. 31.

⁸Page 345.

⁴Page 91.

⁹Notes Kuril Isl., 1896, p. 30.

⁵Stejneger, Proc. U. S. Nat. Mus., 1892, XV, p. 291.

¹⁰Page 91.

6. *CEPPHUS CARBO* Pallas. 10.

Pallas¹ in describing this species says that it arrives in spring at the Kuril Islands, but leaves them soon. I am not aware of any other authentic reference to the species in the Kurils. Blakiston evidently did not obtain it from the islands, as it is plain that he correctly distinguished the true *Cephus carbo*, larger, with larger bill, sooty rather than pure black, and with a white space around the eye, from the true "Kuril Islands black Guillemot," and only considering *C. carbo* as from the Kurils with a "perhaps" added.² I myself saw no true *C. carbo*, neither in the middle Kurils nor at Iturup.

7. *CEPPHUS SNOWI* Stejneger.³ 10½.

Diagnosis.—No white area surrounding the eye; wings entirely black, or with narrow white tips to the larger coverts, forming at most three narrow white bands; under wing coverts smoky gray; black of back with a slate-colored gloss; fourteen tail-feathers.

Habitat.—Kuril islands.

Type.—No. 159351, U.S.N.M. Raikoke, Kuril islands, August 23, 1896. L. Stejneger, No. 7009.

This new species, which I have taken great pleasure in dedicating to Capt. J. H. Snow, of Yokohama, in commemoration of his work of exploration and collecting in the Kuril islands, belongs to the same group as *Cephus columba* Pallas, with which it shares the general coloration, smoky gray color of under wing-coverts, fourteen tail-feathers, and proportionate greater length of foot, features which distinguish them from *Cephus grylle* and *C. mandtii*. It is easily distinguished from *C. columba* in the absence of a defined white wing speculum, all the upper wing-coverts being black, either entirely so or the posterior three rows narrowly tipped with white, forming one to three narrow white bars. In more than one-half of the numerous specimens I saw the wings were entirely black. It can be asserted with absolute certainty that *C. columba* does not breed in the Middle or Southern Kurils, where the present species exclusively occupies the suitable localities in untold thousands. This statement may be necessary, as one might be tempted to regard a few isolated specimens as a merely individual melanistic phase of *C. columba* analogous to the so-called *C. motzfeldi* of the North Atlantic,⁴ which is plainly a melanism.

It is interesting to note that on the American side the type of *C.*

¹ Page 350.

² Page 91.

³ Originally described in the Auk, 1897, p. 201.

⁴ See Collet's exhaustive investigation of this phase On a Melanistic Phase of *Uria Grylle* Christiana Vid. Selsk. Forhandl., 1895, No. 1, 14 pp.

columba retains the white speculum, even where breeding much farther south than the latitude of the Southern Kurils.

Seebohm mistook this bird for the true *C. columba*, regarding the absence of white on the wing-coverts as indicative of the adult summer plumage.¹

Snow's Guillemot is very common in the Middle Kurils, and was found by me exceedingly numerous on Mushir, Raikoke, North and South Ushishir. It probably extends in winter to Yezo, and may also occur in southern Kamchatka. The latter suggestion is based upon a specimen in the American Museum of Natural History in New York, which is said to be from Kamchatka. It was evidently collected by Mr. Snow, and there is consequently a reason for suspecting that the real locality may have been one of the Kuril islands. Snow has collected this species on Ketor² in June, and Mr. Kitahara secured specimens for the Science College Museum, Tokyo, on Urup early in August.

8. BRACHYRAMPHUS PERDIX (Pallas).

A female collected by Snow in the Kuril islands is in the Seebohm collection.³

9. BRACHYRAMPHUS BREVIROSTRIS (Vigors). 9.

Two specimens in the Seebohm collection were collected by Mr. Snow in the Kuril islands.⁴

10. SYNTHLIBORAMPHUS ANTIQUUS (Gmelin). 8.

Pallas⁵ characterized this bird as abundant about the [northern] Kuril islands, and gave the name by which it was known to the inhabitants there as "Wingoroutsch." Since then Wosnessenski found it wintering among the Kurils, probably at Urup.⁶ Snow found it breeding there and collected specimens in June.⁷ Mr. N. Fukushi obtained it on Shikotan island.⁸

PTYCHORAMPHUS ALEUTICUS (Pallas).

This species has been collected on the Kuril islands by Wosnessenski, according to Brandt.⁹ It has not been seen there by others, and there may be a mistake about the locality.

¹ Seebohm, B. Jap. Emp., p. 275.

² Idem, p. 276.

³ Idem, p. 278.

⁴ Idem, p. 279.

⁵ Zoogr. Ross.-As., II, p. 368.

⁶ Brandt, Mém. Biol., 1869, VII, p. 219.

⁷ Blakiston and Pryer, p. 90; Seebohm, B. Jap. Emp., p. 277.

⁸ Blakiston and Pryer, p. 90.

⁹ Mém. Biol., 1869, VII, p. 222.

11. SIMORHYNCHUS PYGMAEUS (Gmelin). 5.

Already noted by Pallas¹ as not infrequent about the fourth Kuril island and those beyond, and Wosnessenski observed it during December, January, and February about the Kurils, especially on Urup.² Snow found it breeding in numbers on Ushishir in June, and in the Seeböhm collection there are nine specimens from that source.

During my visit in 1896 I saw it at Mushir Rocks on August 22, Raikoke August 23, North Ushishir August 24, and on South Ushishir August 25. A young specimen was secured at Raikoke August 23. It measured 190 mm. in total length; tail beyond wings, 12 mm.; iris white; bill dusky, pale at base of tomium and gonys; feet pearl gray, joints darker, webs still more so; under side of tarsus and foot blackish.

In the Science College Museum, Imperial University, Tokyo, there are specimens collected by Mr. Kitahara on Urup in 1895 between July 31 and August 10.

12. SIMORHYNCHUS CRISTATELLUS (Pallas). 4.

According to Pallas³ the Russians at the Eastern Ocean call them by their Kurilian name, *Korokora* or *Turutura*. They are frequent in the further Kuril islands, even to Japan. Blakiston and Pryer (page 89) note specimens collected by Fukushima and specimens and eggs by Snow. In the Seeböhm collection there are specimens collected by the latter and by Wosnessenski.⁴

On August 24 and 25, 1896, I found this species very common on both Ushishir islands. Their number on Crater bay, South Ushishir, was simply immense.

13. SIMORHYNCHUS PUSILLUS (Pallas). 6.

Wosnessenski found this species wintering in the Kurils, principally at the islands of Iturup, Urup, and Simusir.⁵ I have a memorandum from Mr. Kitahara to the effect that a specimen was obtained by him at Ketoi at night on August 15, 1895.

CERORHINCA MONOCERATA (Pallas).

Seeböhm notes one specimen in his collection obtained by Wosnessenski in the Kuril islands and one collected in June by Snow, who found them breeding there.⁶ Blakiston and Pryer (page 92) remark, however, that this species does not appear to range far to the north-

¹ Zoogr., II, p. 372.

² Brandt, Mém. Biol., 1869, VII, p. 229.

³ Zoogr., II, p. 371.

⁴ B. Jap. Emp., p. 296.

⁵ Brandt, Mém. Biol., 1869, VII, p. 234.

⁶ B. Jap. Emp., p. 286.

eastward, Mr. Snow not having noticed it on the Kurils proper, but only as far as Shikotan island.¹ Nevertheless it does range over the entire chain into Kamchatka, though apparently not very common. I myself saw a few specimens at Raikoke on August 23, 1896.

14. CYCLORRHYNCHUS PSITTACULUS (Pallas). 13

Kurilian: Naatschu according to Pallas,² who says that it is not infrequent in the sea about the Kuril islands. Two specimens were obtained during the summer of 1881 by Mr. H. J. Snow on the Kuril islands, where he remarked it was a comparatively uncommon bird, not more than half a dozen pairs being met with during a season's sea-otter hunting.³

This does not agree with my experience, for I found it common at Raikoke, August 23, 1896, though I suspect it to be rather local, since I saw none at the other islands.

There are specimens in the Seebohm collection, obtained in June by Snow.⁴ Snow himself remarks that they are found on the central and northern islands, generally in pairs.⁵

15. LUNDA CIRRHATA Pallas. 2.

A common breeding bird throughout the Kuril chain. Its Kurilian name is given by Pallas as Etubirga or Stupirk,⁶ and both Fukushima and Snow found it breeding and brought home specimens.⁷

Between August 22 and 25, 1896, I found it plentiful at all the islands visited by me.

Snow says that this bird begins to arrive at the islands about first week in May. Commences laying about June 15. Leaves the islands soon after the middle of September.⁸

16. FRATERCULA CORNICULATA (Naumann). 3.

According to Pallas⁹ the Kurilian name was Matschir. Collected by Mr. H. J. Snow, at the Kuril islands, who remarks that it is not so common as the foregoing species, and seldom seen south of Simusir.¹⁰

¹ Snow says: Found about Shikotan and the small islands off the east coast of Yezo, where it breeds in large numbers. I have not noticed this bird come so far north as Iturup. (Notes Kuril Isl., 1896, p. 31.)

² Zoogr., II, p. 366.

³ Blakiston and Pryer, p. 89.

⁴ B. Jap. Emp., p. 285.

⁵ Notes Kuril Isl., 1896, p. 30.

⁶ Zoogr., II, p. 364.

⁷ Blakiston and Pryer, p. 88; Seebohm, B. Jap. Emp., p. 282.

⁸ Notes Kuril Isl., 1896, p. 29.

⁹ Zoogr., II, p. 365.

¹⁰ Blakiston and Pryer, p. 89.

The Seebohm collection contains a specimen by Snow from Shiashkotan in June.¹

I noted it on all the islands of the middle Kurils visited by me in August, 1896.

17. *LARUS SCHISTISAGUS* Stejneger. 70.

Seebohm was right in referring the so-called *Larus marinus* from the Kuril islands, collected by Snow, to the present species,² but is wrong in referring to them as a subspecies of the former. *L. schistisagus* is nearer related to *L. argentatus* than to *L. marinus*.

The slate-backed gull, which I originally described from Kamchatka, is the commonest breeding gull on the Kurils, with the exception of the kittiwake. I found it on all the islands visited by me in August, 1896, and secured a fine specimen on Raikoke August 23. Total length, 655 mm.; wings beyond tail (both worn), 32 mm.; weight, 4½ pounds. Fresh colors: Iris pale straw color; bill yellow, with a crimson spot on mandible near gonys; gape whitish flesh color; naked eye ring purplish gray; feet flesh color, webs darker pink. Fifth primary molting in both wings; pinfeathers all over the body.

The gull called Great Gull, Ounemas by the Kurilians, referred to by Pallas under *Larus cachinnans*, is probably the present species, and so is probably also Snow's *Larus glaucus*.³

18. *LARUS CANUS* Linnaeus. 69.

Seebohm says that this species probably breeds on the Kuril islands.⁴

? *LARUS BRACHYRHYNCHUS* Richardson.

An adult specimen is enumerated by Saunders as in the British Museum from Kuril islands ? February (H. J. Snow), from the Seebohm collection. Locality probably incorrect if really this species.

Larus glaucescens Naumaun, *L. glaucus* Brünnich, and *Larus vegae* (Palmén), being northern species, wintering more or less common in Japan, probably occur on the Kurils during migration, but no authentic specimens are on record so far as I am aware.

19. *RISSA TRIDACTYLA POLLICARIS* Stejneger. 74.

A common breeding bird all over the Kuril chain. I found it numerous on the Mushir Rocks, Raikoke, and the Ushishirs between August 22 and 25, 1896, and Snow obtained specimens at Rashau in June.⁵ The Kurilians called it Kiruga or Keròo, according to Pallas.⁶ Snow says that they begin to lay about June 10.³

¹ B. Jap. Emp., p. 281.

² Idem, p. 291.

³ Notes Kuril Isl., 1896, p. 33.

⁴ B. Jap. Emp., p. 294.

⁵ Seebohm, B. Jap. Emp., p. 294.

⁶ Zoogr., II, p. 321.

20. STERNA CAMTSCHATICA Pallas. 63.

The specimen killed by Mr. Snow at Iturup¹ is in the Seebohm collection.² Seebohm's supposition that it breeds there is very dubious.

Whether the Kurilian names Sischatscha or Naatschitsch, quoted by Pallas under *Sterna hirundo*, belong to the present species or possibly to *S. paradisaea* Brünnich is very doubtful, as the latter has not been recorded from the Kuril islands.

Mr. Snow is said to have seen a white tern at the Kurils.¹ It may have been a stray specimen of *Gygis alba*. It should be remarked, however, that he does not mention it in his Notes on the Kuril islands.

21. STERCORARIUS PARASITICUS (Linnaeus). 75.

Collected by Snow in the Kuril islands. Specimen in the Hakodate Museum, according to Blakiston and Pryer, and in the Seebohm collection there are three, all of the dark phase.³

22. STERCORARIUS LONGICAUDUS Vieillot. 74½.

According to Snow, who brought home specimens in 1881, this species is common north of Urup.⁴

23. STERCORARIUS POMARINUS (Temminck). 75½.

According to Saunders, there is a specimen in the British Museum from Snow as collected in the Kuril islands.⁵

24. DIOMEDIA ALBATRUS Pallas. 77.

Occasional visitor to the Kurils. Pallas gives its Kurilian names, as Pongapith and Ato. According to Seebohm there is a specimen, collected by Snow at Iturup, in the British Museum.⁶ I saw one of the dark phase at Raikoke August 23, 1896. The latter is enumerated by Snow as *Diomedea derogata*.⁷

25. FULMARUS GLACIALIS GLUPISCHA Stejneger. 79.

One of the commonest breeding birds in the Kurils. Pallas, on the authority of Steller, says that great multitudes of this bird were captured by the Kurilians of the Fourth and Fifth island and dried in the sun.⁸ Snow collected many specimens, according to Blakiston and Pryer and Mr. Seebohm.

August 22 to 25, 1896, I observed it at Mushir Rocks, Raikoke, and Ushishir. On Raikoke they were exceedingly numerous, and in Crater Bay of South Ushishir there were flocks of immense size. The downy

¹ Blakiston and Pryer, p. 103.

² B. Jap. Emp., p. 297.

³ Idem., p. 289.

⁴ Blakiston and Pryer, p. 105.

⁵ Sharpe, Cat. B. Brit. Mus., 1896, XXV, p. 327.

⁶ B. Jap. Emp., p. 262.

⁷ Notes Kuril Isl., 1896, p. 34.

⁸ Zoogr., II, p. 313.

young were still in the nests at that time. Among all the thousands of fulmars seen not one belonged to the light phase. It should be remarked, however, that Seebohm records a Kuril island skin in his collection from Snow as typical of the light form.¹ It is probably to these light-colored birds that Snow's *Fulmarus glacialis rodgersi* are to be referred.² At Shana, Iturup, I also observed dark fulmars, September 4 to 6, 1896.

26. *PUFFINUS TENUIROSTRIS* (Temminck). 83.

Frequent about the Kuril islands.³ "About the northern, more particularly," Snow remarks.²

27. *PUFFINUS GRISEUS* (Gmelin). 78.

Snow has collected this species in the Kurils,⁴ and a specimen of his is in the British Museum.⁵ According to Blakiston and Pryer, Snow had not observed it north of Urup.⁶

28. *OCEANODROMA LEUCORHOA* (Vieillot). 80.

Breeding probably throughout the chain. Blakiston and Pryer mention specimens from Shikotan and the Kuril islands in the Hakodate and Sapporo College museums.⁶ Schrenck gives it as obtained by Wosnessenski at Shumshir and southeast of Simushir and Urup.⁷

29. *OCEANODROMA FURCATA* (Gmelin). 81.

Common breeding bird throughout the Kuril islands. Mr. Mereck, of Billing's expedition, brought home plenty of specimens from the further Kuril islands, according to Pallas.⁸ Snow found it breeding in various places. Seebohm specifies⁹ Rashau Island, and gives as authority for the statement Blakiston and Pryer,¹⁰ but I can not find that they ever made it. His last reference¹¹ concerns Blakiston's specimen (No. 1819), which, according to Blakiston's catalogue, was not from the Kurils at all, but from Kamchatka.

30. *HÆMATOPUS OSCULANS* Swinhoe. 93.

Pallas says that it is a frequent bird in the Kurils.¹² Snow observed it at the Kurils, according to Blakiston and Pryer,¹³ and one of his specimens is in Seebohm's collection.¹⁴

Hæmatopus niger is by Pallas, its original describer, credited to the

¹ B. Jap. Emp., p. 269.

² Notes Kuril Isl., 1896, p. 34.

³ Pallas, Zoogr., II, p. 314.

⁴ Seebohm, Ibis, 1884, p. 33.

⁵ Saunders, Cat. B. Brit. Mus., XXV, p. 387.

⁶ Blakiston and Pryer, p. 106.

⁷ Reise Amurl., pp. 515, 516.

⁸ Zoogr., II, p. 315.

⁹ B. Jap. Emp., p. 271.

¹⁰ Ibis, 1879, p. 218.

¹¹ Idem, 1884, p. 33.

¹² Zoogr., II, p. 129.

¹³ Blakiston and Pryer, p. 109.

¹⁴ B. Jap. Emp., p. 313.

Kuril islands, with a Kurilian name, Tachaican.¹ There is scarcely a doubt that the statement is erroneous, being probably based upon some of Merck's mislabeled specimens.

31. *ARENARIA INTERPRES* (Linnaeus). 92.

Collected by Mr. Snow at the Kurils,² and Seebohm thinks it probable that they breed there; he had two specimens from that locality by Snow.³ I only saw a small flock on Srednoi Flat Rock, August 24, 1896.

32. *CHARADRIUS SQUATAROLA* (Linnaeus). 91.

Here enumerated solely upon the statement of Seebohm that the Gray Plover passes the Kurils, Japan, and the Loo-Choo islands in some numbers on the spring and autumn migration.⁴ I am not aware of specimens having been recorded.

33. *CHARADRIUS DOMINICUS FULVUS* (Gmelin). 84.

The same remarks apply to this species. Seebohm says: The Asiatic Golden Plover passes the Kurils, the Japanese islands, and the Loo-Choo islands in great numbers both on the spring and the autumn migrations.⁵

34. *AEGIALITIS MONGOLA* (Pallas). 88.

Since Merck obtained this bird in the Kurils during Billings's expedition⁶ it has been observed there by Snow, and specimens are in the Hakodate Museum⁷ and one, a female, in the British Museum.⁸

35. *GALLINAGO GALLINAGO* (Linnaeus). 117.

Blakiston and Pryer give the common snipe as occurring in Iturup, probably on Blakiston's authority.⁹ I myself saw one on that island at Shana, on September 6, 1896.

36. *GALLINAGO MINIMA* (Brünnrich). 119.

Observed by Blakiston on Iturup.¹⁰

37. *GALLINAGO AUSTRALIS* (Latham). 116.

Snow enumerates this species without particulars.¹¹ It probably occurs on the most southern islands.

¹ Zoogr., II, p. 131.

² Blakiston and Pryer, p. 109.

³ B. Jap. Emp., p. 332.

⁴ Idem, p. 304.

⁵ Idem, p. 303.

⁶ Pallas, Zoogr., II, p. 136.

⁷ Blakiston and Pryer, p. 108.

⁸ Seebohm collection; Sharpe, Cat. B. Brit. Mus., p. 226.

⁹ Blakiston and Pryer, p. 114.

¹⁰ Idem, p. 115.

¹¹ Notes Kuril Isl., 1896, p. 35.

38. *ARQUATELLA COUESI* Ridgway.

Pallas received this species from the Kuril islands, collected by Merck; Wosnessenski obtained it in Urup, one of the specimens now being in the Seebohm collection with two others collected in the Kurils¹ by Snow. Seebohm² calls it a rare winter visitor to the Kuril islands, but I think he is mistaken and that the bird breeds there. I saw numerous specimens on Srednoi Flat Rock and on the beach of North Ushishir on August 24, 1896. A bird of the year was secured and is now in the U. S. National Museum (No. 159353).

39. *TRINGA CRASSIROSTRIS* Temminck and Schlegel. 104.

Snow is the only collector who has brought this species from the Kurils, a female, collected in May, being in the Seebohm collection.³ The specimen is almost certainly from one of the southern islands, most likely from Iturup.

40. *ACTODROMAS RUFICOLLIS* (Pallas). 107.

Collected repeatedly by Snow on the Kuril islands,⁴ and five of his specimens belonging to the Seebohm collection are now in the British Museum.⁵ I obtained it on Srednoi Flat Rock on August 24, 1896.

41. *ACTODROMAS DAMACENSIS* (Horsfield). 108.

Blakiston has recorded this species as obtained in the Kurils during 1882.⁶

42. *PELIDNA ALPINA PACIFICA* (Coues). 105.

Collected by Snow on the Kurils, where Seebohm thinks that it breeds. Six of these specimens are in the Seebohm collection.⁷

On Srednoi Flat Rock, August 24, 1896, I observed a small flock and secured several specimens for identification.

43. *LIMOSA LAPPONICA BAUERI* (Naumann). 101.

Pallas notes this species as occurring in the [northern] Kuril islands on the authority of Steller.⁸ A specimen in Seebohm's collection from the Kurils was collected by Snow in July;⁹ it is a female, now in the British Museum.¹⁰

¹ Sharpe, Cat. B. Brit. Mus., XXIV, p. 584.

² B. Jap. Emp., p. 335.

³ Sharpe, Cat. B. Brit. Mus., p. 602.

⁴ Blakiston, Chrysanthemum, April, 1883, p. 172; Amend. List. B. Jap., p. 37.

⁵ Sharpe, Cat. B. Brit. Mus., XXIV, p. 547.

⁶ Chrysanthemum, April, 1883, p. 172.

⁷ B. Jap. Emp., p. 335; Sharpe, Cat. B. Brit. Mus., XXIV, p. 611.

⁸ Zoogr., II, p. 181.

⁹ B. Jap. Emp., p. 329.

¹⁰ Sharpe, Cat. B. Brit. Mus., XXIV, p. 380.

44. *TOTANUS ATER* (Sander). 97.

Captain Blakiston¹ states that the Kuril islands during the past season have furnished us with No. 97, *Totanus fuscus* Linnaeus, in fine breeding plumage, the only record of this species for the islands.

45. *TOTANUS GLAREOLA* (Linnaeus). 96.

According to Blakiston and Pryer² there are specimens of this species in the Hakodate Museum from the Kuril islands.

46. *TOTANUS NEBULARIUS* (Gunnerus). 95.

Enumerated by Snow as *T. glottis*, without further particulars.³

47. *TOTANUS OCHROPUS* (Linnaeus). 98.

The same remark applies to this as to the foregoing species.

48. *ACTITIS HYPOLEUCOS* (Linnaeus). 100.

Blakiston and Pryer note it² as seen at Etuop island, probably by Blakiston, in which case the identification may be relied on.

49. *HETERACTITIS BREVIPES* (Vieillot). 94.

Mr. Snow has collected it at the Kurils,⁴ and one of his specimens is in the Seeborn collection.⁵ I saw a specimen on North Ushishir, August 24, 1896.

50. *NUMENIUS LINEATUS* (Cuvier). 121.

Enumerated by Snow, but without particulars.³

51. *NUMENIUS CYANOPUS* (Vieillot). 123.

This is probably the curlew to which the Kuril name *Etschkamamuč*, given by Pallas⁶ refers. Blakiston and Pryer⁷ refer to it as collected at Iturup.

52. *NUMENIUS PHAEOPUS VARIEGATUS* (Scopoli). 124.

Also obtained in Iturup, according to the same authority.

53. *PHALAROPUS LOBATUS* (Linnaeus). 112.

Blakiston and Pryer mention specimens from the Kuril islands,⁸ and Seeborn had two specimens in his collection from Mr. Snow.⁹ I observed a flock at Mushir Long Rock on August 22, 1896.

¹ Chrysanthemum, April, 1883, p. 172.

² Page 110.

³ Notes Kuril Isl., 1896, p. 35.

⁴ Blakiston and Pryer, p. 109.

⁵ Sharpe, Cat. B. Brit. Mus., XXIV, p. 761.

⁶ Zoogr., II, p. 168.

⁷ Page 116.

⁸ Page 113.

⁹ B. Jap. Emp., p. 319; Cat. B. Brit. Mus., XXIV, p. 704.

54. *CRYMOPHILUS FULICARIUS* (Linnaeus). 113.

Merek observed it at the Kurils,¹ where it occurs during the migrations, and specimens collected by Snow are in the museum at Hakodate² and British Museum.³

55. *ANSER SEGETUM MIDDENDORFFI* (Severzof). 22.

Pallas speaks of an *Anser vulgaris*, called by the Kurilians *Kuitup*, by the Japanese *Gan*.⁴ It may be this form.

56. *ANSER ALBIFRONS GAMBELI* (Hartlaub). 24.

Captain Snow enumerates the white-fronted goose, without further particulars.⁵

He also enumerates the *Anser minutus*, lesser-fronted goose. As it is not known from Kamchatka the record must be considered doubtful.

57. *BRANTA CANADENSIS HUTCHINSII* (Richardson). 28.

Captain Snow has found this species breeding. A few, he says, have been noticed breeding on Ushishir and Ekarma. A nest with 6 eggs and another with 7 were found on May 16. Young ones were found on June 20.⁶

58. *BRANTA NIGRICANS* (Lawrence). 29.

Beyond Pallas's statement that it is called *Núkespu* by the Kurilians, no record of its occurrence is known to me.⁶

59. *CYGNOPSIS CYGNOIDES* (Pallas). 26.

The only record of this species is that of Pallas,⁷ who says: I have specimens before me sent from the Kuril islands.

60. *OLOR CYGNUS* (Linnaeus). 20.

A few frequent the islands. Noticed on Iturup in winter.⁸

61. *ANAS BOSCHAS* (Linnaeus). 30.

Mr. Snow, according to Blakiston and Pryer,⁹ says that it is not numerous on the Kurils. Pallas gives the Kurilian names of the mallard as *Sa'angitsch*, or *Saaitshitsch*.¹⁰

62. *ANAS ZONORHYNCHA* Swinhoe. 31.

All there is known about this species in the Kurils is the statement by Blakiston and Pryer that Mr. Snow has found a few on the Kurils. They were probably only found on the southern islands.

¹ Pallas, Zoogr., II, p. 205.

² Blakiston and Pryer, p. 113.

³ Sharpe, Cat. B. Brit. Mus., XXVII, p. 697.

⁴ Zoogr., II, p. 223.

⁵ Notes Kuril Isl., 1896, p. 31.

⁶ Zoogr., II, p. 229.

⁷ Idem, II, p. 219.

⁸ Snow, Notes Kuril Isl., 1896, p. 31.

⁹ Page 96.

¹⁰ Zoogr., II, p. 256.

63. DAFILA ACUTA (Linnaeus). 36.

The Kurilian name, according to Pallas,¹ was *Pakarichu* or *Clagi*. No further particulars are on record.

64. NETTION CRECCA (Linnaeus). 37.

Obtained at the Kurils by Mr. Snow.²

65. NETTION FALCATA (Georgi). 39.

Enumerated by Snow without further comment.³

66. NETTION STREPERA (Linnaeus). 42.

Same remark as foregoing species.

67. MARECA PENELOPE (Linnaeus). 35.

Same remark.

68. AYTHYA FULIGULA (Linnaeus). 45.

Kurilian name, according to Pallas, *Jaitschir*.⁴ Snow found it on the southern Kurils and Shikotan.⁵

69. AYTHYA MARILA (Linnaeus). 43.

Enumerated by Snow without particulars.³

70. GLAUCIONETTA CLANGULA (Linnaeus). 49.

The Kurilians, according to Pallas, had a name for the golden eye, namely, *Tschachtschir*.⁵

71. HISTRIONICUS HISTRIONICUS (Linnaeus). 48.

Abundant along all the Kurils, where it breeds. The writer has not been able to find the eggs, but in June, 1888, captured a female with several young ones which were but a day or two old.⁶ I saw a flock of this species at South Ushishir on August 25, 1896.

72. CLANGULA HYEMALIS (Linnaeus). 50.

Called *Aanga* by the Kurilians, according to Pallas.⁷ Plentiful in early spring, when it is found to be making its way northward to its breeding grounds in the Arctic. An occasional straggler gets left behind and is seen on the islands in the summer.⁶

73. ENICONETTA STELLERI (Pallas). 51.

Blakiston and Pryer⁸ specify Iturup as the island where Mr. Snow shot specimens during winter, adding that specimens from the Kurils are in the Hakodate Museum.

¹ Zoogr., II, p. 280.

² Blakiston and Pryer, p. 97.

³ Notes Kuril Isl., 1896, p. 32.

⁴ Zoogr., II, p. 266.

⁵ Zoogr., II, p. 272.

⁶ Snow, Notes Kuril Isl., 1896, p. 32.

⁷ Zoogr., II, p. 276.

⁸ Page 100.

74. SOMATERIA SPECTABILIS (Linnaeus).

The king eider was called by the Kurilians and Kamchodals *Mitù*, according to Pallas, who adds that this species is only seen in spring at the Kurils.¹ It is probably to this species that Snow's *Somateria v-nigra* (?), of which he says that a few of these have been seen about the most northern islands in early spring, should be referred.²

75. OIDEMIA AMERICANA Swainson and Richardson. 53.

Mr. Snow, who has collected several specimens in the Kurils, says that this species is generally found there on the rivers during summer.³ Snow, in his Notes on the Kuril Islands,⁴ adds that a few breed on the northern islands.

76. OIDEMIA STEJNEGERI Ridgway. 52.

Blakiston and Pryer⁵ quote Mr. Snow as saying that he has found a few on the Kurils, but that they go farther north to breed. One of Snow's specimens from the Kurils is in the British Museum, and is enumerated by Salvadori⁶ as *Oidemia carbo* Pallas, a name strictly synonymous with *O. fusca* Linnaeus, for which it was only proposed as a substitute and entirely inadmissible for the eastern species. It is probably this specimen which is figured in Seeborn.⁷

77. MERGANSER MERGANSER (Linnaeus). 55.

Breeds on the Kurils, according to Snow.⁸ Pallas gives the Kurilian name as *Tuipe*.⁹

78. MERGANSER SERRATOR (Linnaeus). 56.

Snow is also authority for the statement that this species breeds on the Kurils.¹⁰ He adds that it occurs in winter on Iturup.

79. PHALACROCORAX URILE (Gmelin). 59.

According to Pallas it is rather rare about the Kuril islands, where it was called *Uril*. The flesh, he says, is poor, but if thoroughly boiled overcomes hunger; when roasted it is exceedingly bad, except when done after the fashion of the Kurilians, who roast the birds, especially the young ones, with feathers and entrails, in a small pit filled with glowing ashes, and then peel them.¹⁰

80. PHALACROCORAX PELAGICUS Pallas. 58.

Specimen and eggs of this species were obtained by Snow on the Kuril islands.¹¹

¹ Zoogr., II, p. 237.

² Notes Kuril Isl., 1896, p. 32.

³ Blakiston and Pryer, p. 100.

⁴ Page 32.

⁵ Page 100.

⁶ Sharpe, Cat. B. Brit. Mus., XXVII, p. 412.

⁷ B. Jap. Emp., p. 250.

⁸ Notes Kuril Isl., 1896, p. 32.

⁹ Zoogr., II, p. 287.

¹⁰ Idem, II, pp. 301, 302.

¹¹ Blakiston and Pryer, p. 102.

A third species of cormorant is enumerated by Snow with a query, but no particulars are given.¹

81. *HERODIAS ALBA* (Linnaeus). 134.

Beyond Snow's statement that he has seen the great egret on Iturup² nothing is known concerning the occurrence of this species. Whether it was the true *H. alba* or the smaller subspecies *modesta*, under which name it is enumerated by Snow, it would be impossible to say without specimens.

82. *LAGOPUS*, species? 156½.

Ptarmigans are found on the northern Kurils, but which species is not known. A specimen obtained by Captain Snow on Shumshu, the first island from Kamchatka, is described by Blakiston and Pryer³ as measuring 200 mm. in the wing, and as being white with the exception of the black tail feathers and line through the eye. This last sentence shows that it was not a willow grouse (*L. lagopus*), but that it belonged to the *L. mutus* group, and probably the same species as the one occurring in Kamchatka.

83. *TURTUR GÉLASTIS* (Temminck). 159.

Snow has observed it on Iturup.⁴

84. *FALCO PEALEI* Ridgway.

The references to *Falco peregrinus* as a common bird on the Kuril islands, from Pallas⁵ to Snow,⁶ who says that it is found throughout the whole chain of islands, seem to belong to the present species. Mr. J. H. Gurney wrote to Mr. Robert Ridgway on August 15, 1891, as follows: I find among my father's peregrine falcons two specimens from the Kuril islands which are young birds and are very dark indeed all over, and especially on the breast, belly, and under the wing. They are far the darkest we have and are evidently your *Falco pealei*.

I observed a blackish falcon on North Ushishir August 24, 1896, which I have no hesitation in pronouncing *F. pealei*.

85. *FALCO SUBBUTEO* Linnaeus. 321.

86. *FALCO AESALON* Linnaeus. 322.

Snow enumerates these two species without further particulars. They are probably among those which mostly frequent the southern islands.⁶

¹ Notes Kuril Isl., p. 32.

² Idem, p. 35.

³ Page 128.

⁴ Blakiston and Pryer, p. 129; Snow, Notes Kuril Isl., p. 36.

⁵ Zoogr., I, p. 326.

⁶ Notes Kuril Isl., p. 38.

87. *ACCIPITER NISUS* (Linnaeus). 318.

The above remark applies equally to the present species. It would be very interesting to know whether the sparrow hawk occurring in the Kurils is the typical *A. nisus* or *A. pallens* Stejneger, inhabiting Kamchatka, and occasionally occurring in Japan.

88. *CIRCUS CYANUS* (Linnaeus). 324.89. *BUTEO JAPONICUS* Temminck and Schlegel. 313.

Collected by Snow on the Kuril islands.¹

90. *HALIAEETUS ALBICILLA* (Linnaeus). 307.

Already known to Pallas as occurring in the Kurils,² probably the northern ones. It has also been observed by Snow on Iturup.³

Snow¹ also notes that he saw on Iturup what he took to be *Aquila chrysaetus*. It is more likely, however, to have been a young *H. albicilla*.

91. *THALASSOAETUS PELAGICUS* (Pallas). 308.

Observed by Mr. Snow on Iturup.³

92. *MILVUS MELANOTIS* Temminck and Schlegel. 310.

According to Blakiston and Pryer,⁵ very numerous at Iturup during the fishing season. I saw several specimens at the village of Shana, on the same island, September 4 to 6, 1896.

93. *PANDION HALIAETUS* (Linnaeus). 309.

Enumerated by Snow, without further particulars.³

94. *ASIO OTUS* (Linnaeus). 301.⁴95. *ASIO ACCIPITRINUS* (Pallas). 300.96. *SYRNIUM URALENSE* (Pallas).

Similarly enumerated by Snow, the latter as *Syrnium uralense rufescens*. It is hardly necessary to say that it is not this form.⁶

97. *CUCULUS CANORUS TELEPHONUS* (Heine). 163.

Known to the Kurilians as *Kakkok*.⁷ It is probably this species which Snow observed on the southern Kurils.⁸

98. *ALCEDO BENGALENSIS* Linnaeus. 175.

Blakiston and Pryer⁹ indicate this species as occurring in Iturup. It is not found in Snow's list, however.

¹ Blakiston and Pryer, pp. 182, 185. ⁶ Stejneger, Proc. U. S. Nat. Mus., 1893, XVI, p. 626.

² Zoogr., I, p. 349.

⁷ Pallas, Zoogr., I, p. 443.

³ Notes Kuril Isl., p. 38.

⁸ Notes Kuril Isl., p. 36.

⁴ Idem, p. 38.

⁹ Page 136.

⁵ Page 181.

99. *DRYOBATES JAPONICUS* (Seeböhm). 167.

Seeböhm says that his examples from the Kuril islands and from Yezo are, on an average, whiter on the under parts than those from southern Japan.¹ In Blakiston's manuscript catalogue I find an entry of a specimen of *D. major* (No. 2729) from the Kurils (Snow), designated as Hakodate Museum, No. 420. On southern Kurils only, according to Snow.²

100. *DRYOBATES MINOR* (Linnaeus). 168.

Beyond Snow's note that it occurs on the southern Kurils only² nothing is definitely known, and specimens are highly desirable, in order to ascertain its status as compared with the Kamchatkan *D. immaculatus* Stejneger.

101. *CHAETURA CAUDACUTA* (Latham). 187.

Mentioned by Snow, without particulars.²

102. *MICROPUS PACIFICUS* (Latham). 186.

Found on Iturup, according to Blakiston and Pryer.³

103. *ALAUDA BLAKISTONI* Stejneger. 266½.

The skylark was observed on the northern Kuril islands by Steller,⁴ and Blakiston and Pryer note having specimens from the Kuril islands.⁵ The latter were collected by Blakiston in Iturup, September 8 to 10, 1881, and two of them are now in the U. S. National Museum (Nos. 96300, 96301).⁶

104. *OTOCORIS ALPESTRIS* (Linnaeus). 267.

Pallas having given a Kurilian name for this bird, namely, *Rikint-schir*,⁷ it has been stated to occur in the Kuril islands.

105. *ANTHUS CERVINUS* (Pallas). 227.

The red-throated pipit probably breeds on the Kurils. Snow collected two specimens (Blakiston, Nos. 2055, 2056).

Locality.—Shumshu; date, June 7, 1876, according to Seeböhm,⁸ one of which is in the U. S. National Museum. Fukushima also obtained specimens on the Kurils in July, which had apricot coloring on the throat, according to Blakiston and Pryer;⁹ while Blakiston himself collected two specimens (Nos. 2776, 2777) in Iturup on September 10, 1881, the former of which is in the U. S. National Museum.

¹ B. Jap. Emp., p. 151.

² Notes Kuril Isl., p. 36.

³ Page 140.

⁴ Pallas, Zoogr., I, p. 524.

⁵ Page 168.

⁶ Stejneger, Proc. U. S. Nat. Mus., 1892, XV, p. 304.

⁷ Zoogr., I, p. 520.

⁸ B. Jap. Emp., p. 117.

⁹ Page 151.

106. *ANTHUS JAPONICUS* (Temminck and Schlegel). 226.

This species has been collected in the Kurils by Snow, probably on Iturup, there being one specimen in the U. S. National Museum through Blakiston. In Seeborn's collection there were three specimens obtained by Wosnessenski in Urup more than fifty years ago.

107. *ANTHUS MACULATUS* Hodgson. 225.

In the U. S. National Museum there is a specimen collected in the Kurils by Captain Snow. The specimen is No. 2806 of Blakiston's collection.

108. *BUDYTES CITREOLUS* (Pallas). 230½.

A single specimen of a young *Budytes* from Ketoi (No. 96236, U. S. N. M.; Blakiston, No. 2781) has been referred to *B. tairanus* by Mr. Seeborn,¹ because it has the head dark olive-green, the eye-stripe yellow, and the ear coverts dark brown. I have carefully examined the same specimen and have come to quite a different conclusion. A glance at the bill at once suggests the distinctness of this bird, both from *B. leucostriatus* and from *B. tairanus*, it being excessively narrow and pointed, while, as Mr. Brooks² correctly says, *B. tairanus* has even a heavier bill than *B. flarus*. In shape and size of the bill No. 96236 agrees exactly with Cashmere specimens of *B. citreolus*, and the yellow eyebrow only corroborates the correctness of referring this specimen to the latter species; the wash over the gray of the top of the head is distinctly yellowish, the abdomen of the same delicate pale canary yellow as the adult *B. citreolus*, with the white under tail-coverts in marked contrast.

This identification is also more satisfactory inasmuch as it does no violence to the geographical distribution of the two species as generally understood. Pallas says of *B. citreolus*³ that he had it ex regionibus ad Lenam, Camtschatca et insulis versus Americam sparsis, while Keyserling and Blasius⁴ expressly mention the Kurils (ostwärts bis auf die Kurilen).⁵ *B. tairanus*, on the other hand, seems to be more

¹Ibis, 1884, p. 39.

²Idem, 1881, p. 240.

³Zoogr., I, p. 503.

⁴Wirbelth. Europas, I, p. xlix.

⁵The range given by Sharpe (Cat. B, Brit. Mus., X, p. 506) is evidently too restricted, as proven by his own references. He says: "From northeastern Europe to the valley of the Yenesei"; but numerous collectors have found this species breeding and migrating farther east. Thus Radde records it as common in Transbaikalia, and Dybowski found it breeding and migrating at the rivers forming the Amur, east of the Jablonnoi Mountains (Journ. f. Ornith., 1868, p. 331; 1874, p. 335); Przewalski found it breeding in southeastern Mongolia, and migrating in Ordos, Halka, and Kansu (Rowley's Orn. Misc., II, p. 193); and David records it from Peking and Shanghai (Ois. de la Chine, p. 304). This bird seems to be local in its distribution, being found in patches over a vast territory, and to travel over very narrow migration routes.

southerly in its distribution, and, if it is to be found in Japanese territory outside of Formosa, must be looked for in the islands nearest to the latter.

I may add that in his *Birds of the Japanese Empire* Seebohm seems to have abandoned his identification of the Kuril islands' bird, as *B. taiwanus*. The birds from the Kurils, he now says, have buffy white (not yellow) eyebrows. This remark is evidently based upon a specimen in the Pryer collection, and Seebohm's identification of it as belonging to the form of *B. flavus* occurring in the Commander islands (i. e., *leucostriatus*) may be quite correct, but it must be remembered that he has not had an opportunity to compare it with the specimen referred to above, which certainly differs from *B. leucostriatus*, the only species thus far found in the Commander islands.

109. BUDYTES FLAVUS LEUCOSTRIATUS (Homeyer).

According to Seebohm,¹ there is one in the Pryer collection from the Kurils. See remarks under foregoing species.

110. MOTACILLA MELANOPE Pallas. 230.

Seebohm notes that this species is probably only a summer visitor to the Kurils, whence he had examples collected by Mr. Snow.²

111. MOTACILLA LUGENS Kittlitz. 229½.

Pallas regarded this species as a constant variety of *M. alba*, and described it—without giving it a formal name, however—from specimens sent him from Kamchatka and the Kurils by his friend Billings.³ It was afterwards observed on Urup by Wosnessenski, where it arrived in 1845, on April 20 (old style), according to Middendorff.⁴ Snow also collected it in various islands, one of his specimens being in the U. S. National Museum. As a matter of fact, it appears to breed on all of them. I saw it on Mushir Long Rock on August 22; at Shana, Iturup, September 4 to 6, and at North Ushishir August 24, 1896. On the latter island I shot two specimens, one of which is now in the U. S. National Museum. They were molting all over, both quills and small plumage. One which was too badly damaged to be skinned matched exactly No. 96211, U.S.N.M., described by me,⁵ except that the first two primaries still belonged to the old plumage.

Motacilla grandis Sharpe is enumerated by Snow⁶ under the name *M. japonica*, as occurring in the Kurils, without further particulars. I am not aware that Kuril specimens are recorded.

¹ B. Jap. Emp., p. 115.

² Idem, p. 114.

³ Zoogr., I, p. 506.

⁴ Iseipt. Russl., p. 124.

⁵ Proc. U. S. Nat. Mus., 1892, XV, No. 904, p. 309.

⁶ Notes Kuril Isl., p. 37.

112. *ALSIONAX LATIROSTRIS* (Raffles). 208.

Blakiston and Pryer are authority for the statement that this species is common throughout Japan, including Yezo and the Kurils.¹ If so, it is probably confined to the southern islands. I am not aware of any record of Kuril specimens.

Hemichelidon siberica (Gmelin) is also enumerated by Snow as occurring in the Kurils,² but without reference to specimens. The identification may therefore be regarded as doubtful.

113. *CYANOPTILA BELLA* (Hay). 207.

Captain Snow, who is undoubtedly familiar with the blue flycatcher, enumerates it (under the name *C. cyanomelana*) as occurring in the Kurils, probably the southern ones only.

PHOENICURUS AUROREUS (Pallas). 253.

According to Steller, the redstart occurs in the Kurils and in Kamchatka,³ but as it has not been found in latter country by later travelers the reference is possibly doubtful, though Steller could hardly be mistaken in the identification.

114. *MELODES CALLIOPE* (Pallas). 252.

There is a record of Wosnessenski observing this species on Urup in 1845, May 9 and September 20 (old style),⁴ since which time it has been collected in various islands by Snow, Kitahara, and myself. Kitahara was fortunate enough to secure a young in the first plumage on Chirnoi, while I collected a young female after the first molt on North Ushishir, on August 24, 1896. In the Science College Museum, Tokyo, there is a male (No. 787) collected on Shikotan on July 7. These species, therefore, probably breed on all the large islands of the chain.

In 1892, while considering the specimens in Henson's Hakodate collection, I expressed a suspicion that the Kamchatkan nightingales breeding on the Kurils, at least the southern ones, may be of a somewhat different coloration from those breeding in Kamchatka and Siberia and partly migrating over Japan.⁵ Last year while in Tokyo I examined the material in the Science College Museum and found that three of the specimens from central Japan have the normal black band behind the scarlet throat and the ash-colored chest, while the breeding bird from Shikotan (No. 787) tallies exactly with Blakiston's May specimens from Yezo (Nos. 96269, 96271, U.S.N.M.), which have the fore neck and breast of a very pale clay color, devoid of gray, and only a few dusky spots to indicate the blackish band. The russet on the upper side of the tail and upper tail coverts in this specimen is also brighter. This strengthens my suspicion, but I do not consider the

¹Page 147.

²Notes Kuril Isl., p. 36.

³Pallas, Zoogr., I, p. 476.

⁴Middendorff, Iseipt. Russl., p. 125.

⁵Proc. U. S. Nat. Mus., 1892, XV, p. 321.

material sufficient for separating the Kuril birds formally, but would suggest that the question be kept in mind and attempts made to secure additional material.

The young in the first plumage being hitherto undescribed I submit the following description of Kitahara's Chirnoi specimen:

Young in first plumage.—Chirnoi islands, Kurils. Science College Museum, Imperial University, Tokyo. Upper surface dark brownish gray, each feather with an ochraceous shaft-streak which widens toward the tip and is edged with blackish; under side ochraceous, paler on throat and belly, the feathers more or less broadly edged with dusky, giving a scaly appearance especially to the breast; wings above dark brownish gray, the outer edge of the feathers margined with tawny olive, and the coverts, except primary coverts, with an apical spot of a lighter tint approaching ochraceous; tail-feathers dark brownish gray, the outer margins washed with tawny olive, especially toward the base.

Dimensions.—Wing, 75 mm.; tail-feathers, 57 mm.; exposed culmen, 10 mm.; tarsus, 30 mm.; middle toe with claw, 22 mm. Wing formula: First primary, 25 mm. long; second shorter than sixth; third equals fourth; longest, 7 mm. longer than second.

115. *MONTICOLA MANILLA* (Boddaert). 256.

Snow enumerates this species, under the name *M. solitaria*, as occurring in the Kurils, but there is no reference to specimens and I do not know of any being on record.

Curiously enough there are no records of thrushes occurring in Iturup or any of the other islands.

116. *PRATINCOLA MAURA* (Pallas). 254.

There is one specimen in the Seebohm collection, from the Kurils,¹ collected by Snow, but no further locality is given.

117. *LOCUSTELLA OCHOTENSIS* (Middendorff). 238.

Breeding on the Kurils, and probably found on all the islands covered by any grass at all, for on August 22, 1896, I found a small colony on the little Mushir Long Rock, where they had a peculiar way of concealing themselves in the rank *Elymus* grass, darting out and in between the tufts with great dexterity.

At Shana, Iturup, on September 6, after a heavy gale offshore quite a number of these birds came on board the vessel, and two were preserved, both young females.

Wosnessenski collected this species on Urup in 1844, and one of his specimens is in the Seebohm collection.² Fukushima collected it on Iturup, according to Blakiston and Pryer.³

¹ B. Jap. Emp., p. 57.

² Idem, p. 73.

³ Page 158.

118. ACANTHOPNEUSTE BOREALIS XANTHODRYAS (Swinhoe). 242.

In the St. Petersburg Academy of Sciences there are three specimens of this form from the Kurils, all collected by Wosnessenski in 1844, two collected in Urup, August 12 and 13, and one in Paramushir, June 26 (old style).¹

No specimens of typical *A. borealis* are recorded from the Kurils. The so-called *Motacilla trochilus*, which, according to Steller, is abundant in the Kurils,² refers probably to one or both forms of this species.

119. TROGLODYTES FUMIGATUS KURILENSIS (Stejneger). 245½.

This form was originally described from a specimen collected by Captain Snow on Shiashkotan in July, 1881.³ On August 24, 1896, I collected two specimens,⁴ male and female, on North Ushishir, where they were fairly common among the driftwood. The exposed culmen of the male measures 14 mm., of the female, 13 mm., their bill being consequently considerably larger than in the typical *T. fumigatus*.

Whether the latter is found on the Kurils nearest Yezo is quite doubtful, as no specimens appear to be in the collections.

? HIRUNDO DASYPUS (Bonaparte). 185.

Whether this is the swallow which the Kurilians, according to Pallas,⁵ called *Kuja-kanà* and which Snow mentions as occurring on the southern Kurils is very doubtful, as no specimens seem to be on record.

120. SITTA AMURENSIS ALBIFRONS (Taczanowski).

Beyond the specimen from the Kurils in the U. S. National Museum (No. 96150), collected by Snow and noted by me,⁶ nothing is known of the occurrence of this form in the chain. It is probable that the Kamchatkan Nuthatch only occur in the most northern islands and that true *S. amurensis* may inhabit the large southern ones.

121. PARUS SEEBOHMI Stejneger. 216.

The marsh-tit collected by Snow in the Kurils (No. 2799, Blakiston)⁷ is now in the U. S. National Museum (No. 96145). I first regarded it as doubtfully belonging to Taczanowski's *P. brevirostris*,⁸ but upon receiving genuine specimens of the latter, was obliged to establish the Japanese birds as *P. seebohmi*.⁹ The exact locality of the specimen in question is unknown, but is probably Iturup.

¹Pleske, Ornithographia Rossica, II, 2, p. 171.

²Pallas, Zoogr., I, p. 494.

³Proc. U. S. Nat. Mus., 1888, p. 548.

⁴Nos. 159358, 159359, U.S.N.M.

⁵Zoogr., I, p. 532.

⁶Proc. U. S. Nat. Mus., 1886, IX, p. 393.

⁷Seebohm, Ibis., 1884, p. 37.

⁸Proc. U. S. Nat. Mus., 1886, IX, pp. 381, 394.

⁹Idem, 1892, XV, p. 343.

122. *PARUS KAMTSCHATKENSIS* (Bonaparte). ?

The occurrence of this species is only known from a specimen mentioned by Pražák as having been obtained in Paramushir.¹ It is somewhat doubtful, however, whether this specimen really belongs to the typical Kamchatkan bird, for he says that it is considerably grayer and approaching *P. baicalensis*. It is not unlikely that Paramushir is inhabited by a distinct race.

123. *PARUS VARIUS* Temminck and Schlegel. 218.

Enumerated by Snow, but no particulars given.²

124. *AEGITHALOS CAUDATUS* (Linnaeus). 220.

Same remark as above.

125. *CORVUS CORONE ORIENTALIS* (Eversmann). 190.126. *CORVUS MACRORHYNCHUS JAPONENSIS* (Bonaparte). 189.

Both species noted by Snow as occurring on the southern Kurils only,² and by Blakiston and Pryer¹ specifically as found on Iturup. Seeböhm had specimens of both species collected by Snow in the Kurils.⁴

127. *CORVUS CORAX* Linnaeus. 191.

The raven's Kuril name is given by Pallas as *Paskur*.⁵ Snow collected it and sent specimens to Blakiston and Pryer, by whom they were distributed to the Hakodate Museum⁶ and to Seeböhm's collection.⁷ Snow says that the raven is to be found on every island in the chain, always in pairs, and that it breeds early, the young being found about the middle of June.² I myself observed it on Mushir Rocks August 22, on Raikoke August 23, and on North Mushir August 24. A specimen, excessively lean and in wretched plumage, was obtained the following day on South Ushishir (No. 159365, U.S.N.M.)

128. *NUCIFRAGA CARYOCATACTES JAPONICUS* Hartert. 197.

On Ketoi island there is a patch of fir trees on a slope facing the northern shore, according to Snow, and amongst these trees he came across a colony of nutcrackers. Pallas⁸ mentions expressly that the Zirbelfichte (*Pinus pumila*) occurs on Ketoi, and Captain Snow's find of these isolated colonies of trees and birds together in such an unlikely place is highly interesting.

129. *PICA CAMTSCHATICA* Stejneger.

Pallas gives *Kakuk* as the Kurilian name for the magpie,⁹ and it is consequently not improbable that the specimens which Seeböhm got

¹ Ornith. Jahrb., 1895, VI, p. 70.

² Notes Kuril Isl., p. 36.

³ Page 141.

⁴ B. Jap. Emp., pp. 95, 96.

⁵ Zoogr., I, p. 380.

⁶ Page 142.

⁷ B. Jap. Emp., p. 94.

⁸ Neue Nord. Begtr., 1783, IV, p. 118.

⁹ Zoogr., I, p. 389.

from Mr. Dresser as having been procured by Mr. Snow on the Kuril islands were really collected on the northernmost islands. According to Seeböhm, the specimens belong to the Kamchatkan form described by me, while one, he says, might be called *Pica caudata leucoptera*. This is evidently only a young bird of the same form.

130. STURNIA VIOLACEA (Boddaert). 203.

Snow says that this bird was noticed on Iturup¹ and Nakisbon, and Pryer² adds that it was observed there in September.

131. EMBERIZA PERSONATA Temminck. 272.

This bird was common at Shana, Iturup, during my visit, September 4 to 6, 1896, and Blakiston and Pryer³ mention it also as collected on that island. One of these specimens (No. 2773, Blakiston), collected September 18, 1881, is in the U. S. National Museum.

132. EMBERIZA YESSOENSIS (Swinhoe). 277.

133. EMBERIZA CIOPSIS Bonaparte. 268.

134. EMBERIZA FUCATA Pallas. 269.

135. EMBERIZA RUSTICA Pallas. 271.

136. EMBERIZA AUREOLA Pallas. 273.

The enumeration of these five species by Captain Snow⁴ is the only evidence of their occurrence in the Kurils. The first three are probably confined to the southern islands, the last mentioned to the northern ones, while *E. rustica* may occur in both groups.

137. PLECTROPHENAX NIVALIS (Linnaeus). 279.

Seeböhm had in his collection two specimens obtained by Mr. Snow from the Kuril islands.⁵

138. CALCARIUS LAPPONICUS (Linnaeus).

An adult male in full breeding plumage collected by Snow in the Kurils is in the Seeböhm collection.⁵ Curiously enough both these species are left out of Snow's list.

139. PINICOLA ENUCLEATOR (Linnaeus). 291.

Two specimens are known to have been collected in the Kurils, both apparently without definite locality. One of them was in the Kaitakushi collection in Sapporo,⁶ the other, a specimen in female plumage, was obtained by Messrs. Owston, Snow & Co.'s collectors, in 1882.⁷

¹ Notes Kuril Isl., p. 36.

² Page 146.

³ Page 170.

⁴ Notes Kuril Isl., p. 37.

⁵ B. Jap. Emp., p. 140.

⁶ Blakiston and Pryer, p. 175.

⁷ Blakiston, Chrysanthemum, April, 1883; Amend. L. B. Jap., p. 63.

140. *LOXIA CURVIROSTRA* Linnaeus. 295.

According to Blakiston and Pryer,¹ Mr. Snow obtained a crossbill at the Kurils. No further information given.

141. *CARDUELIS SPINUS* (Linnaeus). 285.

Enumerated by Snow, without particulars.² I saw the siskin at Shana, Iturup, September 4 and 5, 1896.

142. *CHLORIS KAWARAHIBA* (Temminck). 283.

The green finch described by Steller³ was undoubtedly this species, and probably from one of the northern islands. In the Pryer collection acquired by Seeböhm there were two specimens obtained by Snow from the Kuril islands.⁴ It is not mentioned in Snow's list.

143. *LEUCOSTICTE BRUNNEONUCHA* (Brandt). 288.

Breeds in the Kurils, where it was obtained by Fukushima in July.⁵

With reference to the variety B 1, of Pallas,⁶ from the Kurils, I refer to what I wrote on a previous occasion.⁷

Cabanis' *Montifringilla pustulata* and *M. arctoa* from the Kuril islands, in the museum at Berlin,⁸ have probably an erroneous locality assigned to them. Bonaparte and Schlegel in their *Monographie des Loxiens* figure one of the specimens of the last-mentioned species most beautifully (Plate 45, lower figure), and in the text⁹ refer to it as killed on the Kuril islands and obtained from the collection of Pallas. It is very suspicious, however, that Pallas in his *Zoographia* does not mention having the typical form from the Kurils.

144. *PASSER MONTANUS* (Linnaeus). 281.

Enumerated by Snow with a query,² but I saw it at Shana, Iturup, September 4 and 5, 1896.

145. *URAGUS SANGUINOLENTUS* (Temminck and Schlegel). 289.

Blakiston and Pryer are authority for the statement that Mr. Snow had specimens from the Kurils.¹⁰

¹ Page 176.

² Notes Kuril Isl., p. 37.

³ Pallas, *Zoogr.*, II, p. 14.

⁴ B. Jap. Emp., p. 128.

⁵ Blakiston and Pryer, p. 174.

⁶ *Zoogr.*, II, p. 22.

⁷ Proc. U. S. Nat. Mus., 1892, XV, No. 904, pp. 354, 355.

⁸ Ersch & Gruber, *Encyclop.*, 1849, L, p. 215; Lichtenstein, *Nomencl. Av. Mus. Berol.*, 1854, p. 47.

⁹ Page 59.

¹⁰ Page 174.

146. PYRRHULA GRISEIVENTRIS KURILENSIS Sharpe.

Wosnessenski observed the bullfinch on Urup, May 8, 1845, and beginning of August (old style), according to Middendorff¹ and Seeböhm has specimens collected by him in the Kurils in July.² Blakiston and Pryer³ say that the species is very numerous on Iturup in September, and I found it so there at Shana, September 4, 5, 1896. The specimens I saw were young ones molting from the first, buff plumage into the gray one. Two were preserved for the U. S. National Museum.

¹ Isc. pt. Russl., p. 124.² B. Jap. Emp., p. 129.³ Page 176.

DESCRIPTION OF A SPECIES OF ACTAEON FROM THE QUATERNARY BLUFFS AT SPANISH BIGHT, SAN DIEGO, CALIFORNIA.

By ROBERT E. C. STEARNS.

Honorary Associate in Zoology.

At Spanish Bight, San Diego, a fine exposure of Quaternary marl occurs, containing well preserved fossils, most of which are recent species. Among them some forms have been discovered which appeared to be new, but which have, later, turned up also in the recent fauna of this part of the coast. One of these is the following fine species of *Actaeon*.¹

ACTAEON TRASKII Stearns.

Shell small, conical above, cylindrical, rather solid, opaque, somewhat glossy; sculpture consisting of numerous fine spiral impressed lines or grooves, which become wider toward the base of the body whorl, making the sculpture of the lower portion of the shell lirate; part of the lirae are slightly grooved and in some cases show a tendency to run in pairs; the grooved lines are not quite regular in their relative distances, and some are deeper than others; the surface is otherwise sculptured by sharp, close-set, incremental lines; these latter are subordinate to the spiral sculpture and are more conspicuous on the lower part of the body whorl. Color dull-cream white, with (in the example before me) two obscure, broad, pale rufous bands on the body whorl. Spire short, obtusely conical. Whorls, six (probably, apex in example somewhat eroded); suture distinct, narrowly channeled. Aperture about two-thirds the length of the shell (not quite 9mm.), acutely angular above, rounded and effuse below, finely lirate and glossy within, with a thin glazing on the body whorl. Outer lip thin, simple. Columella short and flexuous, with a conspicuous fold, curving around the same and thickening the edge of the lip, which is moderately produced in the umbilical region.

	A ² mm.	B mm.
Length of shell	11	24
Length of body whorl.....	9	19
Breadth	6	12

¹ Preliminary description in *The Nautilus*, June, 1897, XI, p. 14.

² A, Hamlin's specimen; B, Type in U. S. National Museum, Reg. No. 148241.

A single example in the collection of my friend, Mr. Homer Hamlin, of Los Angeles, enables me to describe this form, which was collected by me some years ago (in the fall of 1887) in the same locality. The fossil specimens collected by me during my association with the United States Geological Survey are in the United States National Museum (Reg. No. 148271).

A fine, large fresh specimen, bearing no indications of fossilization, is in the collection of the United States National Museum (No. 130320), and was collected on the beach of San Diego Bay, the precise spot not being recorded. It is in size about midway between the two fossil specimens above cited, and in color is of deep rosy flesh color, much darker than in the fossils, with a lighter band midway on the whorl. Except in its characters as a living shell it does not differ in any essential respect from the Post Pliocene specimens above mentioned.

Actaeon traskii is apparently of rare occurrence, though Mr. Hamlin has collected it before at the same locality. I failed to obtain it in the San Pedro bluffs of the same age and character, namely, nearly loose sand. It is associated in the Spanish Bight bluffs, which are situated on the Coronado Peninsula opposite the city of San Diego, with the comparatively common allied species *Actaeon* (*Rictaxis*) *punctocaelatus* Carpenter, of which numerous examples were collected by me at the same time. The latter is a less robust and more delicate form; it is found living at many points along the coast from Monterey southerly. Beach specimens were found by me on the shores of Monterey Bay in March, 1867. It sometimes occurs in considerable numbers at Long Beach and San Pedro.



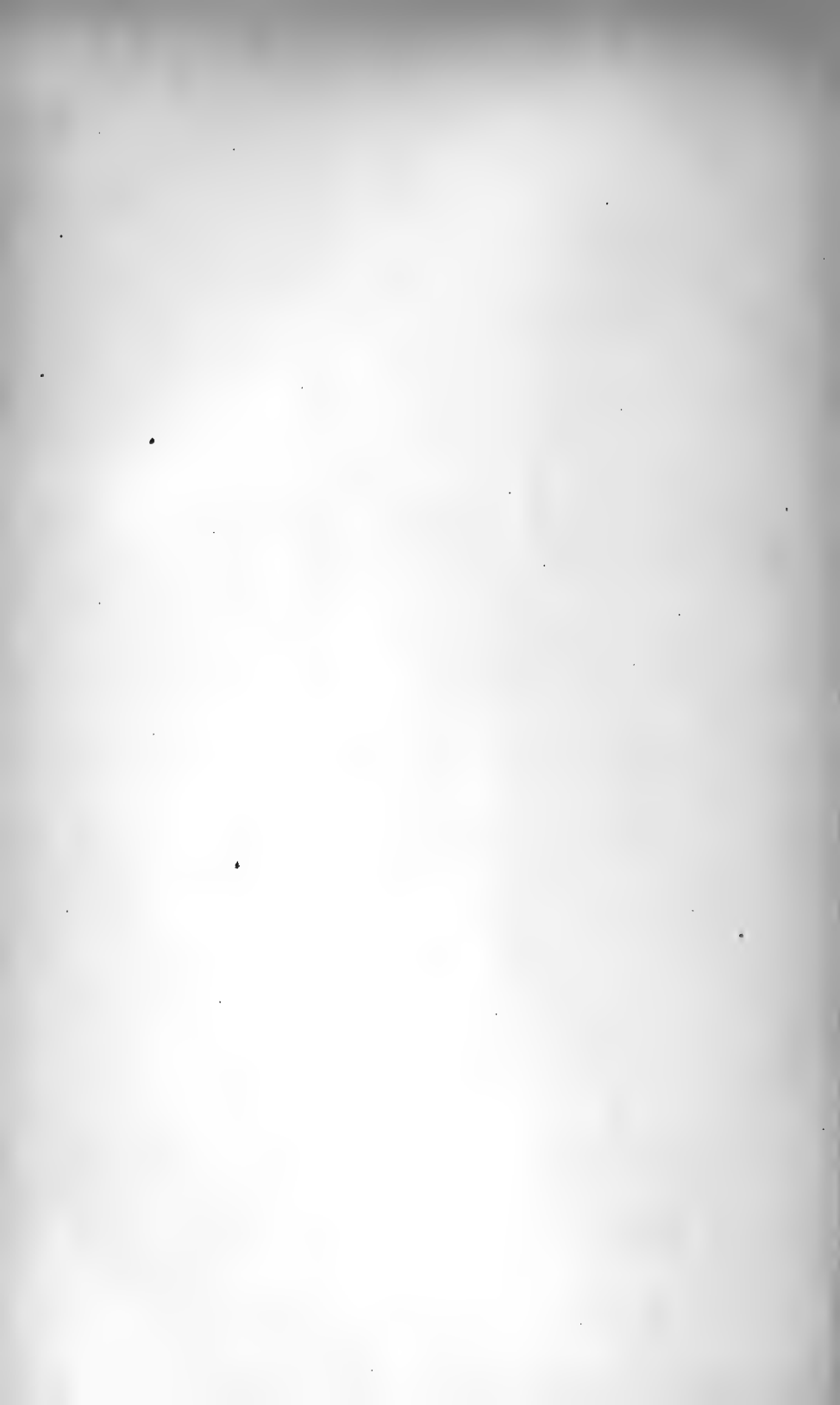
ACTAEON TRASKII
STEARNS.

This new *Actaeon* I have named for Dr. John B. Trask, one of the founders of the California Academy of Sciences, also a pioneer in natural history investigations on the west coast, as well as a skillful physician.

The two species mentioned above must be added to the catalogue of Californian fossils. In Dr. J. G. Cooper's list, published in the Seventh Annual Report of the State Mineralogist of California, he includes *Opalia anomala* and *O. varicostata*, referring them to the *Quaternary* and to the San Diego well. Neither of the species were detected in the well material, and both are *Tertiary* (Pliocene) forms, occurring in the older bluffs of Pacific beach, where I obtained numerous examples in the fall of 1887, and a single individual of a related form, *Scala stearnsii* Dall—a solid, chunky shell, nearly as broad as long (about an inch), described and figured by the author¹—another addition to the California list.

¹Transactions of the Wagner Free Institute of Philadelphia, 1892, III, Pt. 2, p. 245, pl. XXI, fig. 4.

The Spanish Bight examples of *A. punctocaelatus* are without the least trace of the broad dark bands that characterize recent or living specimens. They are also much slenderer, and, on the whole, upon a comparison between numerous examples of both, more attenuated and delicate, though the columellar characters are the same. This fossil varietal aspect may for convenience be known as var. *coronadoensis* (Reg. Nos. 148265-70, U.S.N.M.).



REPORT ON A COLLECTION OF JAPANESE DIPTERA, PRESENTED TO THE U. S. NATIONAL MUSEUM BY THE IMPERIAL UNIVERSITY OF TOKYO.

By D. W. COQUILLET,
Honorary Custodian of the Diptera.

The collection of Diptera presented to the U. S. National Museum by the Imperial University of Tokyo, Japan, through Professor Mitsukuri, contains 629 specimens, representing 124 species, which are distributed in 83 genera and 26 different families. Of these 124 species, 12 were originally described from Japanese specimens; 6 of the others, although described from other countries, have heretofore been reported as occurring in Japan; of the remaining species, 52 were described from other countries than Japan and have not before been recorded from that country, while the remaining 54 species, or almost one-half of the entire number, are considered new to science and are duly characterized in the following pages.

As a whole, the species represented in this collection show a very close relationship to the fauna of Europe. Indeed, quite a large percentage of the species are identical, while others so closely resemble European forms that it becomes extremely difficult for one to decide the question of specific distinctness. A few species have extended their range northward from Malaysia or the East Indies, but these are not so numerous as one would be led to expect would be the case.

In addition to the species represented in this collection, an even 50 species have also been recorded from Japan; 35 of these were originally described from Japanese specimens. Assuming that no error has been made in these references, this will make a total of 174 species of Diptera now known from Japan—a ridiculously small number, which will no doubt be increased at least fivefold when the Empire is thoroughly explored for these and the other orders of insects. Baron Osten Sacken has recorded 250 species of Diptera from the Philippine Islands, and in addition to these, 51 species have been reported as occurring in these islands, making a total of 301 species. We should reasonably expect three or four times this number from a country so fertile and varied as Japan.

In order to complete, so far as possible, our knowledge of the Diptera of Japan, I add herewith a description of a new Syrphid from that country not represented in the collection from the university:

SPHIXIMORPHA PLEURALIS, new species.

Male and female: Head and its members black, the antennal style except its base, the lower corners of the front, and the face, except its upper edge and a median vitta, yellow; antennal process reddish brown, almost as long as the horizontal diameter of the head at its base, of an equal length with the first antennal joint; first two joints of antennae somewhat polished, the third opaque, yellowish-brown pruinose. Thorax black, a yellow spot on each humerus, and in the male with another at each end of the transverse suture of the mesonotum; scutellum black, margined with yellow. Abdomen black, the broad hind margins of the second and third segments and base of the second yellow, the narrow hind margin of the fourth reddish; petiole of abdomen short and thick, the second segment in the female three-fourths as long as wide, in the male slightly longer than wide. Legs black, the trochanters, broad apices of the femora, tibiae except a median band on each, and usually the tarsi, except the apex of each, yellowish-brown. Wings of male hyaline, the portion in front of the third vein and along the fifth in the second basal cell brown; in the female brown, the lower outer corner of the first basal cell, the first posterior cell except the front portion, the discal and third posterior cells except the base of each, also the whole of the second posterior cell, hyaline. Halteres yellow, the base of the peduncle brown. Length, 17 to 21 mm. Three males and one female, presented to the writer by Prof. Carl F. Baker, of Auburn, Alabama.

Type.—No. 3961, U.S.N.M.

The report in detail is as follows:

Family CULICIDAE.

CULEX SUBALBATUS, new species.

Female: Head and its members black, except the basal half of the second antennal joint, which is yellow; the first joint, and the occiput next the eyes, covered with white tomentum; proboscis curving downward toward its apex. Thorax brownish-black, the sides and several spots on the pleura covered with white tomentum, a tuft of black hairs above the insertion of each wing; scutellum, metanotum, and posterior angles of the thorax yellowish-brown. Abdomen brownish-black, thickly covered above with black tomentum, the under side of each segment bearing a fascia of silvery-white tomentum, which is prolonged upon the sides of the segments. Coxae yellowish-brown, the anterior sides of the front ones and the outer sides of the middle and hind ones covered with silvery-white tomentum; femora black, sometimes more

or less yellowish-brown, the under sides of the front and middle ones encroaching upon the posterior sides, also the under sides of the hind ones encroaching both on the anterior and posterior sides, covered with silvery-white tomentum; tibiae and tarsi black; inner claw of front tarsi slightly longer than the outer one and provided with a tooth on the under side, the outer claw destitute of such a tooth. Wings hyaline. Halteres yellow, the knobs brown.

Length, excluding the proboscis, 7 mm. Six specimens (No. 641).

Type.—No. 3962, U.S.N.M.

CULEX PALLENS, new species.

Female: Head yellowish brown; palpi brown, the base yellow; proboscis yellow; antennae brown, the first joint and base of the second yellow. Thorax yellowish-brown, the sides, posterior end, metanotum, and pleura yellowish, the sparse hairs and tomentum yellow; scutellum whitish. Abdomen yellow, its sparse hairs and tomentum also yellow. Legs, including the coxae, yellow; front tarsal claws of an equal size and destitute of a tooth on the under side. Halteres yellow, the knobs brownish-yellow. Wings hyaline, strongly iridescent.

Male differs from the female as follows: Palpi yellow, mottled with brownish-yellow; second joint of antennae and apical portion of joints 3 to 13 silvery-white; outer claw of front tarsi much shorter than the inner one, each bearing a tooth on the under side.

Length, 5 to 6 mm. Four females and six males (No. 640).

Type.—No. 3963, U.S.N.M.

Family TIPULIDAE.

LIBNOTES POECILOPTERA Osten Sacken:

Libnotes poeciloptera OSTEN SACKEN, Ann. Mus. Civ. Sto. Nat. Genova, February 4, 1881, p. 403.

A specimen of each sex (No. 635), agreeing well with the description. The species was originally described from Sumatra and Java. The genus has not heretofore been reported as occurring north of the Philippine Islands. Its former range extended from these islands southward to New Guinea and westward to Ceylon.

CONOSIA SUBSTITUTA Walker.

Limnobia substituta WALKER, List Dipt. Ins. Brit. Mus., 1848, Pt. 1, p. 39.

Two males and one female (No. 631), agreeing well with the short description. Walker's specimen was from China, and he placed it in the same group as *Limnobia punctata* Meigen, in which the small crossvein is near the base of the discal cell, whereas in the Japanese specimens it is beyond the tip of this cell. In another work, published

several years later,¹ this author located *Limnobia irrorata* of Wiedemann, which has the small crossvein as in the Japanese specimens, in a group which he distinguished from the one containing *Limnobia punctata* by the shape of the discal cell and the position of the posterior basal crossvein; and, as in this case he overlooked the great difference in the position of the small crossvein, it is altogether probable that the same thing occurred when describing *Limnobia substituta*. The genus *Conosia* was heretofore reported as extending from Ceylon to Java, Borneo and China, and westward to the Arabian desert.

LIMNOPHILA VARICORNIS, new species.

Male: Head black, opaque, gray pruinose, upper side of the rostrum yellow, palpi brown, antennae as long as the thorax, composed of 16 joints, brown, the third joint pale yellow. Thorax opaque, brownish-black, its posterior margin and that of the prothorax yellow; scutellum yellowish-brown, metanotum and pleura gray pruinose. Abdomen yellow, its hairs also yellow. Legs, including the coxae, yellow. Halteres yellow, the knobs, except their bases, brown. Wings hyaline, all of the veins and cells marked with numerous small brown spots; subcostal crossvein close to the tip of the auxiliary vein and opposite the small crossvein, the latter located at the proximal end of the discal cell, first section of the third vein as long as the last section, the second issuing from it at a less distance from the small crossvein than the length of this crossvein, petiole of the first submarginal cell one-seventh as long as this cell, of an equal length with the small crossvein, first vein at its tip curving forward to the costa and terminating in it, marginal crossvein at less than its own length from the end of the first vein; five posterior cells, the petiole of the second as long as the discal and two-thirds as long as the second posterior cell, base of the fourth posterior cell slightly more proximal than the base of the third, the posterior basal crossvein slightly before the middle of the discal cell.

Length, 10 mm. A single specimen (No. 631).

Type.—No. 3964, U.S.N.M.

ERIOCERA VERTICALIS Wiedemann.

Megistocera verticalis WIEDEMANN, Aus. Zweif. Ins., 1828, I, p. 56.

A male specimen (No. 636), agreeing fairly well with the description. This species was originally described from Java, and has already been referred to the present genus by Osten Sacken.²

DICTENIDIA FASCIATA, new species.

Male: Head polished black, a large yellow spot on each side of the occiput, antennae black, 13 jointed, joint 3 bearing one, joints 4 to 12 each bearing two, long processes on the upper side; palpi brown.

¹ Insecta Saund., Dipt., 1856, p. 436.

² Berliner Ent. Zeitsch., 1886, p. 158.

Thorax and scutellum polished black, two yellow vittae on the mesonotum in front of the suture, a brown spot between the scutellum and insertion of each wing. Abdomen polished black, segments two to five, except a dorsal spot at the base of the second, bright yellow. Coxae black, femora yellow, the apices broadly black, tibiae yellow, the ends and a broad fascia near the middle of the hind ones black; tarsi black. Halteres yellowish-brown. Wings black, the base to the humeral crossvein yellow; a yellowish hyaline fascia crosses each wing between the apices of the anal and of the second posterior cell, and contains the black stigma; a hyaline vitta in the first basal cell before its middle, a subhyaline one in the second basal cell beyond its middle, and a second one in the center of the axillary cell.

Female: Differs from the male as follows: No yellow spots on the occiput; antennae 11-jointed, not furnished with processes, yellow except the first two joints; segments 2 and 5 of the abdomen black; apices of all of the posterior cells except the fifth, brown; no hyaline nor subhyaline vitta in the black portion of the wings.

Length, 13 to 14 mm. One specimen of each sex (No. 638).

Type.—No. 3965, U.S.N.M.

This genus has heretofore been represented by a single species which occurs in Europe, extending from Sweden to Italy.

TIPULA PARVA Loew.

Tipula parva LOEW, Wiener Ent. Monatsch., 1858, p. 102.

Three female specimens (Nos. 633, 634) agreeing quite well with the description, which was based on a male from Japan.

TIPULA NUBIFERA, new species.

Male: Head opaque, yellow, the lower portion of the occiput brown, rostrum, except the extreme base, brownish-black, palpi black, antennae simple, 13-jointed, shorter than the thorax, yellow, changing into brown at the tip. Thorax opaque, yellow, the prothorax marked with a brown dorsal spot and lateral vitta, the latter continued across the middle of the pleura; mesonotum in front of the suture marked with two brown spots, and on either side of these with a large oblong brown spot, behind the suture with two large brown spots, metanotum marked with a brown spot at the posterior end. Abdomen polished yellow, the sutures of the segments, a lateral vitta and a dorsal vitta on segments 4 to 7, black. Legs yellow, apices of the femora and tibiae, and the whole of the tarsi except their extreme bases, brown. Halteres yellowish, the knobs black. Wings gray, a whitish hyaline spot in center of first basal cell; another in center of the inner marginal cell, crossing the costal, and in the opposite direction encroaching upon the first basal cell; a third whitish spot in base of the outer marginal cell, crossing the submarginal and invading the first posterior cell; a fourth in base of discal cell, extending into the first basal; a fifth in apex of

first posterior cell; a sixth in second basal cell beyond the middle, contiguous to the fifth vein; a seventh in anal cell near its middle, finally one in each outer angle of the axillary cell; a distinct brown cloud at base of the third vein, another at the stigma, and a third larger one, filling the outer ends of the marginal and submarginal cells. Length, 32 mm. A single specimen (No. 632).

Type.—No. 3966, U.S.N.M.

PACHYRHINA VIRGATA, new species.

Male: Head opaque, yellow, the rostrum polished, the upper side of the front part reddish, a black spot on the occiput above the neck, palpi yellow, antennae brown, the first two joints yellow, joints 4 to 10 greatly constricted near the middle of their under sides (the apical portion of the antennae wanting in the single specimen before me). Thorax polished, yellow, mesonotum marked with three black vittae, of which the median tapers posteriorly and does not extend behind the suture; the lateral ones each consist of two contiguous lunate spots, an opaque brown spot on the outer side of the anterior end of each, another on the suture and a third on each side of the prothorax; scutellum black, a black dorsal vitta on the metanotum. Abdomen yellow, marked with an interrupted black dorsal vitta. Legs yellow, apices of the tibiae and the whole of the tarsi, brown. Halteres yellowish. Wings hyaline, subcostal cell yellowish, stigma brown. Length, 13 mm. A single specimen (No. 637).

Type.—No. 3967, U.S.N.M.

PACHYRHINA PALLORIS, new species.

Female: Differs from the above description of *virgata* only as follows: Black spot on the occiput reduced to a narrow vitta (antennae, except the two basal joints, wanting). Vittae of the thorax pale brown, the outer ones interrupted at the suture by a lunate velvet-black spot, the spot on the outer side of their anterior ends also velvet-black, prothorax unmarked, scutellum yellow, metanotum, except on the sides, yellowish-brown, a large yellow dorsal spot contiguous to the scutellum. Abdomen marked with a black vitta each side, in addition to the dorsal one. Wings having the costal and subcostal cells brown, the apex of the wing from slightly before the apex of the second vein to the apex of the fifth narrowly bordered with brown, the apices of the veins terminating in this part of the wing also narrowly bordered with brown. Length, 19 mm. A single specimen (No. 637).

Type.—No. 3968, U.S.N.M.

Family BIBIONIDAE.

BIBIO LEPIDUS Loew.

Bibio lepidus LOEW, Sys. Besch. Eur. Zweif. Ins., 1871, II, p. 32.

Four male specimens (No. 699), agreeing well with the description, which was founded on specimens from Great Britain.

BIBIO TENEBROSUS, new species.

Male and female: Black, except the wings, which are pale brown, the base, as far as the small crossvein, grayish-hyaline, the costal cell hyaline before the humeral crossvein and dark brown beyond it; stigma black in the male, dark brown in the female. Hairs of the eyes brown or black, those on the occiput and sides of the mesonotum black, on the pleura and sides of the abdomen at the base pale yellow. First, third, and first section of the fourth vein, also the small crossvein, dark brown, remaining veins yellow. Small crossvein less than two-thirds as long as the first section of the third vein. Hind tarsi of the male slightly swollen, the first joint as long as the next two joints taken together. Length, 9 to 12 mm. Four males and one female (No. 698).

Type.—No. 3969, U.S.N.M.

Family XYLOPHAGIDAE.**CHRYSOPILA DIVES** Loew.

Chrysopila dives LOEW, Sys. Besch. Eur. Zwei. Ins., 1871, II, p. 62.

Four males (No. 695), agreeing well with the description, which was founded on specimens from Lake Baikal, Siberia.

CHRYSOPILA PULLATA, new species.

Male: Black, the third joint of the antennae yellow, halteres and abdomen yellowish brown, wings grayish, brown in the costal cell and dark brown at the apex of the wing, stigma brownish-black, first vein bordered with hyaline from the humeral crossvein nearly to the apex of the auxiliary vein, a whitish spot before the proximal end of the discal cell, one beyond the middle of that cell, another before the middle of the first submarginal cell, and a transverse row of five extending from the marginal to the third posterior cell, crossing the first posterior cell at its middle. All of the hairs black. Length, 6 mm. Two specimens (No. 697).

Type.—No. 3970, U.S.N.M.

LEPTIS FLAVIMEDIA, new species.

Male: Head black, the antennae, palpi, and proboscis yellow, hairs of palpi and on under side of head yellowish white, those on upper part of occiput black. Thorax yellow, the mesonotum, except on the sides and posterior end, black or brown, opaque, gray pruinose; hairs of mesonotum black, those of the pleura mixed yellow and black; scutellum yellow. Abdomen on the first four segments yellow, sometimes marked with a brown dorsal spot at the base of the third and fourth, remaining segments black. Legs, including the coxae, yellow, the front and hind tarsi, and middle ones except at the base, brown.

Halteres yellow. Wings yellowish-hyaline, the apex from the tip of the first vein to that of the fifth dark brown; stigma yellow, not well defined. Length, 8 mm. Three specimens (No. 693).

Type.—No. 3971, U.S.N.M.

ATHERIX IBIS Fabricius.

Atherix ibis FABRICIUS, Ent. Syst., Supp., 1794, p. 556.

Two male specimens (No. 696), agreeing well with others from France in the U. S. National Museum.

Family STRATIOMYIIDAE.

SARGUS NIPHONENSIS Bigot.

Sargus nipponensis BIGOT, Ann. Soc. Ent. France, 1879, p. 221.

Four males and four females (No. 687), agreeing well with the description, which was founded on a specimen from Japan.

SARGUS TENEBRIFER Walker.

Sargus tenebrifer WALKER, List Dipt. Ins. Brit. Mus., 1849, Pt. 3, p. 517.

Seven females (No. 686). The species was originally described from China.

SARGUS AURIFER Walker.

Sargus aurifer WALKER, List Dipt. Ins. Brit. Mus., 1854, Pt. 5, p. 96.

A specimen of each sex (No. 690). The description of Walker was founded on specimens from Hindoostan and north China.

ODONTOMYIA STAUROPHORA Schiner.

Odontomyia staurophora SCHINER, Reise Oesterr. Fregatte Novara, 1868, p. 59.

Three males and one female (No. 726), agreeing well with the description, which was founded on two female specimens from Hongkong, China.

STRATIOMYIA BARCA Walker.

Stratiomyia barca WALKER, List Dipt. Ins. Brit. Mus., 1849, Pt. 3, p. 530.

One male and nine females (No. 717). The species was originally described from China.

EPHIPPIUM TENEBRICA Walker.

Ephippium tenebrica WALKER, List Dipt. Ins. Brit. Mus., 1849, Pt. 3, p. 522.

Eleven males (No. 716), agreeing well with the description, which was based on a specimen from Java.

Family TABANIDAE.

SILVIUS DORSALIS, new species.

Female: Head black, gray pruinose, the face yellow, yellowish pruinose; frontal callosity oblong, reaching from the lowest ocellus nearly to the antennae, polished brownish-black; face on each side of the center with a polished brown spot; palpi yellow, covered with black hairs, proboscis brown, projecting nearly half its length beyond the oral margin; antennae yellow, the annulate portion of the third joint brown, becoming black at the apex, hairs of first two antennal joints and of the front black. Thorax on the upper side yellow, marked with three brown, gray pruinose vittae, the outer ones interrupted at the suture, each one-half as wide as the median, none of them reaching the posterior end of the mesonotum; pleura brown, marked with yellow, scutellum and metanotum yellow. Abdomen yellow, its hairs yellow and black. Legs yellow, apices of tarsi brown. Halteres yellow, the knobs brown. Wings hyaline, the costal margin and apex slightly yellowish, costal cell brown, the stigma yellow.

Length, 12 mm. Three specimens (No. 769).

Type.—No. 3972, U.S.N.M.

TABANUS CHRYSURUS Loew.

Tabanus chrysurus LOEW, Wiener Ent. Monatsch., March, 1858, p. 103.

Seven females (No. 718). The original specimens likewise came from Japan.

TABANUS TRIGONUS, new species.

Male and female: Head black, yellowish-gray pruinose, above the antennae white pruinose; front of female tapering anteriorly, at the narrowest point slightly narrower than the width of the first antennal joint at its base, the callosity polished black, lanceolate, the slender upper portion extending slightly over halfway to the occiput, no trace of an ocellar tubercle; antennae yellow, the first two joints brownish yellow and covered with black hairs, the annulate portion of the third brownish black, the tooth of this joint very large; palpi yellow, covered with black hairs, proboscis brownish black, hairs of occiput and on under side of head pale yellowish; eyes bare, the upper facets in the male very much larger than the lower ones. Thorax, pleura, and scutellum black, grayish pruinose, the short, sparse hairs yellow and black, humeri yellow. Abdomen on the first segment black, opaque, gray pruinose, the hind margin yellow; remaining segments polished, yellowish brown in the female, reddish yellow in the male, darkest toward the apex of the abdomen, segments 2 to 6 each bearing an opaque, light gray pruinose triangle in the middle, the bases of the triangles resting on the posterior margins of the segments, the posterior and lateral margins of these segments yellowish-gray pruinose and covered with yellow

hairs, as are also the gray triangles, hairs on the brown portion of the abdomen black; venter yellowish brown, the hind margins of the segments yellow. Legs black, the tibiae, with the exception of the apices of the front ones, yellow. Halteres yellowish brown. Wings yellowish gray, the centers of the cells usually hyaline, first posterior cell slightly narrowed at its apex, the anterior branch of the third vein bears a long appendage near the base, veins brown, stigma yellow; upper calypteres white, the lower ones yellowish brown.

Length, 22 to 28 mm. Eight males (No. 720) and ten females (Nos. 719 and 722).

Type.—No. 3973, U.S.N.M.

TABANUS TRIGEMINUS, new species.

Female: Differs from the above description of *trigonus* only as follows: Head above the antennae yellowish gray pruinose, antennae on the first two joints black, the tooth of the third unusually small; hairs of the occiput, on the under side of the head and on the pleura, white. Abdomen somewhat polished, black, the narrow posterior margins of the segments yellow, first segment thinly grayish-black pruinose, the middle of the dorsum opaque, light gray pruinose; segment 2 opaque, light gray pruinose except four large spots of the black ground color in a transverse row; segments 3 to 6 opaque, light gray pruinose in the middle, on the posterior margin and on the sides, the gray in the middle forming a triangle on each segment, and on the third usually expanded each side in the form of a small subdorsal triangle, the hairs of the gray portions light yellow; venter black, wholly light gray pruinose or brown pruinose in the middle, the sides broadly light gray pruinose. Legs black, the tibiae, except the apices, yellowish white. Halteres brown, the knobs yellow. Wings hyaline, the stigma yellowish, first posterior cell narrower or only slightly broader at the apex than at the base, anterior branch of the third vein not appendiculate. Length, 17 to 18 mm. Six specimens (No. 721).

Type.—No. 3974, U.S.N.M.

TABANUS TENEBROSUS, new species.

Female: Differs from *trigonus* as follows: Head above the antennae yellowish-gray pruinose, tooth of the third antennal joint very small, hairs of occiput, of under side of the head and on the pleura, white. Abdomen opaque, black, sometimes a reddish spot on sides of the second segment, wholly grayish pruinose, the median triangles, posterior and lateral margins of segments 2 to 6, a lighter gray than the remainder of the abdomen; the darker markings consist principally of pairs of spots bordering the median triangles; venter black, brownish-gray pruinose in the middle, the sides a lighter gray. Wings hyaline, stigma pale yellowish. Length, 18 to 20 mm. Four specimens (No. 721).

Type.—No. 3975, U.S.N.M.

TABANUS HUMILIS, new species.

Female: Differs from *trigonus* as follows: Head above the antennae yellow and highly polished, antennae wholly reddish-yellow, the tooth of the third joint very small, hairs of the palpi mixed white and black, those of the occiput, lower side of the head and on the pleura, white. Scutellum noticeably lighter gray than the mesonotum. Abdomen somewhat polished, black, marked with gray as in *trigonus*, the median triangles extremely small on the last two segments; venter black, light gray pruinose. Extreme apices of the middle and hind tibiae brownish-black. Wings hyaline, stigma yellow, base of anterior branch of the third vein not appendiculate, first posterior cell not narrowed at its apex. Length, 12 to 13 mm. Two specimens (No. 723).

Type.—No. 3976, U.S.N.M.

TABANUS PYRRHUS Walker.

Tabanus pyrrhus WALKER, Ins. Saund., Dipt., 1856, p. 47, pl. II, figs. 4, 5.

Four female specimens (No. 724). The species was originally described from East India.

Family ASILIDAE.

LEPTOGASTER BASILARIS, new species.

Male: Head black, whitish pruinose, the mystax and hairs of the occiput and cheeks also whitish; antennae yellowish-brown, the first two joints yellow, the third bare; proboscis black. Thorax black, the posterior angles yellow, the sides and pleura white pruinose, the hairs whitish, the bristles black; scutellum black, the margin bearing numerous white hairs. Abdomen black, sutures of segments 2 to 5 yellow, the first segment and sutures of the others light gray pruinose; hairs chiefly whitish. Front and middle femora and tibiae dark yellow, the apices brown, hind femora and tibiae brownish, the basal two-fifths white; tarsi brown, the first joint, except the apex, white. Halteres whitish, the knobs brown. Wings hyaline, a brown cloud in the subcostal cell immediately before the apex of the auxiliary vein. Length, 15 mm. A single specimen (No. 707).

Type.—No. 3977, U.S.N.M.

CYRTOPOGON PICTIPENNIS, new species.

Male and female: Black, the halteres, pulvilli, and base of tarsal claws yellow. Head, except the upper part of the occiput and the front in the female, light gray pruinose, face in profile evenly convex from antennae to oral margin, covered with mixed black and yellowish hairs, those of the palpi, antennae, front, and on the upper part of the occiput black, on the lower part of the occiput and on the cheeks principally whitish; third joint of the antennae narrow and nearly linear,

almost five times as long as the style. Thorax somewhat polished, a median line on the anterior third, the sides and a spot at each anterior angle, one behind each humeri and a third on the suture each side, gray pruinose; hairs and bristles of the metanotum black, those of the pleura mixed black and yellowish; scutellum convex, entirely covered with black hairs. Abdomen polished, the posterior margins of segments 2 to 4 in the male, 2 to 5 in the female, gray pruinose, hairs black, those on the sides of the first four segments in the male, on the sides and posterior margins of the first five segments in the female, yellowish. Hairs of legs black, except on the basal two-thirds of the underside of the middle femora and on the basal two-thirds of the hind femora, where they are yellowish, those on the middle and hind tibiae of the female mixed yellow and black; inner side of the apical two-thirds of the front tibiae and the underside of the first joint of the front tarsi densely covered with short golden-yellow hairs. Wings hyaline, a black spot at the apex and a brown cloud covering the vein and crossvein at the apex of the second basal cell, and sometimes the crossvein at the apex of the discal cell; sometimes a brownish cloud covers the small crossvein; veins brown, the third before forking with the second yellow. Length, 10 to 16 mm. Five males and three females (No. 653).

Type.—No. 3978, U.S.N.M.

DASYPOGON JAPONICA Bigot.

Dasypogon japonica BIGOT, Ann. Soc. Ent. France, 1878, p. 411.

Three males and two females (No. 654). The species was originally described from Japan.

OMMATIUS PENNUS Walker.

Ommatius pennus WALKER, List Dipt. Ins. Brit. Mus., 1849, Pt. 2, p. 469.

Three males and four females (No. 655), agreeing fairly well with the description, which was founded on specimens from Corea and Borneo.

ASILUS FLAVICORNIS Ruthe.

Asilus flavicornis RUTHE, Isis, 1831, p. 1217.

Asilus olivierii MACQUART, Dipt. Exot., 1838, I, Pt. 2, p. 136 [252].

One male and six females (No. 661), agreeing well with the descriptions by the various European authors. The species has heretofore been reported from Europe, and belongs to the subgenus *Heligmoneura*. The synonymy given above was first published by Dr. Loew.¹

¹ Linn. Ent., 1849, p. 61.

ASILUS ALBICEPS Meigen.

Asilus albiceps MEIGEN, Sys. Besch. Eur. Zweif. Ins., 1820, II, p. 312 [235].

Asilus canescens WIEDEMANN, in Meigen's Sys. Besch. Eur. Zweif. Ins., 1820, II, p. 336 [254].

Asilus albibarbus ZELLER, Isis, 1840, p. 66.

Asilus nudus LOEW, Isis, 1840, p. 548.

One male and two females (No. 660), agreeing well with the descriptions. This species was also originally described from Europe. It belongs to the subgenus *Philonicus*. The synonymy is according to Dr. Loew.¹

ASILUS ATRIPES Loew.

Asilus atripes LOEW, Neue Beitr., 1854, II, p. 15.

One male and four females (No. 660), agreeing well with the description given by Dr. Schiner.² This species belongs to the subgenus *Tolmerus*, and was also originally described from Europe.

ASILUS ANGUSTICORNIS Loew.

Asilus angusticornis LOEW, Wien Ent. Monatsch., 1858, p. 106.

Four males and six females (No. 659), agreeing well with the description, which was founded on specimens from Japan. It belongs to the subgenus *Neoitamus*.

ASILUS VIRGATIPES, new species.

Male and female: Black, the halteres, under side of the femora, tibiae except the apices of the hind ones, and the tarsi except the last four joints of the hind ones and the apices of all of the claws, yellow. Head yellow pruinose, hairs of the mystax yellow, or mixed black and yellow, those of the antennae black, of the front and on the upper part of the occiput yellow or black, those on the lower part of the occiput, cheeks, palpi, and proboscis yellow. Antennal style over twice as long as the third joint, the latter broad lanceolate. Hairs of upper side of the thorax, except on the posterior angles, black, those in front of the suture short and sparse, behind it rather long and with two rows of bristly hairs, those of each end of the pleura yellow, while the hairs of the middle are yellow, or mixed black and yellow; scutellum covered with long black or yellow hairs and bearing six or eight marginal bristles. Hairs of the abdomen yellow, those on the posterior margin of the first segment, in the middle of segments 2 to 6 except the posterior margin of each, and on the remaining portion of the abdomen except at the tip of the hypopygium and of its anterior dorsal process, sometimes black; segments after the first destitute of a row of bristles in front of the posterior

¹ Linn. Ent., 1849, p. 145.

² Fauna Aust., Dipt., 1862, I, p. 155.

margin; hypopygium horizontal, as long as the third segment of the abdomen, before the middle of its upper side bearing a rather narrow, vertical process, while beyond the middle are two pairs of shorter processes, the anterior ones each bearing a short tooth near the middle of the front side, and above it is a deep concavity; the lower portion of the hypopygium consists of a broad hook, which does not reach the middle of the upper portion; in the female the sixth and following segments of the abdomen are compressed, apparently forming the base of the ovipositor, which is nearly as long as the four preceding segments and is destitute of a circle of spines at the tip. Hairs of the legs mixed yellow and black, front femora destitute of bristles, middle femora each bearing two near the apex, the hind ones bearing three near their apices and one or two near the middle of the front side; hind tibiae of the male each bearing a comb-like row of four bristles on the posterior side near the base, the three basal ones truncated and somewhat hooked at the tips; on the outer side of each hind tibiae are two bristles, one near the base and the other beyond the middle, in the female with six on the outer side and one or two on the posterior side; middle tibiae each bearing two bristles on the outer side; front tibiae each bearing a row of four bristles on the outer side and with two on the posterior side; front tarsi of male bearing several knobbed bristles. Wings hyaline, the portion in front of the fifth vein usually tinged with yellowish, the broad apex and posterior margin beyond the apex of the anal cell gray, the subcostal cell sometimes brown. Length, 23 to 27 mm. Four males and three females (No. 658). This species also belongs to the subgenus *Neoitamus*.

Type.—No. 3979, U.S.N.M.

ASILUS BREVISTYLUS, new species.

Male and female: Differs from the above description of *virgatipes* as follows: Femora wholly black; tarsi brown. Antennal style slightly shorter than the third antennal joint; the latter narrow, almost linear. The two rows of thoracic bristles behind the suture very stout. Scutellum covered with very short hairs, and bearing two or four marginal bristles. Abdomen, except the genitalia, opaque, gray pruinose; a row of yellow bristles in front of the posterior margin of segments 1 to 6; hypopygium destitute of the two pairs of processes beyond the middle of its upper side, the hook like lower portion reaching slightly beyond the middle of the upper part; eighth segment of the abdomen prolonged in a triangle at the apex of its under side; sixth and seventh segments in the female not forming part of the ovipositor, which is three-fourths as long as these two segments taken together. Front femora each bearing 4 or 5 stout bristles on the under side before the middle, and 1 to 3 on the posterior side beyond the middle; middle femora each bearing 8 to 10 in two rows on the under side, 2 on the front side at the first and second third of its length, and 1 to 3 on

the upper side near the tip; hind femora each bearing 6 bristles on the under side in two rows, 5 on the front side, 2 of which are in a transverse row near the tip, and 2 on the upper side before the tip; hind tibiae destitute of a comb-like row of bristles near the base, each bearing 2 bristles on its inner side beyond the middle, 2 on the posterior side before the middle, and 3 or 4 on the front side, the lowest of which is at the last third of the length of the tibia; middle and front tibiae bearing numerous irregularly arranged bristles; front tarsi destitute of knobbed bristles. Wings uniformly tinged with pale yellowish. Length, 24 to 26 mm. Two males and three females (No. 656). Belongs to the subgenus *Eutolmus*.

Type.—No. 3580, U.S.N.M.

ASILUS SCUTELLARIS, new species.

Male and female: Closely related to the preceding species (*brevistylus*), but differs as follows: Tibiae and tarsi black. Scutellum covered with long hairs and bearing 4 or 6 marginal bristles; bristles of abdomen mixed black and yellow; front femora destitute of stout bristles; a row of bristly hairs on the under side of each; middle femora with a few bristly hairs on the under side, 2 bristles on the front side, and 2 on the posterior side near the tip. Wings hyaline; middle of the marginal and first submarginal cells except their bases, also the broad apex and posterior margin of the wing beyond the middle of the axillary cell, dark gray. Length, 24 to 26 mm. Two males and one female (No. 656). Also belongs to subgenus *Eutolmus*.

Type.—No. 3981, U.S.N.M.

PROMACHUS ATER, new species.

Male and female: Black; the tibiae, except the ends, the halteres, and pulvilli, yellow. Hairs of the head light yellow, those of the antennae and of the front chiefly black, bristles of upper part of occiput black; antennal style over twice as long as the third joint, the latter broad lanceolate; face and occiput yellow pruinose, middle of upper half of the latter, and the front, gray pruinose. Hairs and bristles of thorax black, the hairs of the lateral and posterior margins largely yellow, those of the pleura pale yellow; scutellum covered with rather long yellow hairs, and bearing numerous yellow bristles. Abdomen velvety, the first segment and posterior and lateral margins of segments 2 to 6 in the male, also the posterior angles of the seventh in the female, gray pruinose; the eighth segment in the male, the seventh and eighth, except the posterior margin of the seventh, in the female, polished, steel-blue; hairs of abdomen pale yellow, many in the middle of the dorsum of segments 3 to 5 in the male, 3 to 6 in the female, and all those on 6 to 8 both dorsally and ventrally in the male, on 7 and 8 except the posterior angles of the seventh in the female, black; hypopygium of male densely covered above with long white

hairs, the under side with short black ones. Hairs of legs mixed yellow and black, those of the front and middle coxae white, the bristles chiefly black. Wings hyaline, veins brown. Length, 23 to 27 mm. Four males and four females (No. 657).

Type.—No. 3982, U.S.N.M.

LAPHRIA MITSUKURII, new species.

Male and female: Black; the pulvilli, and stems of the halteres largely yellow, bases of tarsal claws reddish. Hairs of mystax light yellow mixed with a few black ones, those of the antennae mixed reddish and black, of the front and upper part of the occiput black, on the lower part of the occiput, of the cheeks and on the proboscis, reddish yellow mixed with black, on the palpi black. Thorax polished, the hairs rather short and sparse, black, on the front end and sides mixed with reddish-yellow ones, those on the pleura chiefly black; scutellum covered with rather short black hairs, and with numerous black and yellow bristly hairs along the margin. Abdomen polished, the first three segments and base of the fourth sparsely covered with rather short black hairs; remainder of abdomen densely covered with appressed bright red hairs, those of the venter mixed black and yellow. Hairs of the legs mixed black and reddish-yellow. Wings hyaline, the veins usually bordered with brown. Length, 19 to 25 mm. Five males and three females (No. 652).

Type.—No. 3983, U.S.N.M.

This fine species is respectfully dedicated to Professor Mitsukuri, to whom this Museum is largely indebted for the very valuable series of insects of which the above specimens form a small part.

LAPHRIA DISPAR, new species.

Male and female: Black; the halteres and pulvilli yellow, base of tarsal claws reddish. Mystax black, the face above it rather densely covered with depressed silvery white hairs; hairs and bristles of the antennae, front and upper part of the occiput, chiefly black; hairs of lower part of occiput, cheeks, and proboscis, in the male white, in the female chiefly black, those of the palpi black. Thorax slightly polished, in the male covered with depressed whitish hairs interspersed with longer, suberect, black ones, in the female with wholly black ones; hairs of pleura white; the fan-like row of bristly hairs in front of the halteres in the male is black above, but changing to white below, in the female wholly black; scutellum in the male covered with depressed white hairs and bearing 10 to 12 marginal yellow bristles, in the female the hairs and bristles are black. Abdomen somewhat polished, tinged with purple; in the male the first four segments covered with depressed white hairs, the remainder with sparser black and white ones, in the female the entire abdomen except the base of the first segment sparsely covered with short, depressed, black hairs. Hairs of legs mixed black and

white, front tibiae on the inner side and front tarsi on the under side covered with very short golden-yellow hairs. Wings gray, darkest toward the apices, the base partly hyaline. Length, 15 to 19 mm. Two males and three females (No. 650).

Type.—No. 3984, U.S.N.M.

Family THEREVIDAE.

PSILOCEPHALA ALBATA, new species.

Male: Black, the apices of the femora, the tibiae except the apices, the first joint of the front tarsi and the first two joints of the others except the apex of each, yellow; hypopygium, except at base, yellowish; halteres brown, the stems largely yellow. Front and face whitish pruinose, a brown streak extends from the antennae to each eye, hairs of the front white, those of the antennae, vertex and upper part of the occiput, black, on the lower part of the occiput, cheeks and mouth parts, white; first antennal joint gray pruinose, as long as the two following joints taken together, the third lanceolate, slightly more than twice as long as wide, the style less than one-fourth as long as the third joint. Thorax gray pruinose, marked with 4 brown vittae, hairs of the center of the dorsum black, those of the margins, pleura and scutellum, white. Abdomen densely white pruinose, its hairs also white; hypopygium opaque, thinly gray pruinose. Hairs of the femora white, the bristles and those of the tibiae black. Wings hyaline, stigma yellowish-brown, fourth posterior cell open.

Female: Differs from the male as follows: Middle and hind femora, yellow. Front, yellowish gray pruinose, the lower portion gray pruinose, two brown spots just below the middle, contiguous to the eyes; hairs of the front black. Abdomen opaque, brown pruinose, the first segment and posterior and lateral margins of the others, gray pruinose, most extended on the posterior part of the abdomen; genitalia polished, black. Length, 9 to 13 mm. Four males and two females (No. 694).

Type.—No. 3985, U.S.N.M.

Family BOMBYLIIDAE.

HYPERALONIA TANTALUS Fabricius.

Anthrax tantalus FABRICIUS, Ent. Sys., 1791, IV, p. 260.

Seven specimens (No. 644). This species has heretofore been reported from Tranquebar, Hindoostan; Java; Celebes; Borneo; Sula; and Shanghai, China.

HYPERALONIA FLAVOFASCIATA Macquart.

Exoprosopa flavofasciata MACQUART, Dipt. Exot., 1855, Supp. V, p. 90.

Six specimens (No. 642). Macquart's specimens were from north China.

HYPERALONIA SIMILIS, new species.

Black, the apex of the scutellum brownish-black. Hairs of front, antennae and face black, lower part of front and whole of face sparsely covered with depressed yellow scales, third joint of antennae elongate-conical on the basal half, the remainder nearly linear, style two-thirds as long at the third joint; proboscis not projecting beyond the oral margin. Thorax opaque, the middle of the dorsum covered with depressed black scales which in some lights have a pearly reflection, intermixed with a few black hairs, in front of the scutellum, on the posterior angles, sides, front end and pleura with golden-yellow hairs; scutellum covered with black scales mixed with a few black hairs, the margin bearing black bristles and a few golden-yellow hairs. Abdomen on the sides bearing a fringe of hairs which on the first segment and anterior angles of the second is chiefly golden-yellow, on the third partly white, the remainder black; dorsum of abdomen densely covered with depressed black scales, except a crossband of golden-yellow ones occupying the whole of the third segment and the posterior half of the second, on the latter broadly interrupted, on the third subinterrupted, with black scales in the middle, the seventh segment bearing an interrupted crossband of depressed white scales. Wings dark brown, with a purplish reflection, the apex from the tip of the first vein to that of the fifth, grayish hyaline. Hairs and bristles of legs chiefly black. Length, 13 mm. Two specimens (No. 643).

Type.—No. 3986, U.S.N.M.

SPOGOSTYLUM DISTIGMA Wiedemann.

Anthrax distigma WIEDEMANN, Aus. Zweif. Ins., 1828, I, p. 309.

Two specimens (No. 649). This species was originally described from Java, and has been reported from Nankauri, one of the Nicobar Islands; from north Bengal, Hindoostan; Borneo, Sumatra, Celebes, Philippine Islands, and several other islands of Malaysia.

ANTHRAX LIMBATA, new species.

Black, the halteres yellow. Hairs of front black, the scales sparse, depressed, pale yellow, scales of the face and cheeks dense and white, hairs of antennae mixed black and yellowish; third joint of antennae conical on its basal fourth, the remainder nearly linear; proboscis not projecting beyond the oral margin. Thorax covered with depressed black scales, those in front of the scutellum yellow, hairs of the sides, front end and pleura also yellow; scutellum covered on the upper side with depressed black scales, the margin with yellow scales and black bristles. Abdomen on the first segment, base of the second and sides of the first four covered with rather long yellow hairs, sides of the fifth and sixth with black ones; dorsum covered with depressed black

scales, the anterior angles of the second segment, a crossband on the bases of the third and fourth, and on the apices of the fifth and sixth segments, covered with yellow scales. Wings hyaline, costal and subcostal cells brown, first basal cell largely smoky, the scales and bristles along the front edges of the wings black. Claws of front tarsi very small. Length, 13 mm. A single specimen (No. 645).

Type.—No. 3987, U.S.N.M.

BOMBYLIUS MAJOR Linnaeus.

Bombylius major LINNAEUS, Fauna Suec., 1761, p. 1918.

One male and six females (No. 646) agreeing in all respects with specimens from Europe and the United States.

BOMBYLIUS ATRICEPS Loew.

Bombylius atriceps LOEW, Berl. Ent. Zeitsch., 1863, p. 301.

Three males and four females (No. 647) agreeing with specimens from the United States.

ANASTOECHUS NITIDULUS Fabricius.

Bombylius nitidulus FABRICIUS, Entom. Sys., 1794, IV, p. 409.

Bombylius diadema MEIGEN, Klass. Besch. Eur. Zweif. Ins., 1804, p. 182.

Bombylius candatus MEIGEN, Klass. Besch. Eur. Zweif. Ins., p. 181.

Anastoechus barbatus OSTEN SACKEN, Bull. U. S. Geol. Sur., April 30, 1877, III, No. 2, p. 252.

Two males and six females (No. 648) agreeing in all respects with specimens from Europe and the United States.

Family DOLICHOPODIDAE.

RHAPHIUM DISPAR, new species.

Male: Head green, the face densely, the front thinly, white pruinose, bristles of vertex and upper part of the occiput black, hairs of lower part of occiput yellowish-white; antennae black, the third joint elongate-oval, twice as long as broad, the terminal style longer than the remainder of the antennae. Thorax bluish-green, thinly white pruinose, the hairs and bristles black, hairs of sides of prothorax and of the front calypteres whitish; scutellum green. Abdomen green, the suture of the first and second segments black, segments three to six and the posterior half of the second densely whitish pruinose, in certain lights concealing the ground color; hairs on sides of first three segments light yellow, other hairs and bristles black; hypopygium projecting less than the length of the sixth abdominal segment beyond the latter, the two filiform processes yellow, projecting forward on the under side of the body and reaching the posterior portion of the third ventral segment. Legs yellow, coxae blackish-brown, white pruinose,

front femora largely, apices of the posterior ones, and the hind tarsi, brown; first joint of front tarsi bearing a fringe of very short black bristles on the upper side, extending from near the base to beyond the middle, second joint noticeably dilated. Wings hyaline, last section of fourth vein gently sinuate, apex of first posterior cell slightly wider than half the length of the hind crossvein. Halteres yellow.

Female: Same as the male with these exceptions: Third joint of antennae oval, only slightly longer than broad. Abdomen not white pruinose, genitalia concealed. Front coxae and front femora wholly yellow; front tarsi destitute of a fringe of black bristles, none of the joints dilated.

Length, 4 to 5 mm. One specimen of each sex (No. 747).

Type.—No. 3988, U.S.N.M.

DOLICHOPUS NITIDUS Fallen.

Dolichopus nitidus FALLÉN, Dipt. Suec., Dolich., 1823, p. 12.

Two female specimens (No. 747) agreeing well with the descriptions of this European species, but the absence of a male specimen throws a certain degree of doubt upon the correctness of this identification.

Family SYRPHIDAE.

MICRODON AURICOMUS, new species.

Male and female: Head greenish-blue, its hairs yellowish-white, those of the front black; antennae brownish-black, apex of second joint and the arista brownish-yellow, the first joint as long as the second and third taken together. Body very robust, green, middle of mesonotum sometimes marked with three purple vittae, each bordered with brassy; hairs of body yellow, usually a few in center of mesonotum, and on the bases of the second and third abdominal segments, black. Legs brownish-black, hairs of femora, of inner side of tibiae, and of the tarsi, chiefly black, those on remainder of tibiae, yellow. Wings hyaline, veins beyond base of discal cell sometimes bordered with brown. Halteres yellow.

Length, 12 to 16 mm. Two males and one female (No. 708).

Type.—No. 3989, U.S.N.M.

PARAGUS FASCIATUS, new species.

Male: Head black, the frontal triangle and the face light yellow, vertical triangle polished, the portion in front of the lowest ocellus opaque, yellowish-gray pruinose; antennae brownish-black, the arista and lower portion of the third joint except at its apex broadly brownish-yellow, the third joint sublanceolate, nearly twice as long as the first two taken together. Thorax polished, greenish-black, its hairs yellow, two gray pruinose vittae on its anterior end; middle of pleura

densely covered with appressed white hairs; scutellum greenish-black, its apex broadly light yellow. Abdomen on the first segment black, in the middle marked with a light yellow fascia widely separated from the lateral margin; remainder of abdomen yellow, a black fascia on the second segment behind the middle, extending to the posterior angles but not reaching the lateral margins; middle and posterior margins of the third segment and the whole of the fourth brownish-yellow. Legs yellow, middle of the posterior femora and tibiae, black. Wings hyaline, the stigma pale gray. Halteres yellow.

Female: Differs from the male as follows: Front polished, greenish-black, the sides opaque, gray pruinose, a black vitta in middle of face (antennae wanting in the single specimen under examination). Abdomen with a black fascia on the posterior margin of the third segment, produced forward in the middle where it crosses the segment, that on the second segment occupying more than its posterior half. Hind legs destitute of black bands.

Length, 6 mm. One specimen of each sex (No. 725).

Type.—No. 3990, U.S.N.M.

MELANOSTOMA MELLINA Linnaeus.

Musca mellina LINNAEUS, Fauna Suec., 1761, p. 1821.

Six males and seven females (No. 678) agreeing in all respects with specimens from the United States.

SYRPHUS SERARIUS Wiedemann.

Syrphus serarius WIEDEMANN, Aus. Zweif. Ins., 1830, I, p. 128.

Three males and two females (No. 672) agreeing well with the description, which was founded on specimens from China.

SYRPHUS RIBESII Linnaeus.

Musca ribesii LINNAEUS, Fauna Suec., 1761, p. 1816.

Two males (No. 674) agreeing in all respects with specimens from the United States.

SYRPHUS ARCUATUS Fallen.

Scaeva arcuata FALLEN, Dipt. Suec., 1816, p. 42.

Seven males (No. 674) agreeing in all respects with specimens from the United States. It has previously been reported from Japan by Motschulsky.¹

SYRPHUS COROLLAE Fabricius.

Syrphus corollae FABRICIUS, Ent. Syst., 1794, IV, p. 306.

A female specimen (No. 674) which agrees very well with specimens from Europe.

¹ Bull. Soc. Imp. Nat. Moscou, 1866, Pt. 1, p. 183.

SYRPHUS BALTEATUS De Geer.

Musca balteata DE GEER, Mém. Serv. Hist. Ins., 1776, VI, p. 116.

Musca alternata SCHRANK, Enum. Ins. Aust. Indig., 1781, p. 448.

Scaeva nectarea FABRICIUS, Mant. Ins., 1787, II, p. 331.

Syrphus nectarinus WIEDEMANN, Aus. Zweif. Ins., 1830, II, p. 128.

Five males and five females (No. 675), which are indistinguishable from European specimens in the U. S. National Museum. Of the synonymy given above the first two were first published by Meigen, the third is by the writer. Wiedemann's specimens were collected in China.

SYRPHUS LATUS, new species.

Female: Occiput and upper part of the front black, the lower part of the front, antennae, face, and cheeks yellow; front projecting forward as far as the facial tubercle, except on the vertex densely yellowish-gray pruinose, its short hairs and those of the antennae black, remaining hairs of the head pale yellow; eyes densely hairy, proboscis brown, very robust; third joint of antennae oval, viewed from the inner side slightly longer than the first two taken together, the latter subequal in length; arista bare. Thorax olive-green, somewhat polished, marked with three black vittae, the sides and scutellum yellow; hairs of thorax and of base of scutellum pale yellow, those at apex of scutellum black. Abdomen subopaque, black, the first segment, anterior two-thirds of the second except on the posterior two-thirds of the lateral margins, also an arcuate fascia in front of the middle of the third, fourth, and fifth segments, yellow, the lateral margins of the abdomen black or brown; hind margins of the second and following segments yellowish-brown, of the fifth yellow; second segment marked in front of the middle with two arcuate lines which unite in the middle of the dorsum and are prolonged to the black on the posterior margin; hairs of abdomen concolorous with the ground color. Legs yellow, hind tarsi largely brown. Wings hyaline, strongly tinged with yellow, most distinct in the costal cell; stigma pale yellow. Halteres, yellow. Length, 16 mm. Two females (No. 680). A broad, robust species resembling *Didea fasciata*.

Type.—No. 3991, U.S.N.M.

SYRPHUS PORCINUS, new species.

Male and female: Of the same form as *latus*, but differing as follows: Front wholly black, on its lower end marked with a polished black spot; facial tubercle projecting much farther forward than the front, hairs of face chiefly black, eyes bare, proboscis slender, third joint of antennae slightly shorter than the first two, its upper edge and the arista brown. Thorax not marked with black vittae. Abdomen of male somewhat polished, yellow, a median vitta and the middle of the hind margin of the first two segments, also the hind margins of the

third and fourth, black; hairs of abdomen beyond the black hind margin of the second segment chiefly black (abdomen of female wanting in the single specimen under examination). Tarsi brown at the apices. Length, 16 mm. A specimen of each sex (No. 679).

Type.—No. 3992, U.S.N.M.

SYRPHUS LAUTUS, new species.

Male and female: Head black, the front, except the vertex, also the antennae, face, and cheeks, yellow; in the female the middle of the front is brown, prolonged as a narrow line to the insertion of the antennae; hairs of front, antennae, and upper part of the face black, those on remainder of face, cheeks, and occiput yellow; eyes densely hairy. Thorax greenish-black, marked with three velvet black vittae, the spaces between them anteriorly gray pruinose, the lateral margins and a spot on the pleura in front of the wings yellowish-gray pruinose; hairs of thorax mixed black and yellow, those at the humeral angles chiefly yellow; scutellum polished, bluish, its hairs black. Abdomen opaque, velvet-black, the first segment and both ends of the second polished bluish, third and fourth segments each marked on the anterior portion with an arcuate yellow fascia, the posterior portion of the fourth segment and the whole of the fifth polished yellow; hairs of the first three segments and base and sides of the fourth black, hairs of remainder of abdomen yellow. Legs yellow, the coxae and bases of the femora black. Wings strongly tinged with yellow, calypteres blackish. Halteres yellow. Length, 17 mm. Two males and two females (No. 669).

Type.—No. 3993, U.S.N.M.

DIDEA FASCIATA Macquart.

Didea fasciata MACQUART, Hist. Nat. Ins., Dipt., 1834, I, p. 508.

Enica foersteri MEIGEN, Syst. Besch. Eur. Zweif. Ins., 1838, VII, p. 140.

A specimen of each sex (No. 681), agreeing well with the descriptions of this European species. The synonymy has already been published by Dr. Schiner.¹

SPHAEROPHORIA CYLINDRICA Say.

Syrphus cylindricus SAY, Amer. Ent., 1824, I, p. 22.

Sphaerophoria contigua MACQUART, Dipt. Exot., 1846, Supp. II, p. 62.

Eleven males and four females (No. 677), agreeing in all respects with specimens from the United States. The synonymy is by Osten Sacken.²

SPHAEROPHORIA TAENIATA Meigen.

Syrphus taeniatus MEIGEN, Syst. Besch. Eur. Zweif. Ins., 1822, III, p. 325.

Seven males and five females (No. 676), agreeing well with the descriptions of this European species. It has already been reported from Japan by Motschulsky.³

¹ Fauna Aus., Dipt., 1862, I, p. 314.

² Catal. Dipt. N. Am., 1878, p. 126.

³ Bull. Soc. Imp. Nat. Moscou, 1866, Pt. 1, p. 183: *Melithriptus*.

BACCHA MACULATA Walker.

Baccha maculata WALKER, Ins. Saund., Dipt., 1856, p. 223.

Six males and three females (No. 706), agreeing with the description, founded on a specimen from the East Indies.

VOLUCELLA JAPONICA Bigot.

Volucella japonica BIGOT, Ann. Soc. Ent. France, 1875, p. 473.

Three specimens (No. 668). The original specimens also came from Japan.

VOLUCELLA NIGRICANS, new species.

Male and female: Head black, the lower part of the front, antennae, and face, yellow, polished, except the upper margin of the face, which is yellowish pruinose; hairs of occiput and underside of the head mixed yellow and black, those of the face yellow, of the front black, except those of the anterior portion in the female, which are yellow; eyes of male hairy, those of the female bare. Thorax polished, black, the humeral angles reddish-yellow, gray pruinose; hairs of thorax black; scutellum polished, black, its hairs and the marginal bristles also black. Abdomen black, somewhat scabrous, the first and fourth segments in the male, the first and fifth in the female, highly polished, the base of the second sometimes polished; hairs concolorous with the abdomen. Legs black, the hairs also black, the pulvilli yellow. Wings hyaline, the base to the proximal end of the discal cell, and extending from the costa to the last vein, yellow, beyond this a broad, irregular brown fascia extending nearly across the wing, veins beyond this, except the proximal portion of the first three, bordered with brown, a yellow costal spot beyond the brown fascia, and between this spot and the tip of the wing the brown border to the veins is enlarged and forms a large brown spot; front calypteres yellowish, the hind ones brown, all of them fringed with golden-yellow hairs. Halteres brown, the knobs light yellow. Length, 18 to 22 mm. Seven males and three females (No. 667). A broad, robust species, belonging to the same group as the preceding.

Type.—No. 3994, U.S.N.M.

MEGASPIS ZONALIS Fabricius.

Syrphus zonalis FABRICIUS, Ent. Syst., 1794, IV, p. 294.

Three males and five females (No. 665). The species has heretofore been reported only from China.

MEGASPIS CINGULATUS Vollenhoven.

Megaspis cingulatus VOLLENHOVEN, Versl. Med. Kon. Akad. Wet. Afd. Natwuk., 1863, XV.

Four males and four females (No. 666). The description was founded on specimens collected in Japan.

ERISTALIS TENAX Linnaeus.

Musca tenax LINNAEUS, Fauna Suec., 1761, p. 1799.

Five males and three females (No. 664). A European species which also occurs in the United States. It was previously recorded from Japan by Dr. Loew.¹

ERISTALIS INCISURALIS Loew.

Eristalis incisuralis LOEW, Wiener Ent. Monatsch., 1858, p. 108.

Four males and three females (No. 662). The species was originally described from Japan.

ERISTALIS OCULARIUS, new species.

Male and female: Head black, the vertex, a large space at base of antennae, and the facial tubercle highly polished, face elsewhere opaque, yellowish-gray pruinose, the cheeks thinly gray pruinose; in the male, an opaque brownish pruinose spot below the lowest ocellus, and the lower triangle opaque, yellowish-gray pruinose next the eyes; in the female, an opaque, velvet-black fascia near the middle, bordered below with a yellowish-gray pruinose spot which extends along the eyes to the face; hairs of front and of upper part of occiput black, remaining hairs of occiput, of face and cheeks, whitish; antennae brown, the under margin of the third joint yellow, the arista very short pubescent; eyes yellowish, thickly marked with purple dots and larger spots, and thinly covered with hairs. Thorax polished black, the lateral margins and pleura opaque, gray pruinose, mesonotum of female marked with five gray pruinose vittae; the sparse hairs of mesonotum chiefly yellow, those of the pleura whitish; scutellum polished black, its hairs mixed black and yellow. Abdomen of male opaque, velvet-black, the sides and posterior margin of the first segment, a lateral spot and the middle of the posterior margin of each of the three following, polished, leaden-gray, most extended on the fourth; abdomen of female similar except that the lateral spots are gray pruinose, those on the third and fourth segments united, forming a crossband which is emarginate in the middle of its posterior side, fifth segment wholly polished; hairs of abdomen short and sparse, those of middle of dorsum mixed black and yellow, the others chiefly yellow. Legs black, extreme apices of femora, basal third of the tibiae, first two joints of the front and middle tarsi, and the first joint of the hind ones, yellow. Wings hyaline, stigma yellowish, a small black spot at its base. Halteres yellow. Length, 11 to 13 mm. Three males and seven females (No. 670).

Type.—No. 3995, U.S.N.M.

¹ Wiener Ent. Monatsch., 1858, p. 108.

ERISTALIS VIRIDIS, new species.

Male and female: Head polished green, the sides of the front, the entire face except the tubercle, also the occiput and cheeks next the eyes, opaque, whitish pruinose; hairs of the head yellow or whitish, those of the vertex chiefly black; antennae yellow, the arista bare; eyes bare, not distinctly spotted. Thorax polished green, marked with four velvet-black vittae, the outer ones interrupted at the suture; posterior margin of thorax also velvet-black, pleura thinly gray pruinose; hairs of thorax short and rather sparse, yellow; scutellum polished green, its base opaque, velvet-black, the hairs yellow. Abdomen polished green, second segment marked with an H-shaped velvet-black spot placed transversely; the third with a velvet-black fascia behind the middle, emarginate in the middle of its posterior side and prolonged anteriorly in the middle to the front end of this segment; fourth segment with a velvet-black dot in front of its center; hairs of abdomen rather sparse and short, yellow. Legs black, apices of femora and broad bases of tibiae, yellow, first joint of front and middle tarsi reddish brown. Wings hyaline, stigma gray, a small spot at its base, yellow. Halteres yellow. Length, 9 to 12 mm. A specimen of each sex (No. 671).

Type.—No. 3996, U.S.N.M.

HELOPHILUS VIRGATUS, new species.

Male and female: Head polished black, the vertex opaque, brown pruinose, the occiput, sides of the face and in the male the entire front except a triangular spot above the antennae, in the female only its sides, opaque, yellowish-gray pruinose; hairs of the head yellow, in the male those of the vertex, in the female those of the entire front, black; antennae brown, partly or largely yellow, the arista yellow, bare; eyes bare. Thorax opaque, velvet-black, two vittae and the lateral margins yellow pruinose, pleura thinly gray pruinose, hairs of thorax short but rather dense, yellow; scutellum polished yellow, its hairs also yellow. Abdomen black, the sides of the first segment and a spot on each side of the second, usually yellow; the first segment and a fascia in front of the middle of the others, gray pruinose, that on the fifth segment in the female interrupted in the middle, bordered in front and behind with velvet-black, the posterior and lateral margins of each of these segments polished bluish-black; hairs short, sparse, black and yellow. Legs black, apices of the front and middle femora, basal two-thirds of the front tibiae, the entire middle tibiae and the first two joints of their tarsi, yellow; posterior femora greatly thickened, their tibiae strongly arcuate. Wings hyaline, the stigma brown. Halteres yellow. Length, 14 to 17 mm. Four males and five females (No. 663).

Type.—No. 3997. U.S.N.M.

XYLOTA LONGA, new species.

Male: Head polished, black, the lower angles of the front, the face, and the sides of the occiput next the eyes gray pruinose; antennae black, the arista reddish-brown. Thorax and scutellum polished, black, a gray pruinose spot at inner side of each humerus, hairs chiefly black. Abdomen narrower than the thorax, polished, black, a triangular opaque black spot on the second and third segments extending the entire length of each in the middle of the dorsum; hairs chiefly yellow. Legs black, hind femora greatly thickened, bearing many short spines on the apical portion of its under side, coxae not spined, hind tibiae strongly arcuate, prolonged into a large tooth at the apex of the inner side. Wings hyaline, the apex beyond the base of the submarginal cell strongly tinged with brown, apex of subcostal cell dark brown. Halteres yellow, the bases of the stems brown. Length, 18 mm. Three specimens (No. 688).

Type.—No. 3998, U.S.N.M.

XYLOTA CUPRINA, new species.

Male: Head black, vertical triangle polished, steel-blue, the face, lower angles of the front, and the occiput gray pruinose; antennae black, the third joint and the arista yellowish brown. Thorax and scutellum green, with a strong coppery tinge, a gray pruinose spot at the inner side of each humerus, middle of pleura gray pruinose, hairs of thorax chiefly yellow. Abdomen opaque, black, the first segment, sides of the next two, and the whole of the fourth, except a spot in the middle at the base, polished, bronze-green. Legs black, the apices of the front and middle femora, broad bases of the tibiae, apices of the front and middle tibiae, and the front and middle tarsi, except the last two joints, yellow. Wings hyaline, apex of the subcostal cell yellow. Halteres yellow. Length, 10 mm. Two specimens (No. 689).

Type.—No. 3999, U.S.N.M.

CHRYSOCHLAMYS CUPREA Scopoli.

Conops cuprea SCOPOLI, Entom. Carn., 1763, p. 355.

A male specimen (No. 682) agreeing well with Schiner's description of this European species.

CHRYSOCHLAMYS NIGRIFRONS Egger.

Chrysochlamys nigrifrons EGGER, Verh. Zool. Botan. Gesell., 1860, p. 661.

A male specimen (No. 682) which agrees well with the descriptions. This species was also originally described from Europe.

SPILOMYIA SALTUUM Fabricius.

Syrphus saltuum FABRICIUS, Ent. Syst., 1794, IV, p. 287.

A female specimen (No. 710) agreeing very well with Schiner's description. Also a European species.

MILESIA UNDULATA Vollenhoven.

Milesia undulata VOLLENHOVEN, Versl. Med. Kon. Akad. Wet. Afd. Natuurk., 1863, XV, p. 12.

Five males and four females (No. 685). This species was originally described from Japan.

Family CONOPIDAE.

CONOPS NIPONENSIS Vollenhoven.

Conops niponensis VOLLENHOVEN, Versl. Med. Kon. Akad. Wet. Afd. Natuurk., 1863, XV, p. 10.

Two male specimens (No. 715). Originally described from Japan.

CONOPS CURTULUS, new species.

Male: Occiput black, nearly the lower half and the upper portion in the middle yellow, narrowly gray pruinose next the eyes below the emarginations in the latter; vertex yellow, remainder of front yellowish brown, sometimes a brown spot in the center and another at base of antennae; face and cheeks yellow, opaque, yellow pruinose except on the antennal process, sides of face and fore part of cheeks with several brown punctures; antennae black, the third joint reddish brown, first joint slightly more than one-half as long as the second, slightly shorter than the third, first two joints of the style subequal in length, the first slightly broader than long, the second nearly twice as wide as the first and nearly twice as wide as long, the third lanceolate, almost three times as long as the first two taken together; proboscis black, below the middle yellowish, about one and one-half times as long as height of head. Thorax brownish black, the humeri yellow, the pleura and metanotum thinly gray pruinose; scutellum brownish black, the margin usually narrowly yellowish. Abdomen black, the posterior margin of each segment except the first yellowish, the posterior half of the sixth and nearly all of the portion beyond it yellow; first segment, a fascia on the posterior margin of the second to fourth, and the remainder of the abdomen beyond the latter gray pruinose; second segment only slightly longer than wide, not longer than the third. Wings grayish hyaline, the portion in front of the third vein and a border to the fifth, pale yellowish brown, the outline of this color indistinct; first vein from its base to the humeral crossvein brown, veins elsewhere yellow, changing into brown at their apices. Halteres yellow. Legs blackish, femora

brown, their broad apices and the whole of the tibiae reddish yellow, pulvilli and claws yellow, apices of the latter black. Length, 10 to 11 mm. Two specimens (No. 714).

Type.—No. 4000, U.S.N.M.

CONOPS OPIMUS, new species.

Male: Differs from the above description of *curtulus* only as follows: Occiput black, except the middle of the upper portion, the gray pruinosity extending across it above the center; face and cheeks destitute of brown punctures; antennae reddish brown, the first joint yellow, second joint of the style only slightly wider than the first; proboscis wholly black. Posterior angles of the thorax and the scutellum, except its extreme base, yellow. Broad apices of wings pale yellowish brown. Length, 12 mm. A single specimen (No. 713).

Type.—No. 4001, U.S.N.M.

PHYSOCEPHALA RUFIPES Fabricius.

Conops rufipes FABRICIUS, Species Insect., 1781, II, p. 466.

A male specimen (No. 712) agreeing well with specimens from Europe.

MYOPA BUCCATA Linnaeus.

Conops buccata LINNAEUS, Fauna Suec., 1761, p. 1006.

A male specimen (No. 711) agreeing with European specimens.

MYOPA TESTACEA Linnaeus.

Conops testacea LINNAEUS, System. Nat., 1766, XII, p. 1006.

A male specimen (No. 711) agreeing well with European specimens in the U. S. National Museum.

Family TACHINIDAE.

SERVILLIA JAKOVLEWII Portchinsky.

Echinomyia jakovlewii PORTCHINSKY, Horae Soc. Ent. Ross., 1882, p. 7.

Two male specimens (No. 735). This species was originally described from eastern Siberia.

SERVILLIA LUTEOLA, new species.

Female: Head opaque, densely yellowish pruinose except the frontal vitta; ocellar bristles stout, directed forward, two pairs of orbital bristles, frontal bristles in single rows, extending to basal fourth of the second antennal joint, bristly hairs of front black, the finer hairs and those of the face, cheeks, and occiput pale yellow; antennae reaching slightly below lowest third of the face, yellow, the third joint black, three-fourths as long as the second, widening to the tip, which is sub-

truncated; arista black, thickened on its basal two-thirds, the first joint almost as long as broad, the second three times as long as broad; palpi slender, linear, yellow, proboscis black. Thorax black, opaque, densely brownish-yellow pruinose, marked with four indistinct black vittae, thickly covered with short, pale yellow hairs, four pairs of postsutural dorso-central macrochaetae and three sternopleural ones; scutellum yellow, opaque, brownish-yellow pruinose, covered with short, yellow hairs and, except at the base, with black macrochaeta, the margin bearing three pairs of longer ones. Abdomen yellow, subopaque, brownish-yellow pruinose, thickly covered with short, pale yellow hairs, the first segment, except the posterior angles, and the middle of the second black, the hairs on the black portions, and for a short distance outside of them, also black; first segment bearing six marginal macrochaetae near the middle of the dorsum, the second and third each with a marginal row, the fourth with a discal and a marginal row. Femora black, apices, tibiae, and bases of tarsi yellow, apices of tarsi brown, tarsi not dilated. Wings grayish-hyaline, the costal margin and border to the veins pale yellowish, the third vein bearing five bristles near its base, elsewhere the veins are bare. Calypteres yellowish-white.

Length, 20 mm. A single specimen (No. 736).

Type.—No. 4002, U.S.N.M.

SERVILLIA POLITULA, new species.

Male: Head black, opaque, sides of front brownish pruinose, no orbital bristles, frontals in two irregular rows, extending to base of second antennal joint, ocellar bristles slender, hairs of front, sides of face, upper part of cheeks, and on the occiput next the eyes chiefly black; face, cheeks, and occiput yellowish-gray pruinose; antennae reaching slightly below lowest fourth of the face, black, the third joint almost as long as the second, widening toward the tip, which is broadly rounded; arista thickened on the basal two-thirds, the first joint noticeably longer than broad, the second nearly three times as long as wide; palpi slender, linear, yellow, the proboscis black. Thorax black, slightly polished, very thinly gray pruinose, thickly covered with rather long black hairs, on the lower part of the pleura with pale yellow ones; four pairs of postsutural dorso-central macrochaetae and three sternopleural ones; scutellum polished, brown, thickly covered with rather long black hairs, which on the posterior portion are intermixed with macrochaetae, the margin bearing four pairs. Abdomen highly polished, reddish-yellow, the first segment, except its posterior angles, a broad dorsal vitta on the second and third, and the whole of the fourth, black; hairs of abdomen rather dense, becoming longer toward the apex, those on the first two segments black, on the posterior angles of the second and on the third and fourth bright yellow, intermixed with several black ones at the apex of the fourth, those of the venter chiefly black; first segment bearing eight marginal macrochaetae near

the middle of the dorsum, the second and third each with a marginal row, the fourth bearing scattered ones on its posterior half. Femora black, the apices, tibiae, and tarsi yellowish, front pulvilli almost as long as the last tarsal joint. Wings hyaline, the veins as far as the small crossvein, with the exception of the penultimate section of the fifth, bordered with pale yellowish, third vein bearing four bristles near its base, veins elsewhere bare. Calypteres gray.

Length, 18 mm. A single specimen (No. 738).

Type.—No. 4003, U.S.N.M.

ECHINOMYIA MICADO Kirby.

Echinomyia micado KIRBY, Ann. Mag. Nat. Hist., 1884, p. 457.

Eleven specimens (No. 737). This species was originally described from Kobe, Japan.

MERIANIA PUPARUM Fabricius.

Musca puparum FABRICIUS, Entom. Syst., 1794, IV, p. 326.

Four male specimens (No. 744), agreeing well with European specimens in the U. S. National Museum.

STURMIA ATROPIVORA Desvoidy.

Sturmia atropivora DESVOIDY, Essai Myod., 1830, p. 171.

Five males and six females (No. 730). This species was also originally described from Europe.

PARAPHANIA BEELZEBUL Wiedemann.

Tachina beelzebul WIEDEMANN, Aus. Zweif. Ins., 1830, II, p. 201.

Tachina imbrassus WALKER, List. Dipt. Ins., 1849, Pt. 4, p. 781.

Two specimens (No. 740). The species was originally described from Java, and Walker's specimens came from Hongkong, China.

HYPOSTENA SIGNIFERA, new species.

Male: Black, opaque, the pruinosity gray and black, calypteres white, wings hyaline. Front at narrowest point one-fourth as wide as either eye, the sides yellowish-gray pruinose, except on the lower part, which, with the face, cheeks, and lower part of the occiput next the eyes, is light-gray pruinose, an opaque dark brown streak near middle of each cheek; frontal bristles descending below middle of second antennal joint, no orbital bristles; antennae four-fifths as long as the face, the third joint two and one-half times as long as the second, arista thickened on its basal fifth, the penultimate joint shorter than long; proboscis less than half as long as height of head, robust, the labella very large; cheeks scarcely one-twelfth as wide as the eye height. Thorax yellowish-gray pruinose, a large spot in the middle of the front end and a broad fascia near the middle, velvet-black, the spot in front

sending five spurs from its posterior side; three pairs of postsutural dorso-central macrochaetae and three sternopleural ones; scutellum velvet-black, bearing three marginal pairs of long macrochaetae. Abdomen yellowish-gray pruinose, the first segment except the posterior margin, a large spot on the second extending nearly its entire length, and a similar spot on the third segment, velvet-black; venter largely velvet-black; first segment of abdomen bearing marginal, the second and third with discal and marginal macrochaetae, the bristly hairs long and suberect. Front pulvilli as long as the last tarsal joint. Third vein bearing one or two bristles near its base, elsewhere the veins are bare.

Length, 6 to 7 mm. Three specimens (No. 743).

Type.—No. 4004, U.S.N.M.

HYPOSTENA VITTIGERA, new species.

Male: Differs from the above description of *signifera* only as follows: Cheeks one-seventh as broad as the eye height, marked with an oblique brown streak anteriorly, in place of the vitta; third joint of antennae more than three times as long as the second. Thorax marked with five velvet-black vittae interrupted at the suture, the three middle ones united at their front ends and again behind the suture; scutellum, on nearly its apical half, gray pruinose; apex of fourth segment of abdomen polished, black, venter largely gray pruinose. Female differs from the male as follows: Front almost as wide as either eye, two pairs of orbital bristles; front pulvilli less than one half as long as the last tarsal joint. Length, 10 to 11 mm. Two males and one female (No. 742).

Type.—No. 4005, U.S.N.M.

Family DEXIIDAE.

DEXIA FLAVIPES, new species.

Male: Black, the antennae, face, cheeks, palpi, apex of proboscis, abdomen, except a dorsal vitta, femora, and tibiae, yellow; front calyp-teres white, the hind ones yellowish; wings hyaline, tinged with yellowish at the base and in the region of the costa. Front at narrowest part one-fifth as wide as either eye, the sides yellow pruinose, no orbital bristles, frontals in single rows, descending to insertion of antennae; face and cheeks pale yellow pruinose, sides of face bare, cheeks slightly more than one-third as broad as the eye height, vibrissae slightly above the level of the front margin of the oral opening; antennae two-thirds as long as the face, the third joint three times as long as the second, longest hairs of arista more than four times as long as its greatest diameter. Thorax yellowish-gray pruinose, marked with four black vittae; three pairs of postsutural dorso-central macrochaetae and two sternopleural ones; scutellum bearing three long marginal

pairs. Abdomen destitute of dorsal macrochaetae on the first segment, the others with discal and marginal. Third vein bearing three bristles at its base, veins elsewhere bare. Front tibiae slightly shorter than the first three tarsal joints, front pullvilli as long as the last tarsal joint. Length, 9 mm. A single specimen (No. 741).

Type.—No. 4006, U.S.N.M.

Family SARCOPHAGIDAE.

SARCOPHAGA PRIVIGNA Rondani.

Sarcophaga privigna RONDANI, Dipt. Ital. Prod., 1862, V, p. 109.

Nine specimens (No. 729), agreeing well with the description, which was founded on specimens from southern Europe.

SARCOPHAGA MELANURA Meigen.

Sarcophaga melanura MEIGEN, Syst. Besch. Eur. Zweif. Ins., 1826, V, p. 23.

A male specimen (No. 729), agreeing well with specimens from Europe in the U. S. National Museum.

Family MUSCIDAE.

MUSCA DOMESTICA Linnaeus.

Musca domestica LINNAEUS, Fauna Suec., 1761, p. 1833.

Thirteen specimens (No. 731) of this cosmopolitan species.

STOMOXYS CALCITRANS Linnaeus.

Stomoxys calcitrans LINNAEUS, Fauna Suec., 1761, p. 1900.

Eleven specimens (No. 733). This is also a nearly cosmopolitan species.

STOMORHINA OBSOLETA Wiedemann.

Idia obsoleta WIEDEMANN, Aus. Zweif. Ins., 1830, II, p. 355.

Two specimens (No. 673). This species was originally described from China.

GRAPHOMYIA MACULATA Scopoli.

Musca maculata SCOPOLI, Ent. Carn., 1763, p. 326.

One male and three females (No. 734), agreeing well with specimens from Europe in the U. S. National Museum.

CALLIPHORA ERYTHROCEPHALA Meigen.

Musca erythrocephala MEIGEN, Syst. Besch. Eur. Zweif. Ins., 1826, V, p. 62.

Two specimens (No. 739), agreeing well with specimens from the United States and Europe.

CALLIPHORA LATA, new species.

Male: Head black, the facial ridges and anterior part of the oral margin reddish-yellow, eyes almost contiguous, frontal vitta obliterated at the narrowest part of the front, sides of front, face, and cheeks yellowish-gray pruinose, hairs of cheeks and on the occiput next the eyes black, remaining hairs of occiput pale yellow; antennae blackish-brown, apex of second joint and base of the third largely reddish-yellow, the third three times as long as the second; arista plumose on its basal three-fourths; proboscis black, palpi yellow. Thorax and scutellum subopaque, black, thinly light gray pruinose, the macrochaetae and short hairs black, three pairs of postsutural dorso-central macrochaetae and three sternopleural ones; prothoracic spiracles yellow. Abdomen polished, dark green, thinly light gray pruinose. Legs black. Wings hyaline, slightly tinged with yellowish at the base and toward the costa; calypteres dark brown. Length, 11 to 13 mm. Nine specimens (No. 727).

Type.—No. 4007, U.S.N.M.

LUCILIA CAESAR Linnaeus.

Musca caesar LINNAEUS. Fauna Suec., 1761, p. 1828.

Somomyia japonica BIGOT, Ann. Soc. Ent. France, 1877, p. 254.

Ten specimens (No. 728). This species has previously been recorded from Japan by Dr. Loew.¹

MUSCINA ANGUSTIFRONS Loew.

Cyrtoneura angustifrons LOEW, Wiener Ent. Mon., 1858, p. 111.

Twelve specimens (No. 732). The species was originally described from Japan.

Family ANTHOMYIIDAE.

SPILOGASTER FLAVIPES, new species.

Male: Head black, gray pruinose, except the frontal vitta, which is not obliterated in any portion of its course, and does not bear a pair of macrochaetae; front at narrowest part one-sixth as wide as either eye; antennae reaching slightly below the lowest third of the face, yellow, the third joint almost twice as long as the second, arista plumose to the tip, the longest hairs more than four times as long as its greatest diameter; proboscis and palpi yellow. Thorax black, the lateral margins yellow, dorsum densely yellowish-gray pruinose, and marked with four black vittae; three pairs of postsutural dorso-central macrochaetae and three sternopleural ones; scutellum, except its extreme base, yellow, a large, yellow spot below each hind calypter. Abdomen polished, yellow, an interrupted dorsal vitta not extending beyond

¹ Wiener Ent. Mon., 1858, p. 110.

the middle of the last segment, black; first segment destitute of dorsal macrochaetae, the three following bearing discal and marginal ones. Legs, including the coxae, yellow. Wings hyaline, tinged with pale yellow at the base and toward the costa, veins bare, costal spine as long as the crossvein at base of discal cell; front calypteres white, the hind ones yellow. Length, 12 mm. A single specimen (No. 741).

Type.—No. 4008, U.S.N.M.

Family SCATOPHAGIDAE.

SCATOPHAGA STERCORARIA Linnaeus.

Musca stercoraria LINNAEUS, Fauna Suec., 1763, p. 1861.

Four specimens (No. 684) of this almost cosmopolitan species. It has previously been recorded from Japan by Dr. Loew.¹

SCATOPHAGA MELLIPES, new species.

Male: Occiput, ocellar triangle, and sides of front black, gray pruinose, frontal vitta reddish brown, next the antennae reddish yellow; face, cheeks, and lower part of occiput yellow and yellow pruinose; antennae on the first two joints and extreme base of the third yellow, remainder of the third joint black; arista pubescent, brown, the base yellow; proboscis brown, palpi yellow, its short hairs and the bristles of the under side yellow, those at the apex black. Thorax black, gray pruinose, and marked with four brown vittae, five pairs of dorso-central macrochaetae, hairs of mesonotum short, black, those of the pleura long, abundant, yellow; one sternopleural macrochaeta; scutellum black, gray pruinose, bearing four long macrochaetae. Abdomen black, olive-gray pruinose, quite thickly covered with rather long yellow hairs intermixed with a few black ones. Coxae black, gray pruinose, remainder of legs yellow, femora destitute of macrochaetae, except a pair on the posterior side of the middle ones near the tip, rather thickly covered with quite long yellow hairs, those on upper side of middle ones and toward the tips of the hind ones chiefly black, hairs of tibiae brown or black; front tibiae destitute of stout macrochaetae, the middle ones each bearing two on the anterior and three on the posterior side, the hind ones with three on the anterior and three or four on the posterior side, beside those at the apices. Wings grayish hyaline, at the base and toward the costa strongly tinged with yellow, crossveins not clouded with brown. Halteres yellow.

Female: Differs from the male as follows: Hairs of dorsum of abdomen very short and chiefly black, those of the legs also short, all femora and tibiae bearing several stout black macrochaetae. Length, 10 to 12 mm. Five males and one female (No. 684).

Type.—No. 4009, U.S.N.M.

¹ Wiener Ent. Mon., 1858, p. 112.

Family HELOMYZIDAE.

HELOMYZA RUBIDA, new species.

Male and female: Yellowish, opaque, except the front, gray pruinose, the hairs and bristles black; face and cheeks yellow pruinose, third joint of antennae orbicular, the arista brown, pubescent; no macrochaetae near the vibrissae. Thorax bearing five pairs of dorso-central macrochaetae, one sternopleural, no humeral, and none above the front coxae; pleura, besides the macrochaetae, bare. All femora bearing several macrochaetae, front and hind tibiae each bearing only a pre-apical one. Wings yellowish hyaline, the small and posterior cross-veins bordered with brown, a large brown spot at apex of second vein and a small one at apices of the third and fourth, costal bristles rather long. Length, 6 mm. Four males and two females (No. 703).

Type.—No. 4010, U.S.N.M.

Family MICROPEZIDAE.

NERIUS FEMORATUS, new species.

Male and female: Head yellowish, a large, polished, black spot back of each eye, front marked with two opaque, velvet-black vittae extending its entire length and separated by a yellow interval; a black spot between each eye and the adjacent antenna; under part of the head yellow pruinose anteriorly, the remainder white pruinose; antennae yellow, the first joint, upper edge of the second, and the upper, apical, and lower edges of the third, except on the base of the latter, brown; first joint slightly broader than long, the second prolonged on its inner side nearly to the middle of the third, the latter almost twice as long as wide; style white, the base yellow; proboscis brown, the minute palpi yellow. Dorsum of thorax brown, usually marked behind the suture with two or four yellowish vittae; two pairs of dorso-central macrochaetae; sides of thorax and the pleura yellow, white pruinose except a broad, black median vitta; one sternopleural macrochaetae, pleura otherwise destitute of macrochaetae and hairs; scutellum brown, a median yellow vitta, a subapical pair of macrochaetae and a shorter discal pair, otherwise the scutellum is bare. Abdomen brown, destitute of macrochaetae, the hairs sparse, brown and yellow; hypopygium of male exserted, hanging down, nearly cylindrical, as long as the last four abdominal segments, consisting of three joints which are successively narrower, the third spine-like; ovipositor of female polished, blackish-brown, as long as the last three abdominal segments taken together. Legs brown, the front coxae, a band on each femur beyond its middle, and the tibiae, yellow; under side of front femora of male ciliate with short spines, inner side of front tibiae and under side of first joint of the front tarsi ciliate with very short spines, other legs of

male and all legs of female bare. Wings grayish-hyaline, the veins yellowish-brown. Halteres yellow. Length, excluding the hypopygium and ovipositor, 9 mm. Three males and two females (No. 692).

Type.—No. 4011, U.S.N.M.

Family ORTALIDAE.

EUPYRGOTA, new genus.

Closely related to *Pyrgota*, but the third antennal joint is longer than the second. Front noticeably widening below, in profile only slightly projecting, the face only slightly retreating; no ocelli; antennae almost as long as the face, the first joint twice as long as broad, the second one and one-half times as long as the first, the third tapering slightly to the apex, which is broadly rounded, the upper edge concave, the lower convex, one and one-fourth times as long as the second; arista bare, inserted slightly before the middle of the third antennal joint; subantennal furrows extending to lowest fifth of the face, eyes almost twice as high as broad, palpi clavate, proboscis very thick. Abdomen of male greatly constricted at the base, consisting of five segments besides the very large hypopygium, the first segment twice as long as wide, more than twice as long as the four following segments taken together. Wings large, third and fourth veins strongly diverging toward their apices, first vein beyond the humeral crossvein thickly beset with short bristles, the others bare; posterior outer angle of the anal cell prolonged in a pointed lobe; small crossvein beyond the middle of the discal cell.

Type.—The following species:

EUPYRGOTA LUTEOLA, new species.

Male: Occiput yellowish brown, front, face, and cheeks reddish yellow; front, except next the eyes, opaque, a brown spot near each upper angle; face and cheeks polished; two black lines extend from the antennae to the lower ends of the subantennal furrows, then diverge and extend to the oral margin near the middle of its lateral portion; a black streak extends downward from each eye halfway to the oral margin; antennae reddish yellow, arista yellowish white, palpi yellow, proboscis brown. Thorax somewhat polished, yellowish white, two median brown vittae extending from the anterior end to halfway beyond the suture, and on either side of them a blackish brown vitta which begins a short distance from the front end of the thorax and extends across it, the side of the scutellum and of the metanotum, the two vittae connected with each other by a black fascia at the base of the scutellum, and on the outer side each throws off a spur which extends along the transverse suture to the insertion of the wing; pleura yellow, mottled with black, bearing one sternopleural macrochaeta and many black bristly hairs; scutellum yellow, the front corners and

extreme base blackish brown, bearing three pairs of bristles. Abdomen somewhat polished, brown, the base and front angles, also the hypopygium, yellow, the latter almost as long as the first abdominal segment. Legs yellow. Wings yellowish-hyaline; a large brown spot fills the apices of the marginal and submarginal and a large portion of the apex of the first posterior cell; second vein very undulating, bearing a stump of a vein from the underside of the last fourth of its length. Halteres yellow. Length, 16 mm. Two specimens (No. 691).

Type.—No. 4012, U.S.N.M.

RIVELLIA BASILARIS Wiedemann.

Trypeta basilaris WIEDEMANN, Ausser. Zweif. Ins., 1830, II, p. 510.

Seven specimens (No. 700). The species was originally described from Sumatra.

Family TRYPETIDAE.

TEPHRITIS PUNCTIGERA, new species.

Male: Yellow, the antennal arista, except at the base, usually one or two spots on the anterior end of the mesonotum, an interrupted fascia near the front end and usually a spot near the posterior end of the pleura, a dot behind the insertion of each wing, the middle and lower edge of the metanotum, and a transverse row of four spots on the abdominal segments 2 to 4, black, the spots on the second abdominal segment sometimes wanting; hairs and bristles yellow, scutellum bearing four bristles. Wings brown, changing into black at the apex, quite thickly covered with whitish drops, costal and subcostal cells hyaline, a small brown spot on the humeral crossvein, another midway between it and the apex of the auxiliary vein, one on the apex of the latter vein, and a fourth on apex of first vein, with rarely a fifth spot between the last two; between the apices of the first and second veins are three hyaline spots: between the apices of the second and third veins is only one, situated close to the second vein; first posterior cell containing two large and from three to six small ones, the extreme apex of this cell wholly black: the first basal cell contains one or two hyaline drops, situated in its apical half; discal cell grayish along its posterior side for three-fourths its length, the remainder contains from four to six hyaline drops; crossveins at both ends of this cell bordered with brown; small crossvein oblique, at almost twice its length from the hind one; first and third veins bristly.

Length, 7 mm. Three specimens (No. 704).

Type.—No. 4013, U.S.N.M.

TRYPETA VIBRISSATA, new species.

Male and female: Head and its members yellow, the macrochaetae and the antennal arista, except its base, black; vibrissae well developed, proboscis robust, not geniculate. Thorax light yellowish, marked

with three pairs of orange-yellow vittae, the middle pair extending from the front end to a point midway between the transverse suture and the base of the scutellum, a pair of black dots midway between their posterior ends and the base of the scutellum; second pair of vittae usually changing into black at their posterior ends, the third pair bearing a black dot at the transverse suture; two black dots back of the insertion of each wing; hairs of thorax short, yellow, the bristles black; pleura with a broad orange-yellow vitta in the middle; scutellum light yellow, a spot at each anterior angle, and the apex black, bearing four bristles; metanotum dark yellow, marked with a median black vitta. Abdomen yellow, yellowish gray pruinose, segments 2 to 6 each bearing a transverse row of four black dots, hairs and bristles chiefly black; ovipositor of female yellow, its first segment almost as long as the last four segments of the abdomen taken together. Legs and halteres light yellow. Wings hyaline, the costal margin, extending beyond the tip of the fourth vein, and three cross-bands, extending obliquely from it to the hind margin of the wing, pale yellow, the broad apex and a narrow margin of the costal border toward its apex, also a narrow border to the crossbands, except on the lower side of the first, brown or black; a black dot at the upper end of the humeral crossvein, and another at the apex of the first vein; the first yellow cross-band extends to the apex of the sixth vein, and includes all of the anal cell and the base of the discal; it incloses a large hyaline spot in the second basal cell; the second yellow cross-band includes the small crossvein and terminates slightly beyond the middle of the distance between the fifth and sixth veins; the third band includes the hind crossvein and terminates at the apex of the fifth vein; first vein bristly, the others bare, small crossvein oblique, situated slightly before the middle of the discal cell, hind crossvein noticeably oblique.

Length, excluding the ovipositor, 7 mm. Three males and one female (No. 701).

Type.—No. 4014, U.S.N.M.

Family SCIOMYZIDAE.

EGGIZONEURA FORMOSA Wiedemann.

Scatophaga formosa WIEDEMANN, Ausser. Zweif. Ins., 1830, II, p. 447.

Dryomyza maculipennis MACQUART, Dipt. Exot., 1849, Supp. IV, p. 273 [246].

Dryomyza gigas VOLLENHOVEN, Versl. Med. Akad. Wet., 1863, p. 15.

Four males and four females (No. 683). The above synonymy has already been published by Osten Sacken.¹ The species was originally described from Japan, and Macquart's specimen came from the East Indies.

¹ Wiener Ent. Zeit., 1882, p. 21.

Family SAPROMYZIDAE.

SAPROMYZA SEXPUNCTATA Meigen.

Sapromyza sexpunctata MEIGEN, Sys. Besch. Eur. Zweif. Ins., 1826, V, p. 262.

Three specimens (No. 702), agreeing well with the descriptions of this European species.

SAPROMYZA EUARESTA, new species.

Head yellow, the center of the occiput, two narrowly separated vittae on the front, two oblique vittae extending from the antennae to the occiput, crossing the cheeks, also a transverse spot above the middle of the anterior edge of the oral margin, dark brown; antennae yellow, the third joint brown in the middle, oval, only slightly longer than broad, arista brown, pubescent; palpi and middle of proboscis yellowish-brown. Thorax, including the pleura, yellowish, opaque, thinly gray pruinose, marked with irregular brown, not pruinose, spots and dots; hairs and bristles black; scutellum brown, a yellow vitta on either side of the middle, bearing four macrochaetae; metanotum brownish-yellow. Abdomen opaque, yellow, segments two to five or six each marked with a posterior brown fascia extended forward in the middle and near the sides, crossing the segments, a marginal row of macrochaetae on segments two to six. Coxae and femora brown, apices of femora and the whole of the tibiae and tarsi yellow. Wings dark brown, marked with numerous whitish-hyaline spots and drops; costal cell whitish-hyaline, crossed near the middle by a brown spot; space between apices of auxiliary and first vein wholly brown; between first and second veins with four or five whitish spots; two in extreme apices of the submarginal and first posterior cells; from four to six in the discal, the ends of this cell brown; small crossvein noticeably before the middle of the discal cell; all veins bare. Halteres yellow. Length, 3.5 mm. Three specimens (No. 705).

Type.—No. 4015, U.S.N.M.

Family AGROMYZIDAE.

CRYPTOCHAETUM GRANDICORNE Rondani.

Cryptochaetum grandicorne RONDANI, Spec. Ital. Ord. Dipt., Agrom., 1875, p. 7.

Eighteen specimens (No. 745), agreeing well with specimens from Italy in the U. S. National Museum.

Family DROSOPHILIDAE.

DROSOPHILA OBSCURA Fallen.

Drosophila obscura FALLEN, Dipt. Suec., Geomyz., 1823, p. 6.

Three specimens (No. 746), agreeing well with the descriptions of this European species.

NOTES ON THE MAMMALS OF THE CATSKILL MOUNTAINS, NEW YORK, WITH GENERAL REMARKS ON THE FAUNA AND FLORA OF THE REGION.

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These notes are based on observations covering the period between August 4 and September 14, 1896, supplemented by such information as could be obtained from the residents of the region. During this time I lived at Evelyne Villa, near Kaaterskill Junction, on the Stony Clove and Catskill Mountain Railroad. This house occupies a hillside at the base of East Kill Mountain, on the right (north) bank of Schoharie Creek, at an elevation of nearly 1,800 feet above the sea, and commands a superb view of Plateau and Hunter mountains and of the Stony Clove between them. The place is surrounded by orchards and farming lands, broken by small bits of forest and larger wooded strips along the streams, which latter are numerous, though of small size, and tributary to Schoharie Creek. This large brook, the main water course of the locality, rises about 8 miles above Evelyne Villa and 10 miles above the town of Hunter, reaching the sea through the Mohawk and Hudson rivers.

The work was of the nature of a reconnoissance rather than a systematic examination of this interesting region; and more was not attempted. The first fortnight was spent in examining the country in the vicinity of Evelyne Villa and Schoharie Creek. After that, the summits of East Kill Mountain (altitude about 3,200 feet), Plateau Mountain (altitude about 3,900 feet), and Hunter Mountain (altitude 4,025 feet) were climbed. On these expeditions I sometimes burdened myself with a shotgun, for the entertainment of my boy and the benefit of an ornithological friend, to whom we are looking for an account of the birds of the Catskill region.¹ We set out long lines of traps of various kinds

¹ Some of the most beautiful pen pictures of the bird life of the Catskills are contained in the earlier writings of John Burroughs. Mr. T. M. Trippé (American Naturalist, January, 1872, VI, pp. 47, 48,) has also furnished interesting notes on a few species, and Mr. Eugene Pintard Bicknell, in the Transactions of the Linnean Society of New York, has given an extended review of the summer birds of a part of the Catskill Mountains in the vicinity of Slide Mountain, the highest of the range (altitude 4,205 feet).

for mammals, dropping them in crevices of the rocks, beside logs, brush heaps, stone heaps, in trees and hollow stumps, and beside the water; some in runways, others in open spots, in thickets, and a few at random, until the whole neighborhood was so beset with traps that not even the house cat escaped them. Trapping was gradually extended upward from the lower levels to the slopes of the East Kill and Plateau mountains, and finally to the top of Hunter Mountain, the highest of the neighboring peaks and second only to Slide Mountain, which exceeds it in height by some 200 feet, though it is much less massive. We also trapped one night around Kaaterskill Lake.

The interior region of the Catskills surrounding Kaaterskill Junction belongs, as a whole, to the Canadian, the lowest of the Boreal faunæ, though slightly mixed with the Alleghenian in the farming lands on the banks of Schoharie Creek. There is some evidence, however, that certain mammals of the Transition and Upper Austral Zones, as the New England cottontail (*Lepus sylvaticus transitionalis*), deer mouse (*Peromyscus leucopus*), and gray fox (*Urocyon cinereoargenteus*), have but lately extended their ranges to this locality by following up the clearings.

Though again well wooded, the barest tags and remnants alone remain of the splendid primeval forests that once covered this area. All is second-growth except in the rockiest gulches, whence the lumber could not have been extricated, and about the rocky summits of a few mountains of the East Jewett ranges, including East Kill Mountain. The hills must have been early stripped of their timber, to judge from the indications of a few remaining stumps and rotten logs, nearly all of which were coniferæ. The woods are now very thoroughly mixed, deciduous trees of numerous species mingling, almost everywhere, with the evergreen coniferæ. On the mountain sides, at the present time, nothing is seen of the regular succession of altitudinal forest zones which may have existed in times past, before the timber was cut. The black spruce, balsam, hemlock, yew, and white pine are the only coniferæ seen by us in the interior valleys of the Catskills, and all grow on the banks of the Schoharie, near Kaaterskill Junction (altitude 1,700 feet). Of these only the black spruce and balsam occupy the mountain peaks. The hemlock and yew scarcely rise on the mountain slopes above 2,500 feet; the white pine is local on the creek banks, and the spruce and balsam increase in abundance from the lowest to the highest level. Of deciduous trees, which are at least as numerous as the coniferous, and in the number of species much more so, the maple, beech, birch, ash, cherry, aspen, basswood, elm, and willow are the most abundant. The red juniper, pitch pine, chestnut, hickory, butternut, and oak are conspicuously absent, although they are characteristic trees of the Hudson River slopes of these mountains, extending up to the Catskill Mountain House, at which point their ranges end rather abruptly. Among the smaller plants, many species were collected in the vicinity

of the Mountain House and Kaaterskill Lake, which were recognized as common species of the lower Hudson, and which were absent from the interior valleys to the westward, or only occurred there as rare stragglers.¹

The following is a list of the trees and shrubs collected and placed in the U. S. National Museum:²

Pinus rigida Miller.
Pinus strobus Linnæus.
Picea mariana (Miller).
Tsuga canadensis (Linnæus).
Abies balsamea (Linnæus).
Juniperus virginiana Linnæus.
Taxus minor (Michaux).
Juglans cinerea Linnæus.
Populus balsamifera Linnæus.
Populus grandidentata Michaux.
Populus tremuloides Michaux.
Salix amygdaloides Andersson.
Salix cordata Muehlenberg.
Salix bebbiana Sargent.
Carpinus caroliniana Walter.
Betula lutea Michaux.
Betula papyrifera Marshall.
Fagus latifolia (Muenchhausen).
Castanea dentata (Marshall).
Quercus prinus Linnæus.
Quercus rubra Linnæus.
Quercus velutina Lamarek.
Ulmus americana Linnæus.
Ribes cynosbati Linnæus.
Ribes lacustre (Pursh).
Ribes oxycanthoides Linnæus.
Hamamelis virginiana Linnæus.
Spiræa salicifolia Linnæus.
Aronia nigra (Willdenow).

Cratægus coccinea Linnæus.
Rubus americanus (Pursh).
Rubus odoratus Linnæus.
Rubus hispidus Linnæus.
Rubus strigosus Michaux.
Rubus occidentalis Linnæus.
Potentilla tridentata Solander.
Prunus pennsylvanica Linnæus.
Prunus serotina Ehrhart.
Prunus virginiana Linnæus.
Rhus hirta (Linnæus).
Ilex laevigata (Pursh).
Ilex verticillata (Linnæus).
Ilicoides mucronata (Linnæus).
Acer saccharinum Linnæus.
Acer saccharum Marshall.
Acer pennsylvanicum Linnæus.
Acer spicatum Lamarek.
Tilia americana Linnæus.
Cornus canadensis Linnæus.
Cornus stolonifera Michaux.
Azalea lutea Linnæus.
Kalmia angustifolia Linnæus.
Gaylussacia dumosa (Andrew).
Fraxinus nigra Marshall.
Sambucus canadensis Linnæus.
Viburnum alnifolia Marshall.
Viburnum cassinoides Linnæus.
Diervilla diervilla (Linnæus).

MOLLUSKS.

Owing to the character of the geological formation, there are but few shells in the Catskills. The following list includes all of the species which we found there:

1. *Polygyra albolabris* Say. Found sparingly from Schoharie Creek to the summits of Plateau and Hunter mountains.
2. *Polygyra dentifera* Binney. Specimens were taken on Schoharie Creek and on the summits of Hunter and Plateau mountains.
3. *Polygyra sayi* Binney. Hunter Mountain; scarce.

¹ Among the stragglers are one or two butternut and oak trees in the vicinity of Kaaterskill Junction which may have been artificially planted.

² For assistance in determining the plants collected, I am indebted to Mr. Charles Louis Pollard; for assistance with the animals, to Messrs. Charles T. Simpson, Barton A. Bean, Leonhard Stejneger, and Gerrit S. Miller, jr.

4. *Polygyra tridentata* Say. Found from the bed of Schoharie Creek up to 3,300 feet altitude on Hunter Mountain.
5. *Polygyra monodon* Rackett. Specimens were taken on the summit of Plateau Mountain.
6. *Pyramidula* species. Found above 3,000 feet on Hunter Mountain.
7. *Selenites concarus* Say. Ranges from Kaaterskill Junction to the summit of Plateau Mountain.
8. *Zonites ligerus* Say. Found in a burned area at the summit of Plateau Mountain.
9. *Succinea obliqua* Say. Found from Schoharie Creek to the summits of Plateau and Hunter mountains; not abundant.
10. *Sphærium partumeium* Say. Found only in Kaaterskill Lake.

CRUSTACEANS.

The only crustacean found was the common crawfish or brook lobster, *Cambarus bartoni* (Fabricius), which is abundant in all the brooks.

FISHES.

1. *Ameiurus nebulosus* (Le Sueur). Small catfish; Common bullhead. A specimen was taken at Kaaterskill Lake, where this fish is said to be abundant.
2. *Catostomus commersonii* (Lacépède). Common sucker; Brook sucker. Abundant in Schoharie Creek. Many were seen from a foot-bridge at the village of Hunter, where 'sucker-wire' is a staple in the hardware stores.
3. *Semotilus atromaculatus* (Mitchill). Horned dace; Creek chub. Abundant in Schoharie Creek and tributary brooks.
4. *Notropis cornutus* (Mitchill). Shiner; Red-fin. Abundant in Schoharie Creek.
5. *Rhinichthys atronasus* (Mitchill). Black-nosed dace. Abundant in Schoharie Creek and its petty tributaries.
6. *Eroglossum maxillingua* (Le Sueur). Cut-lips; Nigger chub; Nigger dick. Abundant in Schoharie Creek.
7. *Salvelinus fontinalis* (Mitchill). Brook trout; Speckled trout. Abundant in Schoharie Creek and the numerous spring brooks that join it.
8. *Lucius reticulatus* (Le Sueur). Common eastern pickerel. My son caught two specimens in Kaaterskill Lake, where the pickerel is abundant.

NOTE.—In addition to the pickerel and catfish, several other fishes are in Kaaterskill Lake. I saw a bream, and a small species that may have been *Fundulus*; and eels are said to have been caught there.

BATRACHIANS.

1. *Spelerpes bilineatus* (Green). Striped-backed salamander. Common along streams.

2. *Desmognathus fusca* (Rafinesque). Dusky salamander. The most abundant salamander; found along streams.

3. *Diemyctylus viridescens* Rafinesque. Spotted triton; Newt; Evet; Eft. Very numerous in Kaaterskill Lake; not seen elsewhere in the region.

4. *Bufo americanus* Le Conte. American toad. Abundant along Schoharie Creek; one specimen taken on Hunter Mountain (altitude, 3,800 feet).

5. *Hyla versicolor* Le Conte. Common tree-toad. Common (August 4 to September 14, 1896).

6. *Rana pipiens* Schreber. Common frog; Leopard frog. Eleven specimens were taken at Kaaterskill Lake, September 10, 1896.

7. *Rana sylvatica* Le Conte. Wood-frog. Two specimens from East Kill Mountain (2,000 feet) and one specimen from Hunter Mountain (3,800 feet).

8. *Rana clamitans* (Latreille). Green frog. Schoharie Creek and Kaaterskill Lake, August 12 to September 10, 1896.

REPTILES.

1. *Thamnophis sirtalis* (Linnaeus). Garter snake. Abundant from the margin of Schoharie Creek up to the summit of Hunter Mountain.

2. *Storeria occipitomaculata* (Storer). Red-bellied brown snake. Common in the Schoharie valley; most often seen after sundown.

NOTE.—No turtles were seen, but a species answering to the description of *Chrysemys picta* (Hermann) was said to abound in Kaaterskill Lake and other pools of the region.

MAMMALS.

A. SPECIES KNOWN TO OCCUR AT THE PRESENT TIME.

LEPUS SYLVATICUS TRANSITIONALIS Bangs.

NEW ENGLAND COTTONTAIL.

Curiously enough, this small rabbit is generally known to the residents of the upper Schoharie valley by the name of 'jack rabbit.' I was informed by persons who had lived near Kaaterskill Junction for many years that this rabbit had extended its range upward into the cleared lands of the Schoharie valley during recent years. Although it is said to be abundant at the present time in the valley, and on the lowest adjacent hills, I was unable to find it; and two specimens trapped by my son, Louis di Zerga Mearns, beside Schoharie Creek, at the nearest bridge, September 4 and 9, 1896, were the only ones seen. These were males.

No. 83111, U.S.N.M. collection, measured as follows: Length, 385 mm.; tail vertebræ, 65; hind foot, 92; head, 72; ear from crown, 66; ear from notch, 59. No. 83112, U.S.N.M., measured, in total length, 370; tail vertebræ, 58; hind foot, 89; head, 74; ear from crown, 57; ear from notch, 52.

LEPUS AMERICANUS VIRGINIANUS (Harlan).

SOUTHERN VARYING HARE.

Two immature specimens (Nos. 83109, 83110, U.S.N.M.) were taken on Hunter Mountain, in spruce and balsam swamps, at altitudes, respectively, of 3,700 and 3,800 feet, on August 31 and September 4, 1896. This hare is abundant on the summits of East Kill, Plateau, and Hunter mountains, descending, at times, along belts of coniferous trees nearly to Schoharie Creek. In the lowest country, it is said to be almost wholly replaced by the cottontail.

ERETHIZON DORSATUS (Linnæus).

CANADA PORCUPINE.

This remarkable beast was formerly abundant throughout this region. During recent years it has become comparatively scarce, except on the mountains. The skeleton of a porcupine was found under the fallen ruins of an observatory on the summit of Hunter Mountain; two other specimens were subsequently trapped there (altitude, 4,025 feet); three were taken at a spring under a shelving rock, at the altitude of 3,800 feet, and a seventh was overtaken and killed in the slide rock on the side of Hunter Mountain, at about 3,000 feet altitude.

Porcupines visit the creamery, on the trail at the base of Hunter Mountain, and leave the marks of their sharp teeth upon the woodwork of the buildings and furniture. They are attracted to this place by their fondness for salt, which makes the best bait for trapping them, though they eat apples, turnips, and in fact almost any fruit or vegetable.

Near the Hunter Mountain trail I set a number of deadfalls, baited with apple, hoping to take specimens of the varying hare; but the porcupines almost invariably sprung the traps, and usually escaped, though one was held fast long enough for it to excavate a large hollow beneath the trap stone, and a very young one was captured. When caught in steel traps set in their well-worn trails, they make continuous efforts to escape, and are so powerful that they sometimes succeed by twisting and breaking the chain holding the trap. When seen on the ground, they are easily overtaken, and only attempt to defend themselves by striking vigorously with their powerful and spiny tails, without attempting to bite or scratch. When attacked by inexperienced dogs, they erect their quills, which afford them such ample protection that their canine enemies seldom continue the attack or forget their

first painful lesson. Those that I caught gave utterance to grunting and sniffing sounds, which were accompanied by nervous facial contortions. At first they lashed out aimless lateral blows with their quilly tails, but declined to bite even when teased. Soon, however, they grew calm, behaving better after a short acquaintance; and it became a painful task to kill such innocent and interesting animals. Although sometimes annoyingly familiar, and prone to gnaw at things about camps and cabins in the woods, porcupines are comparatively harmless and should never be wantonly destroyed. It is to be hoped that such colonies of porcupines as still exist on the peaks of the Catskills can be preserved from extermination by creating a generous public sentiment in their favor.

Of the six skins preserved two were adult females, two immature females, and two, male and female, quite young. Adults differ from the young and immature in having the hair and quills of the back brown instead of black, though mixed, as in the others, with a few long gray hairs. The quills are more yellowish than those of the younger specimens, and the dark longitudinal band on the under side of the tail is much redder. The youngest and only male specimen (No. 83076, U.S.N.M.) is smaller than a cottontail rabbit. It is black, with a sprinkling of long gray hairs all over except on the rump, middle of upper and lower sides of tail, and portions of the head—the gray hairs scattered most thickly across the shoulders, lumbar region, and along the sides. The quills are short, almost concealed by hair, and colored either black or white (never yellowish), and only visible on the crown, cheeks, sides of rump, and tail. The claws are blackish. Another young specimen (No. 83075, U.S.N.M.), twice the bulk of the above, differs in color only in the absence of gray hairs on the middle of the under surface. Two nearly adult females have the quills in part yellowish instead of white; they cover the whole rump and conceal the hair of the part; the under side of the tail is stained centrally with rusty brown, and one specimen is becoming brownish on the back. The color of the hair is black, with a sprinkling of long gray hairs above. The quills cover most of the upper surface and sides of the body. On the back the long hair overtops and conceals the quills, while the reverse is the case on the rump and tail.

Measurements.—Average of two adult females: Length, 678 mm.; tail to end of vertebræ, 190; tail to end of hairs, 230; length of head, 103; hind foot, 90 by 35; fore foot, 71 by 30; ear from anterior base, 29. Weight, 13 pounds. Mammæ, three pairs.

ZAPUS HUDSONIUS (Zimmermann).

MEADOW JUMPING-MOUSE.

Abundant along Schoharie Creek, but not found elsewhere in the region. Nine specimens were trapped along the stream, amid thickets of laurel, witch-hazel, blackberries, and other shrubbery.

Measurements.—Average of five adults: Length, 214 mm.; tail vertebrae, 127 (to end of caudal pencil, 133); length of hind foot and claw, 30.3; ear from crown, 10.6; ear from notch, 13.7; length of head, 25.2. Mammae, four pairs.

ZAPUS INSIGNIS Miller.

WOODLAND JUMPING-MOUSE.

Abundant on Schoharie Creek, where it was trapped in the same places as the meadow jumping-mouse (*Zapus hudsonius*). In some instances both species were taken, on different nights, in the same trap, set in one spot. One was trapped under a fallen spruce, at the altitude of 3,600 feet, on Hunter Mountain. In all, nine specimens were preserved.

This beautiful mammal is at least partially diurnal. When fishing from some high rocks beside Schoharie Creek I saw several of them beneath some laurel bushes on the bank. Females have four pairs of mammae, distributed from the inter-humeral to the inter-femoral region. Females are slightly larger and heavier than males.

Measurements.—Average of two adult males: Length, 225 mm.; tail to end of vertebrae, 137.5 (to end of caudal pencil, 145); hind foot, 30.8; ear from crown, 12.5; ear from notch, 16.3; head, 26.8. Average of four adult females: Length, 236.5; tail vertebrae, 146 (to end of hairs, 155); length of hind foot, 31.4; ear from crown, 13.1; ear from notch, 16.4; head, 27.2.

FIBER ZIBETHICUS (Linnaeus).

MUSKRAT.

The muskrat is abundant at Kaaterskill Lake. It is also said to occur along Schoharie Creek, but we saw no signs of it there.

SYNAPTOMYS FATUUS Bangs.

HUDSONIAN LEMMING-MOUSE.

A single specimen of this species was trapped near the summit of Hunter Mountain, the locality being a marshy place strewn with fallen trees, at the altitude of 3,900 feet. *Microtus pennsylvanicus* was caught in the same spot. This specimen (No. 83166, U.S.N.M.), a nearly mature female, measured: Length, 125 mm.; tail vertebrae, 20; caudal pencil, 3.5; ear from crown, 7; ear from notch, 11; head, 28; hind foot, 18.5.

MICROTUS PENNSYLVANICUS (Ord).

COMMON MEADOW-MOUSE.

Specimens were taken from fields bordering Schoharie Creek (altitude, 1,700 feet) and on the ridge of Hunter Mountain at the altitude of 3,900 feet, the same spot in which the only specimen of *Synaptomys* was

trapped. These specimens are much smaller than those from Highland Falls, New York. Skull, No. 83116, U.S.N.M. collection, measures 28 by 16 mm. in its greatest diameters, and No. 83117 (U.S.N.M.) 27 by 15 mm., both being adult males.¹ In the flesh these two specimens gave the following average measurements: Length, 177 mm.; tail vertebrae, 53.5; head, 33.5; hind foot, 22.5; ear from crown, 7.5; ear from notch, 12.5. These dimensions agree quite closely with those of a series of *Microtus pennsylvanicus* from Fort Snelling, Minnesota, but are considerably smaller than specimens from Highland Falls, New York, which latter have the skull higher and less flattened. The coloration of the Catskill specimens is not appreciably different from that of the series from Highland Falls, on the Lower Hudson.

MICROTUS CHROTORRHINUS (Miller).

RUFIOUS-NOSED MEADOW-MOUSE.

One adult male was trapped in a pile of moss-covered rocks on a shoulder of Hunter Mountain, at an altitude of about 3,500 feet, August 25, 1896. Many traps were subsequently placed about this spot, but no others were caught. This specimen (No. 83114, U.S.N.M.²) gave the following measurements: Length, 171 mm.; tail vertebrae, 50; ear from crown, 8.5; ear from notch, 11; head, 32; hind foot, 20. Though agreeing in cranical characters with the type of *Microtus chrotorrhinus*, it is less yellowish about the nose and face.

EVOTOMYS GAPPERI (Vigors).

RED-BACKED MOUSE.

I refer forty-five red-backed mice collected in the Catskills to *Evotomys gapperi* (Vigors), and not to the subspecies *ochraceus* of Miller.³ Nevertheless they are slightly more yellowish than those from near the type locality of *Evotomys gapperi*, this trifling variation being in the direction of *Evotomys gapperi ochraceus*.

This mouse was not found on the immediate banks of Schoharie Creek, though such Canadian forms as *Tamias striatus lysteri*, *Peromyscus canadensis*, *Sorex fumeus*, and *Zapus insignis* were there in abundance. It was met with in woods close to Kaaterskill Junction (altitude, 1,700 feet), and on the lower slopes of East Kill Mountain, on the opposite (right) side of Schoharie Creek, at the level of about 2,000 feet. Above these points it increased in abundance until, on the summit of Hunter Mountain (altitude, 4,025 feet), it became so numer-

¹Skulls of *Microtus pennsylvanicus* from Highland Falls, New York, measure 30.5 by 16.5 mm.

²The skinned body, in alcohol, is numbered 82982.

³Proc. Bost. Soc. Nat. Hist., 1894, XXVI, p. 193 (from Mount Washington, New Hampshire).

ous that it was difficult to trap any other small mammals there. In the hard-wood forests at low altitudes it was usually taken about moss-covered logs, and in hollow stumps, in dense woods, but on higher ground it was common everywhere.

Specimens were taken on both sides of Schoharie Creek and at altitudes ranging from 1,700 feet up to the actual summit of Hunter Mountain. Seven were trapped around Kaaterskill Lake September 10, 1896. Specimens from these various localities and altitudes exhibited no differences among themselves worth noting.

Farther south, in the Hudson Highlands, only the subspecies *rhoadsi*¹ was found. It occurred in sphagnous swamps overgrown with black spruce and tamarack trees, in the highest part of the mountains, where a single immature specimen was trapped September 30, 1896. This individual, which I have compared with topotypes of *Evotomys gapperi rhoadsi*, in the Department of Agriculture collection, appears to be of this form. The specimen (No. 82832, U.S.N.M.) shows very little of the red dorsal area, the back being brownish gray, as described by Mr. Stone, and quite unlike any of the Catskill specimens.

Measurements.—Average of twenty adult males: Length 142 mm.; tail vertebrae, 41; tail to end of hairs, 49; hind foot, 19.2; ear from crown, 9.1; ear from notch, 13; head 28. Average of sixteen adult females: Length, 144; tail vertebrae, 41; tail to end of hairs, 49; hind foot, 19; ear from crown, 9.1; ear from notch, 13; head, 27.7.

PEROMYSCUS LEUCOPUS (Rafinesque).

EASTERN DEER-MOUSE.

This beautiful mouse was rather abundant along Schoharie Creek, especially about farms and buildings. On the right side of the stream it was found sparingly distributed around the lower third of East Kill Mountain, but was nowhere abundant above the creek bottom. On the left side it was not found above 2,000 feet altitude. Forty-one specimens were collected.

Measurements.—Average of twelve adult males: Length, 174 mm.; tail vertebrae, 79; tail to end of pencil, 84; hind foot, 21.2; ear above crown, 12.7; ear above notch, 16.8; head, 29.5. Average of six adult females: Length, 180; tail vertebrae, 81; to end of hairs, 85; hind foot, 21.5; ear from crown, 13.3; ear from notch, 17.4; head, 30.6.

PEROMYSCUS CANADENSIS (Miller)

CANADIAN DEER-MOUSE.

The Canadian deer mouse, though nowhere abundant, was found from the margin of Schoharie Creek up to the summit of Hunter Mountain, and in all sorts of places—sugar camps, deserted houses, deciduous woods, spruce and balsam swamps, under rocks, among the roots

¹ Described by Mr. Witmer Stone in the American Naturalist for January, 1893, p. 55, from Mays Landing, New Jersey.

of old stumps, in brush heaps, and in open, grassy places; in short, it was found everywhere, but nowhere in abundance. It was much less common than *Peromyscus leucopus* along Schoharie Creek, where both species were sometimes taken in the same spot. When trapped, its cheek pouches are as likely to be filled with food as those of the chipmunk. I do not remember ever to have found food in those of *Peromyscus leucopus*. In his description of *Peromyscus canadensis*,¹ Mr. Gerrit S. Miller, jr., observes: "It is worthy of remark, in this connection, that I have found the cheek pouches of *S[itomys] canadensis* [= *Peromyscus canadensis*] much the more frequently and conspicuously distended with food [than those of *Peromyscus leucopus*]." For the history of the discussion concerning the presence or absence of cheek pouches in the mice of the genus *Peromyscus*, and their use when present, consult especially Baird² and Allen.³

In the flesh, this species is easily distinguished from fresh specimens of *P. leucopus* by its larger ears, different quality and coloration of pelage, and by its longer and tufted tail. These differences are not so striking in cabinet specimens; still it is remarkable that this species should have remained so long unrecognized. The occurrence of *Peromyscus leucopus* and *P. canadensis* together on Schoharie Creek makes it quite certain that they are perfectly distinct species. In the Highlands of the Hudson *P. leucopus* is abundant; but in the highest parts, where the black spruce and tamarack grow, no species of *Peromyscus* could be found. In other words, where *P. canadensis* should have been found the genus was unrepresented. Eighteen specimens were collected in the Catskills.

Measurements.—Averages of seven adult males: Length, 181 mm.; tail vertebræ, 89; tail, measured to end of caudal pencil, 96.5; hind foot, 21.2; height of ear from crown, 13.6; ear from notch, 17.7; length of head, 28.7. Average of three adult females: Length, 190; tail vertebræ, 94; tail to end of hairs, 100; hind foot, 21.5; ear from crown, 15; ear from notch, 17.7; head, 28.2

MUS MUSCULUS Linnæus.

HOUSE MOUSE.

Common in fields and houses. Several were trapped under stacks of fodder corn standing in the fields. None were caught in the woods. Three specimens preserved.

MUS DECUMANUS Pallas.

NORWAY RAT.

Abundant. One was trapped on the base of East Kill Mountain at the altitude of 2,000 feet. No others were seen in the woods.

¹ Proc. Biol. Soc. Wash., June 20, 1893, VIII, p. 62.

² North American Mammals, 1857, p. 460.

³ Bull. Mus. Comp. Zool., 1869, I, p. 229.

ARCTOMYS MONAX (Linnæus).

WOODCHUCK; GROUNDHOG.

This species, the largest of the eastern *Sciurida*, is tolerably common in the Schoharie Valley. Its burrows were frequently seen in all of the cultivated lands, though I saw but one woodchuck.

TAMIAS STRIATUS LYSERI (Richardson).

NORTHERN CHIPMUNK.

The chipmunk of the Schoharie Valley is distinctly of the *lyseri* type. It was common, but shy, occurring from the edge of the creek (altitude 1,700 feet) up to the summit of Hunter Mountain (altitude 4,025 feet). At Palenville, on the Hudson River side of the Catskills, intermediates between the forms *striatus* and *lyseri* occur; in the Hudson Highlands a few individuals from the highest elevations verge toward *lyseri*; lower down the Hudson Valley only true *striatus* is found. No difference was detected between specimens collected in spruce forests and balsam swamps on the mountains and those from the fields and fences along Schoharie Creek. All are *lyseri* and intermediate between the typical form of the subspecies and the pale, yellowish phase found in Maine. The specimens collected had fed most extensively upon mushrooms, wild cherries, and a small bulbous plant, probably a sedge. More than one-half were affected by a subcutaneous parasite (*Cuterebra*) embedded in the cervical, abdominal, or inguinal region. A few individuals of *Peromyscus* were likewise affected by this parasite. Forty-nine specimens of this chipmunk were preserved.

Measurements.—Average of ten adult males: Length, 247 mm.; tail vertebrae, 96; tail to end of hairs, 115; hind foot, 36.3; ear above crown, 11.5; ear above notch, 18.3; head, 45.5. Average of ten adult females: Length, 251; tail vertebrae, 98; tail to end of hairs, 117; hind foot, 36.2; ear above crown, 11.6; ear above notch, 18.5; head, 45.6. Mammae, four pairs.

SCIURUS HUDSONICUS LOQUAX Bangs.

SOUTHERN CHICKAREE OR RED SQUIRREL.

This lively inhabitant of the forest was found at all altitudes, its range extending from sea level to the highest peaks of the Catskills. It is as apt to be found in deciduous as in coniferous woods. Eight specimens were collected; one killed on August 15 was still partly in winter pelage.

Measurements.—Average of four adult males: Length, 313 mm.; tail vertebrae, 124; tail to end of hairs, 180; hind foot, 48.5; ear from crown, 14.7; ear from notch, 23.5; head, 51.7. Average of two adult females: Length, 319; tail vertebrae, 133; tail to end of hairs, 190; hind foot, 50.5; ear from crown, 14; ear from notch, 23; head, 50.

SCIURUS CAROLINENSIS LEUCOTIS (Gapper).

NORTHERN GRAY SQUIRREL.

The gray squirrel is rare in this region. But one individual was seen during our stay.

SCIUROPTERUS SABRINUS MACROTIS, new subspecies.

CANADIAN FLYING SQUIRREL.

During recent years, *Sciuropterus sabrinus* (Shaw) has been considered a subspecies of *Sciuropterus volans* (Linnaeus); but Mr. Outram Bangsh as lately shown¹ these two to be distinct species. Moreover, the form of *Sciuropterus sabrinus* occupying the Canadian life zone, along the northern border of the United States east of the Great Lakes, is so markedly different in size, coloration, and proportions from typical *sabrinus*,² that it requires separation as a subspecies.

Type.—No. 83152, U.S.N.M. collection. Adult female collected by Dr. Edgar A. Mearns, on Hunter Mountain (Catskills), Greene County, New York, at an altitude of 3,300 feet, August 31, 1896. Original number, 4036.

Description of type.—Upper surface of body, fawn color; under surface, yellowish white; sides of head, ash gray; sides of body and upper surface of feet, mouse gray, the latter mixed with white; whiskers, and a narrow ring around eye, black; tail, drab gray above, a little darker terminally, and pale écru drab below. Length, 280 mm.; tail vertebrae, 125; head, 41; length of hind foot, 38; ear from crown, 20; ear from notch, 23.5; skull, 37.5 by 22 (fig. 1).

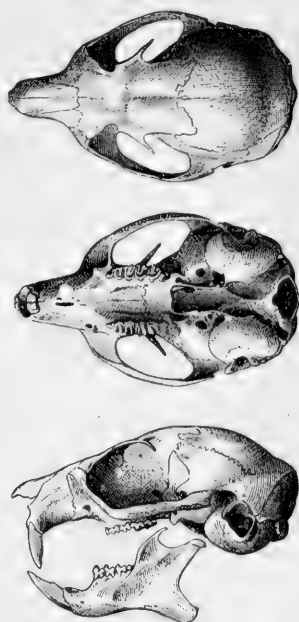


FIG. 1.—SKULL OF *SCIUROPTERUS SABRINUS MACROTIS*. TYPE. (Natural size.)

¹Proc. Biol. Soc. Wash., December 28, 1896, X, pp. 162, 163.

²Respecting the type locality of his '*Sciurus sabrinus*,' Shaw, in his General Zoology, 1801, II, Pt. 1, p. 157, states as follows: "It is found in the southern parts of *Hudson's Bay*, in the forests bordering on *Severn river* in *James's Bay*, and seems to have been first described by Dr. Forster in the Philosophical Transactions. I have given this species a new trivial, in order to avoid the repetition of the title *Hudsonius*, which takes place, through oversight, in the Gmelinian edition of *Systema Naturæ*."

General remarks.—This subspecies is much smaller than typical *sabrinus*, from the west side of Hudson Bay, but has much longer ears (fig. 2), those of *macrotis* measuring 20 mm. against 15 mm. in *sabrinus*.



FIG. 2.—EAR OF *SCIUROPTERUS SABRINUS* (a) FROM HUDSON BAY, AND *S. SABRINUS MACROTIS* (b), TYPE SPECIMEN. (Natural size.)

The fur is more reddish. The sides of the head are clear grayish instead of soiled yellowish white. The tail is shorter, much less full and bushy, and does not have the terminal third blackish. The under parts are whiter. The skull is much smaller, measuring 37.5 by 22 mm. in *macrotis* against 40 by 24 in *sabrinus* (fig. 3). Specimens from the northeastern part of North America agree in size with those from New York and Pennsylvania, but in the northeastern localities the ear is shorter and the coloration somewhat paler and more yellowish than in the Middle States (Catskill Mountains and Erie, Pennsylvania). A series of specimens, labeled as from Matamagaminque, Canada (at the head of Moose River, between Lake Huron and James Bay), is intermediate in size and coloration between those from Hudson Bay and the New England and Middle States. Going northwestward from Hudson Bay and the

Red River region, we find a decided increase in size and a darker coloration, in specimens from Great Slave Lake, Fort Liard, Cumberland House, and Fort Anderson. The largest American flying squirrel in the U. S. National Museum series came from the Yukon River, near the eastern boundary of Alaska. It has the hind foot measuring over 40 mm. in length; the tail about 175, and skull 41.5 by 25.

This species was found in spruce woods, on the ridge of Hunter Mountain, at the altitude of 3,300 feet. Flying squirrels are said to be common everywhere in the region. One seen on August 7, 1896, near the base of East Kill Mountain, at 1,800 feet altitude, may have been either the present species or *Sciuropterus volans* (Linnaeus).

SOREX FUMEUS Miller.

SMOKY SHREW.

Three specimens were taken. One was trapped under a stone wall on the right (north) bank of Schoharie Creek; one in a hollow stump on the south slope of East Jewett Mountain, at about 2,000 feet altitude; and the third under a log, a little farther up the mountain. These specimens,

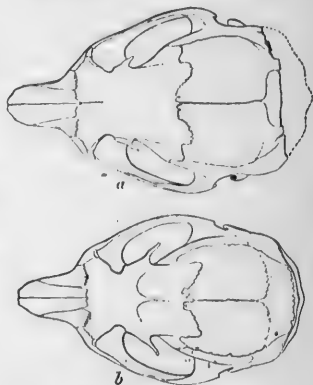


FIG. 3.—SKULL OF *SCIUROPTERUS SABRINUS* (a) FROM GREAT SLAVE LAKE, AND *S. SABRINUS MACROTIS* (b), TYPE SPECIMEN. (Natural size.)

two males and a female, gave the following average measurements: Length, 121 mm.; tail vertebrae, 46; hind foot, 13.5; head, 23.7.

SOREX PERSONATUS I. Geoffroy Saint Hilaire.

COMMON EASTERN SHREW; MASKED SHREW.

Two specimens were trapped; the first (No. 83165, U.S.N.M.) in a balsam swamp, at 3,700 feet altitude; and the second (No. 82945, U.S.N.M.) on the actual summit of Hunter Mountain. Both are females, and so different in color from all others of this species that I have seen that I hesitate in referring them to typical *Sorex personatus*. Their color is a pale yellowish drab, quite different from summer specimens from the Hudson Highlands, Roan Mountain, or Fort Snelling.

Measurements.—No. 83165, U.S.N.M., measures: Length, 99 mm.; tail vertebrae, 40; tail to end of hairs, 45.5; hind foot, 12; ear from crown, 3.2; head, 20. No. 82945: Length, 104; tail vertebrae, 42; hind foot, 12.5.

SOREX MACRURUS Batchelder.

BIG-TAILED SHREW.

Sorex macrurus BATCHELDER, Proc. Biol. Soc. Wash., December 8, 1896, X, pp. 133, 134, text figs. 26–28 (skull and teeth).

On August 24, 1896, I climbed to the summit of Hunter Mountain and distributed about eighty traps along the ridge and on the summit of the mountain. Trapping was continued there until September 4, the traps having been visited nine times and frequently changed from place to place during this period. Among the specimens obtained were eight examples of this recently described shrew. Two of them were preserved in alcohol, two in formalin, and the remaining four as skins with skulls. All appear to be adults. The accompanying text figures of *Sorex macrurus* (figs. 4, 5, 6) were drawn from specimen No. 82940, U.S.N.M. collection, an adult female, taken at the summit of Hunter Mountain, Greene County, New York, August 26, 1896. The enormous size of its tail is shown by comparison with figures of the tails of *Sorex personatus* (adult female, No. 82945, U.S.N.M. collection) and *Sorex fumeus* (adult male, No. 82944, U.S.N.M. collection), from the same region (fig. 6, a, b, c). All were drawn to the same scale by Dr. J. C. McConnell, and are reproduced one and one-half times the natural size.



FIG. 5.—HEAD OF *SOREX MACRURUS* FROM THE CATSKILL MOUNTAINS. ($\times 1\frac{1}{2}$.)

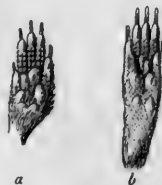


FIG. 4.—FORE FOOT (a) AND HIND FOOT (b) OF *SOREX MACRURUS* FROM THE CATSKILL MOUNTAINS. ($\times 1\frac{1}{2}$.)

The species was hitherto known only from the two specimens described by Mr. Batchelder, who captured the first on September 9, 1895, at Beedes, Essex County, New York, and the second on August 1, 1896, on the bare, open summit of Mount Marcy, the highest of the Adirondack mountains, about 5,300 feet above sea level.

The following measurements were taken from fresh specimens by the author. Average of four adult males: Length, 124 mm.; tail vertebrae, 57; caudal pencil, 7.3; hind foot, 14.7; head, 23.8; ear from crown, 4; ear from notch, 10. Average of four adult females: Length, 123; tail vertebrae, 57; caudal pencil,¹ 7.5; hind foot, 14.8; head, 23.8; ear from crown, 4; ear from notch, 10.

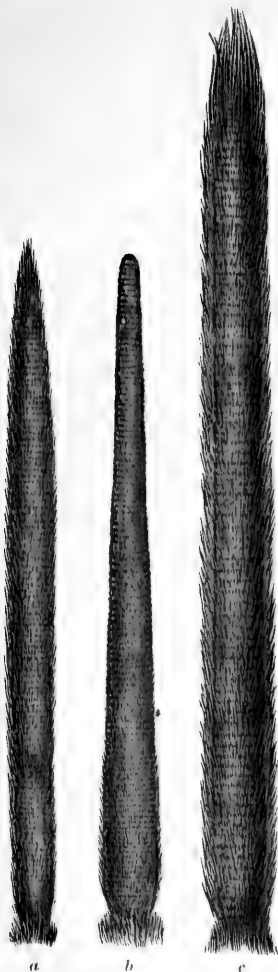
The specimens were trapped in hollows under mossy stones and stumps, usually in wet balsam or spruce woods, or in weedy swamps. The lowest place where it was taken was in a balsam swamp, at about 3,700 feet altitude; others were caught somewhat higher, in a sparsely wooded swamp densely overgrown with asters (*Aster puniceus*), then in bloom; and four were trapped on the top of Hunter Mountain (altitude 4,025 feet).

BLARINA BREVICAUDA (Say).

MOLE SHREW.

Very abundant from Schoharie Creek up to the higher mountain tops, where it appears to be less numerous, though several were taken on the summit of Hunter Mountain. It was frequently trapped during daytime, and the crawfish (*Cambarus bartoni*) proved to be the most seductive bait. Fifty-seven specimens were preserved.

FIG. 6.—TAIL OF *SOREX PERSONATUS* (a),
S. FUMEUS (b), AND *S. MACRURUS* (c).
($\times 2$.)



Measurements.—Average of eleven adult males: Length, 125 mm.; tail vertebrae, 28; hind foot, 15.3; head, 28.6. Average of nineteen adult females: Length, 124; tail vertebrae, 28.1; hind foot, 15.2; head, 29.

¹ Besides their unusual length, the caudal hairs are so rigid as to be capable of sustaining the weight of the stuffed skin.

PARASCALOPS BREWERI (Bachman).**HAIRY-TAILED MOLE; BREWER'S MOLE.**

One specimen taken (No. 83289, U.S.N.M.). If all the mole workings seen were of this species, it is abundant from Schoharie Creek upward to about 2,500 feet, above which altitude but few moles' tunnels were seen.

MYOTIS LUCIFUGUS (Le Conte).**LITTLE BROWN BAT.**

This was the commonest bat in the Catskills, and seen nightly.

An adult male (No. 83000, U.S.N.M.), taken at Kaaterskill Junction, August 21, 1896, presented these dimensions: Length, 93 mm.; tail, 36; alar expanse, 245; longest finger, 61; head, 16; ear from crown, 10; ear from anterior base, 12; tragus, 5. Another male (No. 83001, U.S.N.M.) from the same place, September 12, 1896, measured: Length, 89; tail, 35; alar expanse, 245; longest finger, 57; head, 16; ear from crown, 11; ear from anterior base, 13; tragus, 7.

VESPERTILIO FUSCUS Beauvois.**BROWN BAT.**

Common. An adult male (No. 83002, U.S.N.M.), from Kaaterskill Junction, August 12, 1896, measured: Length, 120 mm.; tail, 45; longest finger, 80; head, 21; ear from crown, 13.5; ear from anterior base, 15.

PROCYON LOTOR (Linnæus).**RACCOON.**

Tracks of the raccoon were seen in several places on or near Schoharie Creek. It was also said to be common about the Mountain House, but its tracks were not seen on the shores of Kaaterskill Lake, a place where they would naturally be looked for.

URSUS AMERICANUS Pallas.**BLACK BEAR.**

I saw recent signs of bears on Plateau Mountain, in August, 1896. Several bears were killed a few miles south of the mountain during the same month. One was seen north of the Jewett ranges during the winter of 1895-96. This species is far from being exterminated in the Catskills, as several individuals are annually killed there.

MEPHITIS MEPHITICA (Shaw).

SKUNK.

Common. Three specimens were trapped on the banks of Schoharie Creek. It was not met with on the mountains.

PUTORIUS VISON (Schreber).

LITTLE BLACK MINK; MOUNTAIN BROOK MINK.

This small mink is common on all the streams of the neighborhood and at Kaaterskill Lake, its prevalence having given rise to such local names as Mink Hollow and Mink Mountain.

A large female mink, heavy with young, was overtaken by the roadside by Mr. Sidney T. Haines, on July 22, 1896, and killed with a whip. It fought viciously. I obtained one specimen (No. 83119, U.S.N.M.) on August 18, 1896.

PUTORIUS NOVEBORACENSIS Emmons.

NEW YORK WEASEL.

One was seen at Evelyn Villa in August, 1896. Weasels, large and small, were said to be common, though I succeeded in trapping but one specimen of the smaller species.

PUTORIUS CICOGNANI (Bonaparte).

BONAPARTE'S WEASEL.

One specimen, a male (No. 83120, U.S.N.M.), was trapped on the left bank of Schoharie Creek, August 23, 1896. Length, 258 mm.; tail vertebrae, 70; black terminal portion of tail, 40; head, 46; hind foot, 34; ear above crown, 8; ear above notch, 19. It uttered a high-pitched cry of rage and attempted to attack me when I came upon it in the trap.

VULPES PENNSYLVANICUS (Boddart).

AMERICAN RED FOX.

This fox is known to be tolerably common throughout the Schoharie valley. Several specimens in local collections were said to have been killed near by. A fox's den was found near Kaaterskill Junction by my son and myself. We carefully set a steel trap in the entrance of the burrow, and fortune at first favored us, as it rained soon after and the fox was caught, but escaped during the night or early morning. From the appearance of the tracks I am of the opinion that it was a gray fox (*Urocyon cinereoargenteus*) and not the present species.

LYNX CANADENSIS Kerr.

CANADA LYNX.

I am informed that there are two mounted specimens in one of the local collections, but I did not see them. Hunters told me that there are still a good many 'lynxes,' as well as 'wilcats,' in the mountains. Very large tracks of a lynx, which I suppose to have been this species and not *Lynx ruffus*, were seen almost daily on the summit of Hunter Mountain during the latter part of August. It often caught varying hares and devoured them in the trail along which my traps were placed.

This is the type locality of Rafinesque's *Lynx montanus*, described¹ as follows:

Lynx montanus. Raf. Ears beardless, black outside, with a white spot, fallow inside; fur grayish and unspotted above, whitish with brown dots underneath, tail grayish.—Obs. On the Highlands of New-York, the Catskill and Peru mountains, the Alleghany, etc. Length from three to four feet, larger than the foregoing [*Lynx canadensis*].

From the above description, this name appears to have been based on the summer pelage of *Lynx canadensis*.

During the winter of 1877-78 a Canada lynx was killed near Rhinebeck, on the Hudson, and brought to Prof. James M. De Garmo, in whose collection I saw it soon after. This is the only record of its occurrence in the immediate vicinity of the Hudson River, during recent years, that has been brought to my attention.

LYNX RUFFUS (Güldenstädt).

WILDCAT; BAY LYNX.

Several stuffed specimens of wilcats said to have been killed in that neighborhood, are preserved in the hotels and stores of the Catskills. It is, in fact, fairly common in these mountains.

B. SPECIES WHOSE OCCURRENCE AT THE PRESENT TIME IS DOUBTFUL.

SCIUROPTERUS VOLANS (Linnæus).

SOUTHERN FLYING SQUIRREL.

The flying squirrels living near Schoharie Creek are quite likely to be of this species.

LASIURUS CINEREUS (Beauvois).

HOARY BAT.

A bat which I saw on August 14, 1896, was supposed to be of this species.

¹ American Monthly Magazine, November, 1817, II, p. 46.

LUTRA HUDSONICA Lacépède.

AMERICAN OTTER.

Otters were said by one or two of the Catskill residents to have been taken occasionally along Schoharie Creek and at Kaaterskill Lake during the past twenty-five years. We saw no signs of them.

MUSTELA AMERICANA Turton.

SABLE; PINE MARTEN.

Some of the residents assert that both the pine marten and the pekan, *M. pennanti* Erxleben, are still sometimes taken in the Catskills; others exclude the pekan, but say that the marten still exists.

CANIS NUBILUS Say.

GRAY TIMBER WOLF.

It is generally believed that the last wolf disappeared from the Catskills, along with the deer, many years ago, though one man expressed the belief that some still remain.

UROCYON CINEREOARGENTEUS (Müller).

EASTERN GRAY FOX.

A few gray foxes were said to have made their appearance in the upper part of Schoharie valley during recent years.

FELIS CONCOLOR Linnæus.

AMERICAN PANTHER.

One man told me that a panther had been killed in the Catskills within the past three years; others that it was extirpated long ago.

DIDELPHIS VIRGINIANA Kerr.

VIRGINIA OPOSSUM.

The opossum seems to be unknown in this portion of the Catskills, though it has been taken near the town of Catskill, at the base of the mountains, on the Hudson River side.

TOPAZ CRYSTALS IN THE MINERAL COLLECTION OF THE U. S. NATIONAL MUSEUM.

By ARTHUR S. EAKLE, PH. D.,

Department of Mineralogy, Harvard University.

The U. S. National Museum collection of minerals contains many excellent crystals of topaz, representing most of the localities from which this mineral has been obtained in crystal form. A large number of the best ones were a part of the Leidy collection, while the balance have been acquired through individual gifts or from dealers.

Topaz has been such a very attractive mineral to investigators, owing to its rich variety of forms, its varying axial ratios, and its physical and optical characteristics, that very little that is wholly new can be added to our seemingly complete knowledge of the mineral, consequently the present article, while adding a little to the crystallography of the mineral from some of the localities, is mainly a description of the collection.

A wide range naturally exists in the perfectness of development of the crystals, but the majority of them have good bright faces and are easily measurable. The Russian crystals are superior to the others in size, beauty, and perfectness.

Many of the crystals have well-defined natural etch figures, especially on the prismatic and brachydome faces, and a few possess "Prärosion" faces.

ALABASHKA.

A larger part of the Russian crystals are credited to Alabashka. They are mounted either as single crystals or shown as group specimens, associated with quartz, feldspar, and mica. They are short, prismatic, with but one termination, and vary in macrodiagonal width from 2 to 5 cm. Owing to the predominance of the brachyprism they have a tetragonal appearance, with the prismatic faces usually striated. The characteristic color is pale blue or green, and a few have a beautiful aquamarine shade.

Two general types of the Alabashka crystals have been described by Kokscharow¹; a simple and more frequently occurring type, consisting

¹Min. Russ., 1854, II, p. 198.

essentially of the three predominating forms $\{120\}$, $\{001\}$, and $\{041\}$ in combination alone, or with narrow faces of some of the other common forms; a rarer and more complex type, in which the unit prism $\{110\}$ has a greater development than the prism $\{120\}$, and whose combinations are much richer in the variety of forms. This second type is not well represented in the lot, as it is seldom that the unit prism is as large as the other prism $\{120\}$, besides the combinations are all quite simple.

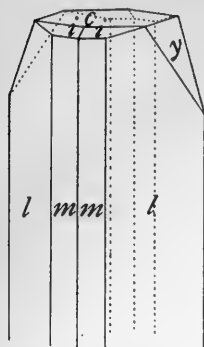


FIG. 1.—TOPAZ CRYSTAL FROM ALABASHKA.

While the general habit is the same for all these crystals, the combinations are quite varied. Fig. 1 represents the simplest and most common type of the crystals. The prism l $\{120\}$, base c $\{001\}$, and dome y $\{041\}$ are largely developed, while the prism m $\{110\}$ and pyramid i $\{223\}$ are shown more as beveling planes. Usually one face of y is much larger than the other, and occasionally u $\{111\}$ is also present. (No. 81247, U.S.N.M.)

On a crystal (fig. 2) there are, besides the forms l , c , y , m , and i , cited above, two additional pyramids, u $\{111\}$ and o $\{221\}$, and the dome f $\{021\}$. The form o is not prominent on any of the crystals, nor does it appear of frequent occurrence. The brachydome f is rare and its faces usually narrow.

The drawing (fig. 3) represents the general appearance of a crystal. In addition to the forms l , c , y , m , i , and u , the very narrow macrodome h $\{023\}$ truncates the edges of i , and the brachypinacoid b $\{010\}$ is present. These last two forms are of very rare occurrence on the Alabashka crystals. (No. 81244, U.S.N.M.)

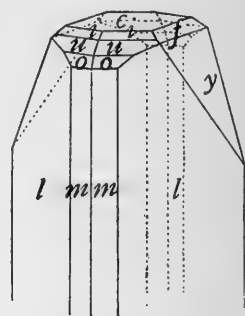


FIG. 2.—TOPAZ CRYSTAL FROM ALABASHKA.

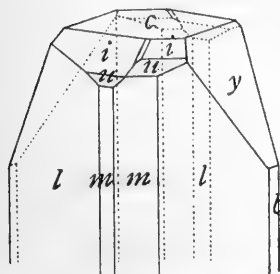


FIG. 3.—TOPAZ CRYSTAL FROM ALABASHKA.

ILMEN MOUNTAINS.

Crystals of topaz from the Miask district are noted for their great variety of combinations and many rare forms, and those of the collection, although lacking many of these rarer forms, yet have much richer and noticeably different combinations from those of the Alabashka crystals. From these latter they have several distinctive characteristics; they are mostly colorless, the base is generally small and sometimes absent, the two brachydomes f $\{021\}$ and h $\{023\}$ are common and the faces of the unit prism m are often broader than those of l .

Fig. 4 is a simple combination and seems to belong to the Adun Chalon type of crystal. No base is present and the brachydome f is proportionately large. Also, the faces of l are broader than those of m . The two remaining forms, u and y , are poorly developed. (No. 81255, U.S.N.M.)

Fig. 5 represents a more general type of these crystals, having the characteristic pyramid x {243} and the additional prism g {130} present as narrow faces. (No. 81253, U.S.N.M.)

One crystal (fig. 6) is marked by the presence of the brachydome X {023} and the macrodome d {201}, two forms which are especially characteristic of the Ilmen Mountain crystals. A rounded face of q {423} and of h {203} is also present. On the crystal represented by the drawing the base is broader than common, making X consequently narrow. (No. 81254, U.S.N.M.)

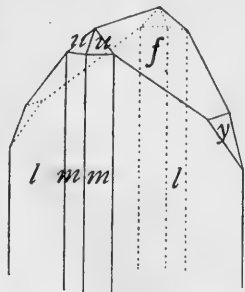


FIG. 4.—TOPAZ CRYSTAL FROM ILMEN MOUNTAINS.

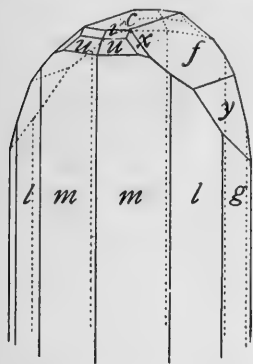


FIG. 5.—TOPAZ CRYSTAL FROM ILMEN MOUNTAINS.

NERCHINSK DISTRICT.

The crystals from this district are credited to the Adun Chalon Mountains and to the Urulga River. Those from the first-named locality are simple in character, and their type is shown in fig. 4. The collection embraces a few single crystals and some large groups.

Those from the region about the Urulga River are fine, clear, colorless crystals, varying in width from 1 to 4 cm., and quite symmetrical in appearance. The combinations are mostly simple. Of the prisms m and l , sometimes one, sometimes the other, predominates, and the same is true of the domes f and y . The macrodome d {201} is a characteristic form. The combination seen here (fig. 7) is that of a steep type of crystal very similar to the common type of Mexican crystals. It shows the two prisms, m and l , with o {221} and domes d {201} and y {041}, terminated by a small base, c {001}. (No. 81256, U.S.N.M.)

Fig. 8 is a square-shaped crystal with broad l faces, distinguished by a great development of the dome f and a long, narrow base. The brachypinacoid b {010} is also prominent. The

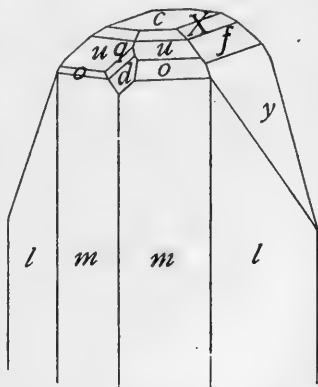


FIG. 6.—TOPAZ CRYSTAL FROM ILMEN MOUNTAINS.

prism m is deeply striated and the other forms are all narrow. (No. 82868, U.S.N.M.)

SCHNECKENSTEIN.

This locality is represented by a good single crystal, about 1 cm. broad, and a few doubly terminated ones in the matrix. They have a pale yellow color.

Four different types of the Schneckenstein crystals have been described by Grünhut,¹ distinguished by the presence and size of certain forms, especially of the brachydome f {021}. The best crystal in the collection belongs to his first type, but is lacking in some of the rarer forms which he mentions. The type is quite similar to the Ilmen Mountain crystals.

Fig. 9 shows the most general combination. The prismatic zone is enriched by the presence of the two narrow prisms g {130} and M {230} and the pinacoid b {010}. The three

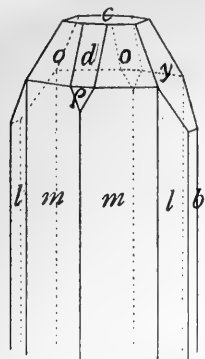


FIG. 7.—TOPAZ CRYSTAL FROM NERCHINSK.

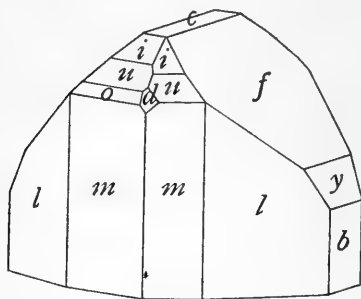


FIG. 8.—TOPAZ CRYSTAL FROM NERCHINSK.

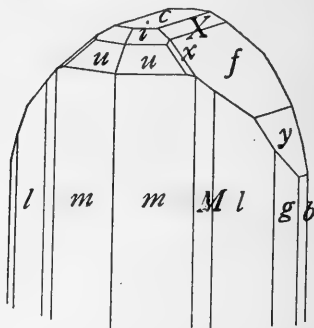


FIG. 9.—TOPAZ CRYSTAL FROM SCHNECKENSTEIN.

brachydomes y , f , and X are present, f predominating, and X very narrow. The prism faces are striated. (No. 82336, U.S.N.M.)

AUSTRALIA.

There is but one representative of this country in the collection. It is a colorless, about 1 cm. broad, crystal with somewhat rounded faces. In type and combination it is exactly similar to the Adun Chalon crystals.

JAPAN.

The collection contains a few colorless and more or less waterworn crystals from Takayama Mura. They are

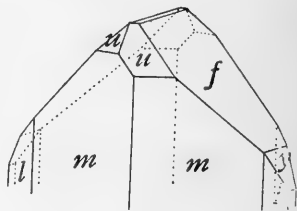


FIG. 10.—TOPAZ CRYSTAL FROM JAPAN.

¹Zeit. Kryst., 1884, IX, p. 124.

characterized by a broad development of the brachydome f and a narrow base and prominent u faces. Fig. 10 shows a common combination. (No. 47119, U.S.N.M.)

Besides these few crystals in the systematic mineral series there are a number of others kept intact in a set of Japanese minerals and rocks, which was presented by that Government to the Museum at the close of the Columbian Exposition. They come from the two localities, Otaniyama, Omi province, and Nakatsugawa, Mino province. The first-named locality is represented by two good crystals, one of them an exceptionally large square prism, measuring 5 cm. across its prismatic face. The combination is of l , c , m , and f . The prism m is narrow and f small in proportion to the size of crystal, while the broad base caps

the prisms without any intervening pyramid faces. The smaller crystal has no base, making the f faces large in consequence. The macrodome d is also prominent.

The Mino province is represented by a lot of small crystals, all of which are characterized by a broad development of the domes f and d and little or no base. The other common forms, y , o , u , i , and b , are present.

BRAZIL.

The well-known Brazilian topaz crystals, although perhaps inferior to the Russian in size and beauty, seem to excel them

in the number of rare forms and combinations. The collection exhibits from the Villa Rica district a fine lot of wine-colored well-formed individuals, as well as several of the common deep-yellow, long prismatic ones.

Two general types are apparent. The first is characterized by long striated prismatic faces, capped usually by a low pyramid. The second has a steeper habit, due to the predominating pyramid o {221} and dome y {041} as terminations.

The crystals of this type are of the uniform wine color and have a richer and more perfect development of forms than those of the first type.

Fig. 11 shows one of the simplest combinations of the first type. It

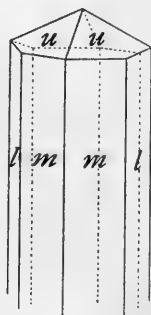


FIG. 11.—TOPAZ CRYSTAL FROM BRAZIL.

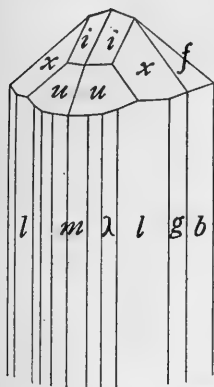


FIG. 12.—TOPAZ CRYSTAL FROM BRAZIL.

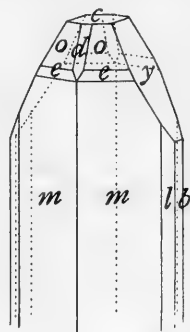


FIG. 13.—TOPAZ CRYSTAL FROM BRAZIL.

consists merely of the two prisms *m* and *l*, terminated by the low pyramid *u*. (No. 81259, U.S.N.M.)

Fig. 12 belongs to the same type, but has a much richer variety of forms. The prismatic zone includes several forms, among which *m* {110}, *Q* {450}, *λ* {470}, *l* {120}, *g* {130}, and *b* {010} were determined.

The terminating forms are *u* {111}, *i* {223}, *f* {021}, and *x* {243}. The faces of the brachypyr- amid *x* are as large as those of *u* and *f*.

The second type of crystal is shown in fig. 13. The faces of *o* and *y* are well developed and narrow faces of the steep pyramid *e* {441} are present. The *o* faces are completely devoid of luster, while those of *d* and *y* are bright.

Fig. 14 is a fine clear crystal of the same type, having a small face of *f* and the pyramid *u*, but no base.

SAN LUIS POTOSI.

Several rose and colorless crystals are exhibited from this locality. They average about 1 cm. in breadth and have a steep pyramidal habit similar to the second type of the Brazilian crystals.

Grünhut¹ describes these crystals, citing several more forms than observed on these particular crystals. The natural etch figures occurring on these crystals are arranged perfectly symmetrical with respect to the three symmetry planes of the crystal, and while agreeing in the main with the shape of those described by Pelikan,² they do not show on the brachydome *y* the right and left unsymmetrical shape of figure which he reports for the etchings on the faces of this dome.

The most complete combination of forms is seen on the crystal shown in fig. 15. It has the pyramids *i*, *u*, and *o*, and also a very narrow *e*, with the domes *d*, *f*, and *y*, the whole truncated by a small base. Of these the forms *e* and *f* are rare for these crystals. The brachypinacoid is, on the other hand, quite common. (No. 49248, U.S.N.M.)

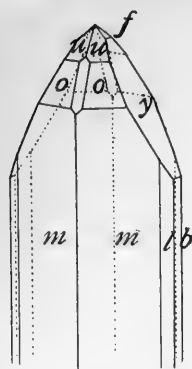


FIG. 14.—TOPAZ CRYSTAL.
FROM BRAZIL.

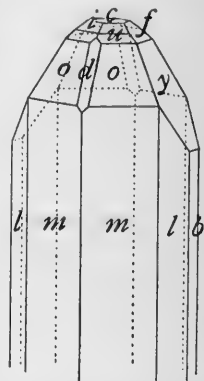


FIG. 15.—TOPAZ CRYSTAL
FROM SAN LUIS PO-
TOSI, MEXICO.

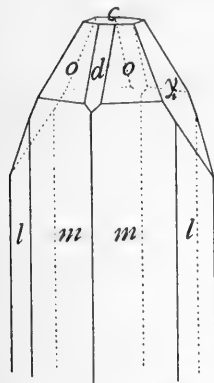


FIG. 16.—TOPAZ CRYSTAL
FROM SAN LUIS PO-
TOSI, MEXICO.

¹Zeit. Kryst., 1884, IX, p. 124.

²Tsch. min. u. petr. Mitth., 1890, XI, p. 331.

Fig. 16 is a simpler combination than the preceding, but is marked by the steep macrodome ρ {401} not shown in the drawing. (No. 50037, U.S.N.M.)

ZACATECAS AND DURANGO.

The crystals from these two localities are so similar to those from San Luis Potosi that no separate description of them is necessary. On one of the Zacatecas crystals a face of the rare prism M {230} occurs.

PIKES PEAK.

The collection embraces some fourteen crystals and pieces from this region. They range from 2 to 5 cm. wide and, unlike most of the crystals heretofore described, they show double terminations. They are colorless or of a faint bluish tint, and some are stained yellowish. All are of the same habit, and quite similar to the Ilmen mountain crystals. Cross and Hillebrand¹ reported the occurrence of topaz from this locality, citing the observed forms, two of which {445} and 142} appear questionable. Later Rev. R. T. Cross² mentions those found in the Platte mountains and gives the forms, all common, except {332}. These three forms mentioned do not occur on any of the crystals examined, but, on the other hand, there are seven forms present not mentioned in their descriptions.

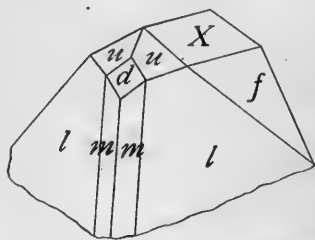


FIG. 17.—TOPAZ CRYSTAL FROM PIKES PEAK, COLORADO.

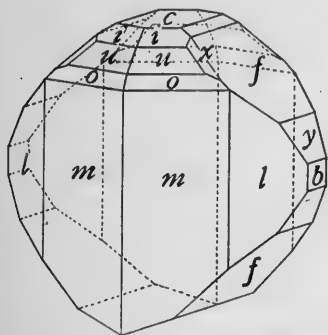


FIG. 18.—TOPAZ CRYSTAL FROM PIKES PEAK, COLORADO.

Fig. 17 is quite a characteristic combination for these crystals. No base is present, the two faces of X meeting in a long edge. The dome f is large, while y is small. The dome d is also common. (No. 82873, U.S.N.M.)

Fig. 18 shows a doubly terminated crystal with a richer variety of forms. The brachypyramid x and pinacoid b are rarer forms.

¹ Am. Jour. Sci., 3d ser., XXIV, p. 281.

² Idem, 3d ser., XXVI, p. 481.

The prism $g \{130\}$ and brachypyramid $J \{6.10.9\}$, besides the common forms, are shown on crystal (fig. 19). Another combination includes the narrow prism $M \{230\}$ between m and l .

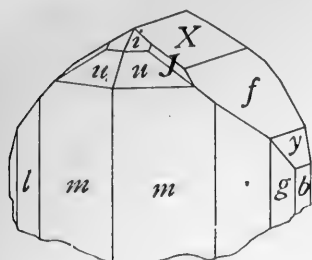


FIG. 19.—TOPAZ CRYSTAL FROM PIKE'S PEAK, COLORADO.

NATHROP, COLORADO.

Several small crystals are exhibited from this locality. They lie in the rhyolite matrix and are similar in type to the Mexican crystals. The observed forms are m , l , b , o , d , y , f , u , and c . Cross¹ cites in addition the prism $g \{130\}$.

THOMAS RANGE, UTAH.

This locality is well represented by a large number of crystals from 1 to 5 mm. in width, some of them doubly terminated. A few have the original rich wine color, but most are colorless. They are very similar to the Mexican crystals in general habit.

In addition to the forms cited by Alling² there occur several quite rare ones, and on a few the extremely rare macropinacoid $a \{100\}$ is well developed both front and rear.

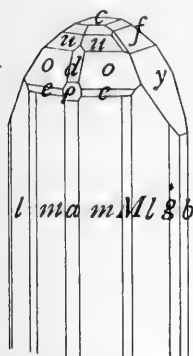


FIG. 21.—TOPAZ CRYSTAL FROM UTAH.

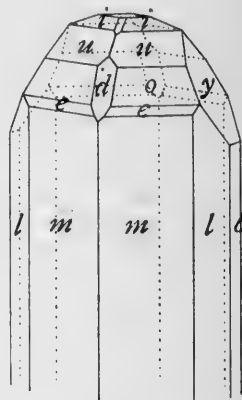


FIG. 20.—TOPAZ CRYSTAL FROM UTAH.

The forms observed in addition to those previously given are $a \{100\}$, $M \{230\}$, $g \{130\}$, $X \{023\}$, $x \{243\}$, $h \{203\}$, and $\rho \{401\}$. Of these x and h occur on but one crystal, and are extremely narrow. The prism g is not infrequent, while on the other hand the prism $u \{140\}$, figured by G. Stanley Brown,³ does not occur on any of the crystals. Many of the crystals show oscillations in their growth, causing reentrant angles or striated planes instead of sharp edges of intersection between planes. The edges

uy , oy , and ly thus appear as if replaced by planes, but measurements show them to have no constant angles with the adjacent faces.

Fig. 20 shows a general combination. It has, besides the common forms, the rarer ones e , b , and h . (No. 45191, U.S.N.M.)

The most general combination of all is seen in fig. 21, having as narrow forms a , M , g , e , p , x , and X .

¹ Am. Jour. Sci., 3d ser., XXXI, p. 432.

² Am. Jour. Sci., 3d ser., XXXIII, p. 146.

³ Dana's System of Mineralogy, p. 493.

CHATHAM, NEW HAMPSHIRE.

Two good crystals from Bald Face Mountain, near Stoneham, Maine, are shown in the collection. They are about 2 cm. in width and perfectly colorless, with bright faces. In habit and combinations they are similar to the Pikes Peak crystals. The base is not present on either of the crystals, and X therefore meets in a long edge.

Fig. 22 shows the type of crystal. The three brachydomes X , f , and y are all well developed. The edge uX is replaced by a plane which is so rounded as to be indeterminate, but from its position corresponds to the form $J \{6.10.9\}$ occurring on the Pikes Peak crystal. (No. 82579, U.S.N.M.)

In conclusion, the writer wishes to express his acknowledgments to Mr. Wirt Tassin, the assistant curator in the department of minerals, for his kindness in permitting the free use of material and instruments for this study.

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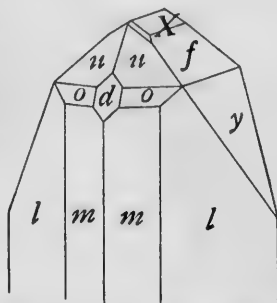


FIG. 22.—TOPAZ CRYSTAL FROM BALD FACE MOUNTAIN, NEW HAMPSHIRE.



NOTES ON CYTHEREA (TIVELA) CRASSATELLOIDES CONRAD, WITH DESCRIPTIONS OF MANY VARIETIES.

By ROBERT E. C. STEARNS,

Honorary Associate in Zoology.

The quahog or hard-shell clam, *Venus mercenaria*, of the Atlantic coast of the United States is probably the largest, most solid and heavy of any of the species of the *Veneridae*. The southern form, known as variety *mortoni* Conrad, frequently attains the weight of between three and four pounds, exclusive of the soft parts. Many specimens of these solid fellows were collected in Tampa Bay in January to March, 1869, by Colonel Jewett, Dr. Stimpson, and myself.

The next representative of the *Veneridae* in the matters of size and weight is *Tivela crassatelloides*, of the west coast. The geographical range of this latter species extends from Ballenas Bay, Lower California (*Albatross*), N. latitude $26^{\circ} 45'$, northerly to Santa Cruz in California proper, as reported. It is abundant in Moro Bay, north of Point Concepcion, and common at Santa Monica and Long Beach in Los Angeles County, on the outer shore of the Coronado peninsula, San Diego, and at many other localities between the limits first indicated. It is at the present time the commonest clam in the Los Angeles markets, which are supplied principally from Santa Monica and Long Beach. It frequently measures 6 inches in length (anterior to posterior margins), and reaches a weight of nearly 2 pounds. As an article of food I regard it as the best of the so-called clams that are found along this part of the coast. Its favorite station is at the lowest tide marks, and it seems to prefer a clean sand to sandy mud or muddy sand between ordinary tide marks, where the other principal clams of the Los Angeles markets are found, namely, *Tapes diversa*, *Chione simillima*, and *C. succincta*.

Tivela crassatelloides was described by Conrad¹ as *Trigona crassatelloides*. It is the *Pachydesma* of Carpenter's British Association report and, until recently, of California authors.

In Reeve's *Conch. Iconica*,² *Cytherea crassatelloides*, it is described, probably quoting Conrad, as follows:

Shell obliquely ovate, rather oblong, moderately triangular, thick, heavy, ventricose, covered with a thick horny epidermis, cream color, rayed with purple-violet.

¹ Jour. Acad. Nat. His. Sci. Phila., 1837, VII, p. 253, pl. XIX, fig. 17.

² Volume XIV, 1864, pl. I.

For a species so numerous in individuals it is quite uniform in outline, though examples are occasionally met with that are decidedly triangular, and infrequently an extremely elongated specimen occurs—not one in a hundred.

The more ventricose individuals are only moderately tumid. The epidermis in large adults is notably thick and deciduous, soon contracts and peels off, even after a good oiling or treatment with glycerine, and the colors are fugitive.

The color of the rays as given in the foregoing description, "purple-violet," suggests that the specimen upon which the description is based was more or less denuded, for when the epidermis is intact the rays can hardly be called purple-violet, although it is possible that such an example may sometimes occur. In half-grown examples or individuals under that size the epidermis is more tenacious or adherent; in these, however, a slight rubbing with sweet oil or glycerine is a wise precaution.

Conrad's description, as will be seen by what follows, is altogether too brief and fails to give any idea of the range of color that is exhibited by this species where a large number from different localities are brought together. The general or ground color of the surface runs from nearly white to dingy cream, to dark cream, pale umber, pale purple, or both tints in the same shell, pale ochre or sienna yellow, pale reddish brown to dark brown or light chocolate, with more or less bluish purple, etc., with various markings upon these ground tints. None of these tints or colors are what may be called brilliant; they are more vivid in the young shells, as well as in fresh or recently collected specimens.

I am not aware of any other species of *Tivela* that exhibits so many color varieties and markings, within so narrow a range of tints, as this. It requires a great number, however, and from many localities to fairly exhibit this variability. With a good series made with this intention a quite attractive result is attainable.

The series which forms the basis for this review, made by me expressly for the U. S. National Museum, includes selections from not less than a thousand specimens.

The first general segregation, the type aspect being in mind, is that ornamented with rays.

The greater proportion in any large promiscuous number are plain, but as a rayed example is the type of the species, the plain shells will have to be classed as varieties. The rayed ones may be grouped as follows:

GROUP I.

Dark rays on a light ground.

First, the typical, ground tints "cream." This must be expanded so as to include other ground tints, namely, dingy cream, dark cream slightly tinted with umber, sometimes very pale purplish; the anterior

angle darker, generally with numerous close set linear rays of purplish brown or brownish purple. The rays otherwise usually reddish brown dark or pale, narrow at the umbones and gradually widening toward the ventral margin. These rays may be few in number on one valve and numerous on the other; they often exhibit a somewhat serial arrangement; again in some individuals the rays on both valves may be few and narrow, linear; in other examples so numerous as to modify by obscuring the ordinary lighter ground tint.

The umbonal region is usually much lighter in these ("cream-color"); sometimes, rarely, the tip of the umbos is white or nearly white, and just below a tint of pale sienna-yellow.

The incremental growth is often marked by broad or narrow zones of purple.

The large adults seldom show the various color features or markings that are so often seen in shells one-third or one-half the maximum size.

The varietal segregation of such individuals as come within this group is no doubt somewhat arbitrary. Nevertheless, following after the type, we have certain facies that are reasonably separable when a large number of shells from different localities are compared, and the selections thus made by me for the U. S. National Museum series, whether the same may be regarded as worthy of varietal distinction or not, may be described as below:

The number of rays in the type, as figured in Reeve, is twenty, four of them being on the posterior slope; six of the rays are broad, the rest narrow, and three of the latter do not reach the beaks of the shell. This is in a general way a fair description of the average of the rayed individual.

The varieties following exhibit either very few, *many less* than the average or *very many more* rays than usual, giving at a glance a distinctive aspect to the examples included in these segregations.

Variety α , pauciradiata.

Light cream ground, rays reddish brown, few, linear, and usually narrow.

Variety β , multiradiata.

Ground tone very pale rufous, often slightly tinted with pale purple; rays reddish brown, numerous, linear, narrow; entire surface of valves closely rayed; rare.

Variety γ , alternata.

Ground color pale brownish or rufous, with more or less narrow rays irregularly alternating with broader rays; rays reddish brown.

Variety δ , eccentrica.

Ground and rays the same color as in the foregoing; the number of the rays on the two valves of the same shell conspicuously unlike; often

one valve will be pauciradiate, the other multiradiate; again, in one valve the rays may be narrow and in the other marked with broad rays. Another aspect is seen with a few rays on one valve; on the other narrow and broad rays alternating, often with wide interspaces of the ground color.

Variety $\delta\delta$, serialis.

The foregoing variety might well be regarded as including this, though separated by me so as to include examples wherever the rays and ground color are of the same tints and shades, but the rays are arranged in a somewhat serial order, the two valves being unlike, however, as to the position of the rays and the number thereof.

These segregations δ and $\delta\delta$ will include nearly all that remain of the examples, inclusive, under the general head of Group I, that do not fall into the previous varietal sections.

Variety ϵ , interrupta.

This is an exceedingly rare aspect; only 1 in 500; the ground color dull white at the umbos, brownish or dark cream below, a few rays of pale rufous brown and these obsolete in the umbonal region and interrupted below.

Variety ζ , luteobrunnea.

Ground color yellowish brown in the umbonal region, warm dark, rufous, with purplish zones and tint below, and narrow and broad rays of pale purplish brown. A very rare variety; only 1 in 500.

GROUP II.

Light rays on a light ground.

Variety η , uniradiata.

In this variety, which is the commonest of the group, the ground color is usually the same as that of the type, though often somewhat darker, a pale umber or purplish ash, for instance, whichever may be the general tone of the surface; an anterior single paler ray extends from the umbo, gradually widening as it approaches the ventral margin; this ray closely adjoins and follows next to the anterior angle of the valves; otherwise this variety is usually plain, though occasionally marked with zones of pale purple or pale umber or a combination of these two tints.

Variety θ , biradiata.

This is a comparatively rare variety, with the ground tints the same as in the preceding. In addition to the anterior ray extending to the ventral edge of the valves, there is a short ray in the opposite direction. The umbonal region in this variety is usually pale ashen blue or faint dull reddish purple.

Variety τ , triradiata.

In this we find the characteristic ground tints of the two preceding varieties, with the dull purplish area in the region of the beaks, with an intermediate, rather broad central ray, which in some instances extends nearly or quite to the ventral margin, though usually terminating or fading into the general surface color at a point one-half or one-third of the distance from the beaks to the lower margin. This median ray is often composed of several narrow ones that interblend or coalesce. Common.

GROUP III.

Ground color warm buff, pale ochre, or sienna yellow.

Variety κ , ochracea.

In this group we have examples wherein the dominant tint of the surface is warmer than either of the foregoing varieties, a warm, rather dingy ochre or sienna yellow or pale yellowish brown, this color being more intense on the upper third or half of the valves, the lower part showing more or less purplish, with zones of the same of a little darker tint and the surface of the valves rather obscurely rayed with numerous linear markings. The anterior slope darker, purplish brown or brownish purple.

This variety leads the way to and connects the foregoing groups (I, II, and III) with the darker groups and varieties below.

GROUP IV.

In this group purple and brown tints prevail, sometimes chestnut and chocolate.

Variety λ , purpureo-chocolata.

Pale reddish brown to chocolate, with purplish tinge and conspicuous or inconspicuous concentric purple zones; frequently obscurely radiately lineated; anterior slope dark purple brown; umbonal region generally dark, though sometimes light; extreme tips of beaks usually dark purple, sometimes light.

GROUP V.

Here we find shells with the dark ground tones of the preceding, but ornamented with light rays.

Variety μ , biserialis.

This variety consists of examples with two white or light-colored rays extending from the beaks; these rays are usually short; ground color purplish brown or brownish-purple, with zones of pale purple

otherwise marked occasionally with faint interrupted linear rays. A rare form. The two-rayed examples in this Group, as well as in Group II, are quite rare.

Variety ν , triserialis.

Three white or light-colored rays; the middle one generally the most conspicuous, sometimes extending nearly to the ventral edges, often quite broad and formed by the coalescing of numerous narrow linear rays; the surface of the valves often exhibit faint lineation or suggestions of rays, also stipple-like markings. Extreme tips of umbos generally purple, though sometimes light.

Frequently the rays on both of the foregoing varieties are only slightly exhibited at the beaks.

Variety ξ , aurora.

Umbonal region whitish; this tint covers about one-third of the surface of the valves from the beaks, the edge of this whitish area closely linearly rayed, suggesting the flame-like radiations from the upper edge of the "northern lights;" the rest of the surface of the valves pale, dingy purplish brown, with zones of pale purple and pale brown. This is a variety of very rare occurrence.

GROUP VI.

This group includes individuals which exhibit two series of rays, dark and light, in the same shell.

Variety α , duplicata.

This is a very rare and pretty variety, in which the general tone of the ground is pale purplish brown, with somewhat darker zones. It differs from all of the other rayed varieties in this, that it has the dark rays of Group I and the light rays of Group V. The light rays are short in some instances; in others the middle light ray extends nearly to the ventral margin. I have found only seven examples in a thousand specimens. The dark rays vary in number; in one example these are as numerous as in Variety β , *multiradiata*.

In most of the foregoing there are subvarietal aspects readily perceived by the eye, but not so pronounced as to admit of a description that would enable one to determine them without a colored figure.

The color variation herein described is exceedingly local, the varieties mentioned under Group I excepted. Of these, *multiradiata* is apparently restricted to the Santa Monica region, as well as *luteobrunnea*.

Mr. Hemphill informed me that the only color variety occurring at San Diego and the region thereabout is *ochracea*, of Group III.

INTERIOR COLORATION.

Occasionally individuals are found in which the muscular scars are pale to dark chocolate, with a touch or tint of bluish purple. In a single example the whole of the inside of both valves was stained with bluish chocolate, the region of the muscular scars being darker than elsewhere. Ordinarily the inside of the valves is of a uniform whiteness, rarely showing a yellowish tinge.

VARIATION IN FORM.

From color variation we come to variation in form. As a whole, with a thousand or more examples under review, the form is found to be remarkably constant. The outline of a few extremes is herewith given.

The smallest, a junior (Plate XXIV, fig. 1), is unusually triangular and short; the only example in the large number I have compared. The next in size (Plate XXIV, fig. 4) is unusually elongated transversely, one of three.

The larger outline (Plate XXIV, fig. 2) is that of a specimen from the outer beach of Coronado Peninsula, San Diego, contained in the collection of Mr. Homer Hamlin, of Los Angeles. Here we find the anterior portion greatly produced, as will be seen by comparison with the middle outline (Plate XXIV, fig. 3), which is a fair representation of the ordinary run of specimens, which are nearly if not quite equilateral.

The large San Diego specimen is from a special habitat, indicating the deeper burrowing or holding on necessary in a rapid tideway, or on a shore where the water deepens quickly and is more or less turbulent. With the greater depth of immersion in the sea bed follows the necessity for greater length of siphons and increased length of shell by the building up or development of the valves in that portion for the protection of the soft parts, and we have here an illustration of the relation of the environment to form, as is also well shown in the large *Cardium* (*C. magnum*) of Florida, when examples from portions of the wave-washed Atlantic shore are compared with those from the quieter beaches on the Gulf side.

EXPLANATION OF PLATES.

PLATE XXIII.

Tivela crassatelloides Conrad.

Typical form, natural size. See page 371.

PLATE XXIV.

(All figures natural size.)

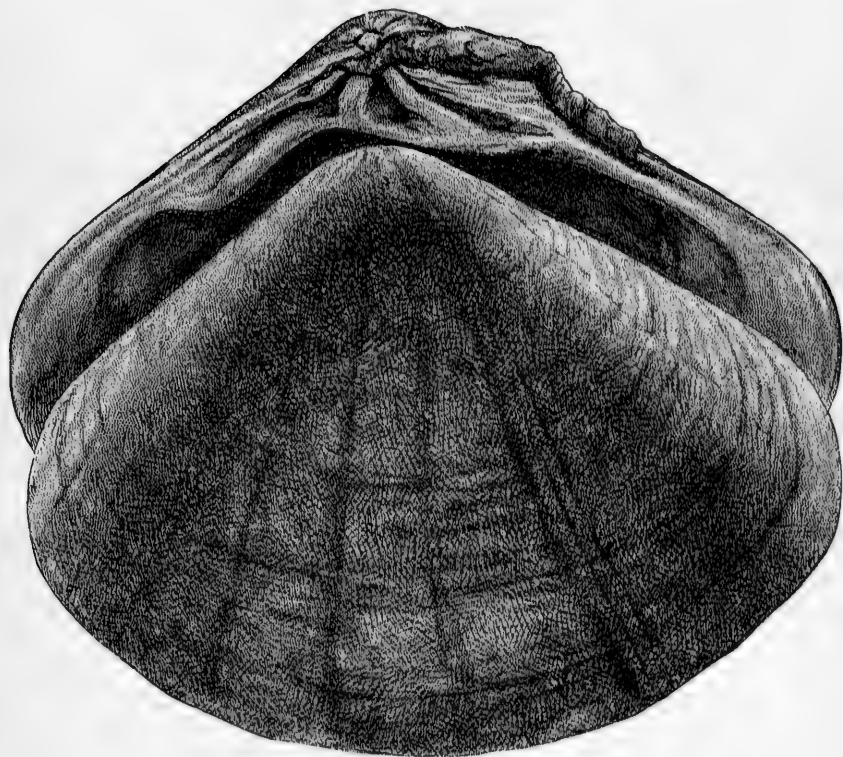
- Fig. 1. *Tivela crassatelloides* Conrad. Outline of an unusually short triangular example. See page 377.
2. Outline of a specimen from San Diego—much produced anteriorly. See page 377.
3. Outline of a typical example from Santa Monica, California. See page 377.
4. Outline of an unusually elongated specimen. See page 377.

PLATE XXV.

- Fig. 1. *Tivela crassatelloides* Conrad.

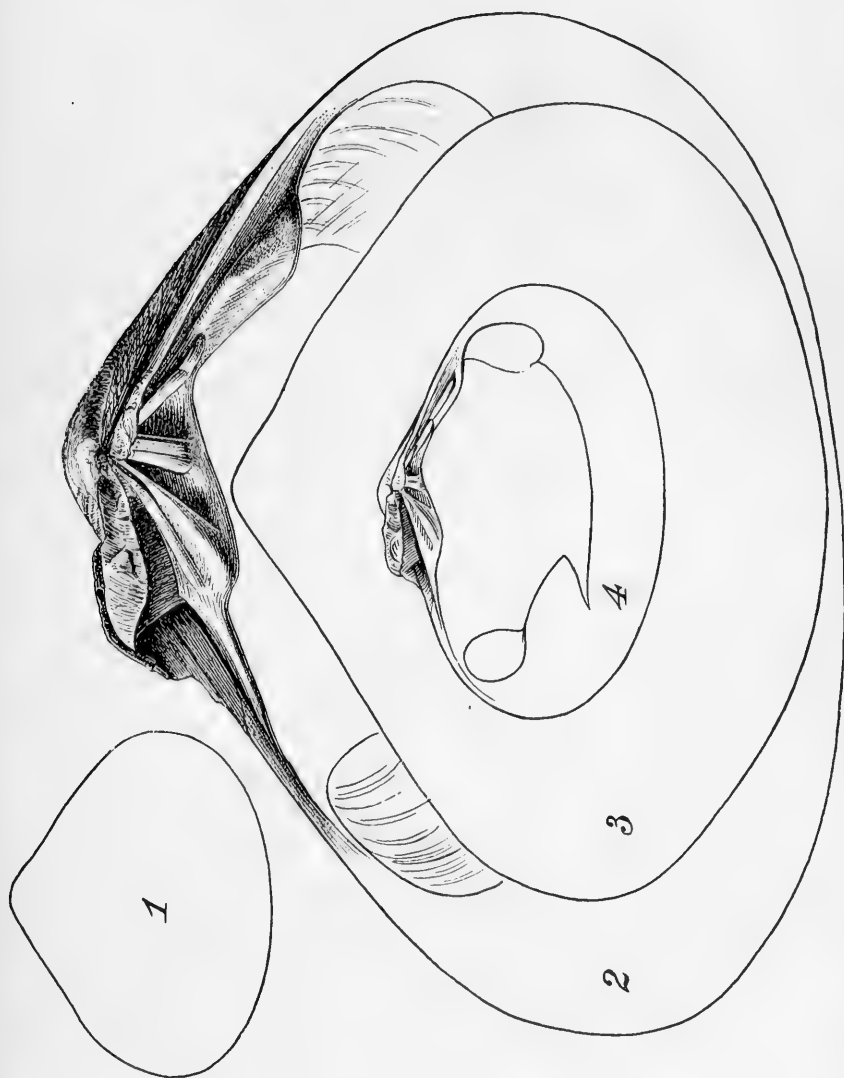
A specimen from San Diego with the right valve and part of the right flap of the mantle removed to show the soft parts. The arrows show the direction of the siphonal current. The heart, perforated by the intestine, is seen above the gills. The anal end of the intestine is free in the atrium of the anal siphon. The distal margin of the branchial siphon is merely granular, of the anal siphon plain. The former is opaque white, the latter translucent white, both marked with black dots around the orifices. The foot is livid, the edge flesh color, bullate, and wrinkled, the sides vertically wrinkled and granulate. The gills flesh color, the heart orange, pulsating once every ten seconds. The adductor muscles are reddish, the mantle dark flesh color, with the edge pale waxen white and wrinkled. The body mass is livid flesh color, the palpi small, single, twisted, distally more or less bifid. The intestine is white externally. Drawn from life by Mr. William H. Dall; two-thirds natural size.

- 1a. Sketch of a curious translucent body, acting as a crop or gizzard, internally situated behind the oral orifice. The upper or transverse portion overhangs the lower like a lip and aliment enters the organ below it. This lip is continuous with the tubular part behind. The figure is of natural size. Drawn from life by Mr. William H. Dall. The specimen from which these figures were taken was collected at San Diego, California.



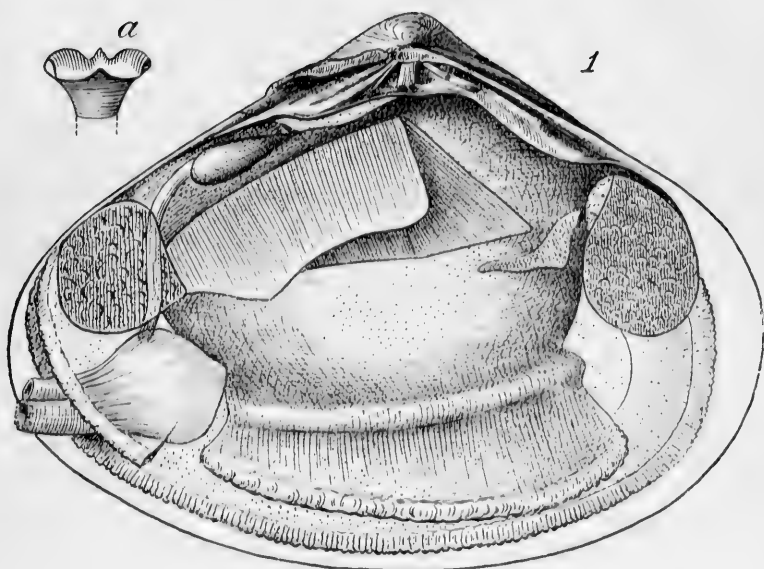
TIVELA CRASSATELLOIDES Conrad.

FOR EXPLANATION OF PLATE SEE PAGE 378.



TIVELA CRASSATELLOIDES Conrad.
FOR EXPLANATION OF PLATE SEE PAGE 378.





ANATOMY OF *TIVELA CRASSATELLOIDES* Conrad.

FOR EXPLANATION OF PLATE SEE PAGE 378.



ON THE OCCURRENCE OF AMPHIUMA, THE SO-CALLED CONGO SNAKE, IN VIRGINIA.

By HUGH M. SMITH,

Assistant, U. S. Fish Commission.

The "Congo snake" (*Amphiura means* Garden), according to Professor Cope,¹ inhabits the austroriparian region, not being found west of Louisiana nor north of Arkansas in the Mississippi Valley. The northern limit of its distribution on the Atlantic coast is not stated by Cope, but Jordan² gives the range as extending from Arkansas to North Carolina and southward. The U. S. National Museum collection contains specimens from Indiana, Arkansas, Louisiana, Mississippi, Florida, Georgia, South Carolina, and North Carolina. From the last-named State there is a single specimen, taken at Tarboro, a town on Tar river, in Edgecombe county. This is the most eastern locality from which the species has been recorded as far as my information goes, with the exception of some examples from southeast Virginia, to which reference will now be made.

In October, 1892, while excavations were in progress for an electric railway between Old Point Comfort and Hampton, Virginia, the workmen unearthed six or eight specimens of *Amphiura* of various sizes, the largest about 20 inches long. One of these was sent to Washington for identification by my friend Capt. N. Raynor, of Hampton. This specimen is now in the U. S. National Museum (Cat. No. 19615). In April, 1897, Capt. Raynor forwarded two more specimens, each 20 inches long, from the same locality. These were sent alive in a small pail of water, and one was retained in an aquarium in the U. S. Fish Commission building, Washington, D. C., until October, 1897.

All of these animals were observed at a depth of 2 or 3 feet beneath the surface, some being below and some above the water level. They were not found in one particular spot, but inhabited an area a quarter of a mile in extent about $1\frac{1}{2}$ miles from James river, comprising the lowest part of a tract of low farming land, where, during winter, water

¹ *Batrachia of North America*, 1889.

² *Manual of the Vertebrates*, 1890, 5th ed.

often remains on the surface, but which in summer is dry and covered with a growth of tall grass, with a few stunted oaks and pines. The excavations which brought the specimens to notice opened up various holes or paths, along which it appeared the animals passed.

This species is unknown to the people of Hampton and vicinity, and must be quite rare, as only the foregoing examples have ever been observed. Excavations through 4 or 5 miles of low land in the same section did not disclose any specimens of *Amphiuma*, although it appeared to be just as favorable for them as the limited area mentioned. Professional "ditchers" who have had much experience in cutting drains and ditches in the region about Hampton have never met with the species.

The locality in which these specimens were found is about 110 miles in an air line northeast of Tarboro. It seems probable that the species will in time be reported from such a favorable region as the Dismal Swamp, 30 miles south of Hampton, and from other suitable intermediate points.

DESCRIPTION OF A NEW SPECIES OF SPINY-TAILED IGUANA FROM GUATEMALA.

By LEONHARD STEJNEGER,

Curator, Division of Reptiles and Batrachians.

The U. S. National Museum has recently received from Mrs. K. I. P. McElroy a few reptiles from Gualan, Guatemala, among which there are three individuals of a very distinct species of the Central American genus *Ctenosaura*. In naming this species I have mentioned the most marked character by which it may be distinguished from all its congeners.

CTENOSAURA PALEARIS, new species.

Diagnosis.—A large dewlap hanging from the posterior part of the throat; caudal whorls of spines separated by a single row of scales; upper side of tibia covered with large hexagonal scales, each armed with a central spine; dorsal crest high, but composed of 35 to 45 spines only; interrupted on rump.

Type.—No. 22703, U.S.N.M.

Habitat.—Gualan, Guatemala.

DESCRIPTION OF TYPE SPECIMEN.

Adult male.—Head rather short; muzzle with decurved profile, covered above with rather large and slightly rugose scales; supraoculars small, nearly granular externally, larger, hexagonal and flat internally, separated from each other by three rows of scales; parietal scales slightly smaller than those on top of muzzle, tubercular; nostrils large, much nearer the tip of snout than the orbit, almost tubular, opening obliquely backward; behind nostrils a large, flat scale; one or two canthal scales; lores flat; temporals slightly smaller than the occipitals, tubercular; 10 or 11 enlarged supralabials; 9 enlarged sublabials; ear opening as large as orbit; dorsal scales small, hardly more than half the size of the ventral scales, gradually increasing in size posteriorly, smooth; a well-developed dorsal crest, barely indicated on the rump. The spines of the crest, 45 in number, all told, begin almost immediately behind the head; first six spines very small, followed by two somewhat

larger ones; ninth is suddenly larger and tenth still larger, equaling the largest; the spines are very compressed, about 8.3 mm. (0.325 inch) high and 3.8 mm. (0.15 inch) wide at base, and falcate in shape; their base is flexible and covered for about one-fourth of their height with two to three rows of minute scales; the last 12 spines decrease gradually in size, the last being equal to the first ones on the nape; about 10 small carinated scales follow until the caudal crest begins; three transverse dermal folds across the throat, which, with a similar one behind the ear, join two longitudinal folds on the side of the neck; these extend backward over the shoulder for some distance; between the anterior and posterior transverse gular folds a large compressed dewlap 32 mm. ($1\frac{1}{4}$ inches) from middle of base to top, the base along the middle of the throat being about 38 mm. ($1\frac{1}{2}$ inches); scales on throat and dewlap slightly smaller than the ventral scales, all smooth; scales on upper side of arm obtusely carinate, those on lower arm slightly larger, more distinctly carinate and somewhat spinous at tip; scales on femur slightly larger than the ventral scales, those on the upper surface obtusely keeled and with a small pointed tubercle at tip; scales on upper middle portion of tibia greatly enlarged, more or less regularly hexagonal, each with a falcate spine near center; scales on upper side of hind feet toward toes enlarged, keeled and spinous; 7 large femoral pores on each side; tail somewhat constricted at insertion, much depressed at base, becoming subcylindrical posteriorly; caudal scales above and laterally in whorls of large spinous scales, separated by a single row of smaller flat scales, the central one being spinous, however; in the spinous row the median scales are shortest, the lateral ones longest, while in the smaller and smooth row the proportion is reversed, so that the anterior outline of the large row is concave and the posterior outline of the small row convex; the outlines of each pair of rows perfectly straight; in the spinous row the scale on each side of the central one is without a spine; the lateral spines are straight, the central ones falcate; the median spines form a caudal crest, in the basal half of which the spines alternate large and small, according to whether they belong to the large or small row; caudal scales below much smaller, three rows corresponding to each pair above, strongly keeled and pointed posteriorly.

Color, green with yellow variegations on throat, dewlap, and lateral folds; dorsal crest pale yellowish; on the body several ill defined, chevron-shaped blackish bands, which do not cross the dorsal crest, but the posterior three of which reach the abdomen; tail marked with broad bands of dull blackish brown.

Measurements of type specimen of Ctenosaura palearis.

	mm.	inches.
Total length.....	429	= 16.9
Tip of snout to front of ear opening.....	41	= 1.6
Width of head at front of ear opening.....	29	= 1.15
Length of tail.....	231	= 9.1
Fore limb.....	69	= 2.7
Hind limb.....	216	= 8.5

Remarks.—There is another specimen (No. 22704, U.S.N.M.) of same age and sex, which differs in no essential feature from the one described, except that the dorsal crest consists of 36 spines only, and that the interruption between the dorsal and caudal crests is complete, being not even indicated by a row of carinated scales. Another peculiarity is that one of the small scales at the base in front of each dorsal spine has developed into a very minute spine. A third specimen (No. 24459, U.S.N.M.) is very young, only 198 mm. (7.8 inches) long. The dewlap is already well indicated, being 5 mm. (0.2 inch) deep; all the other diagnostic characters are also present and well marked. The dorsal crest is quite pronounced, the spines being triangular, about as high as long; the large ones are standing some distance apart, the intervals being wider than the basis of the spines; the small ones at the anterior and posterior ends are placed quite close; the number of the spines is 37; the crest perfectly interrupted on the rump. Eight femoral pores. Color essentially as the adults.

The present species is not nearly related to any of the species known hitherto, and does not require special comparison with any of them. It comes, perhaps, nearest to *C. quinquecarinata* (Gray), but the structure of the tail is very different, and the dorsal crest of *C. palearis* is both longer and higher, with much fewer and broader spines. In addition it differs from *C. quinquecarinata*, as well as from all the other species of the genus, in the possession of the enormously developed dewlap. That part of the generic definition of *Otenosaura* which reads "no gular pouch" will consequently have to be changed, as the presence of this appendage will not justify the establishment of a separate genus for *C. palearis*.



CAMBRIAN BRACHIOPODA: OBOLUS AND LINGULELLA, WITH DESCRIPTION OF NEW SPECIES.

By CHARLES D. WALCOTT,

Honorary Curator, Division of Stratigraphic Paleontology.

In continuation of the study of the Cambrian Brachiopoda all the American forms of *Obolus* known to me have been considered, and those that may be referred to *Lingulella*, which is a somewhat doubtful sub-genus of *Obolus*. A few species from the Lower Ordovician rocks are added, as they form a part of the passage fauna between the Cambrian and Ordovician faunas.

OBOLUS Eichwald, 1829.

(Plate XXVI, figs 3-6.)

Obolus EICHWALD, Zool. Spec., pars, 1829, II, p. 271; and most other writers.—MICKWITZ, Mem. Acad. Imp. Sciences, St. Petersburg, 1896, 8th ser., IV, No. 2, pp. 1-215, pls. I-III.

The student is referred to the memoir of Mickwitz for the synonymy, detailed description, and illustration of *Obolus* and the species referred to the genus. I have illustrated the interiors of the two valves of *O. celatus* and several interiors of *O. apollinis* from specimens worked out of material kindly sent to me by Dr. F. Schmidt.

It is stated in the Paleontology of New York¹ that Mickwitz did not obtain his results from the type species of the genus *Obolus apollinis*, but from a hitherto undescribed form, *Obolus quenstedti*. I find that Mickwitz diagnoses the genus and cites *Obolus apollinis* as the type (p. 128). He says (p. 24), "A more accurate study of the greatly increased material has convinced me that *O. quenstedti* can not be maintained as a species, since it is merely the terminal link of a series of variations, which, like var. *maximus* and *ingricus*, can be traced back to *O. apollinis*. Thus, the typical species remains *O. apollinis* Eichwald."

The figures illustrating the new species are now made up as plates for a monograph of the U. S. Geological Survey, and will be transmitted for publication probably during 1899.

¹ Volume VIII, pl. I, p. 339.

The American species of *Obolus* now known to me are:

American species of Obolus.

Name of species.	Cambrian.			Lower Ordovician.
	L.	M.	U.	
<i>Obolus anceps</i> Walcott.....				x
<i>Obolus loperi</i> Walcott.....			x	x
<i>Obolus mœra</i> Hall and Whitfield.....			x	
<i>Obolus matinalis</i> Hall.....		x		
<i>Obolus mickwitzi</i> Walcott.....		x		
<i>Obolus murrayi</i> Billings.....				x
<i>Obolus pandemia</i> Walcott.....		x		
<i>Obolus namouna</i> Walcott.....		x		
<i>Obolus refulgens</i> Matthew.....			x	
<i>Obolus rhea</i> Walcott.....		x		

OBOLUS MICKWITZI, new species.

General form rounded ovate, with the ventral valve broadly subacuminate, and the dorsal valve obtusely rounded; valves, as shown by the casts, moderately convex, which would give a rather strongly convex shell, as fragments show that it was quite thick over the central portions. Fragments of the shell showing the outer surface indicate that it was marked by concentric lines and striæ of growth; radiating striæ may have been present; they are strongly developed when the outer surface is exfoliated; the casts of the interior of the valves show very strongly concentric undulations and lines of growth, although in some specimens these characters are scarcely perceptible. The fragments of the shell preserved show that it was formed of a thin outer layer, several inner layers or lamellæ of varying thickness, and numerous lamellæ over the anterior and lateral portions of the shell that are slightly oblique to the outer surface. A somewhat rounded ventral valve has a length of 9 mm.; width, 9 mm.; a dorsal valve 9 mm. long has a width of 8 mm.; a more elongate ventral valve is 9 mm. in length and 8 mm. in width; an associated dorsal valve 7.5 mm. in length has a width of 7 mm.

Casts of the interior of the ventral valve show an area of medium length, divided midway by the cast of a strong, rather broad, pedicle furrow, and again a short distance each side of the pedicle furrow by a narrow, sharp, flexure line; striæ of growth cross the area of the pedicle furrow parallel with the front margin. There is slight evidence in one of the casts that the area formed a shelf between the pedicle groove and the lateral margin. The area of the dorsal valve is of medium length and fairly well extended out on to the cardinal slopes. The cast of the visceral cavity is well shown by several specimens. It resembles that of *O. matinalis* and *O. quenstedti* in the extension of the anterior margins almost directly outward from the center toward the impression of the main vascular sinuses; one of the peculiarities of the species is the great development of the area within the parietal scar (Splanchnocœle); in some examples it occupies all the central portions

of the shell, extending to within a short distance of the frontal margin; in others it is limited to the posterior half of the shell. The same features occur in the dorsal valve. There are no traces of a median septum in the ventral valve; in the dorsal valve it is shown in the cast as a very narrow depression between and a little forward of the central muscle scars.

In the ventral valve the anterior lateral muscle scars are distinctly shown; also the trapezoidal area, in which the central, middle, and outside lateral scars occur. In the dorsal valve large central and small anterior lateral scars are clearly defined; also the transmedian scars. Of the markings left on the interior of the shell by the vascular system, the trunk sinuses are usually strongly defined in the smaller shells, extending nearly to the anterior margin, and in the larger shells about three-fourths of the way over the area to the frontal margin.

Owing to the condition of the casts of the interior, the parietal scar is usually not well defined; in the ventral valve it appears to extend from where it arches forward at the center almost directly outward to the trunk sinuses, where it curves backward across the sinus and outside of the anterior lateral muscle scars; it occurs in the dorsal valve over the median line in front, is outward and backward around the side of the large central muscle scar, where it curves outward across the trunk sinuses.

Observations.—Attention has been called to the relatively large size of the visceral cavity (Splanchnocœle) in both valves of the smaller shells. The range of variation in this respect is so great, that it might be accepted as indicating a distinct species if there were not shells intermediate in size in which the splanchnocœle was also intermediate in proportional size. Another marked character in the specimens is the very strong impressions in the cast of the trunk sinuses and muscle scars and visceral markings. This species is somewhat more rounded in outline than *O. mæra* and *O. matinalis*, and it is very distinctly marked by the muscle scars of the dorsal valve.

Formation and locality.—Middle Cambrian, St. Croix sandstone, Hudson, Wisconsin.

Type.—No. 27299, U.S.N.M.

OBOLUS RHEA, new species.

General form elongate ovate, with the ventral valve subacuminate, and the dorsal valve elongate ovate in outline. Outer surface unknown, as all of the shells referred to this species are more or less exfoliated. The surface of the inner layers shows numerous, rather broad, radiating striæ, and concentric lines of growth. The shell appears to have been formed of a thin outer layer and several inner layers or lamellæ arranged in the same manner as in *O. matinalis*. A ventral valve 8 mm. in length has a width of 6 mm.; a shorter broader valve is 6.5 mm. long and 5.5 mm. wide. The two dorsal valves referred to this

species are larger than the ventral valve; one 9.25 mm. long has a width of 6.75 mm., and another 9.25 mm. long has a width of 7.25 mm.

Casts of the interior of the ventral valve show a rather short area that is not clearly defined in any of the specimens.

The cast of the pedicle groove is narrow and merges into the cast of the groove extending forward to the visceral area; the area is also marked by flexure lines, and transverse striae of growth. The area of the dorsal valve is short in the one specimen showing it. The cast of the visceral cavity on the ventral valve is clearly defined by a rather narrow ridge that is expanded anteriorly in what may have represented the heart-shaped cavity. The parietal scar passes around in front of the visceral cavity, and then a little backward to the main vascular sinuses. No traces of a median septum have been seen in either valve.

The only traces of muscle scars observed are some irregular markings in the trapezoidal area, in which the central, middle, and outside lateral scars occur in the ventral valve.

Observations.—This somewhat peculiar species is associated with *Dicellomus politus* and *Obolus namouna*. The dorsal valves are clearly distinct from any described form, approaching in some respects the elongate dorsal valve of *Lingulepis acuminata*, differing, however, in being narrower and more elongate; the ventral valves appear to be broader in proportion than the dorsal valve and approach *O. matinalis* in outline, but are more elongate.

Formation and locality.—Middle Cambrian, St. Croix sandstone, middle bed, at Eau Claire, Wisconsin.

Type.—No. 27300, U.S.N.M.

OBOLUS PANDEMIA, new species.

The external form of this species is much like that of *O. matinalis* Hall. It differs mainly in the characters of the interiors of the valves. In the ventral valve the central ridge is elevated so as to be the most pronounced feature; it not only fills up the space usually occupied by the heart-shaped cavity, but rises much above the interior surface of the shell. The trapezoidal areas and the depressions occupied by the main vascular sinuses are seen only with difficulty. The essential characters of the species are shown by the figures.

Formation and locality.—Middle Cambrian, argillaceous shales embedded in the Rome sandstone, at Shooks Gap, Bays Mountain, 10 miles east of Knoxville, Tennessee.

Type.—No. 27301, U.S.N.M.

OBOLUS ANCEPS, new species.

General form broadly ovate, somewhat subcuneate. Valves moderately convex. Surface marked by fine lines of growth and finer slightly undulating concentric striae. When the outer layer is exfoliated the

outer surface of the inner layer is marked by very fine radiating striae and numerous lines of growth. The inner surface of the shell is nearly smooth, judging from a partial cast in the limestone. The shell is relatively thin and formed of a very thin outer layer and one or more thin inner layers or lamellae, which thicken the shell from the umbonal region and toward the front and sides.

A cast of the interior of a dorsal valve that is referred to this species shows that a strong median ridge was present; also a median septum and a strong main vascular sinus. The area is short and marked by rather prominent flexure lines, as indicated by the flexures in the transverse lines of growth.

Observations.—This species might be taken for the young of *O. matinalis* or *O. mæra*, were it not for the great difference in the thickness of the shell. It occurs at a slightly higher horizon at the base of the Pogonip limestone.

Formation and locality.—Lower Ordovician, lower portion of Pogonip group, northeast of Adams Hill, Eureka district, Nevada.

Type.—No. 27302, U.S.N.M.

OBOLUS LOPERI, new species.

General form subsemicircular, with the ventral valve subacuminate, and the dorsal valve broad ovate to circular in outline. Some of the shells are more elongate than in what is considered to be the typical form. This type of variation is also observed in *O. matinalis* and other species of the genus. Valves moderately convex as they occur in the sandstone. Surface of the shell marked by concentric lines and fine striae of growth, and very narrow radiating undulations that are more or less interrupted by the concentric lines of growth. When the outer layer of the shell is exfoliated the inner layers are seen to be marked by numerous fine, rounded, radiating striae in addition to the concentric lines of growth, exceedingly fine, irregular, interrupted striae that give it in places a pitted appearance, while in a different light it appears to be granulated, a feature of the surface that seems to be present on the surface of all of the inner lamellae; sometimes the impression given is that the shell is minutely punctate.

The markings of the interior, so far as known, are rounded radiating striae. The shell is rather thick and built up of a thin outer layer and several inner layers or lamellae that in the anterior portions of the shell are rounded obliquely to the outer surface.

The largest shell in the collection is a somewhat imperfect dorsal valve 8 mm. in length. A smaller valve, 6 mm. in length, has the same width. A ventral valve, 6 mm. in length, has the portion about the beak broken away and is a little longer than wide.

The only traces of the interior of the valves is a partial cast of the dorsal valve. This shows that the interior lateral muscle scars were

situated on the anterior portion of the valve about one-third the length of the shell from the anterior margin.

Observations.—This species resembles in many respects *O. matinalis*; especially the Texan form referred to that species. The material is poorly preserved, but it appears to be clearly distinct from any described species. Its surface characters are more like those of some species of *Lingulella*, such as *O. (L.) prindlei*, than those of the typical American forms of *Obolus*, such as *O. matinalis*.

The species is named in recognition of the difficult and persevering work of Mr. S. Ward Loper, curator of the Museum of Middlebury College, who made a large collection of fossils, under the most adverse circumstances, in the mountains of Colorado.

Formation and locality.—Reddish sandstone, carrying a fauna intermediate between the Cambrian and Ordovician. Cement Creek, 3 miles north of Hot Springs, and 8 to 10 miles southeast of Crested Butte, Colorado.

Type.—No. 27303, U.S.N.M.

OBOLUS NAMOUNA, new species.

This form is closely related to *O. matinalis*. It differs mainly in the internal character of the dorsal valve. The area, in addition to the narrow area of *O. matinalis*, extends its lines of growth nearly one-fifth the length of the shell. The visceral area is shorter also than in *O. matinalis*, the central and interior lateral scars being closer together. Owing to the somewhat imperfect character of the ventral valve, no special points of difference with the ventral valve of *O. matinalis* can be determined. It is associated on the same slabs of sandstone with *O. rhea*.

Formation and locality.—Middle Cambrian, St. Croix sandstone, Eau Claire, Wisconsin.

Type.—No. 27304, U.S.N.M.

LINGULELLA, a subgenus of OBOLUS.

Glossina PHILLIPS, 1848; not defined.

Lingulella SALTER, 1866, Mem. Geol. Surv. Gt. Brit., III, p. 333.

Schmidtia VOLBORTH, 1869.

Heretofore the data relating to *Lingulella* have been too meager to permit of detailed comparison with other genera. The presence of a peculiar central channel in the cardinal area was the only character of importance observed by Davidson that served to distinguish *Lingulella* from *Lingula*,¹ and the illustrations of *Lingulella ella*, by Walcott, and of *L. celata*,² by Hall, have added little. The present careful working up of all the material relating to *L. ella* has brought out much more than

¹ Brit. Foss. Brach., Sil. Brach., 1866-71, Pt. 7, p. 55.

² This is not a *Lingulella*.

is shown in the former illustrations of that species, and we now have good material of *L. davisii*, the type of *Lingulella*, and of several closely allied species. Before making any comparisons I wish to call attention to the observations that have been made by Salter, Davidson, and Mickwitz. In the original description, Salter calls attention to the resemblance of the muscular scars of *Lingulella* to those of *Obolus*, but he considers that the difference in relative position is sufficient to distinguish the two genera. Attention is also called to *Obolella* Billings, and to the fact that the later figures of Billings "show a very different set of muscular scars."¹ Davidson had the same material that Salter had and more, but was unable to find any satisfactory interiors, and hence left the genus as doubtful; but he evidently considered it as nearly related to *Lingula*.

Mickwitz met with the same difficulty as Davidson, in having unsatisfactory material upon which to base an opinion. After stating that *Obolella* Billings would probably have to make room for the genus *Obolus* Eichwald, he says:

Whether *Lingulella* Salter will share the same fate, I will not venture to predict with the same degree of certainty, since the diagnosis and figures are even more imperfect than in Billings's genus.²

At first thought American paleontologists will be inclined to consider that there must be strong generic distinctions between *Obolus* and *Lingulella*. They have been accustomed to think of *Obolus* as a thick, strong shell, possessing such prominent and peculiar interior scars and markings that nothing in *Lingulella* would suggest generic identity. If we consider, however, that *Obolus* occurs in the Cambrian and Lower Ordovician strata of continental Europe, and that it has not been unquestionably recognized in America at the same horizons, we are led at once to ask, What represents it in America? The first answer is, *Obolella*; but when we compare the calcareous shell of *Obolella* with the semiphosphatic shell of *Obolus*, and note the marked difference in the interior of the ventral valve as compared with that of *Obolus*, we can hardly share Mickwitz's view that the two are congeneric, or, at the best, that *Obolella* is a subgenus of *Obolus*. If *Obolella* does not represent *Obolus* in America, there is only the widely distributed *Lingulella* to compare with *Obolus*.

The study of a series of finely preserved specimens of *Obolus celatus* Volborth leads to the conclusion that the small, thin shells of the *O. celatus* type are representatives of the *Lingulella* type in America and Britain. If the comparison is extended to *Obolus apollinis*, it is found that it is essentially the same, except that the muscular and other markings have been more strongly impressed on the thicker shell. In order to facilitate a comparison of *Obolus* and *Lingulella*, figures of the interior of the shell, drawn from specimens of *Obolus celatus* and *O.*

¹ Mem. Geol. Surv. Gt. Brit., 1866, III, p. 333.

² Mém. Acad. Imp. St. Pétersbourg, 1896, 8th ser., IV, No. 2, p. 126.

apollinis, are given on Plate XXVI, and of the type of *Lingulella* (*L. davisii*) on Plate XXVII. Three other strongly marked forms of *Lingulella* are illustrated on Plate XXVIII.

The memoir of Mickwitz gives the genus *Obolus* a position that it had not held prior to this very thorough investigation. With his descriptions and plates and a fine suit of specimens worked out from material given me by Dr. F. Schmidt, I have been able to make a series of comparisons that at times have led me to doubt the advisability of distinguishing *Lingulella* even as a subgenus of *Obolus*. This distinction is based on the more elongate form of most of the species of *Lingulella* and the greater thickness of the shell of the typical forms of *Obolus*. There are differences in the position, size, and form of the muscular scars, visceral area, and vascular canals of the two, but they are not greater than those between different species referred to *Lingulella* or to *Obolus*. The same general arrangement of muscle scars prevails, but on comparing the interior of the dorsal valve of *O. (L.) davisii* (Plate XXVII, fig. 4), with that of *O. (L.) acutangulus* (Plate XXVIII, fig. 2), or *O. (L.) amplius* (Plate XXVIII, fig. 4), we find as great variation as when the comparison is made with the dorsal valve of *Obolus* (Plate XXVI, fig. 2). The same is true of the ventral valve, although the means of comparison are in this case not so good. The oldest species of *Lingulella* (*L. granvillensis*) of the Upper Olenellus zone has the outline of *Obolus celatus*, and the interior markings of the ventral valve are also of the same type. *O. (L.) acutangulus* (Plate XXVIII, fig. 1) has the heart-shaped pit so characteristic of *Obolus* (Plate XXVI, figs. 1, 4, 5), and the arrangement of the muscular scars is essentially as in *Obolus*, but the outline of the valve is much more elongate. *O. (L.) davisii* and *O. (L.) amplius* vary decidedly from *Obolus* in the interior markings, but not more than from *O. (L.) amplius* and *O. (L.) acutangulus*. The variations are so well shown by the figures on the plates that detailed descriptions will not be entered upon.

The genus *Schmidtia* Volborth is considered as a subgenus of *Obolus* by Mickwitz. A comparison of typical specimens of *Schmidtia celatus* and *Lingulella davisii* leads to the view that *Schmidtia* is identical with *Lingulella*.

The following table gives a list of all the species referred by me to *Lingulella* in this preliminary study of *Obolus* and *Lingulella*:

American species of *Lingulella*.

Name of species.	Cambrian.			Ordovician.
	Lower.	Middle.	Upper.	
<i>O. (L.) acutangulus</i> Roemer.....			x	
<i>O. (L.) amplus</i> Owen.....		x		
<i>O. (L.) argutus</i> Walcott.....			x?	
<i>O. (L.) auga</i> Walcott.....		x		
<i>O. (L.) aurora</i> Hall.....			x	
<i>O. (L.) bellus</i> Walcott.....			x	
<i>O. (L.) bellulus</i> Walcott.....			x	
<i>O. (L.) billingsianus</i> Whiteaves.....			x	
<i>O. (L.) chwarensis</i> Walcott.....		x		
<i>O. (L.) cuneolus</i> Whitfield.....		x		
<i>O. (L.) cyane</i> Billings.....				x
<i>O. (L.) desideratus</i> Walcott.....		x?	x	x
<i>O. (L.) dubius</i> Walcott.....		x		
<i>O. (L.) ella</i> Hall and Whitfield.....		x		
<i>O. (L.) elli</i> Walcott.....			x	
<i>O. (L.) euglyphus</i> Walcott.....		x		
<i>O. (L.) ferrugineus</i> Salter.....		x		
<i>O. (L.) fragilis</i> Walcott.....		x		
<i>O. (L.) franklinensis</i> Walcott.....		x?		
<i>O. (L.) grandis</i> Matthew.....				x
<i>O. (L.) granvillensis</i> Walcott.....	x			
<i>O. (L.) hayesi</i> Walcott.....		x		
<i>O. (L.) helena</i> Walcott.....		x		
<i>O. (L.) iole</i> Billings.....				x
<i>O. (L.) ino</i> Walcott.....		x		
<i>O. (L.) irene</i> Billings.....				x
<i>O. (L.) iris</i> Billings.....				x
<i>O. (L.) laevis</i> Matthew.....			x	
<i>O. (L.) lambornii</i> Meek.....		x		
<i>O. (L.) lambornii</i> var. <i>minimus</i> Walcott.....			x	
<i>O. (L.) leos</i> Walcott.....		x		
<i>O. (L.) lineolatus</i> Walcott.....		x		
<i>O. (L.) mantichus</i> White.....		x		x
<i>O. (L.) martinensis</i> Matthew.....		x		
<i>O. (L.) macconnelli</i> Walcott.....		x		
<i>O. (L.) mosia</i> Hall.....			x	
<i>O. (L.) mosia</i> var. <i>osceola</i> Walcott.....			x	
<i>O. (L.) nanno</i> Walcott.....				
<i>O. (L.) oweni</i> Walcott.....		x		
<i>O. (L.) perattemvatus</i> Whitfield.....		x		
<i>O. (L.) phaon</i> Walcott.....		x		
<i>O. (L.) pogonipensis</i> Walcott.....				x
<i>O. (L.) primus</i> (Conrad) Hall.....			x	
<i>O. (L.) prindlei</i> Walcott.....	x			
<i>O. (L.) punctatus</i> Walcott.....		x		
<i>O. (L.) radulus</i> Matthew.....			x	
<i>O. (L.) roberti</i> Matthew.....				x
<i>O. (L.) rogersi</i> Walcott.....				x
<i>O. (L.) rotundatus</i> Walcott.....			x	x
<i>O. (L.) selwyni</i> Matthew.....				x
<i>O. (L.) similis</i> Walcott.....		x	x	
<i>O. (L.) sinoe</i> Walcott.....		x		
<i>O. (L.) starri</i> Matthew.....			x	
<i>O. (L.) starri</i> var. <i>minor</i> Matthew.....			x	
<i>O. (L.) stoneanus</i> Whitfield.....			x	
<i>O. (L.) tarpa</i> Walcott.....		x		
<i>O. (L.) willisi</i> Walcott.....		x		
<i>O. (L.) winona</i> Hall.....		x		
<i>O. (L.) zetus</i> Walcott.....			x	

SUMMARY.

Fifty-six species, 3 varieties.

Lower Cambrian, 2 species in extreme upper part.

Middle Cambrian, 26 species.

Upper Cambrian, 19 species and 3 varieties.

Ordovician (Lower), 12 species.

Passing from Lower to Middle Cambrian, 2 species in passage beds.

Passing from Middle to Upper Cambrian, 2 species.

Passing from Upper Cambrian to base of Ordovician, 2 species.

Subgenus **LINGULELLA** Salter.

(Plate XXVII, figs. 1-5.)

Lingulella SALTER, Mem. Geol. Surv. Gt. Brit., 1866, III, p. 333.—DAVIDSON, Brit. Foss. Brach., Silur. Brach., 1866, Pt. 7, p. 55.—WALCOTT, 1886, Bull. U. S. Geol. Surv., No. 30, pp. 95-98; Tenth Ann. Rept. U. S. Geol. Surv., 1891, pp. 607-608, pl. LXVII.—HALL and CLARKE (pars), 1892, Pal. New York, VIII, Pt. 1, pp. 55-59, 163, pl. II, figs. 5-13; Eleventh Ann. Rept. New York State Geol., 1894, p. 232, figures in text only.

Diagnosis.—Shell subequivalve, equilateral; elongate-ovate, broad ovate, or subtriangular in outline. Ventral or pedicle valve usually subacuminate, with a distinct cardinal area, pedicle groove, and flexure lines. Dorsal or brachial valve somewhat the shorter, less acuminate, and with a less clearly marked pedicle groove on the shorter cardinal area. Surface of shell marked by fine concentric striae and lines of growth, and in some species finely inosculating and lamellose striae, also, in most if not all species, radiating striae.

Muscular impressions usually indistinctly preserved. In the ventral valve what appears to be a divided umbonal scar has been observed in *O. (L.) darisi* (Plate XXVII, fig. 3, *g*) and *O. (L.) acutangulus* (Plate XXVIII, fig. 1, *h*). A faint trace of a pedicle scar was found in the latter specimen on the shallow groove between the umbonal scars at *m*, Plate XXVIII, fig. 1. Its position is also indicated on Plate XXVII, fig. 3, at *m*. The anterior and concrete laterals are well shown in *O. (L.) acutangulus* (Plate XXVIII, fig. 1, *j* and *c*), but they have not been seen in *O. (L.) darisi* except doubtfully, as shown by *c*, Plate XXVII, fig. 1. The muscular scars of the dorsal (brachial) valve are quite satisfactorily preserved in several species of the genus. The central scars (*h*, Plate XXVII, fig. 4) of *O. (L.) darisi* are clearly defined in a specimen from Port Madoc, and the small anterior laterals and outside laterals are also well shown in the same specimen. In *O. (L.) amplus* (Plate XXVIII, fig. 4) the centrals occur in the same relative position as in *O. (L.) darisi*, but they are much smaller, while in *O. (L.) acutangulus* (fig. 2) they are situated much farther forward and are only a little longer than in *O. (L.) amplus*. The anterior laterals of *O. (L.) darisi* (*j*, Plate XXVII, fig. 4) are situated close to the anterior end of a median ridge, while in *O. (L.) acutangulus* they are a short distance away from the median ridge and much farther forward than in *O. (L.)*

davisi or *O. (L.) amplus*. The outside laterals (*l*, figs. 4, 5) are finely preserved in *O. (L.) davisi*, as are also the transmedian scars (*i*, fig. 5).

The interior markings show vascular sinuses in both valves (*s*, Plate XXVII, figs. 1, 2, 4; Plate XXVIII, figs. 2, 3, 4, 5, 6, 7) and a distinctly marked visceral area (*v*) on the ventral valve. A considerable variation in the outline and position of the vascular sinuses and visceral areas occurs in the species illustrated on the plate, and important modifications occur in several other species.

A narrow median ridge or septum is frequently observable in the dorsal valve (Plate XXVII, fig. 4; Plate XXVIII, figs. 2, 4); but with the exception of what may be considered as indicating its probable presence in one specimen of a ventral valve of *O. (L.) davisi* (see Plate XXVII, fig. 1), no traces of a septum have been observed in the ventral valve of any species referred to the genus.

Type of subgenus, *Lingulella davisi* McCoy.

Observations.—When in Wales, in 1888, I made a small collection of *O. (L.) davisi* at the type locality at Port Madoc, and later Mr. G. J. Williams sent me a number of fine specimens for study. All of the material was carefully prepared by Dr. George H. Girty, who made a preliminary study of the type and other species referred to the genus when superintending the preparation of the drawings. The systematic study of all the species that have been referred to *Lingulella* is now in progress in connection with the study of a considerable amount of new material from various localities in the Cambrian rocks of North America.

The vertical range of *Lingulella* is from the upper horizon of the Olenellus or Lower Cambrian fauna to the summit of the Cambrian and into the Ordovician fauna. The oldest known species is *O. (L.) granvillensis*, which is associated with Olenellus in strata referred to the upper portion of the Olenellus zone. The greatest development of species is in the Middle and Upper Cambrian, only a few forms continuing on into the Lower Ordovician fauna.

There are two other species of *Obolus* in the Lower Ordovician of Newfoundland that will be fully illustrated in the general work upon Cambrian Brachiopoda. They are *Obolus (Lingulobolus) affinis* and *Obolus (Lingulobolus) spissus*. Mr. G. F. Matthew placed the two species under distinct genera, *Lingulobolus affinis* and *Spharobolus spissus*.

The study of a considerable quantity of material that I collected at the typical locality on Great Belle Island leads to the conclusion that both species should be referred to the genus *Obolus*, subgenus *Lingulobolus*, 1895, the latter being the same as the subgenus of *Obolus (Thysanotos)* Mickwitz, 1896, of which *O. (T.) siluricus* Eichwald is the type.

It is a curious and interesting fact that the peculiarity of the area of the dorsal valve, to which Mr. Matthew gives much importance, is also present in the oldest of the *Obolus* group, *O. (L.) granvillensis*, and in one or two other species in the Middle and Upper Cambrian.

DESCRIPTION OF NEW SPECIES.¹

OBOLUS (LINGULELLA) ARGUTUS, new species.

Lingula ? manticula WHITE (pars), Expl. and Sur. West of the 100th Merid., 1874 Prelim. Rep., p. 9; (pars) Expl. and Sur. West of the 100th Merid., 1875, IV, p. 52, pl. III, fig. 2a (not fig. 2b).

General form ovate, with the ventral valve obtusely acuminate; valves moderately convex. Exterior surface of the shell unknown. Very fine radiating striae and concentric lines of growth occur on the outer surface of the inner layer of the shell. The shell appears to be of medium thickness and formed of a thin outer layer and one or more thin inner layers or lamellae. The type specimen of the ventral valve has a length of 6 mm. and a width of 4.5 mm.

Observations.—This species is founded upon one of the specimens illustrated by White as *Lingula ? manticula*. The broadly ovate form of the ventral valve clearly distinguishes it from that species. From the associated fragments of trilobites, it evidently occurs at a lower horizon, which may be either Upper or Middle Cambrian. A dorsal valve from the same locality and in a slightly different character of limestone is provisionally referred to the same species.

In outline this shell resembles *O. (L.) bellus* and *O. (L.) bellulus* from Newfoundland. It may also be compared with *O. (L.) punctatus*, from which it differs in being more ovate.

Formation and locality.—Upper (?) Cambrian, Schellbourne, Schell Creek Range, Nevada.

Type.—No. 27305, U.S.N.M.

OBOLUS (LINGULELLA) AUGA, new species.

General form subeuneate, with the ventral valve obtusely acuminate and the dorsal valve rounded acuminate; valves moderately convex. Surface of the shell, as indicated by casts in the fine sandstone, marked by lines of growth and fine, slightly undulating striae. The inner surface is marked by somewhat irregularly scattered pits or punctae, some of which are unusually large for the size of the shell. The few traces remaining of the shell indicate that it was relatively thin. The largest well-preserved cast of the ventral valve has a length of 5 mm., with a width of 4.5 mm. The dorsal valves are a little shorter, the length and breadth being nearly the same. Casts of the interior of the ventral valve show the presence of a rather long area, divided midway by a narrow, clearly defined cast of a pedicle groove; traces of flexure lines are also preserved. The area of the dorsal valve is proportionately shorter than that of the ventral valve; traces of the visceral cavity (*r*) and the base of the main vascular sinuses are also preserved

¹The figures illustrating the new species are now made up as plates for a monograph of the United States Geological Survey.

in a few specimens, and in one specimen the anterior lateral muscle scars appear to be present.

Observations.—In the form of the valves this species is somewhat similar to *O. (L.) grandis*; otherwise it appears to be quite distinct from any other described species.

Formation and locality.—Middle Cambrian, sandy layers of the Rome formation, at Shooks Gap in Bays Mountain, 10 miles east of Knoxville, Tennessee.

Type.—No. 27306, U.S.N.M.

OBOLOUS (LINGULELLA) BELLUS, new species.

General form ovate, with ventral valve obtusely acuminate; dorsal valve broad ovate; valves moderately convex, as far as can be determined from the somewhat compressed specimens as they occur in the sandy shales.

Surface of shell with numerous concentric lines of growth, with exceedingly fine, slightly irregular striae on the interspaces between the stronger concentric lines. Owing to the roughened surface formed by the fine striae, the outer layer of the shell adheres to the arenaceous matrix, leaving the shiny inner layer on the shell. This is marked by concentric and numerous fine radiating striae.

The shell is apparently thin, and formed of a very thin outer layer, with one or more thin inner layers or lamellae. The casts of the interior surface of the ventral valve show numerous papillae arranged in concentric lines on the posterior half of the shell. These correspond to the punctae of the inner surface.

A large ventral valve has a length of 15 mm.; width, 9 mm.; and a dorsal valve 13 mm. in length has a width of 10 mm. The specimens in the collection average from 2 to 3 mm. smaller than this.

The cast of the area of the ventral valve shows that it was rather long and extended well out onto the cardinal slope; it is divided midway by a strong pedicle furrow, and toward the lateral margin by a narrow flexure line. The area is marked by fine striae of growth parallel to the margin. The area of the dorsal valve is rather short, but it extends laterally well out on the cardinal slopes. The shallow curve corresponding to the pedicle groove of the larger valve is wide and clearly defined.

The casts of the interior of the valves show almost no traces of the vascular markings or muscle scars. Only the anterior lateral muscle scars have been observed in the ventral valve.

Observations.—This fine species occurs in great abundance in the upper beds of Little Bell Island associated with *O. (L.) bellulus*, and also in the higher beds on Great Bell Island, a little below the layers carrying *Lingulobolus affinis* and *Spharobolus spissus*. Although found at some little distance above the horizon in which I collected a species of *Olenus*, I refer the horizon to the Upper Cambrian.

This species appears to be clearly distinct from any described form. It may be compared with *O. (L.) davisi* in relation to its size, but not in other respects, except that it has something of the same general outline.

Formation and locality.—Upper Cambrian, arenaceous shales of the upper beds on Little Bell Island and Great Bell Island, Conception Bay, Newfoundland.

Types.—Nos. 27307-8, U.S.N.M.

OBOLUS (LINGULELLA) BELLULUS, new species.

General form ovate, with the ventral valve obtusely acuminate, and the dorsal valve round ovate. Valves moderately convex. Surface of shell marked by concentric lines of growth and exceedingly fine, irregular striae, that give the same appearance to the surface as that seen on *O. (L.) ella*, *O. (L.) dawsoni*, *O. (L.) fragilis*, and on a larger scale on *O. (L.) radulus*. The outer layer of the shell usually adheres to the arenaceous matrix, leaving the shiny inner layer of the shell. This is marked by concentric striae and lines of growth, and fine radiating striae. The shell is thin and formed of a very thin outer layer, and one or more thin inner layers or lamellae.

The average length of the ventral valve is from 4 to 5 mm.; width, 3 to 3.5 mm. The dorsal valves are a little shorter, 0.5 mm. to 1 mm.

The cast of the area of the ventral valve shows it to be elongate, divided midway by a narrow but strong pedicle furrow and about midway between the pedicle furrow and the lateral margin by a narrow flexure line; it is marked by striae of growth parallel to its base. The area of the dorsal valve is not well shown by the specimens in the collection.

The casts of the interior of the ventral valve show somewhat imperfectly the visceral cavity, but not the muscle scars. In an interior of the dorsal valve the main vascular sinuses are well shown, also the median septum. The central muscle scars are faintly shown in one fragmentary interior of the dorsal valve.

Observations.—This beautiful little species occurs in the arenaceous shales and thin bedded sandstones of Little Bell Island in association with the larger species *O. (L.) bellus*. It is closely related to *O. (L.) dawsoni*, but differs somewhat in form and the more anterior position of the visceral cavity in the dorsal valve. The species is the Upper Cambrian representative of the Middle Cambrian species *O. (L.) dawsoni*. It occurs at about the same horizon as *O. (L.) billingsiana*, but differs decidedly from it in form and convexity, the only points of comparison the material permits of being made.

Formation and locality.—Upper Cambrian, arenaceous shales about 75 feet down in the section of Little Bell Island, Conception Bay, Newfoundland.

Type.—No. 27309, U.S.N.M.

OBOLUS (LINGULELLA) CHUARENSIS, new species.

General form broadly ovate, almost subquadrate, with the ventral valve obtusely acuminate, and the dorsal valve rounded subquadrate, the posterior margin being broadly obtuse; convexity moderate, increasing somewhat in the older shells. Surface of shell marked by rather strong, concentric lines and striae of growth, and very fine, more or less transverse and irregular, apparently imbricating striae such as ornament the surface of *O. (L.) ella*, *O. (L.) willisi*, and *O. (L.) euglyphus*. Fine radiating striae also appear under a strong magnifying glass; when the outer surface is exfoliated the inner layers of the shell show traces of radiating striae; the inner surface is marked by pits or punctae, arranged in more or less irregular concentric lines; also fine radiating striae. The shell is strong and formed of a thin outer layer and several inner layers or lamellae, those near the outer margin being arranged obliquely to the outer surface.

The only traces of the interior markings are those on the casts of the dorsal valve. These show a short and rather broad area, strong vascular sinuses, and traces of the interior lateral muscle scars.

Observations.—The character of the surface ornamentation and the subquadrate form of the dorsal valve leads to comparison with *O. (L.) willisi* of the Middle Cambrian of the Southern Appalachian fauna, and with *O. (L.) ella* of the Rocky Mountain fauna. The species differs from those in being a thicker, stronger shell, and relatively shorter in proportion to its length. The surface is also of the same type as that of *O. (L.) euglyphus*, which occurs at the same horizon in the upper portion of the Tonto sandstone, but not associated with it. It differs from *O. (L.) euglyphus* in being much shorter and broader in proportion to its length.

Formation and locality.—Middle Cambrian, upper layer of the Tonto sandstone, at the head of Nunkoweap and Chuar valleys, Grand Canyon of the Colorado, Arizona.

Type.—No. 27310, U.S.N.M.

OBOLUS (LINGULELLA) DESIDERATUS, new species.

Shell small, subovate, with the ventral valve obtusely acuminate, and dorsal valve broadly ovate. Valves are strongly convex, with the ventral valve fully as much so as the dorsal. There is a slight variation in the outline of the valves, some being slightly more rounded posteriorly than others.

The surface of the shell is marked by fine, concentric lines of growth, and between them very fine, slightly irregular striae; a few rather narrow indistinct undulations radiate from the umbo toward the front and lateral margins; when the outer shell is partially exfoliated the outer surface of the inner layer is marked by very fine, indistinct radiating striae; there are a few traces of small, scattered pits or punctae on the

inner surface. The shell is thin and formed of an outer layer and one or more inner layers or lamellæ.

The average length of the ventral valve is about 4 mm.; width, 3 mm. A dorsal valve 3.5 mm. long has a width of 3 mm.

A cast of the interior of a ventral valve shows an area of medium length, divided midway by a narrow, clearly defined pedicle groove. The area of the dorsal valve is short. Nothing is known of the interior of the ventral valve, but in a cast of a dorsal valve there are traces of the main vascular sinuses, central median septum, and the central muscle scars.

Observations.—This species may be compared with the Middle Cambrian *O. (L.) ferrugineus* of the Atlantic Basin fauna, and *O. (L.) similis* of the Black Hills, Upper Mississippi Valley, and Appalachian faunas. Compared with the Rocky Mountain species it is intermediate between *O. (L.) manticulus* and *O. (L.) rotundatus*. It may also be compared with *O. (L.) granvillensis* of the Olenellus fauna of eastern New York, and *O. (L.) iole* of the Lower Ordovician fauna of Newfoundland.

The specimens that occur at the same geological horizon in the Eureka district, Nevada, are broader proportionately than the typical specimens, and what appears to be the same, or a closely related species, occurs in the upper beds of the Secret Canyon shale just beneath the Hamburg limestone, 1,200 feet lower in the Eureka Cambrian section.

A form that appears to be identical occurs in considerable abundance in the shaly limestone at the base of the lower Knox of Alabama, and also in similar limestones in Tennessee. This similarity is even more striking when the specimens are compared directly with each other and some allowance made for the fact that the Appalachian specimens have all been more or less compressed.

The Tennessee specimens occur in limestones interbedded in or at the summit of the Upper Cambrian Connasauga shale, a short distance beneath the Knox dolomite. Those from Alabama occur at the same horizon on the south side of the Coosa Valley. Compressed specimens referred to *O. (L.) similis* are found in the Coosa shales at Yanceys bend, Coosa River, Cherokee County, Alabama, that can scarcely be distinguished from *O. (L.) desideratus*.

A shell that appears to be identical with this species occurs in the red sandstone and argillaceous shale of the Lower Ordovician of Colorado. The specimens from Trout Creek below Bergen Park are much like those from the Gallatin Range, and the same species of *Billingella* is associated with them. At Cement Creek, 10 miles southeast of Crested Butte, the shells occur in a fine conglomerate and coarse sandstone, associated with a species of *Bathyurus* much like that from the beds containing *O. (L.) desideratus* at Trout Creek.

The vertical range of the shells referred to this species appears to be from the upper beds of the Cambrian into the lower beds of the Ordo-

vician in the Rocky Mountain region. It will require thorough, systematic collecting to establish its range definitely.

Formation and locality.—Upper Cambrian and Lower Ordovician, Gallatin limestone, Crowfoot section, Gallatin range, Yellowstone National Park, Wyoming; Hamburg shale near the Hamburg mine. A variety also occurs in the Secret Canyon shale 1,200 feet below the Hamburg shale, Eureka district, Nevada.

Reddish, sandy beds west side of Trout Creek, below Bergen Park, and Cement Creek; 3 miles north of Hot Springs, 8 to 10 miles southeast of Crested Butte, Colorado.

Shaly limestones at base of Knox dolomite, west of top of Copper Ridge, near railroad cut, 11 miles northwest of Knoxville, Tennessee; also abundantly in the Rogersville shale, both NNE. and SSW. of Rogersville, Tennessee; in thin layers of limestones at base of Knox dolomite along Cowan Creek, Coosa Valley, Cherokee County; also in shaly limestone in suburb of Attala, Alabama; also at same horizon a large variety occurs both on Cowan Creek and in the Oothcaloga Valley, Bartow County, Georgia.

Types.—Nos. 27311–3, U.S.N.M.

OBOLUS (LINGULELLA) DUBIUS, new species.

This is a small shell associated with *O. (L.) ella*. It occurs in the form of casts in argillaceous shale, no traces of the shell substance remaining. The ventral valve averages about 3 mm. in length, and the dorsal valves are a little shorter. A cast of the interior of the ventral valve shows the visceral cavity (*v*) and an unusually strong main vascular sinus on each side. Only one specimen shows these characters. Others only faintly indicate them.

The dorsal valve is rounded ovate, and the cast of its interior shows a very short area that extends well out on the cardinal slopes. The interior markings are a portion of the main vascular sinuses, which resemble somewhat in their form and extension those of the dorsal valve of *O. (L.) chuarensis*. The only muscle scars preserved are the anterior laterals of the dorsal valve.

As far as can be determined by casts, the outer surface is marked by lines of growth and fine, slightly undulating, concentric striae.

Observations.—At first I thought the specimens now referred to this species were the young of *O. (L.) ella*, and so illustrated them.¹ There is still considerable doubt as to their specific relation, but in view of their very distinct interior markings I have referred them to a new species.

Formation and locality.—Middle Cambrian, Chisholm Mine, southwest slope of Ely Mountains, 3 miles northwest of Pioche, Nevada.

Type.—No. 27314, U.S.N.M.

¹ Tenth Annual Rept. U. S. Geol. Sur., 1891, pl. LXVII, figs. 2c, 2d.

OBOLUS (LINGULELLA) ELLSI, new species.

Shell small, broad ovate in outline, with the ventral valve obtusely acuminate and the dorsal valve broadly rounded; valves appear to have been moderately convex, judging from the appearance in the siliceous shale. The surface of the shell is marked by rather strong concentric lines and striae of growth, the striae indicating a slightly lamellose surface. Very fine radiating striae occur on the surface of the inner layers of the shell. A ventral valve 3.5 mm. in length had a width of 2.75 mm.; the dorsal valve is a little shorter than the ventral valve.

Partial casts of the interior of the ventral valve show a very clearly defined area that extended as a shelf on each side of the rather deep, narrow pedicle furrow; portions of the casts that fill the undercut may be observed in several specimens; the flexure lines are narrow, sharp, and situated well out toward the lateral margins. The cast of the visceral area of the ventral valve extends about one third the distance from the area to the anterior margin; it is not well defined, and no traces of muscle scars have been detected; of the vascular system only the base of the main sinuses are shown in any of the casts.

Observations.—This very pretty little species is closely related in form to *O. (L.) rotundatus*, and comparison should also be made with the more rotund variety of *O. (L.) ferrugineus*. It occurs in association with *Aerothele pretiosa* (*Obolella pretiosa* Billings).

The specific name is given in honor of Dr. R. W. Ells reports, whose fine work on the geology of a portion of the Province of Quebec unraveled the stratigraphic relations of the Lauzon slates in which the species occurs. Dr. Ells also guided me to the locality at which the species occurs.

Formation and locality.—Upper Cambrian, Upper Sillery (Lauzon of Logan), Chaudiere River, Grand Trunk Railroad bridge, Province of Quebec, Canada.

Type.—No. 27315, U.S.N.M.

OBOLUS (LINGULELLA) EUGLYPHUS, new species.

General form ovate, with the ventral valve subacuminate, and the dorsal valve broad ovate in outline. There is some range of variation in the outline of the valves; the convexity of the valves is fairly strong, and is nearly the same in each. A ventral valve 11 mm. in length has a width of 8 mm.; convexity, $1\frac{1}{2}$ mm.; and a dorsal valve 9 mm. in length has a width of 8 mm.; convexity, $1\frac{1}{2}$ mm.

The outer surface of the shell is marked by strong concentric lines and striae of growth, and a complex system of lamellose striae of the type of those on *O. (L.) ella*. The striae have a transverse direction, are irregular, and sometimes inosculating. The striae are a little coarser than those on the surface of *O. (L.) ella*, and finer than those of *O. (L.) aurora*. They are also less irregular than those of *O. (L.) ella*,

and more so than those of *O. (L.) aurora*, the result being a surface character intermediate between that of these two species. When the outer layer is exfoliated, the surface of the inner layer is marked by numerous fine, radiating striae and concentric lines of growth. The cast of the inner surface of the shell shows rather numerous papillae that fill the pits or punctae in the shell. The shell is strong and formed of a thin outer layer, and several inner layers or lamellae that are arranged very much as in *O. (L.) acutangulus*.

As shown by casts of the interior, the cardinal area of the ventral valve is rather long and well extended out on the cardinal slopes. It is divided at the center by a cast of a strong, rather deep pedicle furrow, and about three-fifths of the distance between the pedicle furrow and the lateral margin by a sharp, narrow flexure line. The striae of growth cross the area parallel to its base. Only a few traces of them are preserved in the pedicle furrow. The area formed a thin shelf between the pedicle groove and the lateral margins, the undercut extending far back under the area as in *O. (L.) acutangulus*. This is shown in the cast by a thin projection of the embedding rock over the area. The area of the dorsal valve is lower and less prominent. It arches forward at the median line and extends well out on the cardinal slopes.

The cast of the visceral cavity of the ventral valve includes the heart-shaped pit and a slight trace of the trapezoidal area, in which the central, middle, and outside lateral muscle scars occur. There are no traces of a median septum in the ventral valve, and it is only slightly indicated in one specimen of the dorsal valve. This is owing, however, more to the condition of preservation of the specimen than to the character of the septum. No muscle scars are clearly defined in either valve. Of the visceral system the main or trunk sinuses are fairly well shown in the ventral valve, but less so for the dorsal valve.

Observations.—This form has the shape of *O. (L.) acutangulus*, but differs radically in the arrangement of the markings on the interior of the shell. This is especially true of the dorsal valve. In *O. (L.) englyphus* the traces remaining on the casts indicate a very close resemblance to *O. (L.) chuarensis*. The thickness of the shell also allies it with *Obolus* rather than the subgenus *Lingulella*. Attention has been called to the character of the surface, which is intermediate between that of *O. (L.) ella* and *O. (L.) aurora*.

This species is associated with *O. (L.) lineolatus* in the upper beds of the Tonto sandstone. It differs from that species in its surface characters, thickness of shell, and usually in outline. It is also usually a larger species, although a few examples of *O. (L.) lineolatus* approach it in size.

Formation and locality.—Middle Cambrian, Tonto sandstone at the head of Lava and Nunkoweap valleys, Grand Canyon of the Colorado, Arizona.

Type.—No. 27316, U.S.N.M.

OBOLUS (LINGULELLA) FRAGILIS, new species.

General form ovate, with the ventral valve subacuminate and the dorsal valve broad ovate; valves apparently moderately convex, as determined from the specimens more or less compressed in the shale. Surface of shell marked by concentric lines of growth and what appears to be an exceedingly fine papillose surface, which is apparently produced by the inosculating of irregular raised striae, as on the surface of *O. (L.) radulus*. When the outer layer of the shell is exfoliated very fine concentric and radiating striae occur on the surface of the inner layer. The shell is thin and formed of an outer layer and one or more thin inner layers or lamellae.

The average length of the ventral valve is about 5 mm; width, 4 mm. The dorsal valve is a little shorter.

The rather long area of the ventral valve is divided midway by a strong pedicle groove. The area of the dorsal valve is clearly defined on casts of the interior. It is about three-fifths the width of the valve and arched forward at the center.

The casts of the interior of the valves show traces of the vascular markings, but nothing very definite can be said of them.

Observations.—This pretty little species is closely related to *O. (L.) dawsoni*, with which it is associated in the shales of Manuels Brook.

Formation and locality.—Middle Cambrian, shales on Manuels Brook, Conception Bay, Newfoundland. It occurs abundantly with the *Paradoxides davisi* fauna, and also in a band of shales 45 feet lower in the section.

Type.—No. 27317, U.S.N.M.

OBOLUS (LINGULELLA) FRANKLINENSIS, new species.

Shell small, ovate, with the apex of the dorsal valve subacuminate; convexity moderate. Surface of the shell marked by rather strong lines and striae of growth, with very fine, slightly irregular, wavy striae between the coarser concentric striae. Two ventral valves referred to this species have a length of 3 and 3.5 mm., respectively, with a width of about 2.75 mm. There are no dorsal valves in the collection. A partial cast of the interior of the shell carries an impression of radiating striae, and a strong cast of a narrow pedicle furrow, and a few concentric lines of growth.

Observations.—This species is founded on three specimens of the ventral valve that occur in the limestones interbedded in the dark shales above the Lower Cambrian *Olenellus* bearing shales. A larger shell has the same surface characters and occurs at the same relative geologic horizon, and it may belong to this species. The only specimen of it in the collection is apparently a dorsal valve. The exact stratigraphic horizon has not been determined, but from the associated species of *Agnostus* and *Ptychoparia* it appears that the reference should be to the Middle Cambrian.

The material for study is so limited it is difficult to make comparisons with other species. In form the ventral valves resemble that of *O. (L.) lineolatus*, *O. (L.) tarpa*, and in some respects *O. (L.) granvillensis*, with which it would be more naturally compared, owing to its belonging to the Appalachian fauna.

Formation and locality.—Middle (?) Cambrian, St. Albans shale, in limestone lentile a little west of the town of Georgia, about a mile east of Parker's quarry; also a mile SSW. of Highgate Falls, Franklin County, Vermont.

Type.—No. 27318, U.S.N.M.

OBOLUS (LINGULELLA) HAYESI, new species.

Shell small; general form broad ovate, with the ventral valve obtusely acuminate and the dorsal valve rounded ovate; valves moderately convex. Outer surface, as seen in casts, marked by fine, concentric lines and striae of growth; the inner surface had fine, radiating striae and scattered pits or punctae. The shell appears from the casts to have been of medium thickness and built up of several layers or lamellae.

The average length of the ventral valve is about 3.5 mm.; width about 3 mm. The dorsal valves are a little shorter than the ventral valves, the length and width being about the same, although some of the shells are a little wider than long.

The casts of the interior of the ventral valve show a clearly defined strong area, divided midway by the cast of a narrow pedicle groove, and again by a sharp flexure line situated a little nearer the pedicle groove than to the lateral margin. The striae of growth cross the area parallel with its base, arching over the cast of the pedicle furrow. The area formed a thin shelf between the pedicle groove and the lateral margins, the undercut extending back under the area, as shown in the cast, by a thin projection of the imbedding rock over the area. The area of the dorsal valve is of medium length and marked by striae of growth and rather clearly defined flexure lines.

The cast of a ventral valve shows the visceral cavity (*v*) and rather strong and long main vascular sinuses. In the dorsal valve the main vascular sinuses are frequently outlined very beautifully on the siliceous casts; the visceral area surrounded by the parietal band is clearly defined, also the central and anterior lateral muscle scars, and in one cast the transmedian muscle scars.

Observations.—This very pretty species occurs quite abundantly on the siliceous nodules imbedded in the Coosa shales. It resembles in form *O. (L.) lamborni* and *O. (L.) willisi*, but is a much smaller species. The elongate visceral cavity of the dorsal valve is also of the same type as that of those species. The thickening in front of the visceral cavity is similar to that which occurs in *O. matinalis*. In this character and in its broadly ovate form it comes very close to the forms which are referred to *Obolus*.

Formation and locality.—Middle Cambrian, Coosa formation; in and attached to the outer surface of siliceous nodules, Coosa Valley, Cherokee County, Alabama.

Type.—No. 27319, U.S.N.M.

OBOLUS (LINGULELLA) HELENA, new species.

General form ovate, with the ventral valve obtusely acuminate, and the dorsal valve rounded ovate. Valves moderately convex, as far as can be determined from their condition of preservation, in the shales. Surface of shell marked by rather strong lines of growth and very fine irregular, radiating and concentric striae that appear to inosculate, the surface having something of the appearance of *O. (L.) ella*; the character of the surface markings of the inner layers and the interior of the shell is unknown. So far as can be determined, the shell is rather thin and formed of a thin outer layer and one or more thin inner layers or lamellae. A ventral valve 8 mm. in length has a width of 6 mm.; another 7.5 mm. in length has a width of 6 mm. An associated dorsal valve 7 mm. in length has a width of 5 mm. These variations in outline are due to considerable extent to distortion.

As shown in the cast of the interior of the shell, the area of the ventral valve is rather long and marked midway by a strongly defined cast of a pedicle groove, and midway between that and the outer margin by a very distinct flexure line. The area of the dorsal valve is rather long and quite distinctly marked on a cast of the interior. The cast of the interior of the ventral valve shows a strong main vascular sinus on each side of the visceral area, and in a cast of the dorsal valve a slight median septum is indicated; also traces of the main vascular sinuses. The only traces of the muscle scars observed are the anterior laterals and a suggestion of the central scars of the dorsal valve.

Observations.—This species is associated with *O. (L.) ella* in the siliceous shales near Helena, Montana, and what appears to be a similar form occurs with the same species in Big Cottonwood Canyon. In form and surface characters it belongs to the group of which *O. (L.) ella* may be taken as a type.

Formation and locality.—Middle Cambrian; dark siliceous shale in a quarry 1½ miles south of Helena, Montana.

Type.—No. 27320, U.S.N.M.

OBOLUS (LINGULELLA) INO, new species.

Shell a little smaller than the average of the species of the subgenus. General form ovate, with the ventral valve subacuminate and the dorsal valve ovate in outline. There is some range of variation in the outline of the valves. The convexity of the valves is fairly strong, as the shells are preserved in the somewhat shaly sandstones. Ventral valves 7 mm. in length have a width of from 5.5 to 6 mm.; a dorsal valve 5 mm. in width has a length of 5.25 mm.

As far as may be determined from the casts, the outer surface is marked by concentric lines and striae of growth and the inner surface by radiating striae and concentric lines of growth and scattered pits or punctae. The shell appears to have been rather thick and built up of a thin outer layer and numerous lamellae that over the anterior two-thirds of the shell were oblique to the outer layer; the edges of the lamellae show very plainly when the outer layer is removed.

The area of the ventral valve, as shown by casts of the interior, is of medium length, divided midway by a narrow elevated cast of the pedicle furrow, and again by a narrow flexure line about half way between the pedicle groove and the lateral margin; striae of growth cross it parallel with the base. The area of the dorsal valve is relatively long, with the flexure lines clearly defined. The interior markings shown in the cast of the ventral valve are the main vascular sinuses and the outline of the visceral area; in the dorsal valve only traces of the visceral area and main vascular sinuses have been observed.

Observations.—This species appears to be more nearly related to *O. (L.) tarpa* than any other of the Middle Cambrian forms. It is a smaller shell than *O. (L.) tarpa* and less acuminate. It has the outline of some of the species of the Atlantic Basin fauna, such as *O. (L.) radulus*, but it does not appear to be specifically identical with any of them.

Formation and locality.—Middle Cambrian, Rome formation, $2\frac{1}{2}$ miles south of Rome, Georgia, where it occurs abundantly in a layer of shaly sandstone.

Type.—No. 27321, U.S.N.M.

OBOLUS (LINGULELLA) LAMBORNI, var. MINIMUS, new variety.

This variety in its ventral valve closely resembles the adult forms of the ventral valve of *O. (L.) lamborni*. The dorsal valve also has the same general form as most of the dorsal valves of the species. In comparing, however, the young specimens of the same size with the variety *minimus* the ventral valves appear to be more obtuse in the young of *O. (L.) lamborni*.

All of the specimens occur as casts in a somewhat decomposed light-colored buff shale.

Formation and locality.—Upper Cambrian, Rogersville shale, $3\frac{1}{2}$ miles SSW. of Rogersville, Hawkins County, Tennessee.

Type.—No. 27322, U.S.N.M.

OBOLUS (LINGULELLA) LEOS, new species.

Shell small; general form elongate ovate, with the ventral valve subacuminate. The valves are rather strongly convex in the narrow form of the species. Average length of a ventral valve 5 mm., the largest ventral valve has a length of 6 mm.; the dorsal valve is somewhat shorter. The width of the valves varies considerably in

shells occurring in the same hand specimens in the limestone. The surface of the shell is marked by fine concentric lines and striae of growth and very fine, interrupted, radiating striae. Casts of the interior of the shell show stronger radiating striae than the outer surface, also in many specimens unusually large papillae that fill the pits or punctae on the inner surface. The number and strength of the papillae varies in different casts.

The shell appears to have been rather thin and formed of a thin outer layer and one or more thin inner layers or lamellae.

Casts of the interior of the ventral valve show a well-defined area, divided midway by the cast of a strong pedicle groove. The area of the dorsal valve is obscured by adhering fragments.

Casts of the ventral valve show traces of the visceral cavity (*v*) and the main vascular sinuses (*vs*). In the dorsal valve a narrow, long median sinus is clearly defined; also the casts of the central and anterior lateral muscle scars.

Observations.—This neat little species resembles in some respects *O. (L.) similis*. It differs in being more elongate, the interior being more strongly punctate, and in the more anterior position of the central muscle scars in the dorsal valve. Some of the Wisconsin shells referred to *O. (L.) similis* show greater length in proportion to the width than those from the Black Hills, Tennessee, and Georgia. This, however, appears to be confined to a few shells.

Formation and locality.—Upper Cambrian, limestones, Connasauga shale, 1½ miles south of Rome, Georgia.

Type.—No. 27323, U.S.N.M.

OBOLUS (LINGULELLA) LINEOLATUS, new species.

General form, ovate, with the ventral valve subacuminate and the dorsal valve ovate to broad ovate. The range of variation in the outline of the valves is quite strongly marked. The convexity of the valves is moderate, that of the dorsal valve being a little more than that of the ventral.

The surface of the shell is marked by concentric lines and striae of growth, with very fine, concentric striae between them that are sometimes slightly undulating; on some specimens very faint radiating striae can be seen with a strong lens; when the outer layer is exfoliated the inner layer is marked by fine radiating and concentric striae in addition to the stronger concentric striae; as far as can be determined from the imperfect casts of the interior, the inner surface of the shell was nearly smooth. The shell appears to be formed of a very thin outer layer and one or more thin inner layers or lamellae; toward the frontal margins the oblique lamellae increase in number, but do not give any considerable thickness to the shell.

One of the largest of the ventral valves referred without doubt to this species has a length of 7 mm. and a width of 5 mm. An associated

dorsal valve is slightly shorter in proportion to the width. The average size is smaller, not exceeding 5 mm. for the length of the ventral valve. One unusually large ventral valve that is referred to this species with some doubt has a length of 9 mm.

The only traces of the interior of the shell that have been observed are portions of the area and pedicle furrow of the ventral valve and the area of a dorsal valve.

Observations.—This species is very abundant in the upper beds of the Tonto sandstone. It is associated with *O. (L.) euglyphus*, and it is often difficult when the two are in the form of imperfect casts to distinguish between the larger specimens of the two species. They are readily distinguished when the shells are well preserved by the difference in surface markings and the more acuminate ventral valves of *O. (L.) lineolatus*. The latter character, however, is not always of service, especially in the larger shells. In form the ventral valve of this species may be compared with *O. (L.) acutangulus*.

Formation and locality.—Middle Cambrian, Tonto sandstone at the head of Chuar, Kwagunt, and Nunkoweap canyons, Grand Canyon of the Colorado, Arizona.

Types.—Nos. 27324-6, U.S.N.M.

OBOLUS (LINGULELLA) MOSIA var. OSCEOLA, new variety.

There is considerable variation in form of *O. (L.) mosia* as it occurs in the brown sandstone at Osceola Mills, and for the narrow, more elongate variety the name *osceola* is proposed. It is an intermediate form between *O. (L.) mosia* and *O. (L.) perattenuatus*.

Formation and locality.—Upper Cambrian, St. Croix sandstone, Osceola Mills, Wisconsin.

Type.—No. 27327, U.S.N.M.

OBOLUS (LINGULELLA) NANNO, new species.

Shell very small; general form elongate ovate, with the ventral valve subacuminate to acuminate and the dorsal valve elongate ovate in outline. The convexity of the two valves is moderate in the very small shells, increasing slightly with the increase in size. Average length of the ventral valve is about 2 mm. and that of the dorsal valve a little less.

The surface of the shell as it appears in the hard, fine-grained, drab-colored limestone is marked by fine, concentric striae and very faint traces of radiating striae.

Observations.—This minute species occurs in thin layers of limestone interbedded in the Coosa shales. Its small size and acuminate ventral valve distinguish it from other species. It is associated with *Acrotreta* and fragments of trilobites.

Formation and locality.—Middle Cambrian, limestones in Coosa shales, Bluntsville Valley, Alabama.

Type.—No. 27328, U.S.N.M.

OBOLUS (LINGULELLA) OWENI, new species.

General form ovate, with the ventral valve obtusely acuminate, and the dorsal valve more broadly rounded posteriorly; valves appear to have been moderately convex, as far as can be determined from the flattened specimen in the shaly sandstones. Surface of shell marked by concentric lines and striae of growth and indistinct radiating striae. There are no traces of the interior markings observed. The shell is of medium thickness; none of the specimens show how it was built up, further than there were oblique lamellae attached to the outer layer in the anterior portion of the valve. The largest ventral valve from Gibraltar Bluff has a length of 16.5 mm.; width, about 12 mm.; an associated dorsal valve 14 mm. in length, has a width of 11 mm. as it occurs flattened on the surface of the sandstone; a smaller shell referred to this species from Osceola Mills averages from 6 to 8 mm. in length.

As shown in the cast of an interior of a shell, the area is rather long and divided midway by a sharp pedicle furrow; the flexure lines are situated about midway between the cast of the pedicle furrow and the lateral margin. The area formed a thin shelf between the pedicle groove and the lateral margins, the undercut extending far back under the area.

One cast of the interior of a ventral valve shows a slight trace of the visceral area. In a cast of a dorsal valve both the central and anterior lateral muscle scars are somewhat indistinctly preserved.

Observations.—This species is most nearly related to *O. (L.) amplus*. It differs, as far as can be determined from the material for comparison, in being less elongate and in the position of the central and interior lateral muscle scars in the dorsal valve.

The species differs strongly from *O. (L.) stoneanus* in its surface markings, although the outline of the valves is almost the same in the two species.

Formation and locality.—Upper Cambrian, Gibraltar Bluff, near Lodi, Prairie du Sac, and Osceola Mills, Wisconsin.

Types.—Nos. 27329–30, U.S.N.M.

OBOLUS (LINGULELLA) PHAON, new species.

General form ovate, with the ventral valve subacuminate, and the dorsal broadly ovate; valves of moderate convexity; outer surface of the shell marked by fine concentric lines and striae of growth, and very fine, more or less interrupted radiating striae; the interior surface, as seen in casts, is more or less marked by rather large papillae arranged in concentric lines, the papillae corresponding to the pits or punctae on the inner surface of the shell. Judging from the casts, which show very deeply impressed vascular and other markings, the shell must have been rather thick; fragments of it indicate that it was built up of a thin outer layer and several inner layers or lamellae. A ventral valve

13 mm. in length has a width of 11 mm.; a dorsal valve 11 mm. long has a width of 10 mm.

As shown in the cast of the interior of the shell, the area of the ventral valve rises gradually from the margin toward the pedicle groove. It is broken midway by the cast of a strong pedicle furrow and a little more than half way up toward the lateral margin by a strong flexure line; the striae of growth are very fine and cross the area parallel with its base. The cast of the undercut shows that the area formed a thin shelf between the pedicle groove and the lateral margins. The area of the dorsal valve is well defined. As in the ventral valve, the area formed a thin shelf, as shown by the cast of the undercut extending well over the area in several of the specimens.

The cast of the interior of the ventral valve shows the strongly defined, narrow visceral area, the trapezoidal area in which the central, middle, and outside lateral muscle scars occur; also the anterior lateral muscle scars and unusually strong main vascular sinuses. In a specimen not illustrated, what appeared to be lines of growth occur on the ridge in front of the trapezoidal area—a feature that is present in *O. (L.) hayesi* and *O. matinalis*. In a dorsal valve the relatively narrow central vascular area extends forward to nearly the center of the shell; the central and anterior lateral scars are faintly indicated, also transmedian scars and the median septum; the main vascular sinuses are unusually deep and well defined.

Observations.—This species at first inspection might be taken for *O. (L.) amplus*. It occurs at the same horizon in association with *Dicel-lomus polita*. It differs in being a broader and less elongate shell, in having the visceral area of the dorsal valve terminate near the center instead of forward of the center, and, as far as can be determined from the material at hand, in being a thicker shell. It also averages about one-fourth less in size.

Formation and locality.—Middle Cambrian, St. Croix sandstone, upper beds of the section at Eau Claire, Wisconsin.

Type.—No. 27331, U.S.N.M.

OBOLUS (LINGULELLA) POGONIPENSIS, new species.

Shell rather large, general form ovate, almost ovate-cuneate in the ventral valve; dorsal valve is more ovate. Valves moderately convex. Surface of the shell marked by numerous concentric lines and striae of growth and very fine radiating striae; the finer concentric striae are slightly irregular, but not nearly so much so as in many species of the subgenus. The outer surface of the inner layer is marked by very fine radiating striae, also concentric lines of growth. The shell is below the average thickness, and is formed of a thin outer layer and one or more inner layers or lamellae.

The largest ventral valve has a length of 15 mm.; width, 11 mm. As shown by a partial cast, the area is of medium length and divided midway by a narrow, strongly marked cast of the pedicle furrow.

Observations.—This fine species occurs in a shaly limestone in the passage beds between the Cambrian and Ordovician. In form the valves resemble somewhat those of *O. (L.) amplus*. In the absence of all interior markings, no further comparisons can be made.

Formation and locality.—Base of Pogonip limestone, east slope of the ridge east of Hamburg Ridge, Eureka district, Nevada.

Type.—No. 27332, U.S.N.M.

OBOLUS (LINGULELLA) PRINDLEI, new species.

This species was at first considered to be identical with *O. (L.) granvillensis*. The study of a new lot of well-preserved specimens shows that it differs from *granvillensis* in being less elongate, more ovate in outline, and marked upon the interior by a very finely granulated surface; in the east the papillae and the fine depressions between them appear to be arranged in transverse undulating lines. The transverse lines of growth on the area of the ventral valve, as seen in the east, are peculiar in having an imbricating or lamellose-like arrangement. The areas of both valves are rather large for so small a species. The average length of the ventral valve is 3.5 mm. to 4 mm., and the width 3.25 mm. The dorsal valve is a little shorter than the ventral.

O. (L.) prindlei belongs to a group of small shells that is represented by *O. (L.) ferrugineus*, *O. (L.) rotundatus*, *O. (L.) desideratus*, and *O. (L.) granvillensis*. These forms are among the earliest species of the genus, and range through to the Ordovician fauna. *O. (L.) granvillensis* and *prindlei* occur in the upper limit of the Olenellus fauna of eastern New York and western Vermont, and *O. (L.) rotundatus* and *manticulus* are found at the base of the Ordovician fauna.

The specific name is given in recognition of the effective work of Mr. L. M. Prindle, who, as assistant to Prof. T. Nelson Dale, collected the first specimens of the species.

Formation and locality.—Upper limit of Lower Cambrian or passage beds between Lower and Middle Cambrian. Thin bedded limestone in shale, 1 mile southwest of Wynantskill and 5 miles east of Albany, in Rensselaer County, New York.

Types.—Nos. 27333-4, U.S.N.M.

OBOLUS (LINGULELLA) PUNCTATUS, new species.

General form ovate, with the ventral valve subacuminate. Valves moderately convex, with the dorsal valve having a slightly depressed median sinus that extends from near the umbo to the anterior margin. Surface of shell marked by lines and striae of growth, and very fine, slightly undulating striae; also a few faintly indicated radiating striae; when the outer layer is exfoliated the outer surface of the inner layer is seen to be marked by numerous and very fine radiating striae, in

addition to the concentric lines of growth; the interior of the shell as shown by the casts was strongly pitted or punctate, the punctae being arranged in concentric lines following the lines of growth. The shell is relatively thin and formed of a thin outer layer and one or more thin inner layers or lamellae.

The type specimen of the ventral valve has a length of 9 mm.; width, 6.5 mm. An associated dorsal valve has a length of 7 mm.; width, 5.5 mm.

The only interior that shows anything more than the punctate surface is that of a dorsal valve. In this the area is partially shown; it is relatively short and marked by fine striae parallel to its base, and two imperfectly developed flexure lines. The cast of a narrow median septum is well shown and on each side of it the middle lateral muscle scars. The path of advance of the central muscle scars is quite plain; also one of the scars. The only traces of the vascular system is a portion of a main vascular sinus.

Observations.—This is a very pretty and distinct species that occurs in the interbedded limestones of the Secret Canyon shale.

Formations and locality.—Middle Cambrian, upper beds of the Secret Canyon shale, east side of New York and Secret canyons; at the 700-foot level of the Richmond Mine, Ruby Hill, Eureka District, Nevada.

A somewhat similar, if not identical, ventral valve occurs in the upper beds of the Prospect Mountain limestones on the east slope of Prospect Mountain, New York Canyon.

Type.—No. 27335, U.S.N.M.

OBOLUS (LINGULELLA) ROGERSI, new species.

General form elongate-ovate, with the ventral valve subacuminate and the dorsal valve ovate in outline. There is considerable range of variation in the outline of the valves, owing largely to distortion apparently produced by movement of the matrix. The convexity of the valves is fairly strong and nearly the same in both, except that the dorsal valve curves more abruptly inward toward the beak.

The outer surface of the shell usually adheres to the matrix, but in three specimens portions of it are preserved which show that it is of essentially the same character as that of *O. (L.) stoncanus*. The surface is formed by very fine concentric lines and striae of growth crossed transversely by strong undulating, slightly lamellose lines. When the outer layer is exfoliated the inner layers are marked by concentric lines of growth and fine radiating striae. This is also the character of the inner surface, so far as can be determined from the specimens in the collection. The shell is rather thick and built up of a thin outer layer and several inner layers or lamellae, the latter becoming increasingly numerous toward the front. The largest dorsal valve in the collection has a length of 13 mm., with a width of 11 mm., and a smaller ventral valve with a length of 12 mm. has a width of 9 mm. The

dimensions of most of the specimens in the collection average less than those here given.

The area of the ventral valve is relatively short for a species of this type. It is divided midway, as seen in the cast, by a strong pedicle furrow. Owing to the imperfection of the material, none of the specimens show flexure lines or striae of growth. The area of the dorsal valve is short and extends but a short distance on either side of the median line. The cast of the interior of the ventral valve is very much like that of the interior of *O. (L.) cyane*. It has the same median ridge and the transverse trapezoidal area, which includes the central, middle, and outside lateral muscle scars; the main vascular sinuses are indicated by slight ridges. The cast of the interior of the dorsal valve shows a narrow median septum, two central muscle scars of average size, situated a short distance back of the center of the shell, and two small anterior lateral scars, located some distance in advance of the center, which gives an elongated visceral cavity somewhat like that of *O. (L.) hayesi*, of the Middle Cambrian, and *O. (L.) lamborni*, of the Upper Cambrian.

Observations.—The external form of the more elongate specimens of this species is very much like that of *O. (L.) acutangulus*. When compressed laterally it occasionally has the form of *Lingulepis acuminatus*, and before taking up the detailed study of this group of brachiopods I was led to identify some of the specimens as of that species. It is distinguished, however, from all described species of this genus known to me by its highly characteristic surface ornamentation. *O. (L.) stoneanus* has the same type of surface, but it differs from the latter in being a much more elongate shell.

The material studied was collected by Prof. N. S. Shaler and Mr. J. B. Woodworth from the pebbles on the beach on the northern shore of Marthas Vineyard, Massachusetts, and at several points along the shores of Narragansett Bay. The first notice we have of these fossiliferous pebbles is that of Prof. William B. Rogers, who in 1861 announced the discovery, by Mr. Norman Easton, of pebbles carrying fossils of the Potsdam fauna in the Carboniferous conglomerate north of Fall River, Massachusetts. Professor Rogers thought the forms distinctly recognizable as *Lingula* of two species, *Lingula prima* and *Lingula antiqua* Emmons.¹

In 1875 Professor Rogers announced the discovery of impressions suggestive of the fossil *Lingula* mentioned by him from Fall River in the pebbles in the conglomerate at Newport, Rhode Island.² He thought that the pebbles were derived from rocks probably closely connected in time with the Braintree Paradoxides beds.

Among the material sent by Professor Shaler I found the remains of

¹ On Fossiliferous Pebbles of the Potsdam and Carboniferous Conglomerate, North of Fall River, Massachusetts, Boston Soc. Nat. Hist. Proc., 1861, VII, pp. 389-391.

² On the Newport Conglomerate, Boston Soc. Nat. Hist. Proc., 1875, XVIII, p. 100.

a large linguloid brachiopod, which appears to be identical with *Obolus* (*Lingulobolus*) *affinis* Billings, from the Lower Ordovician rocks of Newfoundland. The material is somewhat imperfect, but I do not know of any other large brachiopod of this type from the Cambrian or Ordovician rocks.

On Great Bell Island, Newfoundland, *O. (L.) rogersi* is associated with *O. (L.) bellus* and *O. (Lingulobolus) affinis*.

Formation and locality.—Lower Ordovician, quartzitic pebbles in the Carboniferous conglomerates about Narragansett Bay, Rhode Island, and in the drift along the beaches of the coast of Rhode Island, and also of Marthas Vineyard, Massachusetts, and probably also at other points where the pebbles may have been carried by the glacial drift. Great Bell Island, Conception Bay, Newfoundland.

Type.—No. 27336, U.S.N.M.

OBOLUS (LINGULELLA) ROTUNDATUS, new species.

This small species is associated with *O. (L.) manticulus*. It differs from it in its nearly circular form and more strongly pitted or punctate interior of the valves. A cast of the interior of a dorsal valve shows a well-defined area, the cast of the median ridge and septum, and the central muscle scars. The ventral valve has a length of 3.5 mm.; width, 3 mm. Dorsal valve, length, 3 mm.; width, 3 mm.

Formation and locality.—Upper Cambrian, and in the lower beds of the Ordovician. The type specimens from the Lower Ordovician are from Schellbourne, Schell Creek Range, Nevada; and the Montana specimens from a point west of Bear Creek, south of Gallatin Valley.

Types.—Nos. 27337-8, U.S.N.M.

OBOLUS (LINGULELLA) SIMILIS, new species.

Shell small, general form ovate, with the ventral valve subacuminate, and the dorsal valve rounded-ovate in outline. There is some variation in the outline of the valves. Surface of the shell marked by concentric lines of growth and very fine, slightly irregular, concentric striae; where the outer surface is well preserved fine radiating striae may be seen with a strong magnifying glass. When the outer layer of the shell is exfoliated the outer surface of the inner layer is marked by fine concentric lines and very fine numerous radiating striae; the inner surface of the shell shows concentric lines of growth, and faint, scattered pits or punctae. The shell is of medium thickness, and formed of a thin outer layer, with one or more inner layers or lamellae; the latter are especially prominent toward the front, where they have essentially the same arrangement as in *O. (L.) acutangulus*. The average length of the ventral valve is from 4 to 5 mm.; width, 2.5 mm. An associated dorsal valve 4 mm. in length had a width of 3 mm.

A cast of the interior of a ventral valve shows a clearly defined area of medium length. It is divided midway by a cast of a narrow, strong pedicle furrow, and on each side by flexure lines situated about two-thirds the distance from the pedicle furrow to the lateral margin; a few indistinct striae cross the area parallel with its base. The area of the dorsal valve as seen in a cast is well defined, and rather large; it is marked by fine, transverse striae of growth and indistinct flexure lines. A cast of the interior of the dorsal valve shows a trace of the visceral cavity and a narrow median septum. The only muscle scars observed are the two umbonal scars in the ventral valve and the central scars of the dorsal valve.

Observations.—This very pretty little species occurs in abundance in the compact gray limestone associated with numerous fragments of trilobites and *Dicellomus nana*. The more elongate forms strongly resemble *O. (L.) perattenuatus*, which occurs in the Middle Cambrian sandstones on the southern margin of the Black Hills. The species differs, however, from the latter, in being more ovate, and in having the dorsal valve more obtusely rounded posteriorly. This species may be also compared with *O. (L.) desideratus* and *O. (L.) manticulus*.

A small shell occurs in the St. Croix sandstone of the Upper Mississippi region that appears to be identical with this species, both in its typical form and in its comparatively wide range of variation. With the somewhat abundant supply of material from both the Black Hills and Wisconsin, I am unable to determine any specific differences that are constant.

Formation and locality.—Middle Cambrian, limestone beds in the northern suburbs of Deadwood, Black Hills, South Dakota.

In the Upper Mississippi region the form identified with this species occurs in the yellow or buff colored sandstones of the lower portion of the Upper Cambrian fauna, at Winfield, and 4 miles north of Winfield, Wisconsin, Redwing and Reeds, Minnesota.

A slightly larger shell occurs in the sandstone at Osceola Mills, Wisconsin, that appears to be identical with those from a lower horizon at Winfield, Wisconsin. In the elongate outline of the ventral valve it resembles *O. (L.) perattenuatus*, but the data is insufficient to identify it with that species.

Types.—Nos. 27339–40, U.S.N.M.

OBOLUS (LINGULELLA) SINOE, new species.

General form broad ovate, with the ventral valve broadly subacuminate, and the dorsal valve broadly ovate. Valves moderately convex, as far as can be determined from the series of shells preserved in the fine-grained sandstone. A ventral valve 5 mm. in length has a width of 4.25 mm. A dorsal valve 4 mm. in length has an equal width.

The traces remaining of the exterior shell show it to have been

marked by concentric lines and striae of growth; when the outer layer is exfoliated radiating striae cross the lamellae; a fragment of the inner surface of the shell indicates that there were scattered pits or punctae and fine radiating striae; the shell was relatively thick, and formed of a thin outer layer and several inner layers or lamellae, the lamellae of the interior portion of the shell being arranged in layers slightly oblique to the outer surface of the shell.

Casts of the interior of the ventral valve show a well-defined area marked by strong flexure lines that occur midway between the lateral margins and the narrow, well-defined pedicle groove; striae of growth cross the area parallel with its base. The area of the dorsal valve is relatively short and does not extend very far out on the cardinal slopes. The interior markings of the ventral and dorsal valves show imperfectly the main vascular sinuses and visceral area.

Observations.—This species occurs at the same relative stratigraphic horizon as *O. (L.) ino*, and is about the same size. It differs, however, in its more circular form, which is persistent in a large number of shells. In form it more nearly resembles *O. (L.) rotundatus* of the Upper Cambrian. It differs from that in being uniformly larger and having a thicker, stronger shell. It is also not probable that a Middle Cambrian species would continue to exist until the close of Cambrian time.

Formation and locality.—Middle Cambrian, brown sandstone beneath the alternating layers of sandstone and limestone northwest end of Packsaddle Mountain, Llano County, Texas.

Type.—No. 27341, U.S.N.M.

OBOLUS (LINGULELLA) TARPA, new species.

General form elongate ovate, with the ventral valve subacuminate, and the dorsal valve ovate in outline. There is considerable range of variation in the outline of both valves, owing in part possibly to distortion. The convexity of the two valves is fairly strong, as far as can be determined from the somewhat compressed condition of the shells in the shale and calcareous sandy shales. The largest ventral valve in the collection has a length of 14 mm. The average length of the ventral valve is from 10 to 11 mm. One 11.5 in length has a width of 8 mm.

None of the specimens of the collection show the outer surface, and only traces of concentric and radiating lines have been observed on the inner surface. The shell appears to be moderately thick and formed of numerous lamellae that were oblique to the outer layer in the anterior portions of the shell, in this respect resembling the shell of *O. (L.) acutangulus*.

Casts of the interior of the ventral valve have a moderately long area divided midway by the cast of a strong pedicle furrow, and marked about midway between the pedicle furrow and the lateral margin by a

sharp flexure line; striae of growth cross the area parallel with its base and arch over the cast of the pedicle furrow. The area of the dorsal valve is relatively short, arching forward slightly at the median portion. The only interior markings observed are seen in the casts of the ventral valve, where the visceral area and a portion of the main vascular sinuses are imperfectly preserved.

Observations.—This species strongly recalls in external form *O. (L.) acutangulus*. The material is too imperfect to identify it with the latter. It occurs at a considerable lower geologic horizon, and what is preserved of the interior markings of the ventral valve indicates a considerable difference in the position of the visceral area.

Formation and locality.—Middle Cambrian, Rome formation, a mile east of Postoak Springs, Roane County, Tennessee.

Type.—No. 27342, U.S.N.M.

OBOLUS (LINGULELLA) WILLISI, new species.

General form broadly ovate, with the ventral valve obtusely acuminate, and the dorsal valve almost transversely ovate, the posterior margin being very broadly obtuse; convexity moderate in the specimens preserved in the calcareous sandstone. Surface of shell marked by concentric lines and striae of growth, and very fine irregular striae between them; a few specimens show very narrow, slightly irregular, interrupted radiating ridges or undulations; the inner surface of the shell was more or less strongly pitted or punctate; this character varies greatly in casts from the same layer of shale. The shell, as preserved in the argillaceous shale is relatively thin.

The largest ventral valve, which is shortened slightly by distortion, has a length of 10 mm.; width, 8.5 mm. A well-preserved dorsal valve 8.5 mm. in length has the same width, while another associated dorsal valve 6.5 mm. in length has a width of 7 mm.

As shown in the casts, the area of the ventral valve is rather long, and is divided midway by a strong cast of the pedicle furrow, and again midway between the pedicle furrow and the lateral margins by a well-defined flexure line; fine striae of growth cross the area parallel with its base. The area of the dorsal valve is relatively short, and extends far out onto the cardinal slopes; it is marked by clearly defined, but not strong, flexure lines. Casts of the interior of the ventral valve show traces of the visceral cavity and the main vascular sinuses. In the dorsal valve a narrow median septum is all that is shown, with the exception of faint indications of the central and interior lateral scars and what appears to be the transmedian scar.

Observations.—This species was at first compared with *O. (L.) lamborni*. Like that, it has a strongly pitted or punctate inner surface, and the ventral valve has the same general outline; the dorsal valve, however, is much more transverse and obtuse, and the central muscle scars in the dorsal valve appear to be somewhat differently located.

A single specimen doubtfully referred to this species from near Montevallo, Georgia, shows a surface over a small portion of its area, much like that of *O. (L.) ella*. It is too doubtful to refer to *O. (L.) ella*. This species has quite a vertical range as it occurs in the Rome formation and in the subjacent Coosa shales. Its range of variation is considerable; some of the Coosa shale specimens associated with the Middle Cambrian fauna are very much like *O. (L.) lamborni* from the Rogersville shale of Tennessee.

I take pleasure in naming this species in honor of Mr. Bailey Willis, geologist, who for a considerable time had charge of the work in that region where these specimens were collected by Dr. Cooper Curtice.

Formation and locality.—Middle Cambrian, Rome formation; both in shales and calcareous sandstones, Copper Ridge, 11 miles northwest of Knoxville; 4 miles north-northeast of Knoxville, along First Creek Gap; also 3½ miles southwest of Rogersville, Tennessee; 5 miles north of Cave Spring, Georgia, in shales beneath the limestone; doubtfully in shale one-fourth mile west of hotel at Montevallo, Georgia; Coosa shales of Coosa Valley, on line of Cowan Creek, Cherokee County, Alabama.

Types.—Nos. 27343-6, U.S.N.M.

OBOLUS (LINGULELLA) ZETUS, new species.

This is a small shell that has somewhat the general form of *O. (L.) lamborni*. It differs, however, in being more transverse across the front, and in having a broad, shallow depression in the dorsal valve. It occurs at a higher horizon than *O. (L.) chuarensis*, *O. (L.) euglyphus*, and *O. (L.) lineolatus* of the upper beds of the Tonto sandstone. It has more the form of the true *Obolus* than those species, but its shell is relatively thin and marked by fine radiating striae. All of its essential characters are well shown by the figures illustrating the species.

Formation and locality.—Upper Cambrian, shaly sandstone in the upper beds of the Tonto formation, at the head of Nunkoweap valley, Grand Canyon of the Colorado, Arizona.

Type.—No. 27347, U.S.N.M.

EXPLANATION OF PLATES.

[The letters on the plates refer to the parts as indicated herewith.]

PLATE XXVI.

- | | |
|----------------------------------|--|
| <i>g.</i> Umbonal | <i>f.</i> Flexure lines. |
| <i>h.</i> Central. | <i>vs.</i> Vascular sinus. |
| <i>i.</i> Transmedian. | <i>ps.</i> Parietal band. |
| <i>j.</i> Anterior laterals. | <i>x.</i> Heart-shaped cavity. |
| <i>k.</i> Middle laterals. | <i>o.</i> Scar-like depressions in heart-shaped cavity. |
| <i>l.</i> Outside laterals. | <i>s.</i> Median septum and ridge. |
| <i>p.</i> Pedicle groove. | <i>d.</i> Outline in heart-shaped cavity, showing a stage in the growth of the cavity. |
| <i>a.</i> Central lateral space. | |
| <i>a'.</i> Outer lateral space. | |

	Page.
<i>Obolus (Lingulella) celatus</i> Volborth	385
Fig. 1. Interior of a ventral valve from the Upper Cambrian strata, near Jegedelect.	
2. Interior of dorsal valve, associated with fig. 1.	
<i>Obolus apollinis</i> Eichwald	385, 391
Figs. 3-6. Interior of the posterior portions of four ventral valves from Estland. The variation in form and position of the muscle scars is well shown.	

PLATE XXVII.

<i>g.</i> Umbonal.	<i>l.</i> Outside laterals.	
<i>c.</i> Trapezoidal area, including central scars, middle and outside laterals.	<i>p.</i> Pedicle groove.	
<i>m.</i> Pedicle.	<i>a.</i> Central lateral space.	
<i>h.</i> Central.	<i>a'</i> . Outer lateral space.	
<i>i.</i> Transmedian.	<i>f.</i> Flexure lines.	
<i>j.</i> Anterior laterals.	<i>vs.</i> Vascular sinus.	
<i>k.</i> Middle laterals.	<i>ps.</i> Parietal band.	
	<i>v.</i> Visceral cavity.	
<i>Obolus (Lingulella) davisi</i> McCoy		Page.
		391-4

- Fig. 1. Cast of interior of a flattened ventral valve (x 3), preserving nearly the normal outline of the shell.
2. Cast of interior of a flattened and distorted ventral valve, in which the vascular sinuses and visceral cavity are fairly well indicated.
3. Cast of interior of the posterior portion of a ventral valve (x 3), drawn to illustrate the umbonal and pedicle muscle scars.
4. Cast of interior of dorsal valve (x 3).
5. Cast of interior of a dorsal valve longitudinally shortened by compression.
- From the Lingula Flags at the typical locality—Port Madoc, North Wales.

<i>Obolus (L.) acutangulus</i> Roemer	392-4
6. Cast of interior of ventral valve, from the Upper Cambrian, Llano County, Texas.	

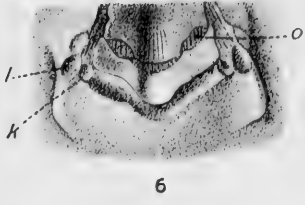
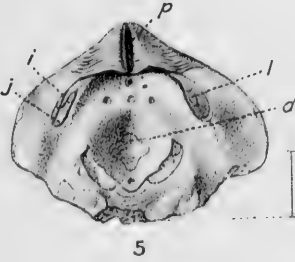
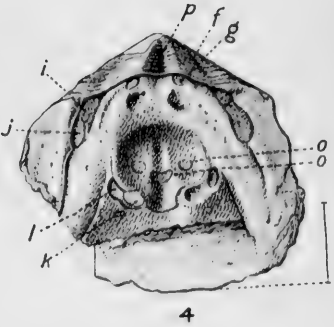
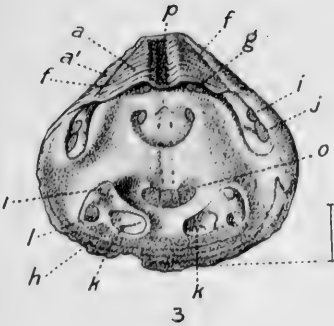
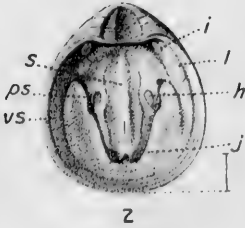
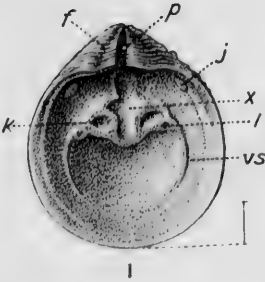
PLATE XXVIII.

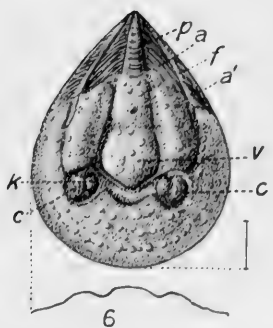
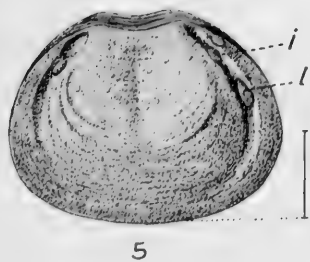
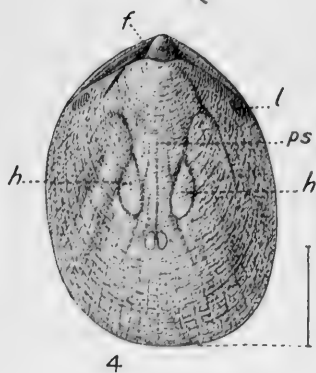
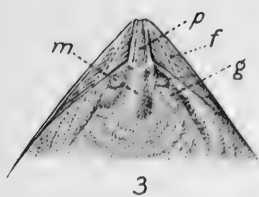
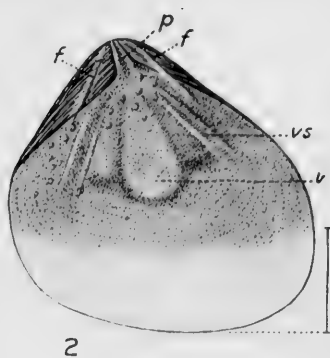
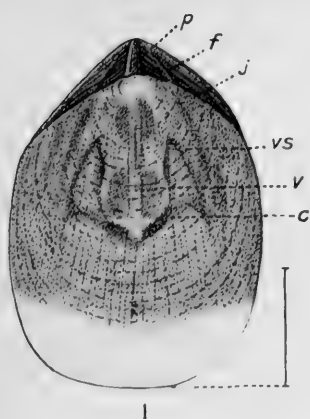
<i>g.</i> Umbonal.	<i>f.</i> Flexure lines.	
<i>m.</i> Pedicle.	<i>vs.</i> Vascular sinus.	
<i>c.</i> Trapezoidal area, including central scars, middle and outside laterals.	<i>ps.</i> Parietal band.	
<i>h.</i> Central.	<i>v.</i> Visceral cavity.	
<i>i.</i> Transmedian.	<i>x.</i> Heart-shaped cavity.	
<i>j.</i> Anterior laterals.	<i>s.</i> Median septum.	
<i>l.</i> Outside laterals.	<i>z.</i> Lateral branches of the vascular system.	
<i>p.</i> Pedicle groove.	<i>n.</i> Supposed accidental marking.	
<i>Obolus (L.) acutangulus</i> Roemer		Page.
		392-4

- Fig. 1. Cast of interior of ventral valve (x 6). This is a beautiful specimen from the Upper Cambrian, Llano County, Texas.
2. Cast of interior of dorsal valve (x 5) and outline of specimen associated with fig. 1.

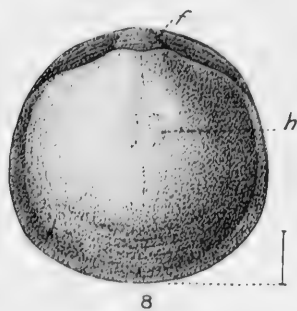
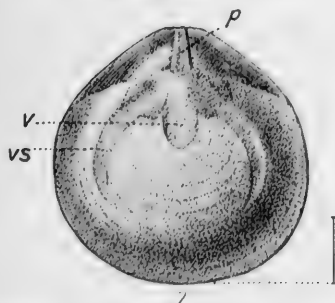
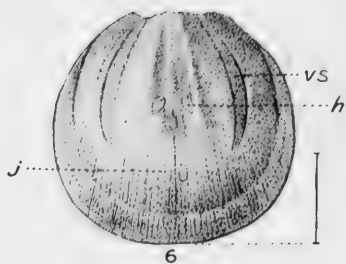
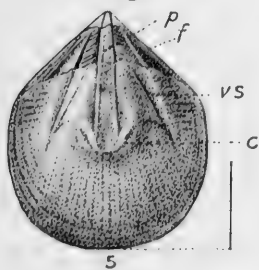
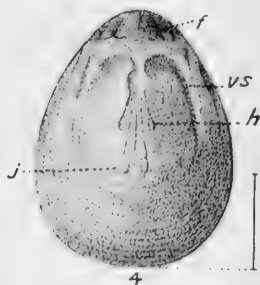
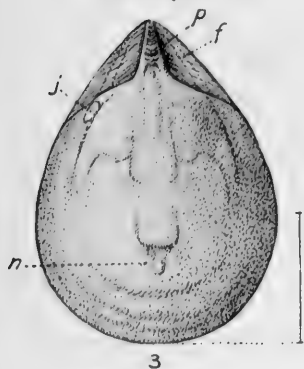
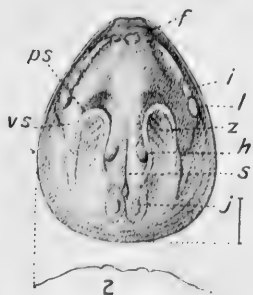
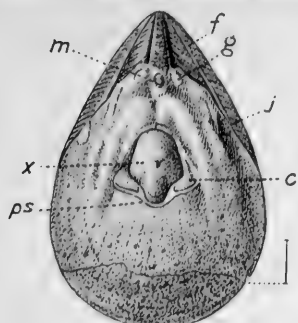
<i>Obolus (L.) amplus</i> Owen	392-1
3. Cast of interior of ventral valve from the Middle Cambrian sandstone at Dakota, Minnesota.	
4. Cast of dorsal valve associated with fig. 3.	

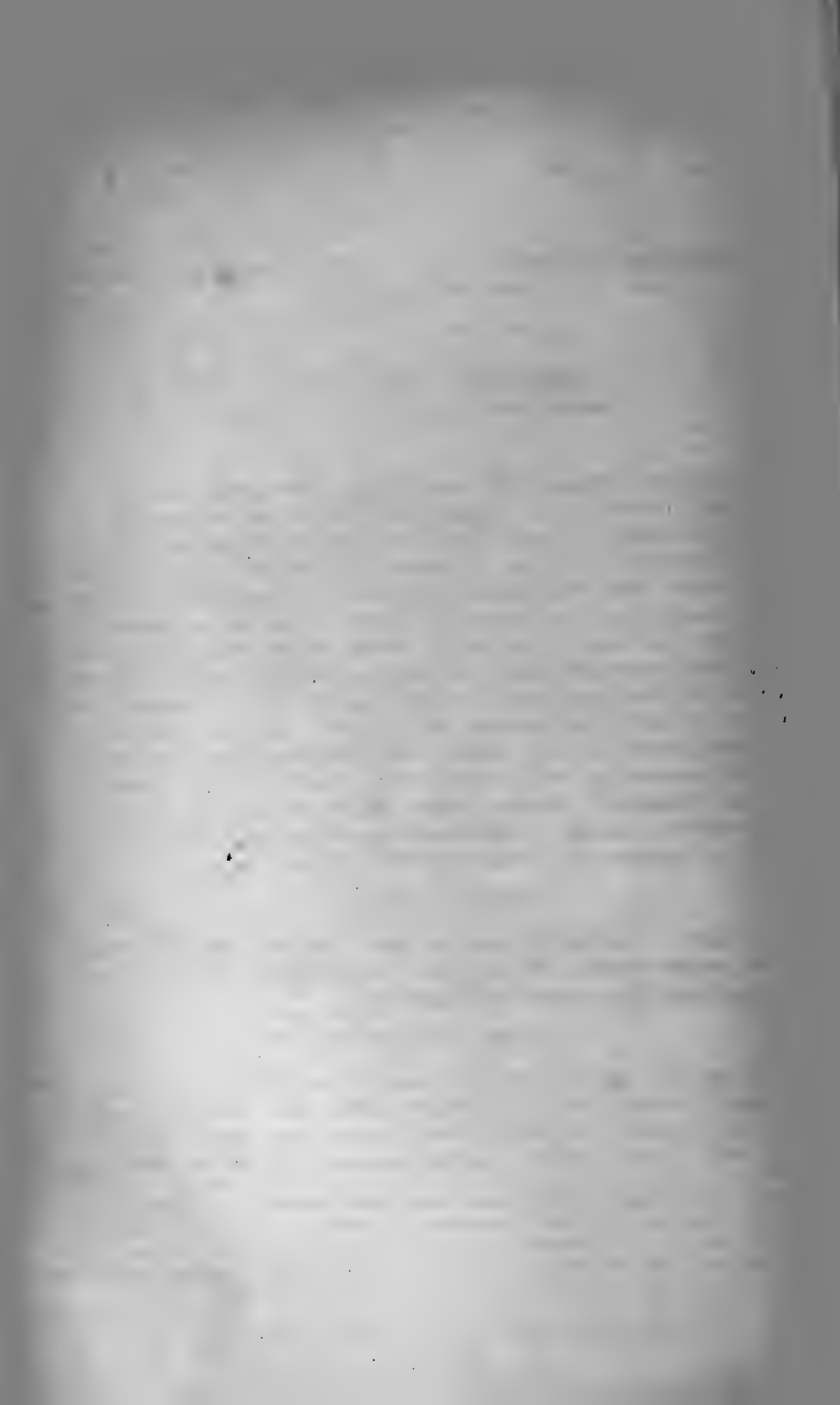
<i>Obolus (L.) ella</i> Hall and Whitfield	390
5. Cast of interior of ventral valve from the Middle Cambrian shales, near Helena, Montana.	
6. Cast of interior of dorsal valve associated with fig. 5.	
7. Cast of interior of ventral valve from the Middle Cambrian shales of East Canyon, Oquirrh Mountains, Utah.	
8. Cast of interior of dorsal valve from the Middle Cambrian shales, near Pioche, Nevada.	











A REVISION OF THE WRENS OF THE GENUS THRYOMANES SCLATER.

By HARRY C. OBERHOLSER,
Assistant Biologist, Department of Agriculture.

The present condition of the genera *Thryothorus* and *Troglodytes* is manifestly unsatisfactory. Either these groups must be better defined or no good reason can be found for recognizing more than one genus for all of the wrens in question. A careful examination of very nearly all the species concerned seems to indicate that *Thryothorus* and *Troglodytes* are capable of definition if the West Indian species¹ commonly referred to the former be transferred to the latter, and if *Thryomanes* be allowed to stand by itself. *Thryomanes*, indeed, is no more closely related to *Thryothorus* on the one hand than it is to *Troglodytes* on the other, and should include *Troglodytes insularis*. *Anorthura*, too, seems sufficiently distinct to be considered of generic value, as the species within its limits form a very homogeneous assemblage.² No trenchant characters appear to separate *Phengopedius* from *Thryothorus*, though the former may profitably be retained as a subgeneric division.

The four genera may be characterized as follows:

THRYOTHORUS.

Bill stout, somewhat curved, and with a conspicuous subterminal notch; angle of rami moderately acute; tarsi stout; tail five-sixths of wing, or more, but never longer than wing.

THRYOMANES.

Bill slender, somewhat curved, compressed, slightly or not at all notched; angle of rami very acute, this most apparent in the skull; nasal fossæ more linear than in *Thryothorus* or *Troglodytes*; tarsi slender; tail at least nine-tenths of wing, sometimes longer than wing.

¹These should therefore now stand as: *Troglodytes mesoleucus* (Sclater); *Troglodytes musicus* (Lawrence); *Troglodytes martinicensis* (Sclater); *Troglodytes rufescens* (Lawrence); *Troglodytes guadeloupensis* (Cory), and *Troglodytes grenadensis* (Lawrence).

²The North American forms should consequently be called: *Anorthura hiemalis* (Vieillot), *Anorthura hiemalis pacifica* (Baird), and *Anorthura alasensis* (Baird).

TROGLODYTES.

Bill rather stout, somewhat curved, and with no subterminal notch; angle of rami moderately acute; nares rather tear-shaped, broadest posteriorly, the superior membranes thickened; tail two-thirds to nine-tenths of wing.

ANORTHURA.

Bill slender and depressed, the culmen almost straight, tomia with no subterminal notch; nares narrow and slit-like, almost covered by overhanging membranes, which are very slightly or not at all thickened; tail less than three-fourths of wing.

The following review of *Thryomanes* has been based upon the examination of 378 specimens, representing very satisfactorily almost all the forms treated. Although it may seem that the number of subspecies admitted is excessive, yet all rest upon characters capable of definition. In a word, the differences do exist, and it becomes simply the question of how far one should go in recognizing by name these geographical variations. The result in the present case will be found to correspond fairly well with the criterion already adopted for other wide-ranging and plastic forms.

Genus THRYOMANES Sclater.

Thryomanes SCLATER, Cat. Coll. Amer. Birds, 1861, p. 22 (subgenus). Type, *Troglodytes bewickii* Audubon.

Chars. gen.—Genus generi *Thryothoro* affine, sed rostro debiliore et compressiore, vix vel haud dentato; tarsi gracilioribus.

Geographic distribution.—United States, north to Pennsylvania, Minnesota, Colorado, and on Pacific coast to British Columbia; south to Lower California, Guadalupe Island, Socorro Island, and on the mainland of Mexico to Oaxaca.

ANALYTICAL KEY TO THE SPECIES AND SUBSPECIES OF THRYOMANES, BASED ON ADULT MALES.

- I. Large, wing averaging 57 mm. or more.
 - A. Upper parts reddish brown.
 - a. Dark *percnus*.
 - a'. Light *cryptus*.
 - B. Upper parts grayish brown.
 - a. Paler, superciliary stripe narrower *eremophilus*.
 - a'. Darker, superciliary stripe broader.
 - b. Larger and darker *murinus*.
 - b'. Smaller and paler *bairdi*.
- II. Small, wing averaging less than 55 mm.
 - A. Exposed culmen usually 15 mm. or more.
 - a. Tail brown, not broadly tipped with whitish *insularis*.
 - a'. Tail black, broadly tipped with whitish.
 - b. Upper surface light grayish brown *leucophrys*.
 - b'. Upper surface dark brown.
 - c. Tail 49 mm. or more *calophonus*.
 - c'. Tail 45 mm. or less *brevicaudus*.

II. Small, wing averaging less than 55 mm.—Continued.

B. Exposed culmen less than 15 mm.

a. Upper parts grayish or smoky brown.

b. Larger, crissum heavily barred.....*chadrenturus*.

b'. Smaller, crissum rather lightly barred.....*cerroensis*.

a'. Upper parts reddish brown.

b. Very dark.

c. Color above burnt umber brown.....*bewickii*.

c'. Color above more sooty.....*spilurus*.

b'. Moderately dark.

c. Darker and rather more sooty above.....*nesophilus*.

c'. Lighter and more rufescent above.....*drymæus*.

THRYOMANES BEWICKII BEWICKII (Audubon).

Troglodytes bewickii AUDUBON, Ornith. Biog., 1831, I, p. 96.

Thryothorus bewicki BONAPARTE, Geog. and Comp. List, 1838, p. 11.

Telmatodytes bewicki CABANIS, Mus. Hein., 1850, I, p. 78.

Thryothorus bewickii var. *bewickii* BAIRD, Review Amer. Birds, 1864, I, p. 126.

Thryomanes bewicki RIDGWAY, Bull. Nutt. Orn. Club, 1877, II, p. 60.

Thryomanes bewicki a. *bewicki* COUES, Birds Col. Vall., 1878, p. 169.

Chars. subsp.—Supra clare rufo-brunneus, infra albidus, hypochondrii dorsi colore lavatis; crisso nigro fasciato; striga alba superciliari medioeri.

Measurements (18 specimens).—Wing, 51.5 to 56.5 (average, 53.6) mm.; tail, 48 to 56 (average, 52) mm.; exposed culmen, 12.5 to 14.5 (average, 13.4) mm.; bill from nostril, 9 to 10 (average, 9.6) mm.; tarsus, 17 to 18.5 (average, 17.6) mm.; middle toe with claw, 14 to 16.5 (average, 15.2) mm.

Type locality.—St. Francisville, Louisiana.

Geographic distribution.—Southeastern United States, north, locally, to central Pennsylvania, southern New Jersey, southern Ohio, southern Michigan, and central Minnesota;¹ west to eastern Iowa, southeastern Nebraska, eastern Kansas, and, in winter, central Texas. Strictly migratory only along the northern border of its range, but apparently not a summer resident in the far South.

Description.—Adult; No. 32288, U.S.N.M.; Macon, Georgia, October, 1848; Prof. Joseph Le Conte. Upper parts uniform rich burnt umber brown, the superior tail-coverts distinctly barred with black, the feathers of the rump with concealed white spots. Wing quills fuscous, the innermost secondaries barred with the color of the back, outer webs of the other secondaries edged with burnt umber and marked crosswise with darker brown; primaries indented externally with ochraceous brown; wing-coverts like the back, the major series with obsolete dark markings. Tail black, the central feathers with regular bars of prout's brown; all the remaining ones broadly tipped with grayish white, and on terminal portion more or less barred externally with the same color, this being most extensive on the outer rectrices, decreasing with each succeeding pair until it is barely noticeable.

¹Trippe, Proc. Essex Inst., 1871, VI, p. 115.

Lores, superciliary stripe and sides of head dull white, the lores and auriculars mixed with brown; postocular streak burnt umber. Lower surface dull white; sides of breast shaded with brownish gray, this color invading the sides of the neck; flanks washed with pale brown; inferior tail-coverts buffy white, barred with blackish brown; axillars and under wing-coverts grayish white.

Young in first plumage.—No. 1104, U.S.N.M.; Carlisle, Pennsylvania, July 5, 1843; S. F. Baird. Upper surface, including central tail-feathers and basal portion of exterior webs of all the rest except outermost pair, prout's brown, obsoletely barred on wings, head, rump, and tail-coverts with darker brown, the feathers of rump with indicated whitish markings, regularly barred on tail with blackish; remainder of tail clove brown, the two outer pairs of rectrices tipped and barred distally on external webs with buffy. Superciliary stripe and cheeks brownish white, the latter mixed with darker; inferior surface brownish white, mottled anteriorly with brownish gray; flanks and crissum ochraceous, the latter barred with brown.

The specimen from which Audubon described his *Troglodytes bewickii* came from near St. Francisville, Louisiana, and his plate and description clearly indicate that this name belongs to the form of *Thryomanes* inhabiting the eastern United States. This race is readily to be distinguished from all the other forms of the genus by the rich burnt umber brown of the upper parts.

The characters of *bewickii* are very constant, the principal variation being a seasonal one. Summer specimens are paler and grayer than examples taken in fall or winter, this difference being proportionate to the amount of wear to which the plumage has been subjected. The bird is always, however, easily distinguishable from *cryptus*, which these worn specimens somewhat resemble.

Two March specimens from Waukeelah, Florida, are duller and rather more grayish than other specimens of corresponding season, but are not otherwise different. Two examples from Texas—one from Waller County, the other from Brazos—are in every respect perfectly typical of *bewickii*.

A series of young birds exhibits a striking range of variation in the shade of the upper surface—from a dark sooty brown to a pale rufescent color; but the average is more reddish than in any of the other forms.

There appears to be no record of Bewick's wren for New York State, New England, or any part of the region north of the Great Lakes; and throughout the northern portion of its range it seems to be only locally common. There seems to be no account of its breeding in Florida, or in the Gulf region of any of the Southern States.

Thirty-four specimens of this form have been examined, these representing the following localities, breeding records being indicated by an asterisk:

Illinois: Sugar Creek Prairie;* Silver Creek Prairie;* Richland County;* Wabash County.*

Indiana: Wheatland.*

Pennsylvania: Carlisle;* Clearville;* Springville;* Needmore;* Charlesville.*

District of Columbia: Washington.

Tennessee: Roane County.

Georgia: Macon.

Florida: Waukeenah.

Texas: Brazos; Waller County.

THRYOMANES BEWICKII CRYPTUS, new subspecies.

Thryothorus bewickii leucogaster BAIRD, Rev. Amer. Birds, 1864, I, p. 127 (nec *Troglodytes leucogastra* Gould, quae *Hemiura leucogastra*).

Thryothorus bewickii bairdi A. O. U. Check-List, 1886, p. 328 (in part).

Chars. subsp.—*Thryomanes* T. b. *bewickii* similis, sed major; notaeo dilutiores et canescentiores.

Measurements (18 specimens).—Wing, 53 to 61 (average, 56.8) mm.; tail, 52 to 61 (average, 56.3) mm.; exposed culmen, 13.5 to 15.5 (average, 14.1) mm.; bill from nostril, 10 to 11 (average, 10.4) mm.; tarsus, 17.5 to 19.5 (average, 18.3) mm.; middle toe with claw, 15 to 17 (average, 16.2) mm.

Type locality.—San Antonio, Texas.

Geographic distribution.—Texas, except the extreme western corner, States of Nuevo Leon and Tamaulipas, in Mexico, with probably Kansas, Indian Territory, and Oklahoma. Migratory north of Texas.

Type.—Male, adult; No. 112838, U.S.N.M.; San Antonio, Texas, January 5, 1887; C. W. Beckham.

Description.—Upper surface rich, warm broccoli brown, darker and more rufous on rump, the feathers of which have more or less concealed white spots; superior tail-coverts hair brown, obscurely barred with blackish. Wings fuscous; innermost secondaries and outer webs of the others marked transversely with the color of the back; primaries margined basally on external webs with buffy; wing coverts like the back, the greater series with obsolete fuscous bars. Middle tail-feathers, and at least basal portion of exterior webs of all but outer pair, hair brown, barred regularly, though not sharply, with blackish; remainder of tail black, with very faintly indicated paler bars, continuous with those on outer webs; two external pairs of feathers broadly tipped with grayish white, the outermost deeply indented with white on outer webs; remainder of rectrices tipped with hair brown. Superciliary white; lores and cheeks grayish white, mingled with brownish; postocular streak like the crown; sides of the neck brownish gray; lower surface grayish white, scarcely tinged with brownish on flanks; crissum slightly washed with ochraceous, and barred with black; axillars and under wing-coverts grayish white.

Young in first plumage.—Female; No. 112317, U.S.N.M.; Lomita, Texas, May 25, 1878; G. B. Sennett. Upper parts, including central rectrices and basal portion of outer webs of all but outermost pair, pale, grayish broccoli brown, lighter and more ochraceous on rump, the feathers of which have hidden grayish white spots; tail barred with black; wings and superior tail-coverts with obsolete transverse markings of darker brown; rest of tail black, the two outer pairs of rectrices tipped with dull gray and distally barred on external webs with dull white. Superciliary stripe dull white; cheeks brownish white, mixed with darker; lower parts brownish white, faintly mottled on breast with dusky; flanks rufescent gray; crissum tinged with ochraceous and barred with black.

This form of Bewick's wren is the one to which Baird's name *leucogaster* is applicable, as the range, "southern borders of United States into Mexico," given by him, taken in connection with the specimens he enumerates, clearly indicates. But it now seems quite certain that by perhaps an interchange of labels Baird was in error when he identified the Texas *Thryomanes* with Gould's *Troglodytes leucogastra*.¹ There seems to be no reasonable doubt of the authenticity of the specimen which Dr. Sharpe catalogues as the type of *Troglodytes leucogastra* Gould,² for it came from the collection of the Zoological Society, where Gould's type was supposed to have been; it was collected in Tamaulipas, Mexico, the type locality of *Troglodytes* (= *Hemiura*) *leucogastra*, whence, until recently, no other specimen (of *Hemiura*) has been recorded; and, finally, it is undoubtedly a *Hemiura*, thus agreeing perfectly with Gould's original description of *Troglodytes leucogastra*, while in that description the expression "*crissoque pallidi-brunnei*" could not possibly apply to any form of Bewick's wren. Baird's term *leucogaster*, as used for the *Thryomanes*, thus having been based upon a misidentification, can not, according to the usual procedure in such cases, be considered entitled to recognition; for in reality he proposed no new name, but merely referred his specimens to a species already described.

The Texan form of *Thryomanes* may be readily distinguished from *bewickii* by much paler, grayer coloration above, as well as by longer tail, wing, culmen and middle toe. In fact, the lack of intermediate specimens strongly suggests the possibility of specific distinctness; but the material at hand is not sufficient satisfactorily to determine this point.

Considerable individual difference is apparent in *cryptus*, even among birds taken at the same season, many being noticeably darker, duller, or more grayish brown above than the type. Worn summer birds are grayer and, of course, much paler than specimens in fresh plumage,

¹ Schlater and Salvin, *Nomenclator Avium Neotrop.*, 1873, p. 155; Salvin and Godman, *Biol. Centr.-Amer.*, Aves, 1880, I, p. 95; Faxon, *Auk*, 1898, XV, p. 60.

² *Cat. Birds Brit. Mus.*, 1881, VI, p. 285.

and in this abraded condition are sometimes rather difficult to distinguish with certainty from *eremophilus*, though typical examples, particularly in fall and winter, are with little difficulty identifiable.

There have been available no specimens from Kansas, Indian Territory, or Oklahoma, but *cryptus* will doubtless be found to be the form occupying this region. Specimens from Rodriguez, Nuevo Leon, Mexico; Santa Rosalia, Tamaulipas; Mier, Tamaulipas; and Fort Clark, Texas, are apparently typical *cryptus*. Young birds seem to be usually paler than the young of any of the other forms.

Sixty-four specimens have been examined, from the following localities, breeding records being designated by an asterisk:

Texas: Cisco; San Angelo; San Antonio;* Lomita;* Dublin; Fort Clark;* San Lorenzo Creek; Beeville; Bee County;* Leon Springs; Brownsville;* Sycamore Creek; Fort Davis; Roma;* Brownwood;* Mouth of Pecos River; Mouth of Devils River; Comanche County; Atascosa County.

Nuevo Leon: Rodriguez; China.*

Tamaulipas: Mier;* Santa Rosalia.*

THRYOMANES BEWICKII EREMOPHILUS, new subspecies.

Thryothorus bewickii bairdi A. O. U. Check-List, 1886, p. 328 (in part).

Chars subsp.—*Thryomanes* T. b. *crypto affinis*; sed partibus superioribus magis griseis distinguendus.

Measurements (18 specimens).—Wing, 51 to 60 (average, 56.1) mm.; tail, 50.5 to 63.5 (average, 56.8) mm.; exposed culmen, 13 to 15 (average, 13.8) mm.; bill from nostril, 9 to 11 (average, 10) mm.; tarsus, 15 to 18.5 (average, 18) mm.; middle toe with claw, 13.5 to 17 (average, 15.5) mm.

Type locality.—Big Hatchet Mountains, Grant County, New Mexico.

Geographic distribution.—Extreme western Texas (in winter to central part), Arizona, New Mexico, and southeastern California, south over the table-lands of western Mexico to central Zacatecas; north to Colorado, southern Utah, southern Nevada, and possibly southeastern Oregon. Resident south of Colorado.

Type.—Male, adult; No. 126774, U.S.N.M.; Big Hatchet Mountains, Grant County, New Mexico, May 19, 1892; Mearns and Holzner.

Description.—Above uniform pale grayish sepia, slightly rufescent on the rump, the feathers of which have more or less concealed white spots; upper tail-coverts hair brown, faintly barred with darker. Wing-quills fuscous, indented externally with the color of the upper surface, wing-coverts like the back. Middle tail-feathers, and basal portion of exterior webs of the rest, with the exception of the outermost pair, hair brown, regularly barred with black; three outer pairs with broad grayish tips, and white indentations on exterior webs, these latter most numerous on the outer pair; other rectrices tipped with hair brown; remainder of tail black. Superciliary stripe white; lores and

cheeks grayish white, somewhat mixed with brown; postocular streak like the crown; sides of neck brownish gray; lower surface dull white, nearly clear white on chin and throat, washed with gray on sides and flanks; crissum heavily barred with black; lining of wing grayish white.

Young in first plumage.—Male; No. 128935, U.S.N.M.; Santa Cruz River, west of Patogone Mountains, Arizona, May 30, 1893; Frank X. Holzner. Upper parts brownish gray, this color extending over the upper surface of the closed tail, the latter barred with black; rump with concealed white spots; wings transversely marked externally with dull brown; rest of tail black, centrally tipped with slate color, the two external pairs of feathers tipped with gray and barred distally on outer webs with white. Superciliary stripe white; lores and cheeks grayish white, mixed with brownish; sides of neck brownish gray, mottled with brown and grayish white; lower parts grayish white, jugulum, breast, and sides thickly speckled with gray; flanks and crissum washed with brownish, the latter barred with black.

The difference existing between *eremophilus* and *cryptus* consists in the rather paler, much more grayish tint of the upper parts, and no difficulty will be experienced in identifying the great majority of specimens. Some intermediates, however, are to be distinguished only by the slightly paler or more grayish color of the wings. This subspecies is more closely allied to *bairdi* than to any of the other Mexican forms, although the ranges of *bairdi* and *eremophilus* are separated by the interposition of a race larger and darker than either.

As in *cryptus*, there exists a considerable amount of individual difference, even at the same season, this consisting principally in the darker or more rufescent color of the upper surface. Two breeding specimens from Paisano, Texas, are perfectly typical of the present race, though rather darker than most Arizona examples. Specimens from San Diego, Chihuahua, Mexico, White Mountains, and the region of Death Valley, California, are identical with those from Arizona and New Mexico. A winter bird from the Valparaiso Mountains, Zacatecas, Mexico, differs only in being slightly darker.

Young birds of *eremophilus* range in color above from a light rufescent gray, hardly distinguishable from the shade of young *cryptus*, to a very dark, dull brownish gray; averaging, however, very much darker than the Texan form. Many of the specimens are fully as deeply colored as the young of *charienturus*, though averaging rather less rufescent.

A single adult bird from Grand Junction, Colorado, is apparently the seventh record for that State and the only one for the western portion.¹ Although no other Colorado specimens have been examined,

¹For these other records see Cooke, Birds of Colorado, Bulletin 37, Colorado Experiment Station, 1897, p. 120; Further Notes on the Birds of Colorado, Bulletin 41, Colorado Experiment Station, 1898, p. 169.

the previous records very probably belong to the present race, with the exception of the birds noted at Burlington and Fort Lyon, which may prove to be *Thryomanes b. cryptus*. In his paper on the birds of south-eastern Oregon,¹ Major Bendire mentions the occurrence of *spilurus* at Camp Harney; but, notwithstanding the fact that within the Great Basin *cremophilus* is not otherwise known to reside north of southern Nevada, it seems almost certain that this reference, if correct specifically, should be here included, for the Pacific coast form does not, in all probability, extend eastward beyond the Cascade Range.

Sixty-seven specimens of *cremophilus* have been examined, from the following localities, breeding records being designated by an asterisk:

Texas: Del Rio; Paisano;* San Angelo; Cisco; Eagle Pass; El Paso.

New Mexico: Grafton; Deming; Big Hatchet Mountains;* Silver City.

Arizona: Dos Cabezas; Santa Rita Mountains;* Apache; Santa Cruz River west of Patogone Mountains;* Tanks;* Santa Catalina Mountains;* Fort Whipple;* Calabasas; Los Nogales;* Fort Huachuca;* Tucson; Chiricahua Mountains;* Huachuca Mountains;* Camp Crittenden.*

California: Resting Spring; White Mountains;* Argus Range;* Furnace Creek, Death Valley.

Utah: Santa Clara; Toquerville; Washington; Iron City.

Nevada: St. Thomas.

Colorado: Grand Junction.

Sonora: San Jose Mountains;* Patogone Mountains.

Chihuahua: San Diego;* San Luis Mountains; east side of San Luis Mountains.

Zacatecas: Valparaiso Mountains.

THRYOMANES BEWICKII PERCNUS, new subspecies.

Thryothorus bewickii spilurus A. O. U. Check List, 1886, p. 327 (in part).

Chars. subsp.—*Thryomanes* T. b. *cremophilus* sat similis, sed corporis parte superiore colore valde saturatiore et rufescentiore, crisso latius fasciato, rostro alisque longioribus, striga superciliari paulo distinctiore, facile distinguendus.

Measurements (10 specimens).—Wing, 49.5 to 61.5 (average, 57.8) mm.; tail, 45.5 to 58 (average, 54.3) mm.; exposed culmen, 13.5 to 16 (average, 15) mm.; bill from nostril, 10 to 11.5 (average, 11) mm.; tarsus, 18 to 19.5 (average, 18.6) mm.; middle toe with claw, 15 to 16.5 (average, 16) mm.

Type locality.—Etzatlan, Jalisco, Mexico.

Geographic distribution.—State of Jalisco, north to Central Zacatecas, south to Guerrero.

Type.—Male, adult; No. 142993, U.S.N.M., Biological Survey collection; Etzatlan, Jalisco, Mexico, June 23, 1892; E. W. Nelson.

¹ Proc. Bost. Soc. Nat. Hist., 1877, XIX, p. 113.

Description.—Upper parts dull prout's brown, rather brighter on the rump, where the feathers have nearly hidden roundish white markings; superior tail-coverts hair brown, transversely marked with blackish. Exposed surface of wings like the back; outer webs of secondaries and greater coverts paler, barred with fuscous; primaries indented basally with buffy. Middle tail-feathers and proximal portion of external webs of all the rest, save the outer pair, hair-brown, regularly barred with black; remainder of tail black, excepting the terminal portion of the feathers—which, on the three outer pairs of feathers, is grayish white, on the others hair brown—and the exterior webs of the outermost pair, which are broadly barred with white. Superciliary stripe white; lores and cheeks grayish white, somewhat mingled with brownish; a dull vandyke brown postocular stripe; sides of neck and breast dull brownish gray; lower surface brownish white; the sides and flanks washed with gray; crissum regularly and strongly barred with black; lining of wing grayish white.

Young in first plumage.—Male; No. 142990, U.S.N.M., Biological Survey collection; Etzatlan, Jalisco, Mexico, June 23, 1892; E. W. Nelson. Above dark grayish brown; the rump with concealed white spots; upper tail-coverts faintly barred with blackish. Wing-coverts and edgings to wing-quills like the back, those on the primaries of a much lighter shade; bars on secondaries very faintly indicated. Middle pair of rectrices hair brown, regularly barred with black; proximal portion of external webs of all but outermost pair with same pattern of coloration; two outer pairs tipped with gray, and on distal portion indented exteriorly with dull white; remainder of tail-feathers tipped with hair brown; rest of tail black. Superciliary stripe white; lores and cheeks brownish white, mixed with dark brownish; lower surface brownish white, speckled anteriorly with dusky; flanks and sides washed with brownish gray; under tail-coverts washed with ochraceous and barred with black.

Mr. Ridgway has already called attention to the difference existing between the birds from western Mexico (Jalisco) and those from California,¹ but did not bestow a name upon the former, not being fully satisfied with regard to their distinctness. Additional material, however, contained chiefly in the collection of the Biological Survey of the Department of Agriculture, proves the Jalisco bird to be not only different from the California races, but separable as well from *bairdi* of Oaxaca and *murinus* of the Valley of Mexico. As there appears to be no name which can be applied to this form, it is here described as new.

The characters which separate *percnus* from *cryptus* are longer wing and culmen, much darker, duller color above, more conspicuous superciliary stripe, and more heavily barred crissum. From *eremophilus* it may be readily discriminated by its much darker, more reddish upper

¹ Manual of N. A. Birds, 1887, p. 551, footnote.

surface, more prominent superciliary stripe, more heavily barred lower tail-coverts, longer wing and culmen, and somewhat shorter tail. In the much duller brown of the upper surface, as well as the decidedly greater length of wing and tail, *percnus* is so different from *bewickii*, *calophonus*, or *spilurus*, that no detailed comparison is necessary.

An April specimen of *percnus* from Zapotlan, Jalisco, Mexico, is noticeably paler and less rufescent than the type, thus somewhat approaching *bairdi*. A female from Tonila, Jalisco, is rather peculiar, being very much smaller, and, in the color of the upper parts, decidedly more richly reddish brown than any of the other specimens of *percnus*. An adult male, collected by Sumichrast in August, 1868, at Puente Colorado, Guerrero, Mexico, is in fresh plumage, and seems to be perfectly typical of the present race. The young of *T. b. percnus* are apparently not with certainty to be distinguished from the young of *bairdi*.

Thirteen specimens examined, from the following localities, breeding records being indicated by an asterisk.

Jalisco: Etzatlan,* Tonila; Zapotlan,* Guadalajara.*

Zacatecas: Plateado.*

Guerrero: Puente Colorado.

THRYOMANES BEWICKII MURINUS (Hartlaub).

Thryothorus murinus HARTLAUB, Rev. et Mag. de Zool, 1852, 2d ser., IV, p. 4.

Thryothorus bewickii murinus RIDGWAY, Auk, 1887, IV, p. 350.

Chars. subsp.—*Thryomanes T. b. pereno* affinis, sed supra saturate cano-brunneus nec obscure rufo-brunneus.

Measurements (10 specimens).—Wing, 57 to 61.5 (average, 58.8) mm.; tail, 56 to 60.5 (average, 58.1) mm.; exposed culmen, 14 to 16 (average, 14.8) mm.; bill from nostril, 9.5 to 12 (average, 10.7) mm.; tarsus, 18.5 to 20.5 (average, 19.4) mm.; middle toe with claw, 15.5 to 18 (average, 16.7) mm.

Type locality.—Rio Frio, Mexico, Mexico.

Geographic distribution.—Mexican States of Hidalgo, Mexico, Tlaxcala, and northern Morelos.

Description.—Male, adult; No. 142976, U.S.N.M., Biological Survey collection; Amecameca, Mexico, Mexico, February 1, 1893; E.W. Nelson. Above warm grayish sepia, darker on the crown, the feathers of the rump with more or less concealed white spots; upper tail-coverts hair brown, obsoletely barred with blackish. Wing quills fuscous, the secondaries margined externally with sepia, and barred with darker brown, most of the primaries indented on basal portion of outer webs with pale brown; wing-coverts like the back, the greater series faintly barred with darker, and edged with lighter brown. Tail black, the central feathers with broad and regular bars of hair brown, the two succeeding pairs tipped, and on basal portion margined on outer webs with hair brown in the shape of broad transverse markings, like those

on the middle rectrices; three outer pairs with grayish white tips and terminal bars on exterior webs, these bars most numerous on the outermost pair. Superciliary white; lores and cheeks grayish white, with some admixture of brownish; postocular stripe sepia; sides of neck deep brownish gray; below grayish white, the sides and flanks brownish gray, more rufescent on the latter; crissum tinged with ochraceous and conspicuously barred with black; axillars and inferior wing-coverts grayish white.

As Mr. Ridgway has already shown,¹ there seems to be little doubt that the *Thryothorus murinus* of Dr. Hartlaub is a *Thryomanes*. If, indeed, any question of this fact remains it should now be set at rest, for Dr. Hartlaub has, by request, kindly reexamined the types, and with regard to them writes as follows:

The type specimen of my *Thr. murinus* (Hamburg Mus.) is before me, together with a fine adult specimen of *Thr. bairdi* in our Bremen collection. Both are Mexican. I can not discover the slightest difference . . . So that Mr. Ridgway is perfectly right in retaining my name *murinus* for Baird's wren.

It is a curious fact that my *Thryothorus murinus* is simply omitted in the Brit. Mus. Catalogue. In Vol. VI, p. 226, the name *murinus* is not to be found! As to the figure, pl. XIII, it is a rather good one. The white longitudinal spots or streaks in the uropygium and lower back are very distinct in my type specimen of the Bremen collection. In the Hamburg type specimen only one white spot is visible. But as to the identity of these two type specimens there is not the slightest doubt.

In view of these facts it is evident that the term *murinus*, having priority over *bairdi*, must be used for some one of the Mexican forms of this group. Rio Frio, the type locality of *murinus*, is on the eastern side of the Valley of Mexico, and as the birds from this region are separable from those of Oaxaca, whence came Messrs. Salvin and Godman's type of *bairdi*, the name *murinus* may be restricted to the former race, and the retention of the subspecific term *bairdi* thus permitted for the latter.

From *cremophilus* the present race differs by reason of its average larger size, particularly the bill; darker coloration above; slightly deeper gray flanks; wider superciliary stripe; more strongly and regularly barred crissum. It may be discriminated from *perennis* by its grayish brown upper parts, which contrast noticeably with the dull reddish brown of typical specimens of the more western form. It may be readily distinguished from *cryptus* by the much darker and grayer upper surface, more heavily barred crissum, more prominent superciliary stripe, and larger general size.

The birds from Pachuca and Real del Monte, Hidalgo, should, however, perhaps be considered the typical examples of this race, for they are the most different from true *bairdi*. The specimen from Amecameca, State of Mexico, which is described above, is practically a topotype of *murinus*, since Rio Frio, the type locality, is but a short distance away and along the same slope of the cordillera. This specimen is

¹ Auk, 1887, IV, p. 349.

almost identical with those from the places in Hidalgo above mentioned, except for a noticeable brownish tinge to the upper surface, which shows a tendency toward *bairdi*. The specimens from Irolo, Hidalgo; Apexoco, Tlaxcala; and Tetela del Volcan, Morelos, are more or less intermediate between *murinus* and *bairdi*, though nearer the former.

Ten specimens examined were from the following localities, breeding records being marked by an asterisk:

Hidalgo: Tula; Real del Monte; Pachuca; Irolo.*

Mexico: Tlalpam; Amecameca.

Morelos: Tetela del Volcan.

Tlaxcala: Apexoco.*

THRYOMANES BEWICKII BAIRDI (Salvin and Godman).

Thryothorus bairdi SALVIN and GODMAN, Biol. Centr.-Amer., Aves., 1880, I, p. 95.

Thryothorus bewickii bairdi RIDGWAY, Proc. U. S. Nat. Mus., 1885, VIII, p. 354.

Chars. subsp.—Thry. b. *murino* persimilis sed minor, superne pallidior, brunnescensior vel magis ochraceus; crisso paululum minus conspiciens fasciato.

Measurements (8 specimens).—Wing, 55.5 to 58.5 (average, 56.7) mm.; tail, 54 to 56.5 (average, 55.6) mm.; exposed culmen, 13.5 to 15.5 (average, 14.1) mm.; bill from nostril, 9.5 to 11.5 (average, 10.3) mm.; tarsus, 18 to 19.5 (average, 18.8) mm.; middle toe with claw, 15 to 17.5 (average, 16.3) mm.

Type locality.—Oaxaca, Mexico.

Geographic distribution.—Oaxaca, southern Puebla, and southwestern Vera Cruz.

Description.—Male, adult; No. 142965, U.S.N.M., Biological Survey collection; Tamazulapam, Oaxaca, Mexico, November 14, 1894; Nelson and Goldman. Upper surface uniform dull brown, intermediate between hair brown and broccoli, the rump with more or less hidden white spots, the tail-coverts hair brown, inconspicuously barred with blackish. Wings fuscous, the secondaries edged externally with light sepia, and obsoletely barred with dark brown; basal part of exterior webs of primaries margined with pale brown; wing-coverts the same color as the back. Tail black, the middle pair of rectrices, together with the basal portion of outer webs of all remaining ones except the outermost pair, hair brown, somewhat irregularly barred with black; three exterior pairs of feathers tipped with grayish white, the outermost pair with wide indentations of white along the whole length of external webs, the two succeeding pairs with similar markings confined to the distal portions; remainder of rectrices with hair brown tips. Superciliary stripe dull white; lores and postocular streak light sepia; auriculars grayish white, streaked narrowly with dark brown; sides of neck deep brownish gray; inferior surface grayish white, the chin and throat almost pure white; sides and flanks brownish gray, more rufescent on the latter, crissum slightly tinged with

ochraceous, heavily barred with black; lining of wing grayish white.

Young in first plumage.—Female; No. 142967, U.S.N.M., Biological Survey collection; Oaxaca, Oaxaca, Mexico, June 22, 1894; Nelson and Goldman. Above slightly rufescent hair brown, rather darker and more reddish on rump, some of the feathers of the latter with hidden whitish spots. Exposed surface of closed wings like the back, the greater coverts and secondaries obsoletely barred with darker. Central rectrices and exterior webs of all the remaining ones except the outer pair, like the back, regularly barred with black; rest of tail black, the feathers tipped with hair brown; two outermost pairs barred distally with white on external webs. Superciliary stripe dull white; lores and cheeks grayish white, mixed with brownish; below brownish white, most nearly clear white on chin and throat, mottled with dull gray on jugulum and breast, heavily washed with brownish gray on sides and flanks, this most rufescent on the latter; crissum washed with ochraceous and barred heavily with black.

The name *Thryothorus bairdi* was proposed by Messrs. Salvin and Godman as a substitute for the untenable *Thryothorus bewickii* var. *leucogaster* of Baird; but the term *bairdi*, as at present understood, includes several recognizable forms, in differentiating which it becomes necessary to employ for one of these the designation *bairdi*.

True *bairdi*, then, as here restricted, may be distinguished from *murinus* by somewhat smaller size, particularly the bill; paler, more brownish or more ochraceous upper parts, and rather less heavily barred crissum. From *perenus*, of western Mexico, it may be separated by paler, more grayish brown upper parts, rather less heavily barred crissum, shorter wing and culmen. It differs appreciably from *cryptus* in darker, grayer color above, and has also a rather wider superciliary stripe. It may be differentiated from *eremophilus* by somewhat darker upper surface, broader superciliary, and rather darker flanks. It has a decidedly longer wing and tail than *charienturus*, besides being noticeably lighter on the upper parts, flanks, and sides. With *drymæcus*, from California, it can scarcely be confused, by reason of its much longer wing and tail, less rufescent upper surface, as well as paler flanks and sides.

With due allowance for individual and seasonal variation, the specimens which are here referred to *bairdi* present but slight aberrant characters. An April bird from Chalchicomula, Puebla, Mexico, is rather darker than the example from Oaxaca, above described, thus inclining toward *murinus*, but it belongs without doubt to the present subspecies.

Nine specimens have been examined, representing the following localities, breeding records being designated by an asterisk:

Oaxaca: Oaxaca; * Tamazulapam.

Puebla: Chalchicomula; * Tehuacan; * Atlitico.*

Vera Cruz: Maltrata; Perote.*

THRYOMANES BEWICKII CHARIENTURUS, new subspecies.

Thryothorus bewickii spilurus A. O. U. Check-List, 1886, p. 327 (in part).

Chars. subsp.—*Thryomanes* T. b. *eremophilo similis*, a quo differt partibus superioribus et hypochondriis obscurioribus, striga superciliari paululum latiore, alis caudaque multo brevioribus.

Measurements (23 specimens).—Wing, 48.5 to 55 (average, 51.7) mm.; tail, 47.5 to 54.5 (average, 51.5) mm.; exposed culmen, 12.5 to 14.5 (average, 13.8) mm.; bill from nostril, 9 to 11.5 (average, 10.2) mm.; tarsus, 18 to 19.5 (average, 18.8) mm.; middle toe with claw, 14 to 16 (average, 15.4) mm.

Type locality.—Nashoguero Valley, Lower California (Mexican and United States boundary line).

Geographic distribution.—Coast region of southern California, north to about Pasadena, south to latitude 28°, Lower California; Santa Catalina Island, California. Resident throughout its range.

Type.—Male, adult; No. 134163, U.S.N.M.; Nashoguero Valley, Lower California, June 5, 1894; Dr. Edgar A. Mearns.

Description.—Upper parts dull grayish sepia, slightly rufescent on rump, the feathers of this part with more or less hidden roundish white markings; superior tail-coverts hair brown, obscurely barred with dusky. Wings fuscous, secondaries alternately barred on external webs with blackish and the color of the back; lesser and median coverts, with margins of greater series, also similar to the upper surface; primaries narrowly edged on basal portion of exterior webs with buffy. Tail black, the central rectrices hair brown, with regular bars of black; exterior feathers with terminal portion dull smoke gray, the outer webs barred with dingy white; remaining feathers barred on external webs and tipped with hair brown. Superciliary stripe white; lores and cheeks grayish white, mixed with brownish; postocular streak like the crown; sides of neck deep brownish gray; chin and throat white (soiled by wear); rest of under surface grayish white (adventitiously washed with brownish); sides and flanks tinged with smoke gray; crissum heavily barred with black; lining of wing grayish white.

Young in first plumage.—Male; No. 134165, U.S.N.M.; Nashoguero Valley, Lower California, June 5, 1894; Dr. Edgar A. Mearns. Above grayish sepia, this color extending over the middle tail-feathers and the basal portion of the external webs of all the rest with exception of outermost pair, these parts of the tail barred with black; remainder of tail clove brown, tipped with slate gray, terminal portions of the two outer pairs of rectrices rather paler, and external webs of outermost pair marked with dull buffy; rump paler than the back and with a few concealed whitish spots, faintly barred, as are also the upper tail-coverts, with darker; wings externally with somewhat obscure bars of dark brown. Superciliary stripe buffy white; cheeks brownish white, much

mixed with darker; lower parts dull white, faintly mottled with brownish gray on breast; sides and flanks smoke gray; crissum tinged with ochraceous and barred with blackish.

From *eremophilus* this race differs in decidedly darker flanks and upper surface, rather broader superciliary stripe, more regularly and heavily barred crissum, as well as much shorter wing and tail. From *murinus*, which it approximates very closely in color above, it differs in conspicuously shorter wing and tail, shorter culmen, darker flanks, and somewhat less heavily barred lower tail-coverts.

Two examples from San Quentin Bay, Lower California, are essentially similar to the type of *charienturus*, although one is darker, this difference being probably due, however, to adventitious stain, as the under surface is very much soiled. Another specimen from the same locality is much paler above, with a bright reddish back that is evidently abnormal. Breeding specimens from Pasadena, California, resemble the type, but are slightly warmer brown above, showing in this respect an inclination toward *drymæus*.

Fall and winter birds are, as would be expected, darker and richer brown. A fine series from Pasadena shows some individual variation in the shade of the upper surface, but only one example can be considered in noticeable degree intermediate between *charienturus* and *drymæus*.

The few young birds examined do not seem to be with certainty distinguishable from the young of *eremophilus*; they are rather darker than *leucophrys* and much less rufescent than *drymæus*.

Thirteen specimens from Santa Catalina Island, California, taken in winter and spring, are not perfectly typical, though very much nearer the present form than to any of the others. In color these island birds are apparently a little darker and less rufescent; the bill and middle toe are slightly longer. These differences are, however, too slight and too inconstant to warrant even subspecific separation from the bird of the mainland.

Mr. Bryant has recorded "*spilurus*" from the mainland of Lower California at the latitude of Cerros Island,¹ but this, of course, refers to the present race, representing, apparently, the southern limit of its distribution.

Fifty specimens examined, from the following localities, breeding stations being designated by an asterisk:

California: Pasadena;* Chilco (mountains 20 miles north of Pasadena);* San Bernardino; Laguna, San Diego County;* Santa Catalina Island.

Lower California: Nashoguero Valley, Mexican boundary line; San Quentin Bay.

¹ Proc. Calif. Acad. Sci., 1889, 2d ser., II, p. 316.

THRYOMANES BEWICKII DRYMÆCUS, new subspecies.

Thryothorus bewickii spilurus A. O. U. Check-List, 1886, p. 327 (in part).

Chars. subsp.—Thry. b. charienturo affinis, sed supra valde rufescens et paulo dilutior.

Measurements (15 specimens).—Wing, 47 to 54.5 (average, 51.4) mm.; tail, 45 to 53 (average, 49.8) mm.; exposed culmen, 13 to 14.5 (average, 13.7) mm.; bill from nostril, 9 to 10.5 (average, 9.8) mm.; tarsus, 17.5 to 19 (average, 18.4) mm.; middle toe with claw, 14.5 to 16.5 (average, 15.5) mm.

Type locality.—Baird, California.

Geographic distribution.—Sacramento and San Joaquin valleys, California, including west slope of Sierra Nevada, west to the coast about San Simeon; casually to Arizona. Resident in suitable localities throughout its breeding range.

Type.—Male, adult; No. 91610, U.S.N.M.; Baird, California, June 6, 1883; C. H. Townsend.

Description.—Above uniform dull rufescent hair brown, the rump with more or less concealed white spots, the tail-coverts slightly grayer than the back, obsoletely barred with darker brown. Wings fuscous; innermost secondaries and outer webs of remainder broadly barred with the color of the upper surface and somewhat with blackish; wing-coverts like the back; primaries edged basally with buffy. Middle rectrices hair brown, barred with black; exterior webs of succeeding pair and basal portion of exterior webs of remainder, excepting outermost pair, like the middle feathers; outer pairs tipped with dull gray, external webs of outermost pair indented terminally on exterior web with white; tips of the other feathers hair brown; rest of tail black. Superciliary stripe white; lores and cheeks white, somewhat mingled with brown; postocular streak like the crown; sides of neck pale brownish gray; lower parts grayish white, adventitiously washed with brownish, lightest on the throat, the flanks and sides tinged with smoke gray, this deepest on the former; under tail-coverts tinged slightly with ochraceous, and barred with black; lining of wing grayish white.

Young in first plumage.—No. 91642, U.S.N.M.; Baird, California, June 6, 1883; C. H. Townsend. Above rufescent broccoli brown, more reddish on rump, the feathers of which have concealed whitish spots; tail-coverts faintly barred with dark brown. Edgings to wing-quills and their coverts brown like the upper parts, with obsolete darker bars. Middle pair of tail-feathers like the back, regularly barred with black; exterior webs of all but outermost pair of feathers the same; three outer pairs tipped with gray and barred on terminal portion of exterior webs with dull white; remainder of tail clove brown. Superciliary stripe white, lores and cheeks brownish white, mixed with darker; postocular

streak like the crown; lower surface brownish white, anteriorly with fine dusky markings; sides and flanks pale brownish gray, the latter more rufescent; crissum pale ochraceous, barred with black.

Thryomanes b. drymaceus may be distinguished from *T. b. charienturus* by rather paler, decidedly more rufescent flanks and upper surface, together with somewhat shorter tail. Compared with *cremophilus*, it is darker, more rufescent above, with a somewhat more prominent superciliary stripe, and decidedly shorter wing and tail. The characters which separate *drymaceus* from *cryptus* consist in rather darker flanks and upper surface, rather more conspicuous superciliary stripe, somewhat more heavily and regularly barred crissum, much shorter wing and tail. It differs from *leucophrys* in much more rufescent color above, more heavily barred crissum, and much shorter culmen.

A spring specimen from Wheatland, California, is, by reason of its darker, more sooty color above, somewhat intermediate between *drymaceus* and *spilurus*, but seems to be nearer the former. One example from Stanford University, taken in March, seems to be without doubt referable to *drymaceus*, though all the others from the same locality are typical *spilurus*. One of the winter birds from Pasadena, California, and an October specimen from Calabasas, Arizona, apparently also belong to the present race.

Young birds in first plumage are distinguishable from those of *charienturus* by their much more rufescent coloration. They are appreciably paler than the young of *calophonus*.

Twenty three specimens of this form have been examined, representing the following localities, breeding records being designated by an asterisk:

California: San Simeon; Jackson; Jolon; Tejon Mountains;* Walker Basin; Baird;* Ager;* Placerville; Wheatland; Coulterville;* Sacramento; Yreka;* Los Angeles; Calaveras County; Pasadena; Stanford University; Nevada City.

Arizona: Calabasas.

THRYOMANES BEWICKII SPILURUS (Vigors).

Troglodytes spilurus VIGORS, Zool. Voyage Blossom, 1839, p. 18, pl. iv, fig. 1.

Thryothorus bewickii var. *spilurus* BAIRD, Rev. Amer. Birds, 1861, I, p. 126 (in part).

Thryothorus spilurus COOPER, Birds Calif., 1870, I, p. 69 (in part).

Thryomanes bewickii spilurus RIDGWAY, Bull. U. S. Geol. and Geog. Surv. Terr., 1876, 11, No. 2, p. 186 (in part).

Chars. subsp.—*Thryomanes* *T. b. drymoeco* similis; sed notaco, lateribus, hypochondriisque conspicue obscurioribus, haud difficile dignoscendus.

Measurements (18 specimens).—Wing, 49 to 53.5 (average, 51.1) mm.; tail, 45 to 52 (average, 49.1) mm.; exposed culmen, 12.5 to 14.5 (average, 13.4) mm.; bill from nostril, 9 to 11 (average, 9.8) mm.; tarsus, 17 to 19.5 (average, 18.5) mm.; middle toe with claw, 15.5 to 16.5 (average, 16.1) mm.

Type locality.—Coast of California, probably vicinity of San Francisco.

Geographic distribution.—Vicinity of San Francisco Bay, California; occasional on Cosumnes River, California.

Description.—Male, adult; No. 162703, U.S.N.M.; Stanford University, California, January 9, 1897; Ralph Arnold.¹ Upper surface sepia brown, shading toward vandyke brown on rump, the feathers of the latter with more or less concealed white spots; superior tail-coverts sepia, obsoletely barred with blackish. Wings fuscous; exterior webs of secondaries margined with bistre and indistinctly barred with blackish; wing-coverts like the back; exterior webs of primaries edged basally with light brown. Tail black, the central pair of rectrices sepia, with imperfect bars of black; the succeeding pair tipped, and all the rest more or less margined externally with sepia, with also indicated transverse markings of blackish; the four exterior pairs of feathers grayish white on their terminal portions, the outermost pair indented externally with the same color. Superciliary stripe white; lores and sides of head grayish white, the two last mixed with the color of the back; postocular streak bistre; sides of neck dark brownish gray; under surface grayish white, lightest on chin and upper throat; sides of body heavily washed with gray; flanks rufescent gray; inferior tail-coverts tinged with rufous and heavily barred with black; lining of wing grayish white.

In the original description of his *Troglodytes spilurus* Vigors mentions no locality; but as the *Blossom* touched at no points on the Pacific coast of the United States excepting San Francisco and Monterey, it seems fair to assume that the type of this race came from one of these two places. No specimens from Monterey have been examined, but climatic and topographic conditions render very probable the supposition that there occurs here the same form of *Thryomanes* as the one found at San Francisco. Furthermore, both plate and description, insufficient and unsatisfactory as they are, seem to fit the San Francisco bird rather better than the one (*drymceus*) which occupies the interior of California, reaching the coast at San Simeon; and this latter, in all probability, is the only other form to which the name *spilurus* could be applied. Under the circumstances, therefore, it seems reasonably safe to adopt *spilurus* for the race inhabiting the neighborhood of San Francisco Bay.

Thryomanes bewickii spilurus may be distinguished from *bewickii* by its duller brown upper surface, darker sides and flanks, broader superciliary stripe, shorter wing and tail, rather longer middle toe and tarsus. It may be separated from *charienturus* by darker, decidedly more rufescent flanks and upper parts and by shorter tail; from *drymceus* by the much darker color of sides, flanks and upper surface.

Specimens at hand from the vicinity of the eastern and southern

¹This specimen has been presented to the U. S. National Museum by Mr. Joseph Grinnell.

shores of San Francisco Bay are, with two exceptions, quite uniform in the deep sooty brown of the upper surface; these two exceptions being noticeably more reddish brown. Specimens from Nicasio are also more rufescent above and on the sides and flanks as well, some examples being, in this latter particular, scarcely distinguishable from *calophonus*. Two autumn or winter birds from the Cosumnes River are rather paler than typical *spilurus*, but should evidently be referred to this form, they having probably wandered thither from the coast region. Owing to lack of specimens from the northern part of the California coast, it is impossible to determine how far *spilurus* ranges in that direction.

Twenty-one specimens examined, from the following localities, breeding stations being designated by an asterisk:

California: Stanford University; Palo Alto; Nicasio; Oakland; San Francisco; Alameda; San Mateo; Berryessa; * Cosumnes River.

THRYOMANES BEWICKII CALOPHONUS, new subspecies.

Thryothorus bewickii spilurus A. O. U. Check-List, 1886, p. 327 (in part).

Chars. subsp.—Thry. b. *spiluro* persimilis, sed paulo major; rostro multo longiore; neonon hypochondriis paululum rufescentioribus.

Measurements (17 specimens).—Wing, 50.5 to 54.5 (average, 53) mm.; tail, 49.5 to 51.5 (average, 51.4) mm.; exposed culmen, 13.5 to 15 (average, 14.8) mm.; bill from nostril, 10 to 11.5 (average, 10.8) mm.; tarsus, 17.5 to 20 (average, 19.3) mm.; middle toe with claw, 16 to 17.5 (average, 16.9) mm.

Type locality.—South Park, King County, Washington.

Geographic distribution.—Pacific slope, from Oregon north to southern Vancouver Island, the valley of the Fraser River, and slightly farther along the mainland coast. Resident probably throughout its range, at least from Puget Sound southward.

Type.—Male, adult; No. 135210, U.S.N.M.; South Park, King County, Washington, December 19, 1894; L. M. Turner.

Description.—Above rich dark bistre, slightly deeper on head, shading to vandyke brown on rump, the feathers of which have more or less concealed white spots; upper tail coverts sepia, inconspicuously marked transversely with darker brown. Wings fuscous, their coverts and the exterior webs of secondaries mostly like the back, the latter obscurely barred with blackish, basal half of outer primaries margined exteriorly with pale brown. Tail black, middle feathers sepia, with narrow bars of black; all the rest tipped with dull gray and more or less distinctly barred externally with sepia; outer pair with indentations of grayish white on terminal portion of exterior webs. Superciliary stripe white, lores and cheeks grayish white, the two last mentioned mixed with dark brown; postocular streak reddish sepia; sides of neck deep brownish gray; lower parts grayish white, most nearly pure white on chin, strongly tinged with brownish gray on sides, this color

becoming more ferruginous and more conspicuous on flanks; lower tail-coverts heavily barred with black; lining of wing grayish white.

Young in first plumage.—No. 7129, U.S.N.M.; Shoalwater Bay, Washington; Dr. J. G. Cooper. Upper parts, including central rectrices and outer webs of the others, excepting the outermost pair, dark rufescent broccoli brown, more reddish on rump, some feathers of which have concealed whitish spots; wings obsoletely barred with darker; tail regularly barred with blackish; remainder of tail clove brown, the two outer pairs of rectrices tipped, and barred externally on terminal portion with buffy. Superciliary stripe buffy whitish; cheeks brownish white, mixed with brown; under surface brownish white, heavily mottled on breast and jugulum with dull smoke gray; flanks rufescent gray; lower tail-coverts ochraceous, barred with blackish.

Since the type of *Troglodytes spilurus* Vigors undoubtedly came from California, the present race seems to have received hitherto no distinctive title. It differs from *spilurus*, its nearest ally, in conspicuously larger bill, besides averaging greater in all its other measurements. The upper surface seems to be usually rather deeper and richer brown; the flanks somewhat more rufescent. From *bewickii*, *calophonus* is easily distinguished by deeper, more sooty brown above, much darker sides and flanks, wider superciliary stripe, decidedly longer bill, tarsus and middle toe. It may be readily separated from *drymæus* by the much darker flanks and upper surface, larger bill and feet. Compared with *nesophilus*, it differs in darker, more reddish brown upper surface, and in larger size, this most apparent in the tail and culmen. From *charienturus* this northwest coast form may be readily discriminated by darker, much more reddish brown flanks and upper surface, longer middle toe and culmen.

Very little difference in color appears to exist between winter and summer specimens of *calophonus*, though birds in very much worn plumage are perhaps slightly paler and more grayish. There is, however, much individual variation, the upper parts ranging from deep sooty brown to a much lighter and strongly rufescent color. Young birds in first plumage are similar to those of *drymæus*, but are more deeply brownish.

There seem to be no published records for this bird north of the valley of the Fraser River, and it is probably a permanent resident in that region, since specimens have been obtained at Agassiz, British Columbia, as late as December 5. It appears to be confined strictly to the region west of the Cascade Mountain divide.

Twenty-six specimens examined, from localities in the appended list, breeding records being designated by an asterisk:

Oregon: Salem;* Cedar Mills, Washington County; Forest Grove.*

Washington: Seattle;* Mount Vernon;* South Park, King County; Fort Steilacoom; Tenino;* Shoalwater Bay.*

British Columbia: New Westminster; Agassiz.

THRYOMANES BEWICKII NESOPHILUS, new subspecies.

Thryothorus bewickii spilurus A. O. U. Check-List, 1886, p. 327 (in part).

Chars. subsp.—*Thryomanes* T. b. *charienturo* affinis, a quo differt notaco, lateribus hypochondriisque obscurioribus ac rufescentioribus.

Measurements (6 specimens).—Wing, 49 to 53 (average, 51.4) mm; tail, 47 to 51 (average, 48.8) mm; exposed culmen, 13.5 to 14.5 (average, 14.1) mm; bill from nostril, 10 to 11 (average, 10.2) mm; tarsus, 18.5 to 19.5 (average, 18.8) mm; middle toe with claw, 15 to 16 (average, 15.7) mm.

Type locality.—Santa Cruz Island, California.

Geographic distribution.—Santa Rosa and Santa Cruz islands, California.

Type.—Male, adult; No. 117641, U.S.N.M., Santa Cruz Island, California, February 7, 1889; C. H. Townsend.

Description.—Above grayish bistre, rather darker on head, somewhat more rufous on rump, the feathers there with more or less concealed white spots; upper tail-coverts hair brown, obscurely barred with blackish. Wings fuscous, the secondaries marked on external webs, the innermost ones on both, with alternate bars of brownish olive and blackish; primaries indented basally on outer webs with buffy; lesser and middle coverts like the back; greater series barred on exterior webs and tipped with this same color. Central rectrices and exterior webs of all but outer pair like the back in color, but regularly barred with black; tips of the feathers hair brown, indentations on distal portion of external webs of outer pair dull white; remainder of tail black. Superciliary stripe white; lores and cheeks grayish white mixed with dull brown; postocular streak brownish olive; sides of neck brownish gray, under surface dull brownish white, most nearly pure white on chin and throat; sides washed with brownish gray; flanks strongly tinged with the same; under tail-coverts slightly washed with ochraceous and heavily barred with black; lining of wing grayish white.

Young in first plumage.—Female; No. 136705, U.S.N.M., Biological Survey collection; Santa Rosa Island, California, July 3, 1892; C. P. Streater. Upper surface grayish sepia, slightly more reddish on rump, a few feathers of the latter with hidden white spots; superior tail-coverts obsoletely barred. Exposed surface of the closed wing like the back, barred, except on the median and lesser coverts, with darker; very narrow edgings to primaries pale buffy. Tail black; the central feathers, with external webs of all but the outermost pair, like the upper parts in color, barred regularly with black; all the rectrices tipped with hair brown, the two outer pairs more or less indented on external webs with white. Superciliary stripe white; lores and cheeks brownish white, mixed with brown; lower parts brownish white,

heavily mottled on throat and breast with dull gray; sides and flanks dark brownish gray; crissum ochraceous, faintly barred with dusky.

This new subspecies may be distinguished from *charienturus* by the darker, more rufescent coloration of the upper surface, sides and flanks; the tail also averages appreciably shorter. It is noticeably lighter and rather more grayish than *spilurus*, besides having a somewhat longer culmen. From *drymæus* it is without difficulty separable by the noticeably darker and rather more sooty color of the flanks and upper surface. The tail also averages slightly shorter.

Four of the adult examples, though summer birds in very poor condition, are practically identical with the type, if anything somewhat darker. A July bird from Santa Cruz Island is rather lighter and more rufescent than the type, which, however, may be the result of wear, as the latter is in fresh winter plumage.

The young in first plumage are apparently not to be discriminated from those of *charienturus*, though they perhaps average more rufescent. They are usually darker than the young of *drymæus*.

Eleven specimens examined, from the following localities, breeding records being indicated by an asterisk:

California: Santa Rosa Island;* Santa Cruz Island.*

THRYOMANES BEWICKII LEUCOPHRYS (Anthony).

Thryothorus leucophrys ANTHONY, Auk, January, 1895, XII, p. 52.

Chars. subsp.—Thryomanes T. b. charienturo similis, sed supra pallidior; rostro longiore; subcaudalibus minus conspicue nigro fasciatis.

Measurements (16 specimens).—Wing, 48 to 56.5 (average, 52.8) mm.; tail, 46.5 to 55 (average, 50.7) mm.; exposed culmen, 14 to 16 (average, 14.9) mm.; bill from nostril, 10 to 11.5 (average, 10.8) mm.; tarsus, 19 to 20.5 (average, 19.4) mm.; middle toe and claw, 14.5 to 17 (average, 15.7) mm.

Type locality.—San Clemente Island, California.

Geographic distribution.—San Clemente Island, California.

Type.—Male, adult; No. 5514, Coll. A. W. Anthony; San Clemente Island, California, August 27, 1894; A. W. Anthony.

Description.—Upper surface rather light rufescent hair brown, slightly deeper on head, the feathers of the rump with more or less concealed white spots; superior tail-coverts hair brown, very faintly barred with darker. Wings fuscous, the innermost secondaries and outer webs of the rest barred with the color of the back; primaries margined on basal part of external webs with pale brown; lesser and middle coverts similar to the upper parts, greater series obsoletely barred and tipped with the same color. Central tail-feathers and proximal portion of exterior webs of all the rest save the outer pair, hair brown, regularly barred with blackish; remainder of tail black, the three outer pairs of rectrices broadly tipped, and barred on terminal portion with grayish white, this most extensive on outer webs of exte-

rior pair; remaining feathers tipped with hair brown. Broad superciliary stripe white; lores and cheeks white, somewhat mingled with brownish; postocular streak like the crown; sides of neck brownish gray; chin and throat pure white; rest of lower surface grayish white; sides and flanks tinged with brownish gray, this color deepest and most brownish on the latter; crissum tinged with ochraceous, and barred narrowly with black; axillars and lower wing-coverts grayish white.

Young in first plumage.—Male; No. 308, Coll. J. Grinnell; San Clemente Island, California, June 2, 1897; J. Grinnell. Upper parts, including middle rectrices and proximal portion of outer webs of all but exterior pair, brownish gray, slightly paler on the rump, the feathers of which have hidden spots of dull white; tail barred with black; remainder of tail black, tipped with slate gray, the two outer pairs of feathers barred distally on external webs with dull white. Edges of greater wing-coverts slightly rufescent, outer margins of primaries buffy; secondaries and greater coverts obsoletely barred with dark brown. Superciliary stripe white; lores and cheeks grayish white, mixed with brown; postocular streak dark brown; lower parts brownish white; throat, breast, and sides thickly mottled with dusky, this light and dark marking invading the sides of the neck; sides and flanks pale brownish gray, more rufescent on the latter; crissum washed with ochraceous and barred with blackish.

The characters which separate *T. b. leucophrys* from *charienturus* consist in the rather paler, grayer flanks and upper parts, the longer bill, and less heavily barred inferior tail-coverts. Compared with *nesophilus*, *leucophrys* is readily distinguishable by its much paler and grayer coloration, less heavily barred crissum, longer bill, somewhat longer wings and tail. The interior form, *eremophilus*, approaches very close to *leucophrys* in color above, though averaging rather more rufescent, at least in winter, but differs in its narrow superciliary stripe, paler flanks, decidedly longer wings and tail, shorter bill and tarsus.

The examination of good series of *leucophrys* and *charienturus* shows that no one of the characters which serve to separate these forms is entirely constant. Some specimens of *leucophrys* are quite as conspicuously barred on the crissum as is *charienturus*; gray examples of the latter almost exactly match the darker ones of *leucophrys*; while the broad superciliary stripe, a character emphasized by Mr. Anthony in the name *leucophrys*, is one common to apparently all the Pacific coast forms, though it is due to say that the type of *leucophrys* presents in this respect a rather exaggerated phase, a difference not borne out by the other specimens from San Clemente Island, even after proper allowance has been made for reduction in width by natural abrasion. In view of these facts it seems unadvisable longer to accord *leucophrys* more than subspecific rank.

The type is a bird in fresh fall plumage, and seems to be noticeably more rufescent above than any of the other specimens in similar con-

dition. Some of these are considerably darker on the upper parts than is the type; others are appreciably lighter. Specimens in worn plumage are considerably browner, though not conspicuously paler.

Young in first plumage appear to be quite uniform, and paler than the young of *charienturus*. The dusky spotting of the anterior lower parts is apparently more conspicuous than in any of the other forms the young of which has been available, *bewickii* and *calophonus* excepted.

Thirty-one specimens of *leucophrys* have been examined, all from San Clemente Island, California.

THRYOMANES BEWICKII CERROENSIS (Anthony).

Thryothorus cerroensis ANTHONY, Auk, April, 1897, XIV, p. 166.

Chars. subsp.—Thryomanes T. b. *charienturo* persimilis, sed rostro brevior; nec crisso late nigro fasciato.

Measurements (5 specimens).—Wing, 49 to 51 (average, 50.4) mm.; tail, 47.5 to 52 (average, 50.1) mm.; exposed culmen, 12.5 to 13.5 (average, 12.9) mm.; bill from nostril, 9 to 10 (average, 9.4) mm.; tarsus, 17.5 to 18.5 (average, 18.1) mm.; middle toe with claw, 14.5 to 16 (average, 15) mm.

Type locality.—Cerro Island, Lower California.

Geographic distribution.—Cerro Island, Lower California.

Type.—Adult; No. 7391, Coll. A. W. Anthony; Cerro Island, Lower California, September 3, 1896; A. W. Anthony.

Description.—Above slightly rufescent hair brown, rather darker on head, more rufescent on rump, the feathers of the latter with more or less hidden white spots; upper tail-coverts hair brown, obsoletely barred with dusky. Wings fuscous, the secondaries transversely marked on outer webs with the color of the back; primaries edged basally with the same; margins of greater coverts, together with all of the lesser and median series, of the same shade as the back. Tail black, the central rectrices, together with basal portion of external webs of all but outer pair, hair brown, regularly barred with black; three outer pairs of feathers broadly terminated by dull smoke gray, the remainder by hair brown; outermost pair marked transversely on external webs with dull white. Superciliary stripe white; lores and cheeks grayish white, somewhat mixed with brown; postocular streak of same color as the crown; sides of neck brownish gray; chin and throat white; rest of under surface grayish white medially, smoke gray laterally, deepest on flanks; crissum tinged with ochraceous, barred with black; lining of wing grayish white.

This island form is very closely allied to *charienturus*, from which, however, it may be separated by somewhat smaller size—this most appreciable in the bill—and by rather less heavily barred lower tail-coverts. With the type and the few other specimens at present avail-

able for comparison, there is observable little, if any, material difference in color above, though *cerroensis* appears to be rather lighter.

Although the characters above given will serve to discriminate *cerroensis*, they can be considered only average distinctions, and consequently do not warrant more than subspecific rank, which status it seems therefore necessary that *cerroensis* should occupy. The wide terminal band of gray on the tail-feathers and lower tail-coverts, which Mr. Anthony regards as a character separating the Cerros Island bird from *charienturus*, is a purely individual variation, and consequently of no diagnostic value. The same may be said of the indistinctness of the barring on the central rectrices, which is observable to a greater or less extent in all the forms of the genus. The wide lateral areas of gray in the type are apparently due in part to the make of the skin and are probably not of much diagnostic importance, for some specimens of *charienturus* are very similar in this respect.

The present subspecies of *bewickii* is well differentiated from *Thryomanes brevicaudus* by its conspicuously longer tail, longer wing, and very much shorter culmen, aside from its somewhat paler upper surface. From *nesophilus* it may be distinguished by its much paler and less rufescent upper surface, grayer flanks and sides, shorter bill, and slightly greater length of tail. It averages also rather less in all its other measurements. The characters which separate this form from *leucophrys* are the darker upper parts, rather more deeply gray flanks, much shorter bill, appreciably shorter wing and tarsus. It differs from *drymaeus* in somewhat darker, much less rufescent sides, flanks, and upper surface, less heavily barred erisum, shorter bill, and slightly shorter wing.

A May specimen is rather more grayish than the type, this being possibly due to abrasion. Three other birds, when allowance has been made for their worn condition, are but slightly different from the type.

Five specimens examined, all from Cerros Island.

THRYOMANES INSULARIS (Lawrence).

Troglodytes insularis LAWRENCE, Ann. N. Y. Lyc. Nat. Hist., 1871, X, p. 3 (ex Baird, manuscript).

Chars. sp.—*Thryomanes* *T. b. leucophryi* affinis, sed alis caudaque brevioribus, rectricibus fuscis utrinque fasciatis, nec late albido terminatis, striga superciliari magis restricta, corpore infra ochraceo lavato, erisso maculato nec fasciato, primo visu distinguendus.

Measurements (10 specimens).—Wing, 46.5 to 51 (average, 48.7) mm.; tail, 42 to 47 (average, 44.5) mm.; exposed culmen, 15 to 16 (average, 15.2) mm.; bill from nostril, 11 to 12 (average, 11.5) mm.; tarsus, 18.5 to 21 (average, 19.9) mm.; middle toe with claw, 14 to 17 (average, 15.4) mm.

Type locality.—Socorro Island, western Mexico.

Geographic distribution.—Socorro Island, western Mexico.

Description.—Male, adult; No. 117482, U.S.N.M.; Socorro Island, western Mexico, March 8, 1889; O. H. Townsend.¹ Above hair brown, inclining to rufous on rump and superior tail-coverts, the back with narrow obsolete transverse markings, feathers of the rump with more or less concealed subterminal white spots. Tail fuscous, broadly barred with buffy white on external rectrices, this color deepening to hair brown on central feathers and becoming more or less obsolete, at least basally, on all but the middle pair. Wings fuscous, the innermost secondaries and exterior margins of the rest broadly barred with hair brown; two outer primaries narrowly edged, remainder indented basally on external webs with buffy white; greater and lesser wing-coverts like the back, the former barred distally with fuscous; outer edge of alula buffy white. Lores, superciliary stripe, and sides of head dull buffy white, the lores and auriculars slightly mixed with dusky; postocular streak hair brown; sides of neck pale wood brown, shading gradually into the color of the nape; under surface brownish white, the sides washed with grayish brown; flanks light wood brown; crissum mixed with ochraceous buff, the feathers with shaft spots of dark brown; lining of wing dull white.

Although a very distinct species, *Thryomanes insularis* seems to be most closely allied to *Thryomanes b. leucophrys*, from which it differs in its less conspicuous superciliary stripe, more rufescent rump, spotted instead of barred crissum, pronounced ochraceous tinge to the lower parts, usually evident cross markings on the back, together with fuscous tail-feathers barred on both webs and not broadly tipped with whitish. The wing and tail of *insularis* are shorter than those of *leucophrys*, approaching nearer to *brevicaudus* than to any other member of the genus. The base of the bill below is yellowish, at least in dried skins, whereas in all the other forms it is generally whitish or grayish.

The principal individual variation consists in the depth of the buffy or ochraceous suffusion beneath, and in the depth of the color above, although the range of neither is great. The crissum is sometimes almost immaculate, though occasionally the spots have become almost bars. Several of the specimens examined have been for a long time in the U. S. National Museum collection, and are much more brownish than those recently collected.

There can be no doubt about the propriety of placing this species in the genus *Thryomanes*, for in structural characters it agrees perfectly with other members of the group, although the wren² occupying Clarion Island, some distance to the westward, can not be considered congeneric, but must, at least for the present, be referred to *Troglodytes*.

Ten specimens examined, all from Socorro Island.

¹The type of this species is so discolored that the present description has been taken from a fresh specimen.

²*Troglodytes tanneri* Townsend, Proc. U. S. Nat. Mus., 1890, XIII, p. 133.

THRYOMANES BREVICAUDUS Ridgway.

Thryomanes brevicauda RIDGWAY, Bull. U. S. Geol. & Geog. Surv. Terr., 1876, II, No. 2, p. 186.

Thryothorus brevicauda SHARPE, Cat. Birds Brit. Mus., 1881, VI, p. 227.

Chars. sp.—*Thryomanes* T. b. *cerroensi* affinis, sed cauda brevissima, rostro multo longiore, alis brevioribus, notaeo obscuriore, primo visu distinguendus.

Measurements (4 specimens).—Wing, 45.5 to 50 (average, 47.9) mm.; tail, 40.5 to 44 (average, 42.2) mm.; exposed culmen, 16 to 17 (average, 16.5) mm.; bill from nostril, 11 to 12.5 (average, 11.8) mm.; tarsus, 17 to 18.5 (average, 17.9) mm.; middle toe with claw, 15 to 16.5 (average, 16) mm.

Type locality.—Guadalupe Island, Lower California.

Geographic distribution.—Guadalupe Island, Lower California.

Type.—Adult; No. 70042, U.S.N.M.; Guadalupe Island, Lower California; E. Palmer.

Description.—Upper parts uniform dull grayish bistre, the feathers of the rump with no indication of white spots. Wing-quills fuscous, secondaries obsoletely barred externally, the innermost on both webs, with the color of the back; primaries margined basally with pale brown; wing-coverts like the upper surface. Middle rectrices, and at least basal portion of external webs of the rest, hair brown with regular bars of blackish; remainder of tail brownish slate, nearly all the feathers with obscure transverse markings of blackish, these continuous with those on the outer webs; tips of rectrices dull brownish gray, the exterior webs of two outermost pairs indented distally with grayish white. Conspicuous superciliary stripe dull white; lores and cheeks grayish white, mixed with brown; postocular streak brown like the back; sides of neck grayish brown, but slightly paler than the shade of the upper surface; under parts dull grayish white, almost pure white on chin and throat; sides and flanks deep brownish gray; crissum narrowly barred with black; axillars and lower wing-coverts grayish white.

Young in first plumage.—Female?; No. 141646, U.S.N.M., Biological Survey collection; Guadalupe Island, Lower California, May 25, 1892; C. P. Streater. Upper surface dark brownish gray, this color extending over the central pair of tail feathers and the external webs of all the rest save outermost pair, these portions barred with black; remainder of tail black, tipped with dull gray, exterior webs of outermost pair of rectrices marked with an irregular stripe of dull white, and margined with the same color. Rump slightly paler and more rufescent than the back, some of the feathers with concealed spots of light grayish; edgings of greater coverts somewhat rufescent, those of primaries buffy. Superciliary stripe white; postocular streak like the crown; lores and cheeks brownish white, somewhat mixed with darker; below

brownish white, chin almost pure white, the throat and breast with faint spots of gray; sides and flanks strongly tinged with brownish gray; crissum washed with ochraceous and finely barred with blackish.

The very short tail of *Thryomanes brevicaudus* will serve readily to distinguish this species from any of its congeners excepting *insularis*. It has, furthermore, much shorter wings and a decidedly longer culmen than *charienturus*, as well as more narrowly marked lower tail-coverts. Compared with *leucophrys* it is darker and appreciably browner on the upper surface; the wings and tarsus are shorter; the bill of greater length. It has a decidedly shorter wing, longer bill, somewhat shorter tarsus, and rather less heavily barred crissum than *nesophilus*, from which, in color above, it is not conspicuously different. The characters which separate it from *insularis* consist in shorter tarsus, somewhat shorter tail, longer bill, more extensive superciliary stripe, barred crissum, ochraceous wash below, and black tail broadly tipped with whitish. One of the three adult specimens examined is very much grayer throughout than the type, being also, from abrasion, somewhat paler.

The third specimen is intermediate in color between the type and the one just mentioned. The single young bird is darker than the young of *leucophrys*, but can apparently not be distinguished from some examples of *charienturus*.

Four specimens examined, all from Guadalupe Island, Lower California.

The present investigation has been based primarily on the collection of the U. S. National Museum, together with that of the Biological Survey of the Department of Agriculture. The writer wishes here to thank Mr. Ridgway for access to the former and Dr. C. Hart Merriam for permission to make use of the latter. He is also under obligation to Mr. Joseph Grinnell, of Pasadena, California, whose generous loan of series of California birds has in large measure contributed to the elucidation of the various western forms.

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Table of measurements.

MALES.

[Measurements in millimeters.]

Number of speci- mens.	Name of species.	Wing.			Tail.			Exposed culmen.			Bill from nostril.			Tarsus.			Middle toe with claw.		
		Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.
13	<i>beickii</i>	54.2	56.5	51.5	52.5	56	48	13.3	14.5	12.5	9.6	10	9	17.7	18.5	17	15.3	16.5	14
13	<i>cryptus</i>	57.4	61	54.5	56.4	61	52	14.1	15.5	13.5	10.4	11	10	18.4	19.5	17.5	16.2	17	15
15	<i>eremophilus</i>	57.5	60	55	57.9	63.5	50.5	14	15	13	10.1	11	9.5	18.1	18.5	17.5	15.5	17	14.5
6	<i>percaus</i>	60	61.5	57.5	58.9	58	54	13.2	16	14	11.1	11.5	10.5	18.7	19.5	18	15.8	16.5	15
6	<i>marinus</i>	59.6	61.5	57	58.8	60.5	56	14.9	16	14	10.6	12	10	19.3	20.5	18.5	16.5	18	15.5
5	<i>bairdi</i>	57	58.5	55.5	55.7	56.5	54	14.2	15.5	13.5	10.2	11.5	9.5	18.7	19	18	16.1	17	15
14	<i>charienturus</i>	52.5	55	50	52	54.5	47.5	14	14.5	13.5	10.4	11.5	10	19	19.5	18	15.5	16	15
10	<i>drymæus</i>	52.4	54.5	50	50.6	53	49	13.9	14.5	13	10	10.5	9.5	18.6	19	17.5	15.7	16.5	15
13	<i>spilurus</i>	51.4	53.5	49	49.5	52	45	13.5	14.5	12.5	9.8	11	9	18.6	19.5	17.5	16.3	16.5	15.5
11	<i>cataphonus</i>	53.6	54.5	52	51.5	54.5	49.5	15	15	15	10.9	11.5	10	19.5	20	19	17	17.5	16
5	<i>nesophylus</i>	51.9	53	50.5	49.1	51	47	14.2	14.5	13.5	10.2	11	10	18.8	19.5	18.5	15.6	16	15
9	<i>leucophrys</i>	53.7	56.5	52.5	52.1	55	49.5	13.1	16	14.5	11.1	11.5	10.5	19.3	19.5	19	15.7	16.5	14.5
6	<i>cerroensis</i>	51	52	52	52	52	52	9.5			9.5			18.5			14.5		
6	<i>indiaris</i>	48.3	50.5	46.5	45	47	42	13.1	15.5	15	11.5	12	11	20	20.5	19.5	14.9	16	14
1	<i>brevicaudus</i>	50		42				16			11			17			16.5		

FEMALES.

Number of speci- mens.	Name of species.	Wing.			Tail.			Exposed culmen.			Bill from nostril.			Tarsus.			Middle toe with claw.		
		Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.
5	<i>beickii</i>	52.1	53	51.5	50.7	53	49	13.5	14	13	9.6	10	9.5	17.4	18	17	15	15.5	14
3	<i>cryptus</i>	53.7	54	53	55.3	56	54.5	14	14.5	13.5	10.5	11	10	18.3	18.5	18	16.2	17	15
3	<i>eremophilus</i>	52.5	54	51	54.1	56	50.5	13.6	14.5	13	9.8	10.5	9	17.5	18.5	15	15.4	16	13.5
5	<i>percaus</i>	53.7	57	49.5	50.8	54	45.5	14.5	15	13.5	10.7	11	10	18.5	18.5	15	16.2	16.5	15
3	<i>marinus</i>	57.8	57	57.3	58	56.5	54	14	14	14	10	10.5	9.5	19.5	19.5	18.5	16.8	17	16.5
2	<i>bairdi</i>	56.2	57	55.5	55.3	56.5	54	14	14.5	13.5	10.3	11	10	19	19.5	18.5	16.7	17.5	15.5
9	<i>charienturus</i>	50.5	52	48.5	50.8	53	49.5	13.4	14	12.5	9.9	11	9	18.4	19	18	15.2	16	14.5
4	<i>drymæus</i>	49.1	50	47	48.5	52	45	13.3	14	13	9.3	10	9	18.3	18.5	17	15.8	16.5	15.5
3	<i>spilurus</i>	50	50.5	49.5	47.7	48	47	13.2	13.5	13	9.5	10	9.5	18	18.5	17	16.8	17.5	15
6	<i>cataphonus</i>	51.8	54	50.5	51.3	54	49.5	14.3	15	13.5	10.6	11	10.5	18.8	19.5	17.5	16.8	17.5	16
1	<i>nesophylus</i>	49		47.5				13.5			10			19			16		
1	<i>leucophrys</i>	49		48				14.7	15.5	14	10.3	11	10	19.5	20.5	19	15.7	17	15
2	<i>cerroensis</i>	50	51	49	49	50.5	47.5	12.8	13	12.5	9.3	9.5	9	17.8	18	17.5	14.8	15	14.5
1	<i>brevicaudus</i>	49		44										18			15.5		

AMERICAN ONISCROID DIPLOPODA OF THE ORDER MEROCHETA.

By O. F. COOK,
Custodian of Myriapoda.

In July, 1896, I collected near Auburn, Alabama, a small oniscoid diplopod the affinities of which have been difficult of determination. It is quite similar to a species described from Arkansas by Bollman as *Sphæriodesmus pudicus*. The true genus *Sphæriodesmus* is, however, a very different form, and among described genera the type under discussion approximates rather to *Cyclodesmus*, but offers differences apparently important and at least unique.

Outside the Merocheta are to be found adaptations for securing safety by coiling up, conspicuously in the Oniscomorpha and in the family Striariidæ of the Cælocheta, where the first segment is produced in front into a large hood for the protection of the head. In the Oniscomorpha the specialization for the habit referred to has reached its highest development, and the primitive condition of the ventral protected parts is evidence that this adaptation dates well back in the history of that order.

In the 20-segmented Merocheta the modifications necessary to render the habit of coiling up an effective means of defense have been executed in spite of greater initial difficulty, since the segments had, by the coalescence of all primitive sutures, become solid and inflexible chitinous rings. Moreover, this protective scheme seems to have been carried out, not once merely, but several times independently, for it appears from a comparative study of the five genera enumerated by Latzel as composing the subfamily Sphæriodesmia that these have nothing in common except this power of coiling closely. As conspicuous proof of the truth of this view, there need be noted only the fact that while some of the anterior segments are in each case enlarged to complete the armor of the closed animal, there have been at least three different inventions, if the expression may be permitted, to serve the same purpose. In *Oniscodesmus* and *Cyrtodesmus* the second segment is enlarged, in *Cyclodesmus* the third segment, and in *Sphæriodesmus* the fourth and fifth, as may be better understood from reference to the plates. But even *Oniscodesmus* and *Cyrtodesmus* are widely distinct in all their characters, and the enlarged second segments do not resemble each other, showing that even where the same segment has been modified the histories of the changes may have been entirely independent.

The new Alabama form resembles, as stated above, the genus *Cyclodesmus* rather than the others thus far mentioned. But from *Cyclodesmus*, as well as from all other Merocheta, it differs conspicuously in the possession on each segment of a deep cavity located at the base of the carina in front. From the alcoholic material available I have not been able to demonstrate in connection with these pits the existence of any repugnatorial pores, and there are two facts that seem to negative such an explanation of their nature and function.

The first is that the cavities are not located in a position corresponding to that occupied by pores in any other member of the order. In general the pores of Merocheta are near the margin, but in the few instances where they are far removed from the lateral edge the pore is still distinctly a part of the carina, and not an excavation in the body cylinder as in the present case, to say nothing of the anomaly of finding a repugnatorial pore at the bottom of a deep cavity.

The second unique circumstance is that in no diplopoda are repugnatorial pores known to occur in front of the fifth segment, where they normally begin, all exceptions being in the suppression of the pores of that segment. The peculiar cavities of the new type are, however, apparent on the fourth and third segments! The only other paired cavities affecting the dorsal surface of the segments of diplopoda are the so-called "scobina" of the Anocheta, but these are found near the median line, are located near or at the anterior edge of the segment, and offer no similarity of form or structure which would give ground for asserting a homology with the pits discovered on the Alabama specimens under discussion.

It is also noteworthy that these cavities form a continuous series occurring on all segments from the third to the penultimate. Without exception the pore series is at least once interrupted in all known Merocheta, so that if the cavities were in form and function normal pores, they would still be unique in position, number, and distribution. It accordingly seems desirable to hold the newly recognized type as distinct from *Cyclodesmus*, notwithstanding the general resemblance in habit.

References to the descriptions and plates of other American onisciform genera are added, together with descriptions of an interesting new species of *Oniscodesmus*. A systematic arrangement is also proposed, and a key to the families is given, but this must be looked upon as artificial, the forms included not composing a natural group.

ANALYTICAL KEY TO THE AMERICAN FAMILIES OF ONISCIFORM MEROCHETA.

Segments with a posterior border composed of a transverse row of convex, rectangular areas; penultimate segment with its carinae as broad or broader than the small, rounded last segment: Family ONISCODESMIDÆ.

Segments without a posterior areate border; last segment subquadrate, much broader than the carinae of segment 19.....

Second segment largest, the carinae broad and expanded downward to protect the sides of the head; repugnatorial pores present; supplementary margin pectinate; last segment much broader than long, the posterior margin notched and tuberculate: Family CYRTODESMIDÆ.

Second segment distinctly smaller than the third; repugnatorial pores wanting; supplementary margin entire or wanting; last segment nearly as long as broad, the posterior margin an entire, thin edge.....

Carinae increasing in size to segment 5; segments 4 and 5 with carinae much larger than segment 3; antennae rather slender, joints 5 and 6 subequal: Family SPINARHODESMIDÆ.

Carinae increasing in size only to segment 3, which is much the largest; antennae rather robust, joint 5 distinctly shorter than 6.....

Surface of segments smooth, even, and polished, without pores or depressions of any sort: Family CYCLODESMIDÆ.

Surface of segments granular-hispid; posterior subsegments convex or with a transverse row of conic tubercles; at the base of the carinae in front a large, deep cavity: Family DESMONIDÆ.

Family ONISCODESMIDÆ (Saussure).

Oniscodesmides SAUSSURE, Mem. Mex. Myriap., 1860, p. 14.

Oniscodesmida COOK, Brandtia, 1896, p. 28.

Body very small, less than three times as long as broad; dorsum strongly convex, the carinae very broad, sloping obliquely downward; surface of segments smooth, the posterior margin ornamented by a transverse row of rectangular areas.

Antennae robust, subclavate, joint 5 over twice as long as joint 6; joints 2 to 5 subequal in length.

Second segment with carinae much the largest of all, broadly expanded and extending obliquely downward beyond the level of the others.

Lateral carinae triangular, entire.

Repugnatorial pores distinct, located near the middle of the base of the carinae.

Supplementary margin wanting.

Last segment small, the apex rounded and depressed, more or less concealed by the much larger penultimate segment.

Copulatory legs strongly divaricate, consisting of two rami, subequal in size and length.

The affinities of *Oniscodesmus* and its allies are evidently with the Pterodesmidae and other forms generally arranged near *Cryptodesmus*. The transverse posterior row of rectangular areas are the most conspicuous evidence of this relationship, which is also indicated by the location of the pores, the short and robust antennae, and the form of the terminal segments. This last feature separates the Oniscodesmidae readily from all other American Merocheta adapted for being rolled into a sphere or close spiral.

In none of the known Oniscodesmidae is the last segment larger than

the carinae of the preceding, while in the other four families, Cyrtodesmidae, Sphaeriodesmidae, Cyclodesmidae, Desmonidae, the last segment is much broader than the carinae, and forms a large rectangular plate closing the posterior face of the strongly arched armor.

This less perfect armor and less convex body may be taken as reasons for supposing that the Oniscodesmidae are less specialized for the coil-ing-up habit than the other families, but as this adaptation has evidently arisen independently in several cases which thus do not form a phylogenetic series, there is less satisfaction in attempting to decide which has proceeded furthest, even though the lines seem to converge.

ANALYTICAL KEY TO THE GENERA OF ONISCODESMIDÆ.

Pores borne on distinct, rounded tubercles: Genus *Lignydesmus*.

Pores not raised above the surface of the segments.....

Second segment somewhat semicircular in lateral outline, without a posterior areate border; border of other segments short; sinus of segment 19 as broad as its carinae: Genus *Detodesmus*.

Second segment merely oblong in lateral view, with an areate border which becomes longer on succeeding segments; sinus of segment 19 less than half as wide as its carinae: Genus *Oniscodesmus*.

Genus ONISCODESMUS Gervais and Goudot.

Oniscodesmus GERVAIS and GOUDOT, Ann. Soc. Ent. France, 1844, 2d ser., II, p. xxviii.

The authors of this genus described the first species as a *Polydesmus*, and at the end of the same paragraph erected the new genus for it.

The body is less convex and more similar in shape to the Pterodesmidae than in the species described by Peters under *Oniscodesmus*, but which have been recognized as independent genera, as appears below.

The other distinguishing feature of the present genus is the small last segment, or rather the small part of the last segment, which can be seen from above through the small notch between the large carinae of segment 19.

ONISCODESMUS ONISCINUS (Gervais and Goudot).

(Plate XXIX, figs. 1a, 1b.)

Polydesmus oniscinus GERVAIS and GOUDOT, Ann. Soc. Ent. France, 1844, 2d ser., II, p. xxviii.

Oniscodesmus oniscinus GERVAIS, Ann. Sci. Nat., 3d ser., I, p. 64, pl. v, figs. 7, 9; Apteres, 1847, IV, p. 90, pl. XLIV, fig. 4.

Type.—A specimen supposed to be the type of this species is in the British Museum, and from this the two figures were traced.

Locality.—Colombia.

From a new species described below, *O. oniscinus* differs more conspicuously in the broader notch of segment 19, which in *O. micrurus* is closed to a narrow slit, as may be seen from a comparison of the figures.

ONISCODESMUS MICRURUS, new species.

(Plate XXIX, figs. 2a-2k.)

Type.—No. 296, Berlin Museum.

Locality.—Bogota, Colombia.

Length, about 10 mm.; width, 4.1 mm.

Color in alcohol, light horn brown.

Vertex rather flat, without hairs, sulcus rather shallow; clypeus sparsely hairy, densely rugulose transversely, antennae rather densely pilose, especially distad.

First segment subreniform, about twice as broad as long, the anterior margin slightly concave, the posterior strongly convex; only the anterior corners are developed, and these are rounded; behind the anterior margin is a transverse row of about six slight, broadly rounded prominences.

Second segment with large, spatulate, broadly rounded carinae, much exceeding in size, and extending far below those of the other segments. The lateral and anterior margins are raised, and behind the anterior margin is a prominent transverse ridge extending obliquely mesad, but interrupted medianly by a distinct longitudinal impression.

Third and subsequent segments with narrowly triangular carinae, becoming broader and more rounded caudad; surface of segments smooth, convex; parallel to the posterior margin is a transverse, somewhat irregular sulcus limiting a row of more or less rectangular convex areas present on all segments from the second to the eighteenth, but less distinct on those of the posterior end of the body.

Repugnatorial pores small, located near the middle of the carinae, not far from their bases.

Supplementary margin wanting. The posterior edge of the dorsal part of the segment is produced beyond the actual rim of the body cylinder, so that the supplementary margin, if present, would not be visible from above. Another unusual adaptation is seen in the fact that this rim is deeply and broadly emarginate opposite the insertion of the legs, allowing the segments to be fitted against each other more compactly than when the cylindrical form of the individual segments remains complete.

Segment 19 with very broad semicircular carinae, separated from each other only by a narrow slit, so that the last segment is from above almost entirely concealed, being considerably shorter than segment 19.

Last segment greatly reduced, the apex, which projects beyond the anal valves, being merely a somewhat rounded tubercle bearing a few setae.

Anal valves flat, scarcely margined; superior setiferous tubercles rudimentary, the setae located near the superior corner of the valves; inferior setae on slight tubercles above the middle of the valves.

Preanal scale broadly triangular, setiferous tubercles distinct.

Sterna very narrow, the coxæ nearly in contact.

Legs sparsely hirsute, the third joint with a few long hairs on the ventral face, the succeeding joints with hairs shorter and more numerous.

The specimen which serves as the type of this species is preserved in alcohol and is marked as a type of *Oniscodesmus rubriceps* Peters, with which, as represented by the dried specimen supposed to be the true type, it has no close relationship, as a comparison of the drawings will show.

From *Oniscodesmus oniscinus* the present form differs most conspicuously in the structure of the last two segments.

Genus LIGNYDESMUS Cook.

Lignydesmus Cook, Brandtia, 1896, p. 28.

Second segment with anterior marginal ridge very prominent and broad, expanded below into a broad marginal rim.

Segments with posterior areate margin very convex and long, occupying over a third of the surface of the individual segments; surface of segments covered with a black adherent bloom or powder.

Repugnatorial pores located in contact with the transverse sulcus which bounds the areate margin, and elevated on a distinct rounded tubercle.

Segment 19 with subrectangular sinus exposing the broadly rounded last segment.

LIGNYDESMUS RUBRICEPS (Peters).

(Plate XXX, figs. 2a-2f.)

Oniscodesmus rubriceps PETERS, Monatsber. K. Akad. Wiss. Berlin, 1864, p. 617.

Lignydesmus rubriceps COOK, Brandtia, 1896, p. 28.

Type.—Berlin Museum, a dried specimen.

Locality.—Bogota, Colombia.

Genus DETODESMUS Cook.

Detodesmus Cook, Brandtia, 1896, p. 28.

Second segment expanded in front on each side of the middle so that the lateral aspect is somewhat semicircular; anterior margin narrow and not so prominent as in *Lignydesmus*; areate margin wanting.

Segments with areate margin very short, occupying less than one-fourth of the dorsal surface; areas small; surface of segments clean and polished.

Repugnatorial pores distinctly removed from the areate margin, not elevated on a tubercle.

Segment 19 with a rounded sinus about as wide as its carinæ; exposed part of last segment broadly rounded.

Copulatory legs with a large, bulbous, hairy base bearing two rami of subequal length, of which the anterior is rather slender and ends in a point, while the posterior bears distally a subcapitate process turned laterad.

The apparent difference in detail, if not in type, between the copulatory legs of this genus and those of *Oniscodesmus* adds an argument, if any were necessary, to proof of the distinctness of the genera, although these important structures had not been described for *Oniscodesmus* when *Detodesmus* was recognized as separate.

DETODESMUS AURANTIACUS (Peters).

(Plate XXX, figs. 1a-1c.)

Oniscodesmus aurantiacus PETERS, Monatsber. K. Akad. Wiss. Berlin, 1864, p. 530

Detodesmus aurantiacus COOK, Brandtia, 1896, p. 26.

Type.—No. 245, Berlin Museum.

Locality.—Caracas, Venezuela.

Family CYRTODESMIDÆ Cook.

Cyrtodesmidæ COOK, Brandtia, 1896, p. 28.

Body small, five or six times as long as broad; dorsum very strongly convex, the carinæ broad, projecting almost directly downward; surface of segments pilose, hispid, or tuberculate, without an areate border.

Second segment more or less enlarged and decurved, much exceeding all the others.

Lateral carinæ rounded or subquadrate, with a deep notch in the posterior margin at base.

Repugnatorial pores distinct, surrounded by a raised rim or borne on a special tubercle; the pores are located near the middle of the carinæ, near the base.

Supplementary margin finely and regularly pectinate.

Last segment much broader than long, subrectangular, the posterior margin notched and tuberculate; several setiferous tubercles are located below the margin.

It seems certain that the forms placed here can not be arranged under any other family. As yet the copulatory legs have not been described or figured, nor has there been the comparative study necessary to determine the affinities of the family. As a suggestion, however, the *Doratodesmidæ* of the Malay region might be mentioned. Here, as in the *Cyrtodesmidæ*, the body appears rather slender when extended, on account of the vertical carinæ, and when coiled it is more lenticular and less spherical than the other American families treated here. In the coiled animal there would be left on each side an open space were this not covered by the greatly enlarged carinæ of the second segment, against which the carinæ of most of the other segments can be brought into contact, thus forming a complete armor.

Genus CYRTODESMUS Gervais.

Cyrtodesmus GERVAIS, Apteres, 1847, IV, p. 92.

Second segment with carinæ broadly rounded, but not as much expanded and decurved as in the other genera associated in the present family.

Segments evenly convex, densely velvety pilose.

Lateral carinæ with a deep notch in the posterior margin near the base.

Repugnatorial pores with the normal formula, located in the middle of the carinæ, slightly laterad from the notch, raised on distinct papillæ.

CYRTODESMUS VELUTINUS (Gervais and Goudot).

(Plate XXIX, figs. 3a, 3b.)

Polydesmus velutinus GERVAIS and GOUDOT, Bull. Soc. Ent., France, 1844, 2d ser., II, p. xxviii.

Cyrtodesmus velutinus GERVAIS, Apteres, 1847, IV, p. 93, pl. XLIV, fig. 5.

Type.—British Museum.

Locality.—Colombia.

Genus ONCODESMUS Cook.

Oncodesmus COOK, Brandtia, 1896, p. 28.

The second segment is here much larger than in *Cyrtodesmus*, and the surface of the segments, instead of being densely and uniformly hispid, is beset merely with coarse granules, giving the animal an appearance very distinct from that of *Cyrtodesmus*. These differences are supplemented by others which in the absence of more detailed notes can not be stated till the types can be reexamined.

ONCODESMUS GRANOSUS (Gervais and Goudot).

Polydesmus granosus GERVAIS and GOUDOT, Ann. Soc. Ent., France, 1844, 2d ser., II, p. xxviii.

Cyrtodesmus granosus GERVAIS, Apteres, 1847, IV, p. 93.

Oncodesmus granosus COOK, Brandtia, 1896, p. 28.

Type.—British Museum.

Locality.—Colombia.

CYLIOCYRTUS, new genus.

Type.—*C. asper* (Peters), from Colombia.

First segment small, included between the enormously enlarged flabellate carinæ of the second segment.

Segments densely covered with rough tubercles; carinæ notched at base.

Repugnatorial pores located on a special tubercle or papilla.

Supplementary margin regularly pectinate with long teeth.

Last segment with the apical papillæ located below the projecting notched rim.

Anal valves and preanal scale entirely flat.

The affinities of this and the preceding genus may prove to lie with *Doratodesmus* rather than with other American forms or even *Cyrtodesmus*.

In the greatly enlarged second segment and the tuberculate segments this genus resembles *Oncodesmus* rather than *Cyrtodesmus*, but the hispidity of the tubercles gives a general appearance more like that of *Cyrtodesmus*, for *Oncodesmus* is coarsely granular and not hispid at all.

CYLIOCYRTUS ASPER (Peters).

(Plate XXX, figs. 3a, 3d.)

Cyrtodesmus asper PETERS, Monatsber. R. Akad., Wiss. Berlin, 1864, p. 618.

Type.—Berlin Museum.

Locality.—Bogota, Colombia.

Family CYCLODESMIDÆ Silvestri.

Cyclodesmidæ SILVESTRI, Ann. Mus. Civ., Genova, 1895, XXXIV, p. 747.

Body very small, about five times as long as broad; dorsum very strongly convex, the carinæ broad, vertical; surface of segments smooth and polished.

Antennæ moderately robust, filiform, joint 6 slightly longer than joint 2, and distinctly larger than joints 3 to 5, which are subequal.

Second segment crescentic, much smaller than the third, which has the carinæ much expanded and projecting downward far beyond the level of the others.

Lateral carinæ rounded-triangular on anterior segments, with a straight lateral margin and distinct posterior corner on posterior segments.

Repugnatorial pores wanting.

Supplementary margin wanting.

Last segment large, subquadrate, many times broader than the carinæ of segment 19; its posterior margin forms an even, thin edge.

Copulatory legs not known.

Genus CYCLODESMUS Humbert and Saussure.

Cyclodesmus HUMBERT and SAUSSURE, Revue et Mag. Zool., 1869, p. 149.

CYCLODESMUS AZTECUS Humbert and Saussure.

Cyclodesmus aztecus HUMBERT and SAUSSURE, Revue et Mag. Zool., 1869, p. 150; Etudes sur les Myriap., 1872, p. 24, pl. I, figs. 3-3c.

Type.—Supposed to be in Paris.

Locality.—Eastern cordillera of Mexico.

CYCLODESMUS PORCELLANUS Pocock.

Cyclodesmus porcellanus POCK, Journ. Linn. Soc., 1893, XXIV, p. 509, pl. xxxix, figs. 1, 1a.

Type.—British Museum.

Locality.—Jamaica.

CYCLODESMUS HUBBARDII Cook.

(Plate XXXI, figs. 2a-2g.)

Cyclodesmus hubbardii COOK, Brandtia, 1896, p. 28.

Type.—No. 682, U.S.N.M.

Locality.—Jamaica.

Length, about 10 mm.; width, 2 mm.

Color in alcohol, whitish, apparently mottled with grayish, as the delicate and translucent exoskeleton allows the contents of the alimentary canal to show through. On drying the specimens do not become pure white, as in *C. porcellanus*, which has, notwithstanding its smaller size, an apparently much firmer exoskeleton.

Segments without a notch in the posterior margin at the base of the carinae.

The habitat of the specimens is given as "a small damp cave, Mandeville, Jamaica," where they were collected by Mr. H. G. Hubbard, for whom the species is named. The subterranean life may have reacted upon this species to render its exoskeleton thinner, colorless, and transparent. Specimens were compared with the types of *C. porcellanus*, a smaller species, distinct in the notched segments.

Family SPHÆRIODESMIDÆ (Humbert and Saussure).

Sphæriodesmii HUMBERT and SAUSSURE, Revue et Mag. Zool., 1869, p. 149.

Sphæriodesmiens HUMBERT and SAUSSURE, Etudes, 1872, p. 20.

Body rather small, less than three times as long as wide; dorsum strongly convex, the carinae very broad, curved downward so as to form with the dorsum nearly a semicircle; surface of segments smooth and polished.

Antennae rather slender, filiform, joints 2 to 6 subequal, the fourth being slightly shortest, and the third and fifth shorter than the second and sixth.

First segment lenticular in outline instead of subelliptic or rhomboidal as in the other families.

Second and third segments crescentic, the third larger than the second, but much exceeded by the greatly expanded fourth and fifth segments.

Lateral carinae entire, triangular on anterior segments, quadrate on posterior.

Repugnatorial pores wanting.

Supplementary margin rather long, of rather firm and even texture, and quite entire.

Last segment subsemicircular, broader than the carinæ of segment 19; broader and shorter than the last segment in *Cyclodesmidæ* and *Desmonidæ*; posterior margin an even, thin edge.

Copulatory legs of typical genus, simple, falcate.

This family may be understood to consist for present purposes of the monotypic genus *Sphæriodesmus*, the second supposed species of which is certainly generically distinct and probably does not belong in the present family, as is pointed out below.

In *Sphæriodesmus* the body cavity is distinctly more flattened than in the other glomeroid families, and the carinæ are decurved so as to project far below the ventral plane of the body cavity. This feature reaches perhaps its highest development here, and is correlated, as in similar forms, with more slender legs than the otherwise robust body would lead us to expect. It will be understood that, as these animals coil up, their legs may not be too bulky, and as the carinæ project far downward, the legs must have considerable length so as not to be interfered with in crawling.

The anterior segments are so entirely different from those of other families that the supposition of the independent acquisition of this provision for coiling up seems to be the only possible explanation, for it is well-nigh unthinkable, or at least violently unreasonable, to suppose that adaptation for this means of defense having been acquired by the enlargement, say, of the third segment the modification should have gradually been transferred to the fourth, for during the process of change the efficiency of the arrangement would have been destroyed. The form of the copulatory legs, the proportions of the antennal joints, together with the form of the segments as referred to above, are in the line of the view that *Sphæriodesmus* at least has no tangible relationship with the other glomeroid types of *Merocheta*. If this be admitted, the similarity in form of the posterior segments of the body in this family, the *Cyclodesmidæ* and *Desmonidæ*, must be looked upon as an instance of strikingly close approximation. We have, however, only to bring into the comparison the several genera of *Oniscidæ*, which have taken on practically the same form, to realize that the possibilities of approximation are great enough to be taken into account far more widely than is customary among systematists.

Genus SPHÆRIODESMUS Peters.

Glomeridesmus SAUSSURE, *Linnaea Entom.*, 1858, XIII, p. 328; not *Glomeridesmus* Gervais.

Sphæriodesmus PETERS, *Monatsber. K. Preuss. Akad. Wiss. Berlin*, 1864, p. 529.

SPHÆRIODESMUS MEXICANUS (Saussure).

(Plate XXXI, figs. 1a-1k.)

Glomeridesmus mexicanus SAUSSURE, Linnea Entom., 1858, XIII, p. 328; Mem.

Mex. Myriap., 1860, p. 18, pl. I, figs. 1-1c.

Sphariodesmus mexicanus PETERS, Monatsber. K. Akad. Wiss. Berlin, 1861,

p. 529.—SAUSSURE and HUMBERT, Etudes, 1872, p. 21, pl. I, figs. 1, 1l.

Type.—Supposed to be in Paris.*Locality*.—Cordova, Mexico.

Two specimens of *Sphariodesmus* have come into my hands for study through the kindness of Professor Kraepelin, director of the Hamburg Museum. They seem to correspond in every particular with the descriptions and plates cited above. They are from Vera Cruz, Mexico, while the type of *S. mexicanus* was from Cordova, only 70 miles away. Thus, while it is well nigh impossible in some families of Diplopoda to fix species by descriptions of external characters, an identification seems justified in the present instance.

The details of the structure of the copulatory legs can be better understood from the plates, these not having been previously described or figured.

Humbert and Saussure give the measurements of the typical specimens as 32 by 16 mm., and state that they have four individuals measuring 16 by 5 mm. which they propose to consider provisionally as the young of the present species, although already provided with twenty segments. These are indubitably a distinct species, probably of another genus.

CYLIONUS, new genus.

Type.—*Cylionus gracilis* (Humbert and Saussure), from Mexico.

From the descriptions and plates of this species it appears that at least a generic separation from *Sphariodesmus* is necessary. The copulatory legs of *Sphariodesmus* are here made known for the first time, and a comparison with the plates of *C. gracilis* shows a complete difference in type of structure. The resemblance is, indeed, with *Desmonus*, rather than with *Sphariodesmus*, there being a large incurved spine, presumably containing the seminal duct. It appears, also, in addition to the much smaller size (11 by 2.5 mm.), that the body is much more strongly convex, laterally compressed, and slender; the fourth segment is larger than the fifth; the carinae of other segments are narrower and sinuate posteriorly, and the last segment is longer and has a transverse depression or furrow somewhat above the posterior margin. Moreover, from one of the drawings it appears that joint 6 of the antennae is distinctly longer than joint 5. All these differences point in the direction of *Desmonus*, but the enlarged fourth and fifth segments, and the want of any notice of the remarkable dorsal pits of *Desmonus* seem to forbid, for the present, reference to that vicinity, and the genus is accordingly left near *Sphariodesmus*, where it may be the more readily found.

CYLIONUS GRACILIS (Humbert and Saussure).

Spharionotus gracilis HUMBERT and SAUSSURE, Rev. et Mag. Zool., 1869, p. 149;
Etudes sur les Myriapodes, 1872, p. 22, pl. I, figs. 2, 2l.

Type.—Supposed to be in Paris.

Locality.—Eastern cordillera of Mexico.

DESMONIDÆ, new family.

Body very small, about four times as long as broad; dorsum very strongly convex, the carinae broad, sloping somewhat obliquely downward; surface of segments finely hispid, transversely convex, or provided with a transverse row of rounded elevations or conic tubercles.

Antennae rather robust, subelavate, the sixth joint distinctly longer and thicker than the others, joints 2 to 5 being subequal in length.

Second segment crescentic, much smaller than the laterally expanded and decurved third segment, which much exceeds all the others in size. The fourth segment has, however, the carinae larger and more produced than the fifth and following segments, which is not the case in the Cyclodesmidae.

Lateral carinae entire, subtriangular, becoming quadrate caudad.

Repugnatorial pores, if present, situated in large, deep cavities at the anterior shoulder of the carinae at base. These cavities are not known in any other diplopoda.

Supplementary margin very short, delicate, and hyaline.

Last segment semielliptic, somewhat longer than broad, several times broader than the carinae of segment 19; the posterior margin forms an even, thin edge.

Copulatory legs lying almost in contact, consisting of a bifid, robust ramus, and a slender simple attenuate process bearing the seminal duct and lying, when at rest, in a groove along the mesial face of the larger branch.

DESMONUS, new genus.

Type.—*Desmonus earlei*, new species, from Alabama.

The generic characters are included among those given for the family. Should it be found necessary to associate here the genus *Cyphodesmus* Peters, it may be distinguished by the much larger size, slighter development of the carinae of the third segment, and larger tubercles of the transverse row.

DESMONUS EARLEI, new species.

(Plate XXXII, figs. 1a-1n.)

Type.—No. 681, U.S.N.M.

Locality.—Auburn, Alabama.

Length, 7 mm.; width, 1.7 mm.

Color uniform light horn brown to whitish, usually appearing dark on account of adherent particles of earth or humus.

Vertex evenly convex, smooth and shining, without hairs; sulcus distinct; clypeus sparsely hirsute; antennae sparsely hirsute, the hairs of the distal joints shorter and more numerous than those of the proximal.

First segment trapezoidal, anterior margin transverse, medianly slightly and very broadly emarginate, lateral corners somewhat rounded; lateral margins slightly curved, converging, posterior margin transverse, somewhat over half as broad as the anterior; the segment is over twice as broad as long; with the exception of a fine marginal raised rim its surface is smooth and even.

Second segment subcrenate, the carinae rather straight, and narrowly and acutely triangular; anterior and posterior margins of middle part of segment transverse; the carinae project downward and forward so as to slightly exceed the anterior margin of the first segment, which is thus entirely included between them; margins of carinae with fine raised rims. Surface of segment smooth and even.

Third segment saddle-shaped, much larger than any of the others. The carinae are conspicuously broader than those of the other segments, and slightly broader than the dorsal part of the segment itself. They are rather strongly falcate, being somewhat prominent and arcuate in front and broadly emarginate behind. The posterior corner is somewhat produced. The carinae also extend vertically much below a line drawn across the points of those of the second and fourth segments. Margins of carinae with a distinct raised rim. Surface of segment smooth and even.

Fourth segment with carinae conspicuously smaller than those of the third, and triangular, like those of the following segments. They are, however, broader and produced somewhat farther ventrad than those of the fifth segment. The surface is distinctly more convex on its posterior part than with the preceding, and has traces of the prominences conspicuous on the other segments.

Segments dorsally finely and rather sparsely granular hispid, so that the animals are usually more or less covered with a layer of adherent particles of earth or rotten vegetable matter, which serves in life to render them very inconspicuous. Segments from the fourth to the penultimate have a transverse crest, usually of twelve rounded, broadly subconic prominences arranged in a row, except that the one on each side of the middle pair is somewhat smaller than those between which it stands and is slightly in front of them. With this exception the dorsal prominences are larger than those farther down; on posterior segments they become more sharply acute.

Carinae of anterior segments from the fifth to the tenth rather narrowly triangular, their sides converging to a rounded point; from the middle of the body the carinae are increasingly broader and more dis-

tinctly truncate laterad; in all cases there is a distinct raised margin, which is slightly broader laterad; the anterior margin is straight, while the posterior is concave toward the end and convex near the base, there being a very slight notch or emargination where the carina joins the segment.

Repugnatorial pores not evident, unless located in the very large and deep cavities found close to the anterior base of the carinæ. These cavities are distinct on all segments from the third to the penultimate, those of the third segment being smaller than the others.

Supplementary margin very short, entire; the segments are very slightly constricted at the transverse suture, and the anterior subsegment is very short and not sculptured.

Last segment nearly as high as broad, with traces of rounded prominences, the surface otherwise smooth; margin thin, even, slightly produced mesad; on the under surface, slightly removed from the margin, are two pairs of fine setæ equally distant from each other.

Anal valves flat, smooth, not margined, much exceeded by the edge of the last segment; preanal scale rounded, triangular, the setæ rising from punctations not located on tubercles.

Copulatory legs consisting of two unequal branches, a slender spine-like structure, simple and gradually narrowed to a sharp point, and a subclavate, much larger, distally bifid arm, which is hirsute on its lateral surface for about three-quarters of its length; on its inner surface it has a large longitudinal groove, into which the slender arm may be laid.

This species is named for my friend Prof. F. S. Earle, who kindly assisted me in collecting a suite of specimens near Auburn, Alabama, in July, 1896. The most favored localities seemed to be woods consisting of deciduous trees with a mixture of pine, the same situations affected by the curious glomeroid form previously described as *Onomeris underwoodii*. On account of the roughened dorsum and adherent particles of dirt, *Desmonus* is even more inconspicuous than the smooth and polished *Onomeris*. Occurring with these were occasional specimens of the terrestrial isopod crustacean *Armadillidium*, and these three independent approximations to the same form, habits, and place in the economy of nature was very striking, and furnished instructive evidence on the possibilities of parallel development. The case is also worthy of note as furnishing an instance of close approximation in form, coloration, and habits, without evident reason for supposing that any implication of mimicry is involved.

DESMONUS PUDICUS (Bollman).

(Platè XXXII, figs. 2a, 2b.)

Sphæriodesmus pudicus BOLLMAN, Entomologica Americana, 1888, IV, p. 3; Bull. U. S. Nat. Mus., 1893, No. 46, p. 75.

Type.—No. 173, U.S.N.M.

Locality.—Arkansas.

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Closely allied to the preceding, but distinct in the much less prominent elevations of the segments. The surface itself seems, however, to be rougher than in *D. earlei* and the adherent matter is more abundant, giving the creature a more uniform and darker color. Following is Bollman's original description of the species, evidently drawn partly from living material. The U. S. National Museum contains one of the original specimens, the female.

General color pinkish, especially posteriorly, anterior half of segments darkest, a black median dorsal line, antennae dark, legs pale. Body widest and highest anteriorly, tapering posteriorly, smooth, setae absent. Vertex smooth, somewhat sulcate. Antennae subclavate, about equaling width of body. Dorsal plates smooth, four preceding the last with an indistinct row of obtuse scales; lateral plates, except the first, antepenult and penult, with their posterior margin serrate. Anal plate triangular with the angles rounded, sparsely pilose. Legs long and slender, extending beyond sides of body. Male: Ventral plate of second pair of legs produced into two short cones; coxae of second and third pairs more pilose than others; copulation foot much twisted, end expanded and divided, pilose. Length of body, 7 mm.; width, 2 mm.

Habitat.—Little Rock and Okolona.

From this it appears that the copulatory legs are also considerably different from those of *D. earlei* as here figured.

The curious cavities described on the segments of *D. earlei* are present in identical form in the present species, but their unique character and position might well account for their being overlooked. Moreover, they are in most cases filled up and concealed by adherent particles of dirt.

Genus CYPHODESMUS Peters.

Oniscodesmus SAUSSURE, Mem. Mex. Myriap., 1860, p. 20 (not *Oniscodesmus* Gervais and Goudot).

Cyphodesmus PETERS, Monatsber. K. Akad. Wiss. Berlin, 1864, p. 530.

The affinities of *Cyphodesmus* seem to lie with *Desmonus*; at least this is the inference one is obliged to draw from the descriptions and figures of the type and only known species. Generic distinctness is, however, indicated by the comparatively slight development of the carinae of the third segment in *Cyphodesmus*, the much larger, more prominent, and somewhat spiniform process with which the segments are armed, and finally the much greater size, being several times as large as *Desmonus*. It would seem doubtful whether *Cyphodesmus* is able to coil up as effectively as *Desmonus*, as the anterior segments are figured like the others, with a transverse row of tubercles. No mention of the large cavities of the segments of *Desmonus* is made, but their unusual position might well account for their being overlooked, as in the case of Bollman's species of *Desmonus*.

CYPHODESMUS MEXICANUS (Saussure).

Oniscodesmus mexicanus SAUSSURE, Linnæa Entom., 1858; XIII, p. 328; Mem. Myr. Mex., p. 23, pl. I, figs 2-2d.

Cyphodesmus mexicanus PETERS, Monatsber. K. Akad. Wiss. Berlin, 1864, p. 530.

Type.—Supposed to be in Paris.

Locality.—Cordova, Mexico.

. EXPLANATION OF PLATES.

PLATE XXIX.

Oniscodesmus oniscinus.

Fig. 1a. First five segments, lateral view.

1b. Last segments, posterior view.

Oniscodesmus micrurus.

2a. Body, lateral view.

2b. First six segments, lateral view.

2c. Head and first two segments, anterior view.

2d. Antenna.

2e. Leg from a middle segment.

2f. Seventh segment of male, anterior view, showing below the copulatory and normal legs.

2g. Copulatory leg, anterior view.

2h. Same, anterior-lateral view.

2i. Same, posterior view.

2j. Last segments, posterior-dorsal view.

2k. Same, ventral view, showing preanal scale and anal valves.

Cyrtodesmus velutinus.

3a. First three segments, lateral view.

3b. Carinae of segments 5 and 6, latero-dorsal view.

PLATE XXX.

Detodesmus aurantiacus.

Fig. 1a. Copulatory legs, posterior view.

1b. Last segments, posterior-dorsal view.

1c. First six segments, lateral view.

Lignydesmus rubriceps.

2a. A body-segment and pair of legs, posterior view.

2b. Last segments, posterior-dorsal view.

2c. First and second segments, anterior-dorsal view.

2d. Same, with head and antenna, anterior view.

2e. First six segments, lateral view.

2f. Seventh segment, dorsal view, showing the poriferous tubercles.

Cylioecyrtus asper.

- Fig. 3a. Last three segments, posterior view.
3b. Same, ventral view.
3c. Carina of segment 15, showing the repugnatorial pore.
3d. Head and first three segments, lateral view.

PLATE XXXI.

Sphariodesmus mexicanus.

- Fig. 1a. Head, antenna and first seven segments, lateral view.
1b. Normal leg.
1c. A segment, posterior view.
1d. Head and first four segments, anterior view.
1e. A segment from the middle of the body, lateral view.
1f. Antenna.
1g. Copulatory legs, posterior view.
1h. Same, lateral view.
1i. Same, anterior view.
1j. Last six segments, lateral view.
1k. Last three segments, posterior view.

Cyclodesmus hubbardii.

- 2a. Head and first four segments, anterior view.
2b. Head and nine anterior segments, lateral view.
2c. Antenna.
2d. A segment, lateral view.
2e. Last two segments, posterior view.
2f. Last four segments, lateral view.
2g. A segment, posterior view.

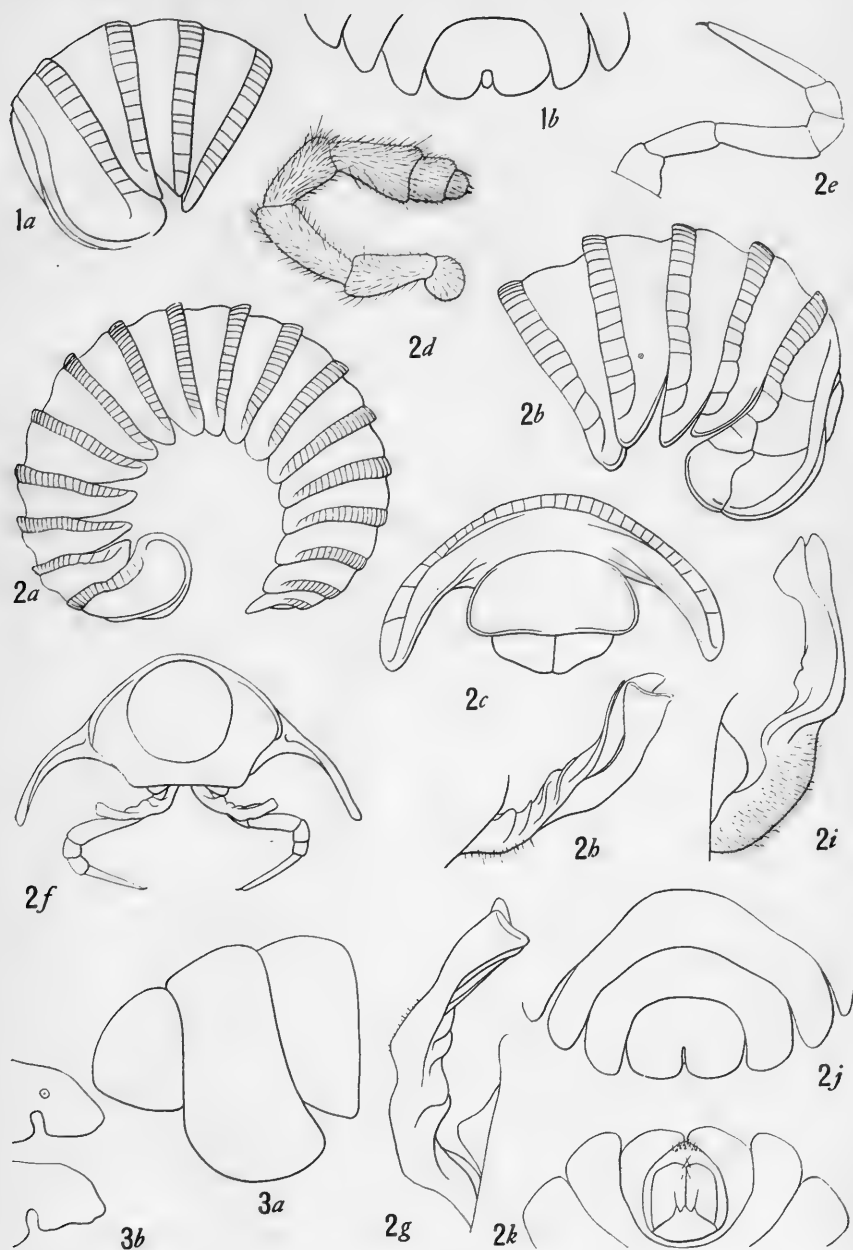
PLATE XXXII.

Desmonus carlei.

- Fig. 1a. The entire animal, coiled into a sphere, lateral view.
1b. Head and first eight segments of extended animal.
1c. Antenna.
1d. Posterior view of segment from middle of body.
1e. Lateral view of same, showing location of deep cavity.
1f. Head and first four segments, anterior-dorsal view.
1g. Seventh segment, ventral view, showing the copulatory legs *in situ*.
1h. Copulatory legs, anterior view.
1i. Same, posterior view.
1j. Same, mesial view.
1k. Same, lateral view.
1l. Normal leg.
1m. Segments 16 to 20, ventral view.
1n. Segments 17 to 20, posterior view.

Desmonus pudicus.

- 2a. Last four segments, lateral view.
2b. Segment from middle of body, lateral view.

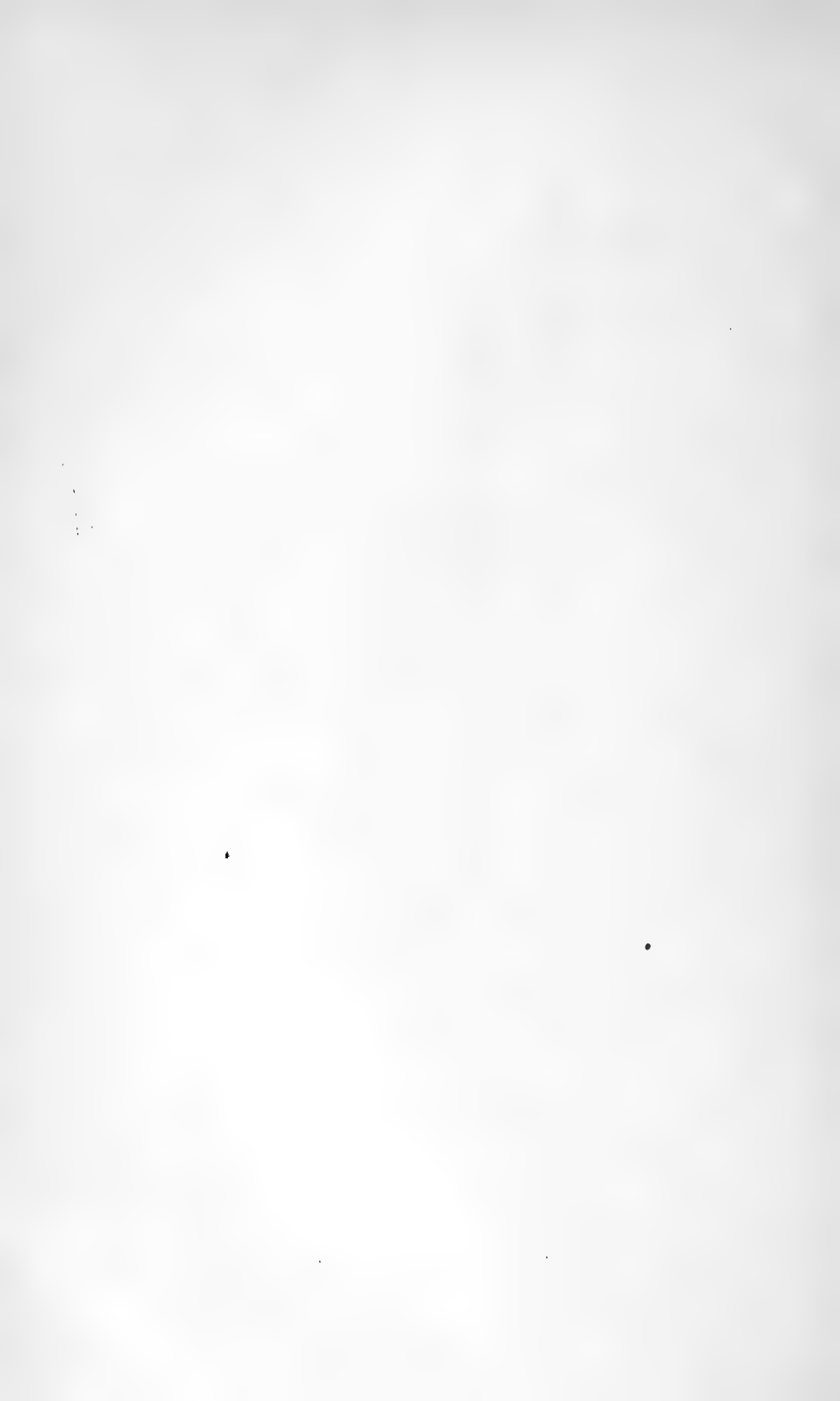


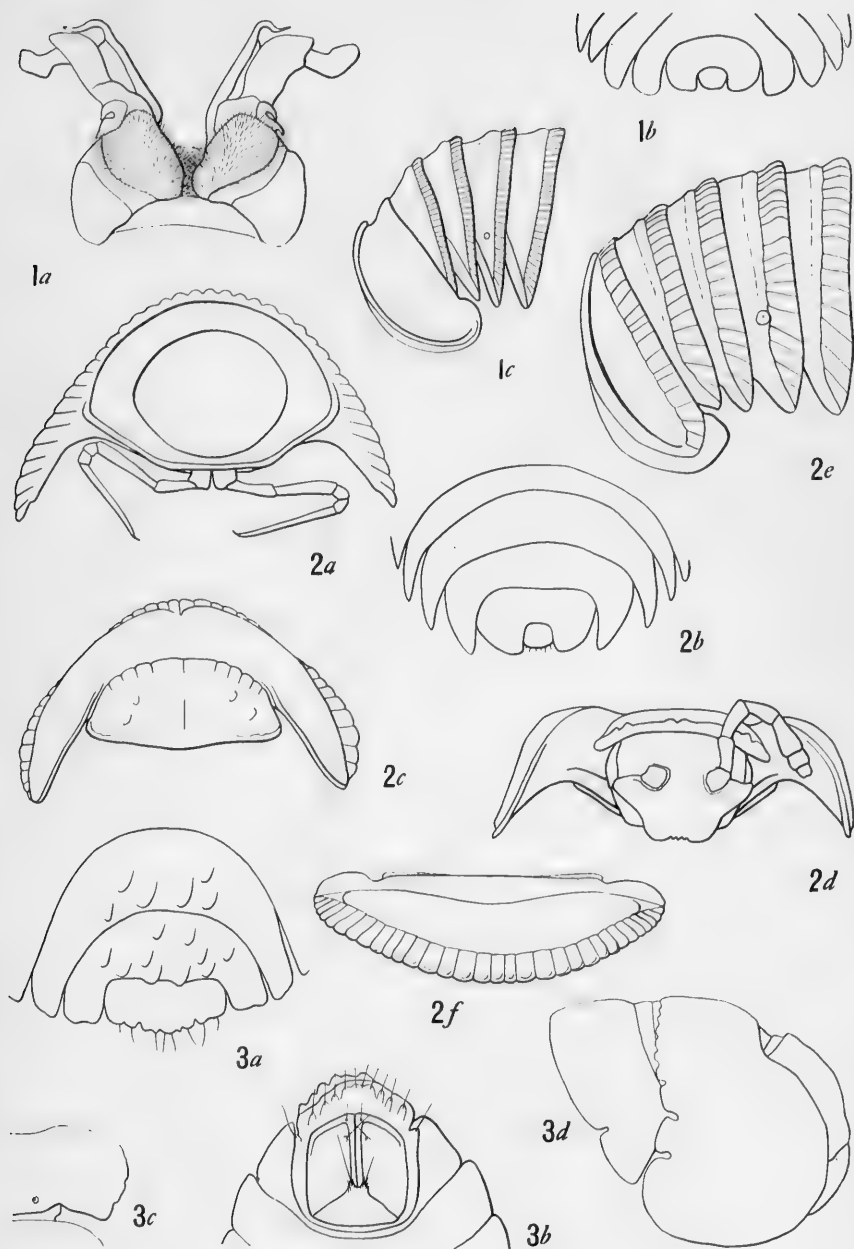
AMERICAN ONISCROID MEROCHETA.

FIG. 1. *Oniscodesmus oniscinus*.
 FIG. 2. *Oniscodesmus micrurus*.

FIG. 3. *Cyrtodesmus velutinus*.

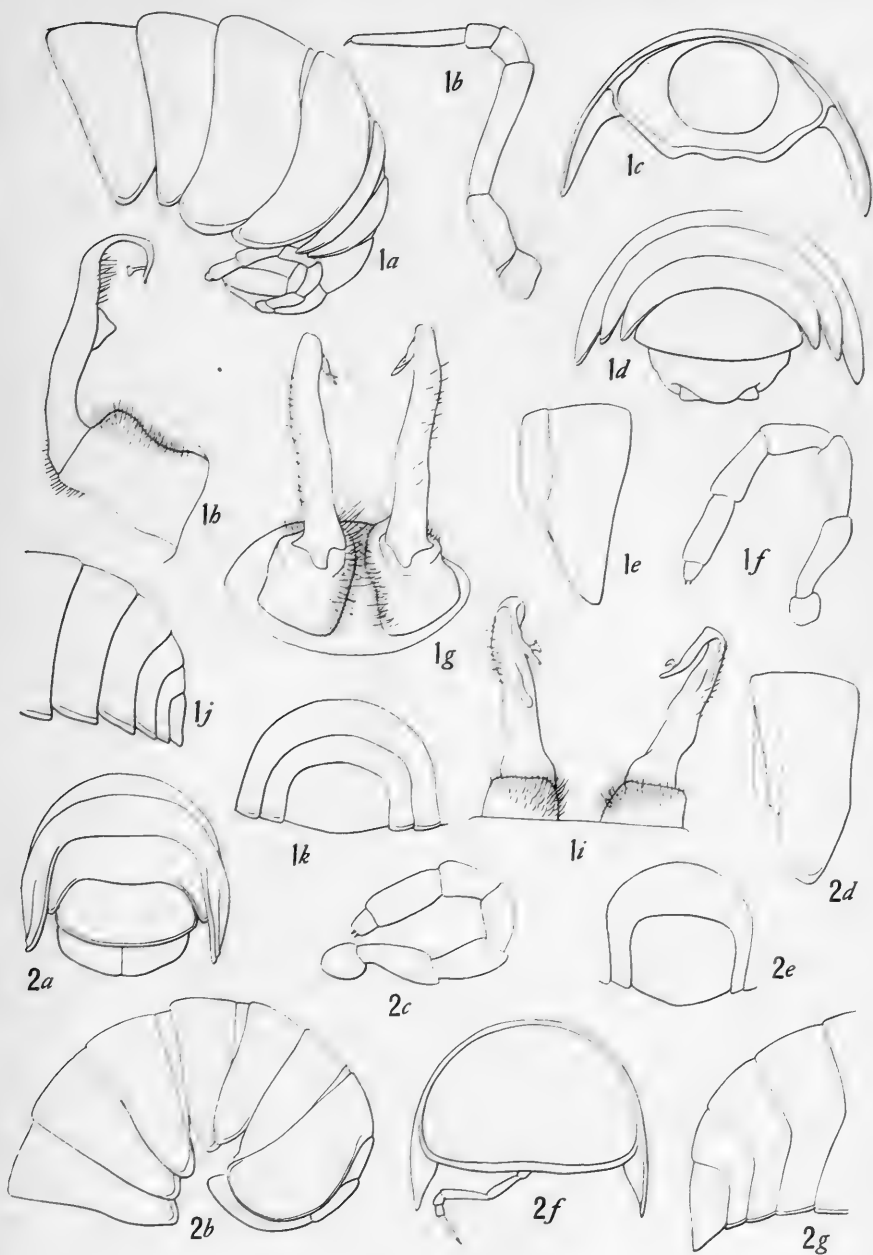
FOR EXPLANATION OF PLATE SEE PAGE 467.





AMERICAN ONISCROID MEROCHETA.

FIG. 1. *Delodesmus aurantiaeus*.FIG. 2. *Ligydesmus rubriceps*.FIG. 3. *Cyliocyrtus asper*.

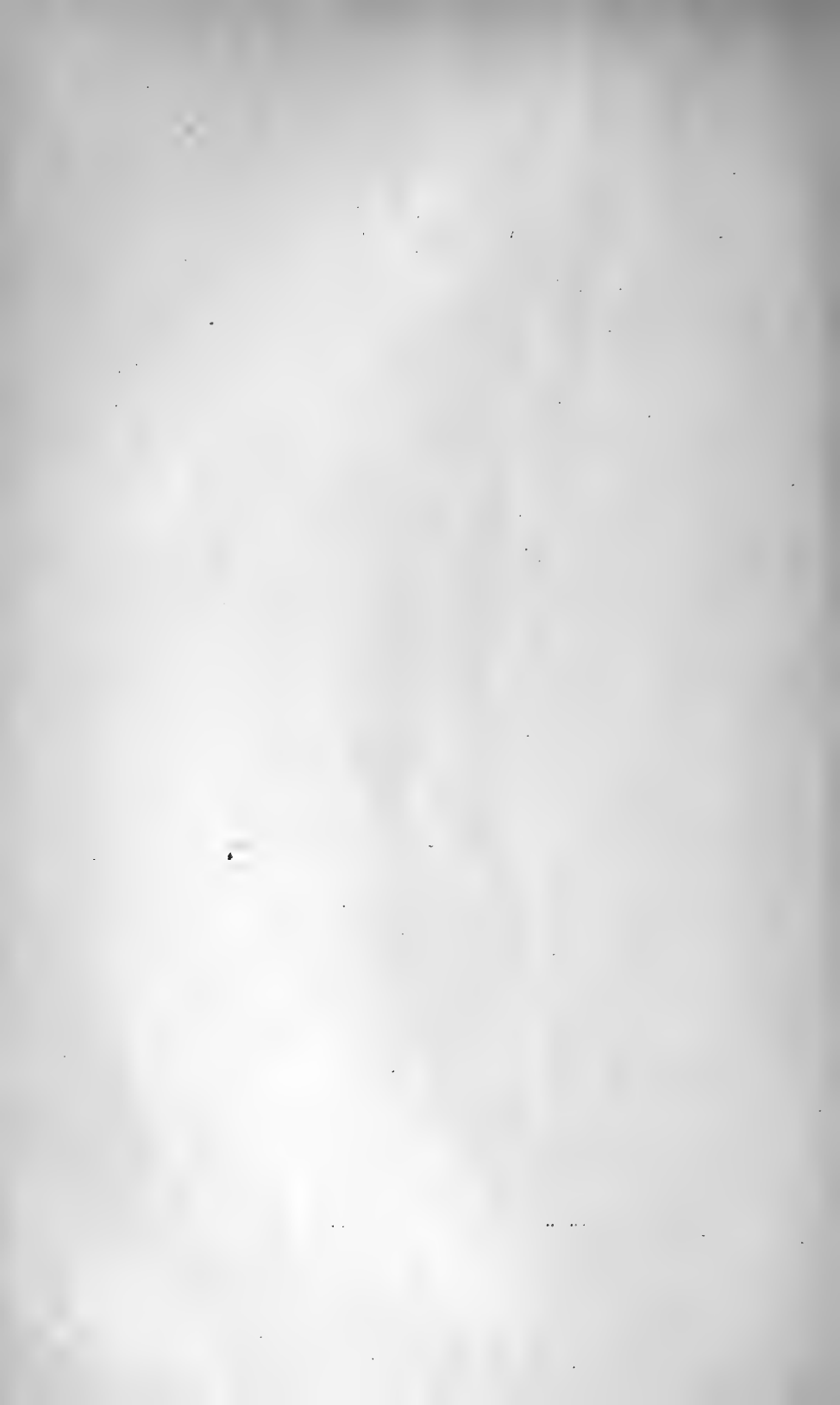


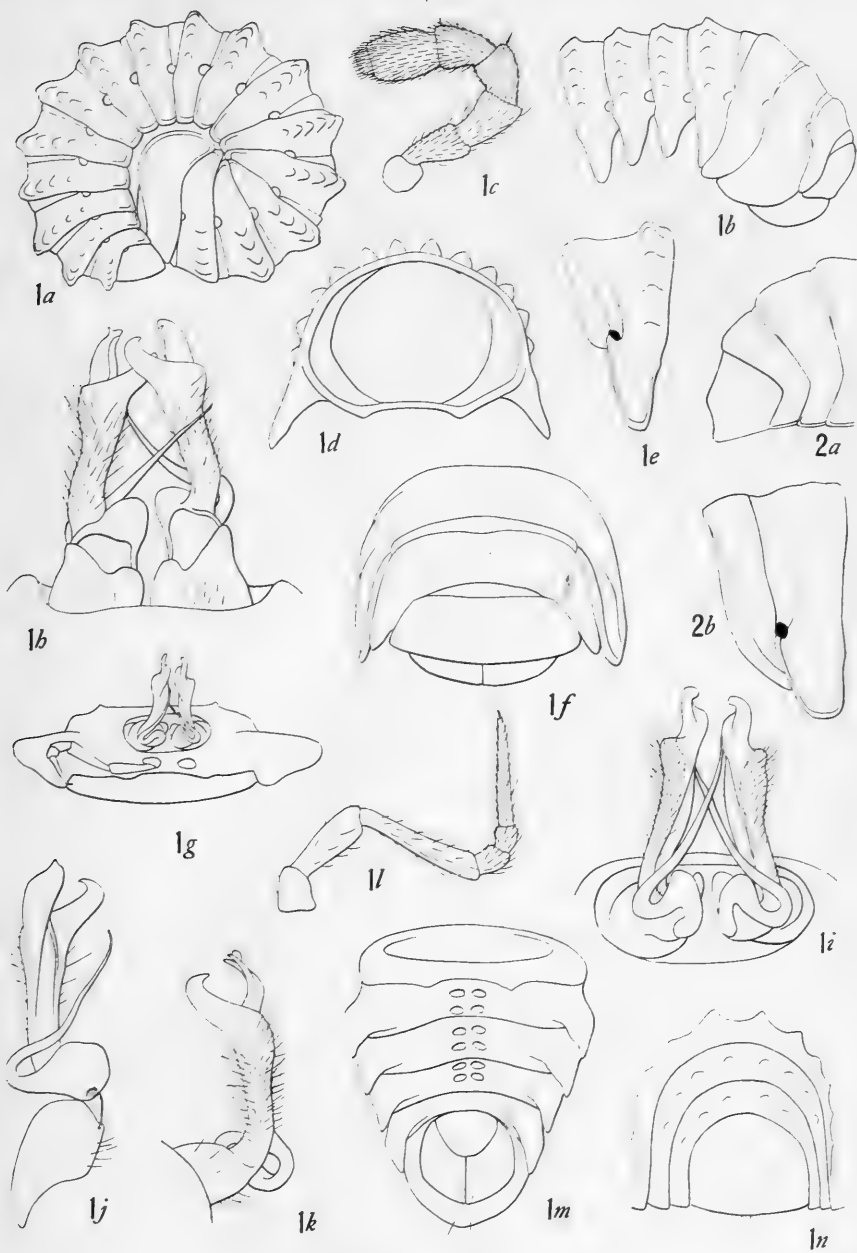
AMERICAN ONISCROID MEROCHETA.

FIG. 1. *Sphaeriodesmus mexicanus*.

FIG. 2. *Cyclodesmus hubbardii*.

FOR EXPLANATION OF PLATE SEE PAGE 468.





AMERICAN ONISCROID MEROCHETA.

FIG. 1. *Desmonus earlei*.

FIG. 2. *Desmonus pudicus*.

FOR EXPLANATION OF PLATE SEE PAGE 468.

THE OSTEOLOGY AND RELATIONSHIPS OF THE FAMILY ZEIDÆ.

By EDWIN CHAPIN STARKS,
Biological Survey, Department of Agriculture

The position of the family Zeidæ having been so long in doubt, I have written this paper as an attempt to point out its relationships, and especially to describe its osteological characters and put the results of my investigations in such shape that they may be available when its allies nearer than these considered here shall be studied.

Notwithstanding the many characters in which *Zeus* differs from the Chaetodonts, the condition of the post-temporal, the crowded anterior vertebrae, and the inferior articulation of the ribs show its relation to them; and its relationship to that group is still more apparent when the Chaetodontoid fishes are studied as a whole.

Thus, the Teuthoidæ possess the simple post-clavicle of *Zeus* and approach it nearer in having the post-temporal more firmly articulated to the skull, while the Ephippidæ have no posterior opening of the myodome to the exterior.

Though showing an alliance to the Scombridæ, it is certainly much nearer to the Chaetodontidæ.

Zeus, however, presents some remarkable peculiarities and stands apart from the Chaetodontoids in the absence of a basisphenoid, in the peculiarly modified prefrontals, in the unmodified articulation of the skull with the vertebrae, in the arrangement of the suspensorium, and in the increased number of vertebrae.

It may be of interest to note, without attempting anything like an exhaustive survey, a few of the places in which the family Zeidæ, in its relations to the Chaetodontoid fishes, has been placed by different authors.

Swainson¹ has placed his large family Zeidæ, which includes many diverse and little related forms, after the Scombridæ (arranged in descending order), which are in a "tribe" apart from Chaetodontidæ.

¹ *Zeidæ* Swainson, Nat. Hist. Fishes, etc., 1839, II, p. 175.

Dr. Günther,¹ in his Catalogue of Fishes in the British Museum, places it among the Scombroid fishes, between Scombridae and Carangidae, while the family Chaetodontidae is separated from it by many large families, such as the Cottidae, Sciaenidae, and others.

In Dr. Günther's² Introduction to the Study of Fishes, Zeidae (Cyttidae) is happily placed in the same division with Aconuridae (=Teuthidae) (Eighth Division Acanthopterygii Cotto-scombriformes), though Carangidae is interposed between them, while Chaetodontidae is in a division with Percidae (First Division Acanthopterygii Perciformes) and separated from it by many large families.

Dr. Gill,³ in his Arrangement of Families of Fishes, has given it a place in the midst of his group Scombroidea which follows Chaetodontioidea.

In Dr. Gill's⁴ Families and Subfamilies of Fishes, Zeidae is placed in the same group as in his previous arrangement, but the group Chaetodontioidea is separated from it by the great group Percoidea and other related groups.

Dr. Gill,⁵ in his account of fishes in the Standard Natural History, has placed Zeidae after the Scombroid fishes and before the Chaetodontoids.

Jordan and Gilbert,⁶ in their synopsis of Fishes of North America, and Dr. Jordan,⁷ in his Catalogue of Fishes of North America, place Zeidae (Zenidae) between Bramidae and Berycidae (=Holocentridae), with several large families between it and Chaetodontidae.

Jordan and Evermann,⁸ in their Check-list of Fishes, have placed it just before the Chaetodontidae.

The skeletons from which my observations were made I prepared from an alcoholic specimen of *Zeus faber* (No. 48531) loaned me for that purpose, by the U. S. National Museum, and from specimens of several Chaetodontoid fishes from the collections of Leland Stanford Junior University, for which I am indebted to Dr. David Starr Jordan.

The plates illustrating this article are from drawings made by Chloe Lesley Starks.

DIAGNOSIS.

Prefrontals not pierced by an olfactory foramen; basis cranii well developed; basisphenoid absent; myodome not opening to the exterior

¹ *Cyttina* Günther, Cat. Fishes Brit. Mus., II, p. 393.

² *Cyttidae* Günther, Introduction to the Study of Fishes, 1880, p. 450.

³ *Zenidae* Gill, Arr. Fam. Fishes, 1872, p. 8 (Fam. No. 84).

⁴ *Zeidae* Gill, Families and Subfamilies of Fishes, Nat. Acad. Sci., Sixth Memoir, 1893, VI, p. 134.

⁵ *Zenidae* Gill, Standard Nat. Hist., Boston, 1885, p. 208.

⁶ *Zenidae* Jordan and Gilbert, Synopsis of Fishes, North America, Bull. XVI, U. S. Nat. Mus., 1882, p. 458.

⁷ *Zenidae* Jordan, Cat. Fishes North America., U. S. Fish Comm. Rept., 1884, p. 74.

⁸ *Zeidae* Jordan and Evermann, Check-list of Fishes, North and Middle America, Rept. U. S. Fish Comm., 1895, p. 418.

posteriorly; post-temporal forming an integral part of the skull; arrangement of elements of suspensorium not typical; post-clavicle of a single piece; two pairs of superior pharyngeals bearing teeth; basi-branchials united; vertebræ compressed anteriorly and number $13 + 17 + \text{hypural} = 31$; posterior surface of centrum convex; posterior and anterior zygapophyses present; inferior zygapophyses absent; parapophyses ankylosed at distal ends; articulation of ribs inferior on vertebræ or parapophyses; epipleurals absent.

DESCRIPTION IN DETAIL.¹

THE SKULL.

(Plate XXXIII, figs. 1-3.)

Exoccipitals (*eo*) entirely surrounding foramen magnum, broadly meeting above and below; articular facets not meeting.

Supraoccipital (*so*) exposing only a small surface above; crest very small; posteriorly two knife-like ridges, continuous with similar ones on exoccipitals, extend downward to articular facets; between them supraoccipital reaches down over upper suture of exoccipitals to border of foramen magnum.

Basioccipital (*bo*) alone forming condyle for centrum of atlas.

Frontals (*fr*) large and exceedingly thick; much pitted and irregularly honeycombed, breaking up large sensory canals posteriorly.

Ethmoid (*e*) blade-like, thin, and high; its length slightly less than that of frontals, or about one-third length of entire skull; much cartilage between its anterior end and vomer.

Prefrontals (*pf*) rather long; no olfactory foramen; large space between them and ethmoid for olfactory nerve, connection with vomer through intervention of cartilage.

Vomer (*v*) wide and flat; at right angles with ethmoid; small patches of teeth at outer anterior corners only.

Parasphenoid (*pas*) sending lateral processes upward to articulate with prootic; posterior end forked, nearly reaching to condyle of basioccipital.

Parietals (*p*) broadly meeting in front of supraoccipital.

Alisphenoids (*als*) long, bordering upper two-thirds of brain cavity; upper ends nearly meeting.

Basis cranii well developed and thick; myodome large, not opening to exterior posteriorly.

SHOULDER GIRDLE.

(Plate XXXVI, figs. 11, 12.)

Post-temporal (*pot*) bent at an obtuse angle rather than forked; from deep notch for articulation of supraclavicle its respective ends run upward and inward, and downward and inward at about the same

¹Elements not mentioned are typical or sufficiently explained by the drawings.

slant; upper portion twice as long as lower; articulated with skull by subdentate sutures; entire portion below angle joined to pterotic and opisthotic; upper end joined broadly to epiotic; two narrow dermal bones articulated firmly along its anterior edge, but not bridging over space between it and skull proper.

Supraclavicle (*sc*) comparatively short, spreading out fan-like and divided into three short spines.

Clavicle (*cl*) very slender and long, bent at an angle at about its middle; pectoral fin well below angle; about half of hypercoracoid lying under it and joined by squamous suture.

First actinost (*a*) very large and long, joined to hypocoracoid; upper three gradually growing smaller and joined to hypercoracoid; upper ray of pectoral working directly upon hypercoracoid.

Postclavicle (*pc*) of a single piece; heavy, long, and bayonet-shaped.

SUSPENSORIUM, OPERCLES, MAXILLARIES, AND MANDIBLE.

(Plates XXXVI, fig. 9; XXXVII, fig. 13.)

The suspensorium is turned back upon itself. The mesopterygoid has crowded itself in between the quadrate and metapterygoid, still holding its attachment with the pterygoid by drawing the upper end of that bone after it and bending it around the upper end of quadrate, carrying the palatine back till it is posterior to the mandibular articulation of the quadrate, attaching itself to the side of the symplectic, and crowding the metapterygoid far from its usual proximity to the quadrate.

This crowding back of the suspensorium has worked in an opposite way upon the opercular apparatus. The mandible in following the palatine back has swung on the quadrate as a fulcrum, and thrown its long lower or posterior end (angular) forward, which has drawn the opercular bones after it, elongating them and giving them a general trend downward and forward.

Perhaps this state of affairs is all brought about by a gradual decrease in the size of the skull proper, pulling the palatine toward the hyomandibular, and the rest following as described.

Hyomandibular (*hm*) rather elongate; its head simple without differentiated knob; separated by a long space from symplectic.

Symplectic (*sy*) an exceedingly long, slender splint, its anterior end running in a groove behind posterior third of quadrate.

Pterygoid (*pt*) extending upward and backward; upper end turning backward around quadrate.

Mesopterygoid (*mspt*) articulated with symplectic posteriorly, and holding on its posterior upper edge the metapterygoid.

Metapterygoid (*mpt*) very small; its upper end touching hyomandibular.

Preopercle (*pop*) a long, slender bone bent on a slight even curve.

Opercle (*op*) triangular in shape, bearing subopercle (*sop*) below, which turns up around its anterior edge a short distance.

Interopercle (*iop*) long and feather-shaped, supported by ligaments only; attached to opercle and subopercle posteriorly, to angular anteriorly.

Mandible strong and heavy; nearly vertical; lower edge¹ only of articular united with dentary (*d*), leaving a space above which is bounded by an upper limb of articular extending forward to meet upper limb of dentary.

A portion of articular (*ar*) projecting backward from its articulation with quadrate.

Angular (*an*) large; pointed behind and extending posteriorly past articular; reaching to dentary anteriorly.

Premaxillaries (*pm*) with a long, backward-extending process reaching to above eye, or well past the anterior half of skull; lower ends forked; large process developed on the posterior edge extending behind maxillary; anterior or toothed part of premaxillaries slightly meeting above, but immediately behind a large open space is left between them.

HYOID APPARATUS.

(Plate XXXIV, fig. 5.)

Interhyal (*ihs*) very long and rather stout, firmly articulated in a shallow socket in epihyal.

Epihyal (*ephy*) triangular in shape.

Ceratohyal (*chy*) with a concave portion cut out below, which breaks its subcircular outline; a narrow foramen slightly above center.

Hypohyals (*hhy*) exceedingly large and conspicuous; entirely lateral in position; urohyal and glossohyal so placed between opposing pairs of hypohyals that they connect only through those bones.

Urohyal (*uhy*) higher than long, attached a little above the middle of its anterior edge.

Branchiostegals (*br*) eight in number, all attached to outer surface of ceratohyal.

BRANCHIAL ARCHES.

(Plate XXXIV, fig. 4.)

Basibranchials (*bbr*) coossified, forming a long splint of bone reaching from between front of hypobranchials of third arch to glossohyal.

Hypobranchials (*hbr*) of third arch short, meeting in a median line behind basibranchial; each sends a long process forward, which curves under basibranchial to in front of hypobranchials of second arch where it meets its opposite fellow.

Ossified hypobranchials and basibranchials of fourth arch absent as usual.

First pair of superior pharyngobranchials (*phbr*) extraordinarily long and slender; upper ends hollow and quill-like; toothless.

Second pair of superior pharyngobranchials as long as first, but stouter; tooth patches at lower ends small.

Third and last pair of superior pharyngobranchials large; tooth patches several times larger than those of second pair; rather elongate above.

¹ Described as if mandible were in its normal position—that is, subhorizontal.

Third epibranchials (*ebr*) broadly join large superior pharyngobranchials.

Fourth epibranchials closely join third along upper half, but very slightly, if at all, joined to large superior pharyngobranchials.

PELVIC GIRDLE.

(Plate XXXV, fig. 7.)

Pelvic girdle (*pg*) composed of two wide, thin, nearly vertical plates, braced through their middle by a long ridge; each sending a long process backward just under skin of belly.

ORBITALS AND NASALS.

(Plate XXXVI, fig. 10.)

Orbitals forming a long narrow chain of bones some distance below eye; preorbital (*por*) attaching to near lower end of palatine; at its center is a short hooked spine; suborbitals (*sor*) five in number.

Nasals (*na*) present; rather small; posterior in position owing to produced ethmoid and vomer.

VERTEBRAL COLUMN.

(Plate XXXVIII, figs. 14-16.)

Vertebral formula: $13+17+\text{hypural}=31$.

Body of vertebræ round and symmetrical, but very deeply pitted; anteriorly much compressed and higher than long; no inferior zygopophyses; posterior zygopophyses only on anterior vertebræ; anterior zygopophyses well developed for whole length of vertebral column.

Atlas higher than long; centrum deeply concave on anterior surface, deeply convex on posterior; neural processes not connected above; flaring outward anteriorly and joined rather firmly to ridges on each side of foramen magnum; lateral to condyle for articulation with exoccipitals a notch is developed for reception of a corresponding process on exoccipitals.

No parapophyses on first seven vertebræ; well developed on succeeding abdominal vertebræ; those of opposite sides of each vertebra ankylosed at their distal ends, as well as those of different vertebræ being joined together by sutures forming a sharp ridge, to the very edge of which ribs are joined, thus bringing bases of opposing ribs close together.

Hæmal processes of the fourteenth, fifteenth, and sixteenth vertebræ form a tube which surrounds the upper end of large interhæmal spine.

Neural spines pointing irregularly on account of interneurals not coinciding with them, the latter being less in number.

Anterior zygopophyses developed upward, forming a sheath for spinal cord.

Last vertebra assisted in forming hypural by the spines of the two succeeding vertebræ.

Ribs slender; anterior ones fitting into deep sockets low on the vertebræ; no epipleurals in evidence.

DORSAL AND ANAL ELEMENTS.

(Plate XXXV, figs. 6-8.)

First two dorsal spines with backward-downward developed processes at their bases for attachment of muscles.

First two interhæmal spines ankylosed, forming a large spine which runs upward, bordering abdominal cavity behind and at its upper end fitting into a tube formed by the hæmal spines of three vertebræ.

Interneurals of spinous dorsal wide and rather irregular in shape.

Interspinous rays of fin spines of dorsal and anal without greatly developed lateral laminae.

Interspinous rays of soft fin rays uniformly thin and flat, with a wide, thin lateral lamina of bone developed at right angles to them at their middles. At the base between each two spines an arch is left, each one forming half an arch on each side of it.

EXPLANATION OF PLATES.

SIGNIFICANCE OF REFERENCE LETTERS USED ON PLATES.

PLATE XXXIII.

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Figs. 1-3. Lateral, superior, and posterior views of skull.....	471
als. Alisphenoid.	
bo. Basioccipital.	
epo. Epiotic.	
e. Ethmoid.	
eo. Exoccipital.	
fr. Frontal.	
na. Nasal.	
pas. Parasphenoid.	
p. Parietal.	
pot. Post-temporal.	
pro. Prootic.	
pto. Pterotic.	
pf. Prefrontal.	
spo. Sphenotic.	
so. Supraoccipital.	
v. Vomer.	

PLATE XXXIV.

Fig. 4. Branchial arches	473
bbr. Basibranchials.	
cbr. Ceratobranchials.	
ebr. Epibranchials.	
hbr. Hypobranchials.	
iph. Inferior pharyngeal.	
phbr. Superior pharyngobranchials.	

Fig. 5. Hyoid apparatus	473
<i>brr.</i> Branchiostegal rays.	
<i>chy.</i> Ceratohyal.	
<i>ephy.</i> Epihyal.	
<i>ghy.</i> Glossohyal.	
<i>hhy.</i> Hypohyal.	
<i>ihy.</i> Interhyal.	
<i>uhy.</i> Urohyal.	

PLATE XXXV.

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<i>ds.</i> Dorsal spines.	
<i>ins.</i> Interneural spines.	
7. Pelvic girdle	474
<i>pg.</i> Pelvic bone.	
<i>vf.</i> Ventral fin.	
8. Anterior elements of anal fin	475
<i>as.</i> Anal spines.	
<i>hs.</i> Hæmal spines.	
<i>ih.</i> Interhæmal spines.	

PLATE XXXVI.

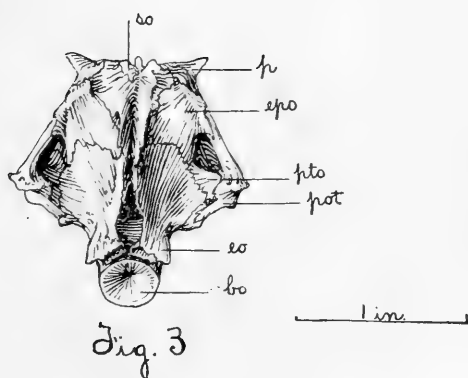
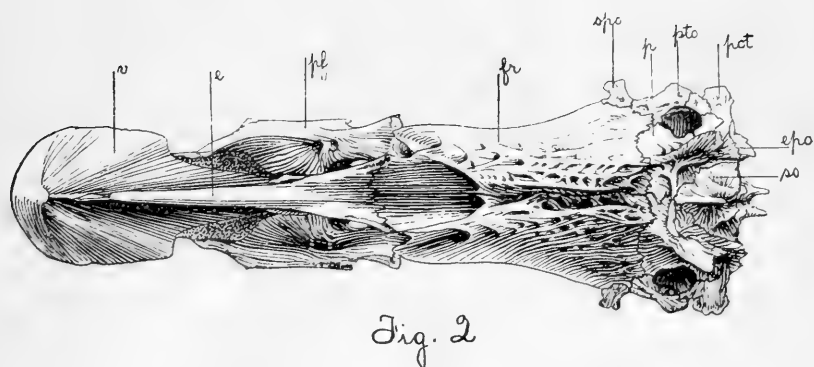
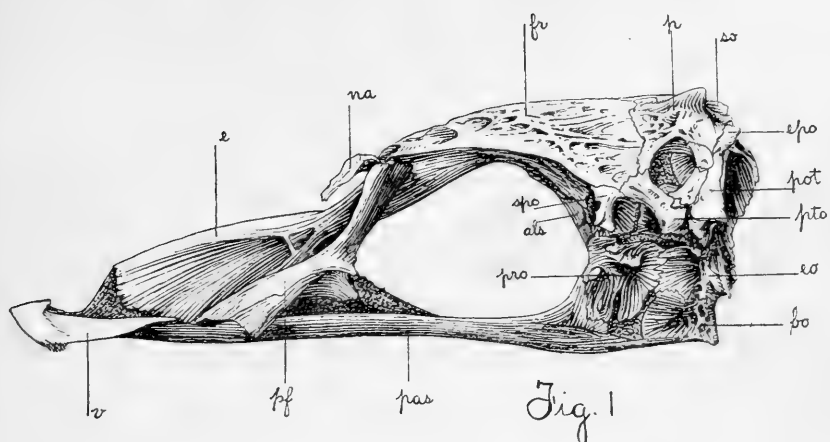
Fig. 9. Maxillaries	473
<i>m.</i> Maxillary.	
<i>pm.</i> Premaxillary.	
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<i>por.</i> Preorbital.	
<i>sor.</i> Suborbitals.	
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<i>scl.</i> Supraclavicle.	
12. Shoulder girdle	471
<i>a.</i> Actinosts.	
<i>cl.</i> Clavicle.	
<i>hyc.</i> Hypercoracoid.	
<i>hypc.</i> Hypocoracoid.	
<i>pcl.</i> Postclavicle.	
<i>pf.</i> Pectoral fin.	

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<i>an.</i> Angular.	
<i>ar.</i> Articular.	
<i>d.</i> Dentary.	
<i>hm.</i> Hyomandibular.	
<i>iop.</i> Interoperculum.	
<i>mspt.</i> Mesopterygoid.	
<i>mpt.</i> Metapterygoid.	
<i>op.</i> Operculum.	
<i>pa.</i> Palatine.	
<i>pop.</i> Preoperculum.	
<i>pt.</i> Pterygoid.	
<i>q.</i> Quadrate.	
<i>sop.</i> Suboperculum.	
<i>sy.</i> Symplectic.	

PLATE XXXVIII.

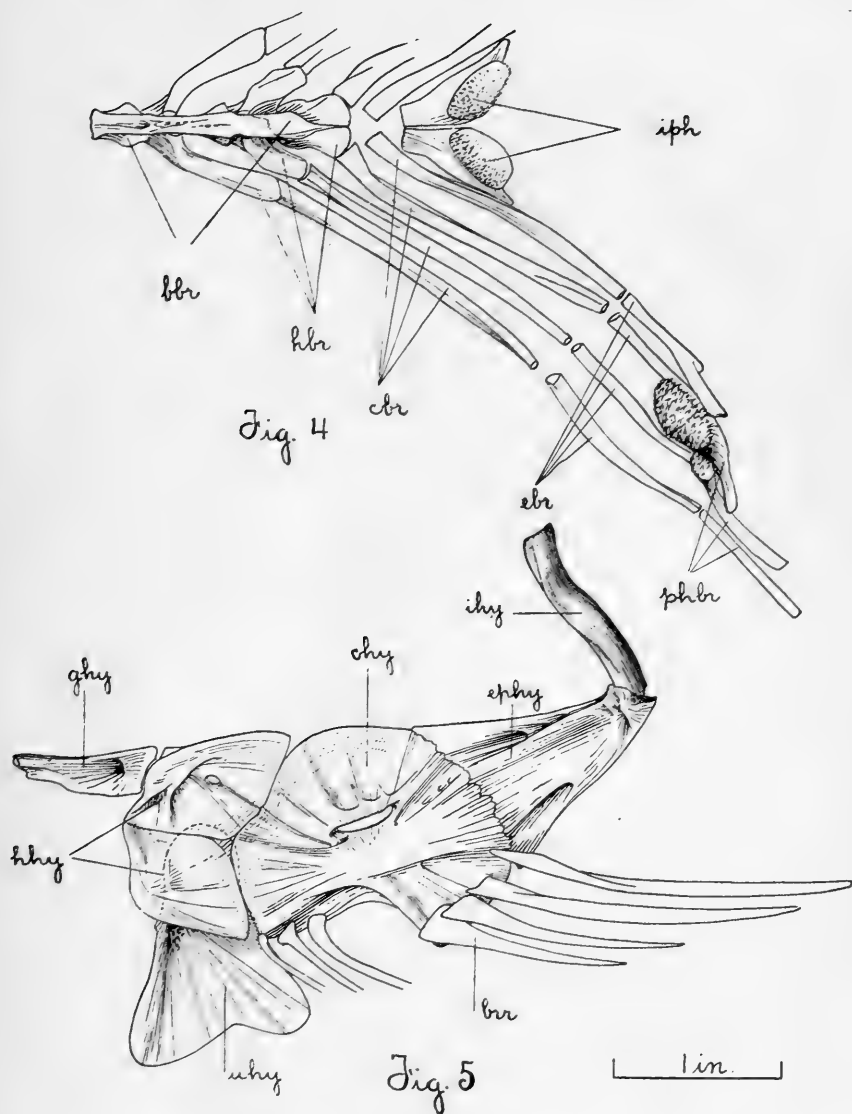
Fig. 14. Vertebrae	474
<i>hs.</i> Hæmal spines.	
<i>ih.</i> Interhæmal spine.	
15. Hypural	475
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LATERAL, SUPERIOR, AND POSTERIOR VIEWS OF SKULL.

FOR EXPLANATION OF PLATE SEE PAGE 475.

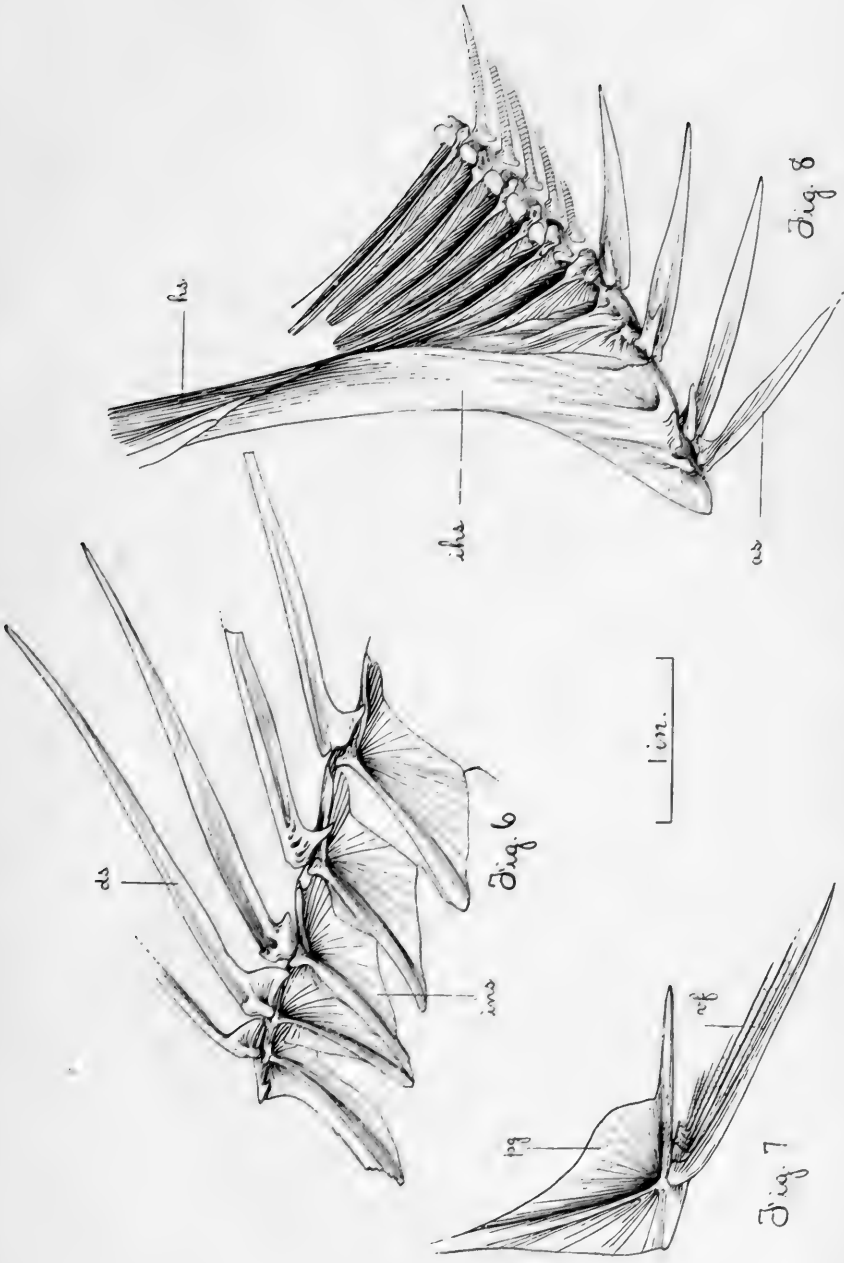




BRANCHIAL ARCHES AND HYOID APPARATUS.

FOR EXPLANATION OF PLATE SEE PAGES 475, 476.





ANTERIOR ELEMENTS OF DORSAL AND ANAL FINS, AND PELVIC GIRDLE.

FOR EXPLANATION OF PLATE SEE PAGE 476.

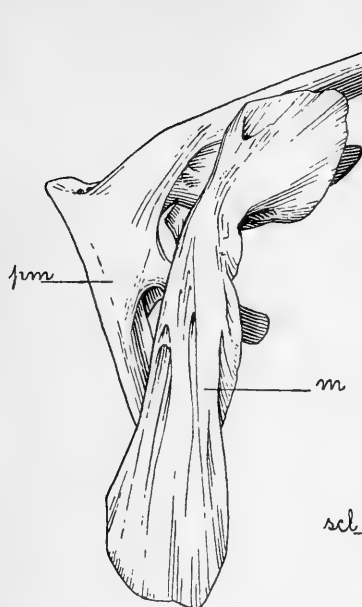


Fig. 9

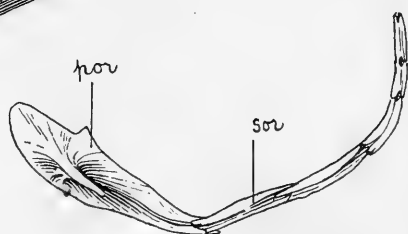


Fig. 10

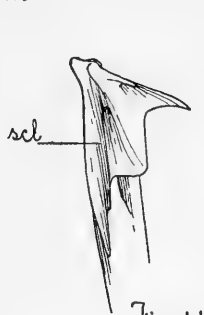


Fig. 11

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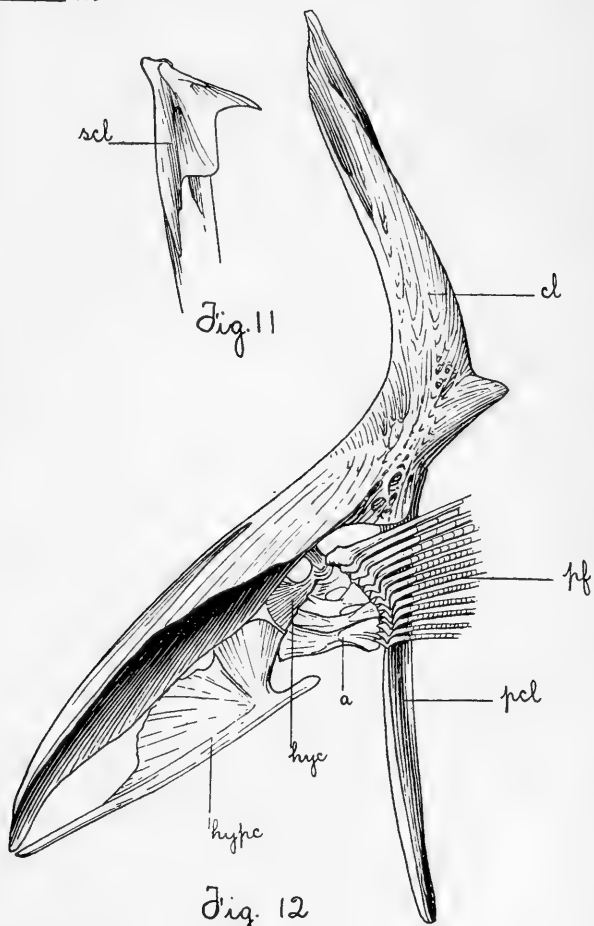


Fig. 12

MAXILLARIES, SUBORBITAL RING, SUPERCLAVICLE, AND SHOULDER GIRDLE.

FOR EXPLANATION OF PLATE SEE PAGE 476.

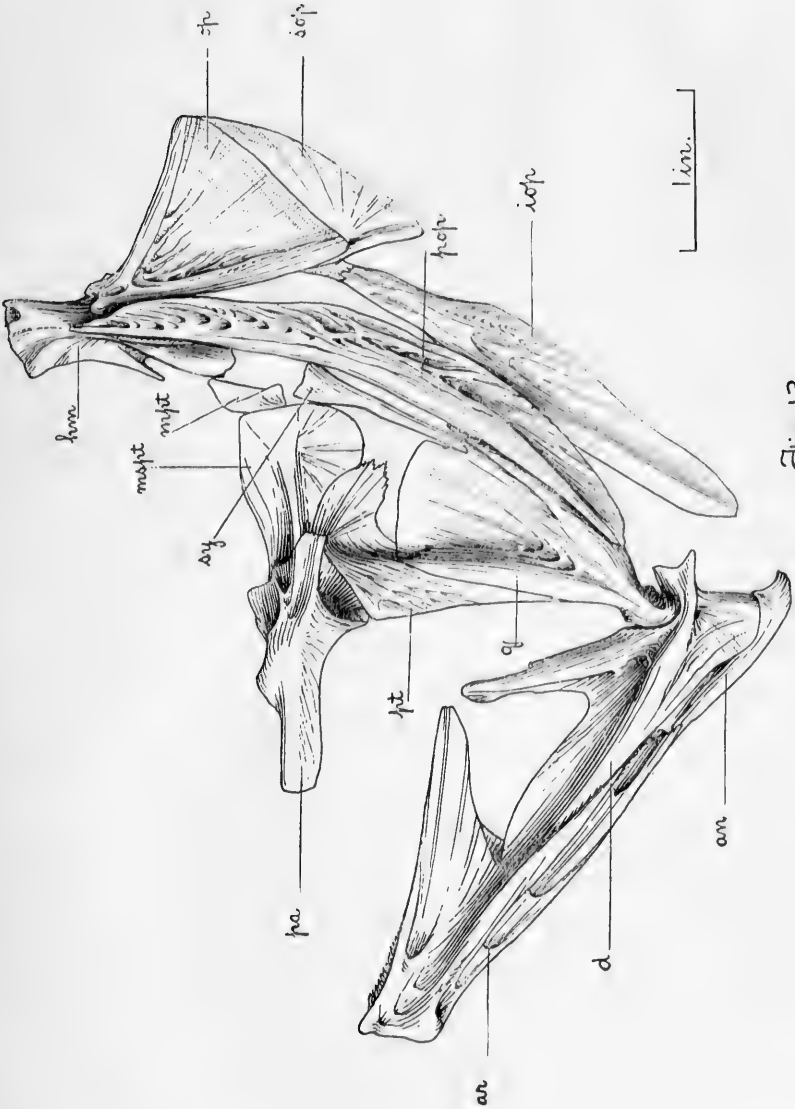
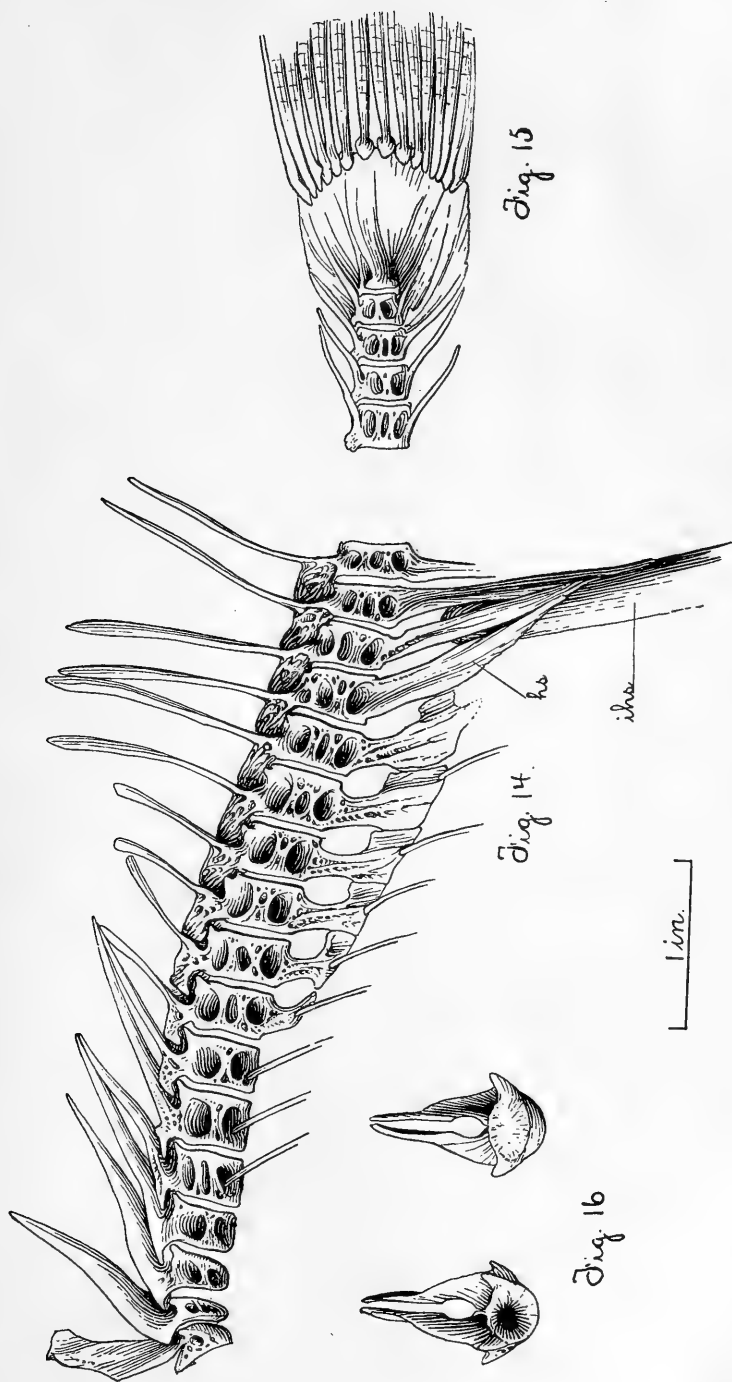


Fig. 13

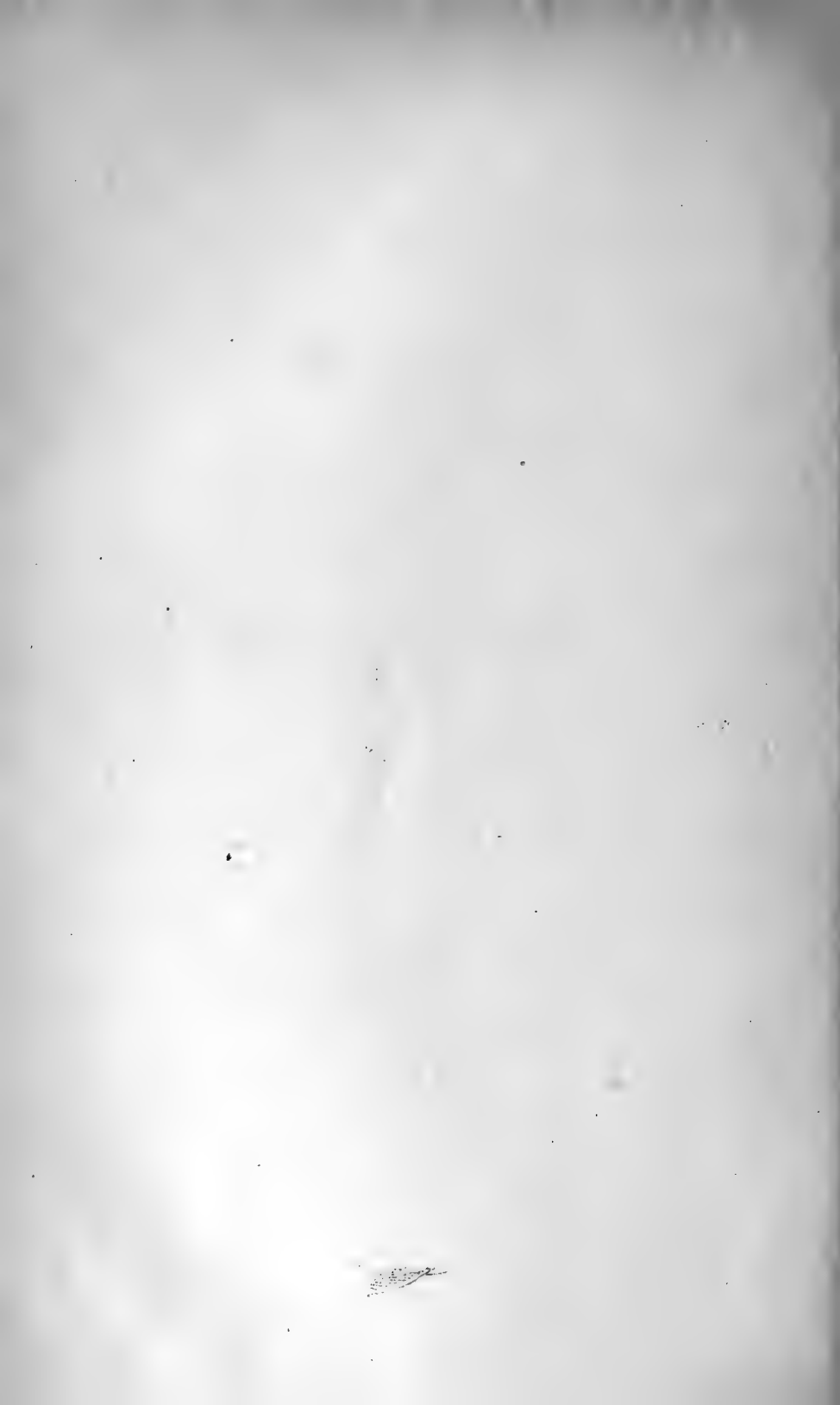
SUSPENSORIUM, LOWER JAW, AND OPERCLES.

FOR EXPLANATION OF PLATE SEE PAGE 476.



VERTEBRÆ, HYPURAL, AND ATLAS.

FOR EXPLANATION OF PLATE SEE PAGE 476.



A CONTRIBUTION TO THE KNOWLEDGE OF THE VARIATIONS OF THE TREE FROG *HYLA REGILLA*.

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Sometime Aid, Department of Reptiles.

It would be difficult to cite a department of natural history, animal or vegetable, that has not suffered more or less confusion from the extensive synonymy possessed by some of its west American representatives. This has come about by the too ready and free description as new of specimens brought in by the various Government exploring expeditions, and also by private individuals, often meager material collected at points whose precise location and geographical relation to each other were many times but vaguely understood. With, then, no intermediate forms at hand, and frequently with incomplete or no comparison with types already described from the same region, it is easy to see how the multitude of names has sprung up. In the case of alcoholic specimens, especially with batrachians, there was an additional source of danger from imperfect preservation, for if the alcohol were too strong the specimens would be hardened and contracted out of their normal proportions, while if it were too weak they would be macerated and relaxed, in either case rendering liable misidentification and consequent duplication of species.

The Pacific tree frog has not been neglected in the race for this sort of distinction, and indeed is well-nigh a leader, no fewer than seven names having been applied by different persons at various times to hylas from beyond the Rockies. It is with the idea of making an effort to clear up this ambiguity, which even the latest writers on the subject have left almost as cloudy as before, that this paper has been prepared, and it is purposed to show that all the tree frogs of the Pacific region, variant as they may seem at first glance, are really referable to but a single species. The collection at hand in the U. S. National Museum is the most extensive in existence, not only in the number of specimens, but also in the number and distribution of localities represented, comprising 512 specimens from 75 localities, and so a reasonable amount of confidence is placed in the conclusions reached from examining this mass of material.

The first mention of a Pacific hyla appears to be that by Baird and Girard, in October, 1852,¹ who, under "Descriptions of new species of reptiles, collected by the U. S. Exploring Expedition under the command of Capt. Charles Wilkes, U. S. N.," describe *Hyla regilla* as follows:

Hyla regilla: This is a species of medium size, the largest individual observed measuring one and a half inch from the nose to the posterior extremity of the body, the head itself occupying about half of this length. The hind legs are long and slender, the web extending only to half the length of the longest toe; fingers comparatively long. The general color is green above, turning to orange yellow along the sides of the head, abdomen, and legs. Two oblong, brownish black spots exist on the occiput, from which two vittæ (one pair) of the same black color extend along the dorsal region; a similar band passes from the tip of the nose, across the eye and tympanum, and along the abdomen, when it is interrupted, and forms a series of black and irregular small spots. In the immature state, green is the prevailing color, a few black spots being present along the whitish abdomen. Specimens of this species were collected on Sacramento River, in Oregon and on Puget Sound.

Two of these specimens still exist in a moderate state of preservation in the U. S. National Museum collection as Nos. 9182, from Puget Sound, Washington, and 15405, from Sacramento River, California.

Described in the same month as *Hyla regilla*, but a little later,² is *Hyla scapularis*, by Hallowell, from Oregon. After an anatomical description, in which attention is called to the granulations on the body, a point omitted by Baird and Girard, although their specimens possess rough skins, there is the following in regard to the skin:

Ground color above greenish olive, presenting numerous irregular bluish blotches upon the surface; several deeper colored blotches upon the sides; a bluish vitta, about two-thirds of a line in breadth, extends from the posterior part of the eye along the sides of the neck over the shoulder, a short distance beyond which it terminates; upper surface of extremities marked with bluish spots.

This specimen was not examined and may not now be in existence.

The next mention is by Baird and Girard in February, 1853,³ where, in a list of reptiles collected in California by Dr. John L. Le Conte, *Hyla regilla* is included, and *Hyla scapularis* given as a synonym.

Following this, in July, 1854,⁴ Hallowell describes *Hyla nebulosa* from two specimens collected at Tejon Pass, California, by Dr. A. L. Heermann. The granulations and other anatomical peculiarities are mentioned, and the color is described:

Uniform light gray upon the upper part of the body and sides; snout light ash; a considerable number of dark colored subcircular spots, about a line in diameter, scattered over the upper part of the body and upon the sides, in some specimens mingled with irregular blotches upon the back; extremities, ash color above, with grayish spots; abdomen greenish yellow; chin light yellow; under surface of extremities orange colored.

One of these specimens still exists in a very poor condition in the National Museum collection as No. 3230, which will be spoken of again.

¹ Proc. Phila. Acad. Nat. Sci., VI, p. 174.

² Idem, VI, p. 183.

³ Idem, VI, p. 301.

⁴ Idem, VII, p. 96.

Immediately following this description¹ is one of *Hyla scapularis* var. *hypochondriaca*. This is said to be—

Of a uniform pale olive color above, without spots, paler toward the sides; numerous small, elevated, smooth points upon the surface, resembling tubercles; upper surface of extremities pale olive; a narrow, dark colored vitta extending from the anterior margin of the eye to the snout, another much broader from the posterior margin of the eye to the shoulder; margin of upper jaw of same color as the vitta; posterior part of abdomen and under surface of extremities orange colored; chin and throat white; abdomen thickly granulated. It will be observed that it wants the squalus tooth-like mark upon the head and the markings upon the back which belong to *scapularis*.

These specimens also are in the Museum collection as No. 3235, Tejon Pass, California, Dr. A. L. Heermann, and a careful examination of them shows that two of the nine specimens do possess the squalus spot on the head, denied them in the original description, but it is very dim and indistinct, and there are also faint indications of dorsal stripes.

In 1866, owing to the preoccupation of the name *nebulosa* by a species of hyla described by Spix, Cope renamed Hallowell's specimens *Hyla cadaverina*.² As said above, one of the specimens is in the U. S. National Museum collection.

The same year³ Cope described *Hyla curta*, collected at Cape St. Lucas, Lower California, by John Xantus. This is a stout form, with—

size small, breadth of jaws entering total length two and two-thirds times. Males without gular vocal vesicle. Femur posteriorly unicolor, basal fold weak, a dark labial border and band from nostril to axilla, above ashy brown, with a dark interocular triangle and a broad dorso-lateral band on each side, often broken into elongate spots. Limbs punctulate and cross barred. * * * The groin is sometimes mottled with black, and the sides often with brown or marbled, which may extend over the iliac region. Sometimes all the dark markings are marbled with paler. There is a band on the front of the humerus, and the hind limbs are frequently double banded.

These are in the Museum collection as No. 5293, nineteen specimens, and an examination leads to the belief that a small vocal sac does exist, as the throats of two or three of the males are slightly wrinkled, and that the apparent absence is partly due to the specimens being young, few of them being over an inch in length, and partly to their having been collected out of the breeding season.

In his "Batrachia of North America"⁴ Cope gathered all the Pacific Hylas together as *Hyla regilla*, with the three varieties, *regilla* proper, *scapularis*, and *laticeps*. *Laticeps* he describes from eleven specimens from Cape St. Lucas (No. 5308, U.S.N.M.), collected by Xantus, but the description is very incomplete and confused from being mixed up with one of *curta*, which he seems uncertain whether to merge with the variety *regilla* or still keep separate. The three specimens of *scapularis*,

¹ Page 97.

² Journ. Phila. Acad. Nat. Sci., 2d ser., VI, p. 84.

³ Proc. Phila. Acad. Nat. Sci., XVIII, p. 313.

⁴ Bulletin No. 34, U. S. Nat. Mus., 1889, pp. 355-361.

said to be from San Francisco, I have been unable to trace. He distinguishes the three varieties by their proportions, *scapularis* being said to possess a long head and a long body, *regilla* a short head and a long body, and *laticeps* a short head and a short body, or, according to his key:

Head elongate; width enters length of body considerably over three times	<i>scapularis</i> .
Head short; width one-third of length	<i>regilla</i> .
Head short and broad; breadth contained in total length two and two-thirds times	<i>laticeps</i> .

It was inability to distinguish specimens by the employment of these characters so stated that led to the investigations to be detailed later.

The synonymy then stands:

Hyla regilla BAIRD and GIRARD, Proc. Phila. Acad. Nat. Sci., 1852, VI, p. 174.

Hyla scapularis HALLOWELL, Proc. Phila. Acad. Nat. Sci., 1852, VI, p. 183.

Hyla nebulosa HALLOWELL, Proc. Phila. Acad. Nat. Sci., 1854, VII, p. 96.

Hyla scapularis var. *hypochondriaca* HALLOWELL, Proc. Phila. Acad. Nat. Sci., 1854, VII, p. 97.

Hyla cadaverina COPE, Journ. Phila. Acad. Nat. Sci., 1866, 2d ser., VI, p. 84.

Hyla curta COPE, Proc. Phila. Acad. Nat. Sci., 1866, XVIII, p. 313.

Hyla regilla var. *laticeps* COPE, Bulletin 34, U. S. Nat. Mus., 1889, p. 359.

According to Cope, *Hyla regilla* is most nearly related to *Hyla pickeringii*, *H. squirella*, and *H. eximia*. It has a decided resemblance in shape, and almost exact coincidence in habits, with *pickeringii*, its representative in the Northeast, but it is rather more robust than *squirella*, which takes its place in the South and Southeast.

Its distribution, as shown by the specimens in the U. S. National Museum collection, is mainly restricted to the Pacific watershed, from Vancouver Island and Chlewyuck Lake, Washington, to Cape St. Lucas, and from the coast to the east base of the Cascades and Sierra Nevada. Specimens from Walla Walla, Washington, and Chewaucan Valley, and Klamath Lake, Oregon, show that in this region its range is extended well into the desert area of the Great Basin, but in such case following streams which either rise in the Cascades or, like the Columbia, flow into the Pacific.

A most remarkable extension of its range occurs in the Death Valley region east of Mount Whitney, where *Hyla regilla* has been collected at isolated springs in desert ranges and valleys more than halfway across the Great Basin, reaching Vegas Valley, Nevada, the easternmost point recorded.¹ In this region it has been taken at Hot, Saratoga,

¹ Five specimens, No. 11534, long recorded as from "Eastern Colorado," are really from eastern California, the original label bearing "East Cala," instead of "East Colo.," as it was misread. One specimen, No. 11529, stated as being collected at Ringgold Barracks, Texas, is without definite locality, as that number is rightly occupied by a specimen of *Holbrookia maculata*. And No. 11481, one individual entered in the U. S. National Museum register as from Ogden, Utah, has probably been so done by mistake, as the species has not been found in the eastern part of the Great Basin elsewhere.

Resting, Pahrump, and Vegas springs, and in the Panamint and Charleston mountains. Of these, Hot Springs, the nearest point to the Sierra Nevada, is separated from that range by more than 40 miles, and like the other springs is situated in the midst of an extremely hot and arid desert. An almost equal distance intervenes between Johnson Canyon and Saratoga Springs, showing that in this semiisolated area the species seems to have spread from place to place by means not altogether satisfactorily explained at present. It may be that the distribution was brought about by the great inland lakes formerly existing in Panamint and Death valleys, and that the species, going up the streams flowing into them from various directions, or following the shrinking borders, has stranded where it is now found. At the present time the floods which occasionally swell the dry channels into temporary streams, thrusting out into the deserts to soon vanish, may assist in further increasing the range.

It has also been collected on Santa Cruz and Cerros islands, each nearly 20 miles distant from the mainland.

Moreover, it may be noticed that in altitude *Hyla regilla* ranges from sea level up to nearly 10,000 feet in the vicinity of Mount Whitney. Thus it occurs from the Lower Sonoran well up into the Boreal Zone, equal to the difference in the latitude between Florida and Labrador, and the extension of its range is thus second to that of no other hyla in North America. Within its range it is quite a common species, especially frequenting marshy land and the edges of springs, ponds, and other bodies of water.

Hyla regilla is a moderate-size species, the largest specimens in the collection measuring 47 mm., or not quite $1\frac{7}{8}$ inches in length. The head is small to medium, rather more pointed than rounded in front, and shorter than broad, with the width at the tympana about one-third of the total length. In profile it is inclined to be flat, with the snout rounding. Eyes projecting only moderately, and tympanum about half the size of the orbit. A small fold of skin, beginning at the posterior angle of the eye, runs over the tympanum to above the arm. Another well-marked fold crosses the breast, just at the posterior edge of the arms, into which it is continued a short distance. The skin everywhere, except on the sides of the head, is covered with minute elevations, which on the abdomen, lower surface of thighs, and less on the throat, are crowded together as granulations. On the upper surface numerous larger papules or tubercles are intermingled with the smaller, becoming fewer on the head. Gular sac quite prominent in most males. The limbs are moderate. The fingers are free, except that a very slight web connects their bases. The disks vary from small to moderate. The length of the tibia is about half the total length. The webbing of the toes varies considerably, as do the disks. There is a small outer metatarsal tubercle, and a larger, marked inner one. A thin ala extends along the inner side of the tarsus.

The color of the under surface is almost always white or yellowish white, but that of the upper is extremely variant. In general it may be described as a lighter ground color, upon which are superimposed various markings, blotches, stripes, and spots, of a light or a dark brown. The ground color ranges in alcohol from a light grayish green to a dark, ashy olive, but the greatest variation in the coloring is especially in regard to the amount and distribution of the dark blotches. Still, though at first glance there seems to be no regular scheme in which the markings are applied, by looking more closely the different individuals can without apparent exception be arranged according to a system of five more or less distinct styles of coloration, which seem to follow each other in direct sequence, from few markings up to many.

There are no specimens absolutely without dark markings of some kind. Even the very lightest individuals of style I, as perhaps best shown in No. 3236, U.S.N.M., a large female from Shoalwater Bay, Washington, possess a dark vitta along each side of the head, a marking which is constant in the species in all of the five styles, and which indeed seems to serve as a foundation for the superstructure of added blotches. It consists of a rather wide brown line beginning at the snout, where it joins its fellow of the opposite side, and passing through the nostril, gradually widening until it reaches the eye. From the posterior angle of the eyelids it is continued back as a band nearly as broad as the orbit, inclosing the tympanum and passing over the arm to a point above the armpit. Here the side marking may stop, but as a rule it is carried farther back as a row of quadrate blotches and spots often reaching into the groin, and sometimes the band itself runs back the length of the humerus behind the axilla. There is a brown edging to the upper lip, which may be a little irregular, but is always present. This is the usual extent of the marking in style I (fig. 2), but very rarely light indistinct blotches may appear on the femora and tibiae of the largest individuals. In all the styles the space between the head stripe and the lip edging is considerably lighter than the ground color, in some being almost white below the tympana.

As remarked above, this combination of markings is also found in the other styles, with additional blotchings. In style II (fig. 3) begins a system of dorsal blotches, that is carried through those following, and enlarged upon. The first to appear is a triangular, or rudely Y or T shaped, blotch between the eyes, connecting the lids and running to about their centers and back to the tympana. In style II the stem of the Y may be lacking, and the branches not completely joined at the median line, or the stem and branches may all be present, though barely connected at the center. This is never the only dorsal marking, but stripes are always found with it. In style II there are two dorsal longitudinal stripes, beginning above the arms and separated by about one-third of the body width, running nearly or quite to the pelvic elevation. Often there are two or three cross bars on the femora, tibiae,

and tarsi, but not always, and rarely one or two small spots on the rump, posterior to the longitudinal stripes, as shown in a small male of No. 11498, U.S.N.M., from Walla Walla, Washington.

Style III (fig. 4) has the longitudinal stripes only about two-thirds as long as in style II, there are additional dorsal blotches, the bars on the hind legs are always present and pronounced, and the arms and forearms possess light bars. The dorsal spots, as admirably shown in specimens of No. 14727, U.S.N.M., from Fort Klamath, Oregon, are irregularly arranged in three rows, two continuing out the line of the stripes, and the third beginning about the middle of the body and running back along the median line, the last one being frequently located just above the anus. Two small spots are situated above the tympana midway between them and the cephalic blotch, and even with the end of the Y stem. The cephalic blotch is less often Y or T shaped, and rather a concave-sided triangle. A few minute spots may be exterior to the larger blotches. One individual referred to style III, from No. 11943, U.S.N.M., "Oregon," has the cephalic triangle reduced to a cross band, and the dorsal blotches broken up into over 30 irregular small spots with the ground color showing through their centers, producing a most curious, mottled appearance.

Styles IV (fig. 5) and V are natural sequences of style III. In style IV the anterior dorsal stripes are longer than in style III, resembling the condition in style II, and the posterior blotches are confluent into one or two more short stripes. There are also more spots on the top and sides of the rump and the dorso-lateral spots are larger. In this and V as in III, the bars and bands on the limbs are well marked.

Style V (fig. 6) passes easily from IV, the stripes lengthening, and the larger blotches becoming stripes, so that there are three longitudinal dorsal series of more or less broken stripes, one medial and two lateral, with numerous blotches and spots, especially about the rump. The lateral stripes begin above the tympana.

Of these, style I is distinct and sharply outlined by the absence of any dorsal markings whatever, and II is usually unmistakable, but III, IV, and V have a tendency to run into each other, and frequently can be separated only in a general way.

The different styles have been described, beginning with the lightest, as though those with more markings were the result of evolution in the adding of color. Yet, as a matter of fact, it is probable that the darkest style of coloration is closer to the primitive appearance, for not only do the majority of the other North American hylas possess the triangular blotch on the head, or two spots corresponding to it, with often dorsal markings also, but this condition is found as well in *Chorophilus*, *Acris*, and *Rana*, showing the wide extent of more color. It is a curious fact that the larger individuals are the darker, as indicated by figures drawn from the comparison of many specimens. There are exceptions, but that the averages from the bulk of individuals

show more than a tendency in this direction is well established by characteristics shown in the following tables:

Characters of Hyla regilla from California west of the Sierra Nevada Range.

Style of color.....	I.	II.	III.	IV.	V.
Number of specimens examined...	8	23	36	18	10
Average length in millimeters....	28.18	29.25	30.08	30.30	32.55

The numerical differences between these averages are small, but unmistakable, and considering the number of specimens taken into account, namely, 95, from several localities, they can be depended upon. Thirty-seven specimens from the Panamint Mountains also show the same relation between increase in size (age) and color.

Characters of Hyla regilla from the Panamint Mountains.

Style of color	I.	II.	III.	IV.	V.
Number of specimens examined...	1	2	18	12	4
Average length in millimeters.....	32.50	34.25	36.05	37.04	38.125

This last shows the condition among individuals from an altitude of 6,000 to 7,000 feet, and the same holds true for 48 specimens from low desert valleys, Saratoga Springs and Panamint Valley, California, and Ash Meadows and Oasis and Vegas valleys, Nevada.

Characters of Hyla regilla from desert valleys.

Style of color	I.	II.	III.	IV.	V.
Number of specimens examined...	0	13	17	14	4
Average length in millimeters.....		24.46	25.70	28.28	32.125

The law is good for 51 individuals from Oregon and Washington, with the slight exception that the average length in style II is greater than that in style III, an irregularity of no moment, considering that only 7 specimens of each were measured and in view of the figures already given.

Characters of Hyla regilla from Oregon and Washington.

Style of color	I.	II.	III.	IV.	V.
Number of specimens examined...	23	7	7	5	9
Average length in millimeters.....	25.74	31.21	28.42	33.70	35.33

In the case of 31 specimens from Lower California, they are all of so nearly the same size as to show no decided tendency, one way or another,¹ as follows:

Characters of Hyla regilla from Lower California.

Style of color	I.	II.	III.	IV.	V.
Number of specimens examined...	3	2	11	11	4
Average length in millimeters.....	30.66	27.25	30.66	30.66	30.50

In regard to whether there is a difference in color between the sexes, the males appear to average a little heavier marking than do the females, as indicated by the following data:

Characters of males and females of Hyla regilla.

Style of color.....	I.	II.	III.	IV.	V.
Number of males	3	10	37	43	15
Number of females.....	22	19	24	12	8

Of the 108 males examined, 50 belong to the first three styles, and 58 to the latter two, thus throwing the average between styles III and IV, and nearer to IV. Forty-one of the 85 females come under the first two styles, so that they average between styles II and III, with a slight margin in favor of style III. These results are influenced, however, by the fact that the majority of the specimens from the south, which are darker, are also males, while of the lighter specimens of the north more females seem to have been collected. It is possible that if the sexes were equally represented from each locality the average coloration would be practically the same.

In this connection comes up the point of distribution of color north and south, hinted at above. The figures already given in showing the relation between size and color indicate that northerly the first styles of color are more numerous represented than in the south, and vice versa. A color observation of 323 individuals bears out this indication and proves it to be a law. The following tables show the distribution of color if the range of the species be divided into three sections—north, middle, and south.

¹The fact, which then seems to be firmly established, that the younger individuals are the lighter, and that they become gradually darker as they increase in size, really would seem to indicate that the ancestral color was light and with few markings, were it not for the overwhelming testimony offered by allied forms that the primitive appearance was darker, for it is hardly likely that they have all evolved in the same color direction. At present the solution of the seeming contradiction does not present itself.

Characters of Hyla regilla from Oregon and Washington.

Style and color	I.	II.	III.	IV.	V.
Number of specimens	23	7	7	5	9

The average of these 51 lies between styles I and II.

Characters of Hyla regilla from California north of Santa Barbara.

Style of color	I.	II.	III.	IV.	V.
Number of specimens	26	27	38	31	14

In this case the average is seen to fall in style III, a decided addition of markings over the specimens from farther north, and the adding of color goes on in the southern section, where the average is between styles III and IV, as seen:

Characters of Hyla regilla from California south of Santa Barbara, including Lower California.

Style of color	I.	II.	III.	IV.	V.
Number of specimens	12	9	50	55	10

Thus the adding of pigment is shown to increase gradually from the north to the south, and though these figures were taken from the markings, they will probably apply nearly as well to the ground color, which darkens with added blotches. In Washington, particularly, the ground color is very light, in striking contrast to specimens from Santa Ysabel, San Diego County, California, in which it is so dark an ashy green as to decidedly obscure the markings. It is difficult to account for this darkening in southern latitudes. As a rule dark tints are associated with moisture, but it does not seem to hold in this case, for the forests of Washington and Oregon certainly have a damper atmosphere than do the sandy plains and valleys of southern California and Nevada, and yet in the northern states nearly half of the individuals come under style I, while the desert specimens average in style III, or nearly IV, and the specimens of style I are very few. So, possibly, the deepening of the pigment may be attributable to the southern sun. Yet it will be seen that the several styles occur throughout the range, and all would probably be found represented in every locality, if 100 or more specimens were examined.

In spite of the great variance in color, then, the different styles are so closely connected, and to a great extent actually confluent, that the unity as a species in this respect is very evident. Since Cope, however, separates three varieties by means of the relative proportions, that is another point to be looked into. In order to ascertain their exact value

very careful measurements were made of 304 specimens throughout the entire range, the results of which are given below. The method pursued was as follows: With a pair of sharp-pointed dividers the length from the tip of the snout to the end of the pelvis, the breadth of the head at the posterior edges of the tympana, and the length of the tibiæ, were determined in millimeters and half millimeters. Where the two tibiæ were found to be of different lengths, and quite often the left one was a very little shorter, the average was taken as nearly as possible. Then the proportion of the head to the body was found, and of the tibiæ to the body. To establish a constant standard, the length of the body in all cases was fixed at 100, and the breadth of the head computed in percentage of this. In most cases this proportion varied from 32 to 36 per cent. In like fashion in the second proportion, the length of the body being still fixed at 100, the length of the tibiæ was calculated to suit it, the figures usually being found to range from 48 to 50 per cent. In order to insure as complete accuracy as possible, in the great majority of cases each measurement was taken twice, and the result obtained by the proportion was calculated to two decimal places, thus indicating the more delicately any variation, and proving of advantage when the averages were struck. The uniformity with which, approximately, the same figures reappeared was a matter of some little surprise at first, in the light of the proportions claimed by Cope in distinguishing his three varieties, but the persistence removed all doubts as to its correctness. As was to be expected, some few specimens gave extreme figures, which taken alone might indicate almost a subspecific difference, but the gaps are so completely filled in, usually by specimens from the same locality even, that the discrepancies are unmistakably due to individual variation and exaggeration, and have no real significance. Since the proportion of the head and body is the one used by Cope in separating his varieties, especial notice has been paid to that, but it is found to differ no more than does that of the body and tibia, which is very little.

The narrowest heads observed give the proportions of 30.96 per cent in the total length, or entering it not quite three and a quarter times. But this is found in only 3 specimens, 2 from Puget Sound and 1 from Fort Tejon, California, and as the specimens are quite small, only 21 mm. in length, and since the head appears to be normally slightly narrower in younger individuals, it is probable that this accounts for the proportion. At all events, it seems clear that it is a case of individual variation, and of no value as a varietal distinction.

The broadest head belongs to a specimen from the Panamint Mountains, Johnson Canyon, with the proportion of 39.48 per cent, but another specimen from that locality has a head 34.67 per cent, and the average of 34 specimens is 36.83 per cent. This seems an approach to the variety *laticeps*, but *laticeps* was described from Cape St. Lucas specimens, and besides really does not exist, to judge from the proportions of the type specimens. To them Cope ascribes a head breadth of

two and two-thirds times in the total length, or, then, a proportion of 37.50 per cent. Careful and repeated measurements of the types of *laticeps* show that the widest head from among 9 specimens is only 34.78 per cent, while there is 1 as narrow as 31.44 per cent, and the average is 33.08 per cent. The types of *curta*, from practically the same locality, have extremes of 35.19 and 32.11 per cent, and an average of 33.67 per cent.

The accompanying table will serve to show more plainly the proportions of specimens from some of the different localities:

Proportions of Hyla regilla.

Locality.	Number of specimens.	Average length.	Ratio of head to body.			Ratio of tibia to body.		
			Broad-est.	Narrow-est.	Average.	Long-est.	Short-est.	Average.
Vancouver Island, British Columbia.....	1	mm. 40.00			35.81			47.50
Fort Vancouver, Washington.....	6	24.60	34.21	31.88	33.11	50.00	47.82	49.53
Puget Sound, Washington.....	16	26.28	34.70	30.96	32.38	52.50	47.87	49.78
Shoalwater Bay, Washington.....	1	47.00			31.92			48.93
Walla Walla, Washington.....	3	30.50	33.93	32.79	33.34	49.80	46.42	47.74
Fort Umpqua, Oregon.....	3	35.00	34.18	31.17	32.23	49.35	48.10	48.53
Fort Klamath, Oregon.....	12	35.87	34.09	31.83	33.07	52.27	45.16	48.51
"Oregon".....	10	25.45	35.42	31.92	33.58	52.00	48.08	50.12
Sonoma County, California.....	20	31.50	34.48	31.49	33.17	52.50	46.46	48.60
Lake Tahoe, California.....	23	22.89	36.17	31.25	33.73	52.77	47.91	50.14
Monterey, California.....	10	33.05	36.76	33.33	34.66	52.33	48.57	50.39
Santa Barbara, California.....	20	30.04	36.06	32.56	34.15	52.27	47.76	49.74
Santa Cruz Island, California.....	20	35.45	38.24	33.68	36.46	51.51	47.43	49.89
Old Fort Tejon, California.....	17	33.60	36.42	31.82	33.79	52.50	48.57	50.58
Panamint Mountains, California.....	34	36.32	39.48	34.67	36.83	52.11	46.15	49.44
Hot Springs and Saratoga Springs, California.....	10	28.65	37.40	32.49	34.78	50.00	46.51	47.96
Ash Meadows, Nevada.....	14	27.00	35.18	31.74	32.90	49.12	45.83	47.83
Oasis Valley, Nevada.....	10	27.45	37.28	34.54	35.61	46.40	44.23	45.00
Pahrump Valley, Nevada.....	5	26.90	35.48	32.44	34.04	50.00	45.60	47.83
Between Pahrump and Vegas valleys, Nevada.....	2	38.00	36.50	35.90	36.20	47.30	46.15	46.72
Vegas Valley, Nevada.....	11	25.80	38.46	35.01	36.87	48.71	44.00	46.23
Ogden, Utah.....	1	40.00			32.56			51.25
San Diego, California.....	11	28.40	34.00	31.58	32.79	52.33	49.09	50.09
Santa Ysabel, California.....	14	30.64	32.27	32.14	33.52	50.91	47.00	48.66
Average from San Diego County, California.....	25	29.68			33.38			49.28
Cape St. Lucas, <i>curta</i>	15	26.30	35.19	32.00	33.67	50.94	48.00	49.87
Cape St. Lucas, <i>laticeps</i>	9	33.88	34.78	31.44	33.08	51.61	45.07	49.24
Average of last two.....	24	29.14			33.44			49.66

From the above it will be seen how close together the averages run, especially in regard to head proportions, though there is not much variation in those of the tibiae. Still, in the desert localities, the legs become a very little shorter and at the same time the head a trifle broader, the animal assuming rather more of a squat form, in accordance with its changed surroundings. As a rule, the gradations show beautifully—as, for instance, in passing from Pahrump to Vegas valleys. It appears that the northern specimens have rather narrower heads than those farther south, and particularly when compared with the desert forms, but the difference is so slight and so inconstant as to make it impracticable as a basis for nomenclatural distinction.

Of the North American hylas, *regilla* is one of the most limited in the extent of the digital disks and webbing of the feet. Although

there is considerable variation in this, as in all else, still the diminution is very marked as a rule, in some cases being not much more than is found in some species of *Chorophilus*. This has been naturally brought about to some degree by the scarcity of water in a part of the range and by the diminished vegetation which accompanies and is implied by the lessened moisture. Where trees and shrubs exist, as in the higher altitudes of middle and southern California and Nevada, as distinguished from the lower valleys and deserts, and in northern California, Oregon, and Washington, *regilla* tends to become more arboreal, but it is generally terrestrial in its habits, resembling, as said before, *Hyla pickeringii*, in being chiefly found about ponds, springs, and like moist localities. This may account for the size of the digital disks being reduced to a greater degree than is the webbing between the toes, for though the arboreal life might be only rarely possible, the opportunity for swimming would more frequently present itself.

As would be expected, then, the greatest reduction is usually found in the desert region, the webbing increasing toward the north and with rising altitudes. In spite of the indication, however, that with higher altitudes go more webs, Nos. 20190-203, from Santa Ysabel, at an altitude of some 1,500 feet, in the mountains of San Diego County, have the smallest webs and disks of all examined. The specimens were fresh, collected considerably less than a year before they were examined, and were in perfect preservation, so that the reduction is natural, and not due to shrinkage in the alcohol. The web (fig. 8), starting from the base of the first phalanx of the fifth toe, swings back, but is attached to the fourth toe at the joint between the second and third phalanges. Sweeping back from a corresponding point on the opposite side of the toe, it is brought forward again to the joint between the first and second phalanges of the third toe, and starting from a little back of the end of the second phalanx, it is attached midway the first phalanx of the second toe. From near the joint of the first phalanx it then goes to a like point on the first toe. This small amount of webbing is also found in specimens from Santa Barbara and Sonoma County, and the disks are correspondingly lessened.

But in specimens from Johnson and Surprise canyons, Panamint Mountains (altitude 6,000 feet), of even more arid character than Santa Ysabel, the webbing reaches its maximum (fig. 9), connecting the bases of the disks on all the toes, though the last phalanges of all except the fifth are merely widely fringed. In no other specimens do so much web and so large disks occur.

The usual webbing, however, of middle and southern California and Nevada, though like the specimens from Ysabel in other respects, differs in that the webbing runs up both sides of the fourth toe to the middle of the second phalanx. This degree is also found in Cape St. Lucas specimens, and, only slightly increased, in those from Lake Tahoe, though these show the change toward the northern type.

The invariable condition north of California, and which occurs also in

the Sierra Nevada and Panamint Mountains, is one of much more decided webbing and larger disks (fig. 10). The web seems to arise from the middle of the first phalanx of the fifth toe, though really fringing it to the disk, and after the sweep back runs to the joint between the first and second phalanges of the fourth toe, though keeping rather close to the second phalanx. From here, again, it fringes the first phalanx of the third toe to the disk, and in like manner the others. The existent type specimens of *regilla* belong in this category.

From the various data given there seems to be but one conclusion to draw—which is, that the various species of Pacific hylas described within the last forty-five years appear to have been established on insufficient characters, and intergrade to such a degree as not to be specifically or even subspecifically separable. Although northern specimens may seem to be lighter and to have narrower heads, and desert specimens to be darker and shorter limbed, and in spite of all the numerous differences in color, in proportion, and in webbing, still all intergrade and are finally referable to one species, *Hyla regilla* of Baird and Girard.

In conclusion, I wish to express my deep obligation to Dr. Leonhard Stejneger, curator of the reptile department of the U. S. National Museum, for the opportunities he has afforded me for studying these forms, and various kindnesses and aid in the preparation of this paper.

I append a list of the specimens of *Hyla regilla* in the U. S. National Museum.

List of specimens of Hyla regilla in U. S. National Museum.

Mus. No.	Number of specimens.	Locality.	Collector.
3227	32	Sonoma County, California.....	E. Samuels.
3229	2	Yuba, California.....	Dr. J. S. Newberry.
3230	1	Tejon Pass, California.....	Dr. A. L. Heerman. Type <i>nebulosa</i> .
3232	3	Fort Vancouver, Washington.....	Dr. J. G. Cooper. Type <i>cadaverina</i> .
3235	9	Tejon Pass, California.....	Dr. A. L. Heerman. Type <i>hypochondriaca</i> .
3236	1	Shoalwater Bay, Washington.....	Dr. J. G. Cooper.
3238	4	Fort Reading, California.....	Dr. Hammond.
3245	3	Monterey, California.....	Dr. G. Suckley.
3246	3	Fort Vancouver, Washington.....	Dr. J. G. Cooper.
3252	5	Puget Sound, Washington.....	Dr. G. Suckley.
3253	1	Asforia, Oregon.....	Lieut. W. P. Trowbridge.
4652	3	Fort Umpqua, Oregon.....	Dr. E. Vollum.
4895	9	Fort Tejon, California.....	J. Xantus.
5293	19	Cape St. Lucas, California.....	J. Xantus. Type <i>curta</i> .
5308	11	Cape St. Lucas, California.....	J. Xantus. Type <i>laticeps</i> .
5632	3	Fort Crook, California.....	John Fielner.
5977	7	Puget Sound, Washington.....	Dr. C. B. Kennerly.
6029	4	Santa Barbara, California.....	Dr. Webb.
8572	1	Cerroso Island, Lower California.....	Dr. J. H. Streets.
8682	22	Lake Tahoe, California.....	H. W. Henshaw.
8688	37	Santa Barbara, California.....	H. W. Henshaw.
8697	1	Fort Tejon, California.....	H. W. Henshaw.
8701	7	Santa Barbara, California.....	H. W. Henshaw.
8702	1	Mount Whitney, California.....	H. W. Henshaw.
8703	4	Fort Tejon, California.....	H. W. Henshaw.
8704	1	Los Angeles, California.....	William Somers.
9181	4	Puget Sound, Washington.....	
9182	1	Puget Sound, Washington.....	C. P. Expl. Exped. Type <i>regilla</i> .
9424	1	Chilowynuck Lake, Washington.....	Dr. C. B. Kennerly.
9486	1	Monterey, California.....	W. H. Dall.
9491	1	Cottonwood Canyon, California.....	
9496	1	Monterey, California.....	W. H. Dall.

List of specimens of Hyla regilla in U. S. National Museum—Continued.

Mus. No.	Number of specimens.	Locality.	Collector.
9499	5	Lake Tahoe, California.....	H. W. Henshaw.
9500	2	Southern California.....	H. W. Henshaw.
11123	12	(?)	(?)
11481	1	Ogden, Utah.....	Expl. W. 100th Meridian.
11498	3	Walla Walla, Washington.....	Capt. Charles Bendire.
11522	4	Chewaukan Valley, Oregon.....	H. W. Henshaw.
11529	1	(?)	(?)
11534	5	East California.....	H. W. Henshaw.
11574	11	San Diego, California.....	Dr. John Le Conte.
11920	1	Monterey, California.....	Dr. D. S. Jordan.
11940	3	Fort Bidwell, California.....	H. W. Henshaw.
11943	10	"Oregon".....	H. W. Henshaw.
11947	2	Plumas County, California.....	G. Thompson.
11969	1	Cerro Island, Lower California.....	L. Belding.
12659	2	La Paz, Lower California.....	L. Belding.
13457-9	3	La Paz, Lower California.....	L. Belding.
13609	1	Lower California.....	C. R. Orcutt.
13610	2	San Diego, California.....	C. R. Orcutt.
13768	3	Des Chutes River, Oregon.....	Capt. Charles Bendire.
13796	1	Baird, California.....	C. H. Townsend.
13894	1	San Diego, California.....	C. R. Orcutt.
13953-4	3	Berkeley, California.....	R. E. C. Stearns.
13961	1	Sierra Nevada Mountains, California.....	R. E. C. Stearns.
14077	1	Baird, California.....	L. W. Green.
14727	9	Fort Klamath, Oregon.....	Dr. J. C. Merrill.
15409	1	Sacramento River, California.....	Expl. Exped. Type <i>regilla</i> .
15440	1	Fort Klamath, Oregon.....	Dr. J. C. Merrill.
15918-37	20	Santa Cruz Island, California.....	C. H. Townsend.
16287-8	2	San Diego, California.....	C. R. Orcutt.
16289	1	(?)	(?)
16524-6	3	San Diego County, California.....	C. R. Orcutt.
17408	1	Los Angeles, California.....	M. M. Green.
18790-823	34	Johnson Canyon, Panamint Mountains.....	Death Valley Expedition.
18824-7	4	Surprise Canyon, Panamint Mountains.....	Death Valley Expedition.
18828-9	2	Panamint, Panamint Mountains.....	Death Valley Expedition.
18830	1	Whitney Creek, California.....	Death Valley Expedition.
18831-6	6	Whitney Meadows, California.....	Death Valley Expedition.
18837	1	Mount Whitney, California.....	Death Valley Expedition.
18838-9	2	Panamint Mountains, California.....	Death Valley Expedition.
18840-5	6	Panamint Valley, California.....	Death Valley Expedition.
18846-52	7	Resting Spring, California.....	Death Valley Expedition.
18853-5	3	Saratoga Springs, California.....	Death Valley Expedition.
18856	1	Hot Springs, California.....	Death Valley Expedition.
18857-8	2	Kern River, California.....	Death Valley Expedition.
18859	1	Walkers Basin, California.....	Death Valley Expedition.
18860	1	Antelope Valley, California.....	Death Valley Expedition.
18861-4	4	Old Fort Tejon, California.....	Death Valley Expedition.
18865	1	South Fork Merced River, California.....	Death Valley Expedition.
18866	1	Horse Corral Meadows, California.....	Death Valley Expedition.
18867	1	Kings River, California.....	Death Valley Expedition.
18868-70	3	Cottonwood Meadow, California.....	Death Valley Expedition.
18871-4	4	Monterey, California.....	Death Valley Expedition.
18875-9	5	Charleston Mountains, Nevada.....	Death Valley Expedition.
18880-4	5	Pahrump Valley, Nevada.....	Death Valley Expedition.
18885-6	2	Between Pahrump and Vegas valleys, Nevada.....	Death Valley Expedition.
18887-8	2	Corn Creek, Lincoln County, Nevada.....	Death Valley Expedition.
18889-90	11	Vegas Valley, Nevada.....	Death Valley Expedition.
18900-1	2	Vegas Valley Cottonwood Spring, Nevada.....	Death Valley Expedition.
18902-12	11	Oasis Valley, Nevada.....	Death Valley Expedition.
18913-26	14	Ash Meadows, Nevada.....	Death Valley Expedition.
19277	1	San Quentin, Lower California.....	G. P. Merrill.
20190-203	14	Santa Ysabel, California.....	H. W. Henshaw.
20380	1	Witch Creek, California.....	H. W. Henshaw.
21499	1	Valley de los Palmas, Lower California.....	A. W. Anthony.
22060-80	15	Tecate River, Lower California.....	Dr. E. A. Mearns.
22412	1	Vancouver Island, British Columbia.....	John Macoun.
23676-94	19	San Pedro Mountains, Lower California.....	C. H. Townsend.
23695	1	Fort Townsend, Washington.....	C. H. Townsend.

EXPLANATION OF PLATE XXXIX.

- Fig. 1. Profile of head, diagrammatic.
2. Coloration, style I.
3. Coloration, style II.
4. Coloration, style III.
5. Coloration, style IV.
6. Coloration, style V.
7. Under surface of right hand, somewhat enlarged.
8, 9, and 10. Under surface of right foot, somewhat enlarged.
8. No. 20191, U.S.N.M., Santa Ysabel, California.
9. No. 18809, U.S.N.M., Panamint Mountains, California.
10. No. 14727, U.S.N.M., Fort Klamath, Oregon.



1.



2.



3.



4.



5.



6.



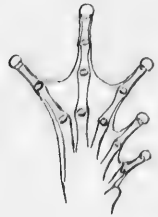
7.



8.



9.



10.

THE TREE FROG *HYLA REGILLA*.

FOR EXPLANATION OF PLATE SEE PAGE 492.



JAPANESE HYMENOPTERA OF THE FAMILY TENTHREDINIDÆ.

By C. L. MARLATT, M. S.,

First Assistant Entomologist, Department of Agriculture.

The following list of sawflies, with descriptions of new species, is based on material presented by Dr. K. Mitsukuri, of the Imperial University, Tokyo, Japan. Most of the specimens are supposed to have been taken either at Tokyo or Nagasaki. The collection is a very interesting one and contains many species which are striking from their divergence from the types of the same genera in America and Europe. This is notably the case with the genus *Cimbex*. Several species of this genus present a remarkable resemblance to our *Vespas*, and this resemblance is without question a protective one. Unfortunately there is some doubt as to the localities from which the specimens were obtained, yet nearly all of the specimens are labeled in Japanese characters, either in ancient or modern script, giving notes of locality, which are, for the most part, evidently very restricted. With the assistance of Dr. Philip Jaisohn, and with the aid of a Japanese dictionary, I have translated the labels on the backs of the cards on which the specimens are mounted and have given them in brackets at the close of the descriptions in connection with the numbers which the specimens bear. These labels are of mountains, small towns or places, particular woods, etc.; evidently localities well known to the collector, but not given on the ordinary maps of Japan. Other labels relate to the habits of the insects themselves, as, for instance, the *Lophyrus* is labeled as occurring on pine, and one of the species of *Cimbex* is called the "silkworm" in description of its cocoon, and another, the "bee," indicating its resemblance to some wild bee. All of the specimens are mounted on large flat cards, with the wings and legs beautifully spread, affording a very ready means of studying all the structural features except those of the central area of the lower surface. Most of the species in this collection prove to be new. This would seem to indicate that the insect fauna of Japan, at least in this family, is but scantily worked up. In all twenty-six new species are described.

1. *PHYLLOTOMA INFUMATA*, new species.

Female.—Length, 7 mm.; expanse, 16 mm.; robust, shining; front of head and base of antennæ clothed with rather long, whitish hairs; antennæ short, not longer than head and thorax, clavate, second joint about half as long as first, third nearly twice as long as fourth; sheath rather narrow, obliquely truncate at apex; claws simple, without inner tooth; outer veins of middle cells of hind wings nearly interstitial. Color black and orange yellow; all of head and meso- and metanotum, tibiae and tarsi, and the tip of ovipositor, sharply defined, brownish black; pronotum, tegulae, and the body, except as noted, and the femora, orange yellow; margin of basal plates yellow; wings strongly infuscated, veins dark brown.

Male.—Length, 5 mm.; expanse, 12 mm.; less robust than female, but agreeing in structural and colorational characters, except that the anterior tibiae are yellow, infuscate above and at tip, and there is a tendency to the same in the other tibiae and an accompanying yellowing of the basal half of the tarsal joints, particularly in the case of the fore and middle feet.

Type.—No. 3817, U.S.N.M.

Described from one female and twelve males. (Gifu Mountains), (No. 1).

2. *PHYLLOTOMA? FLAVESCENS*, new species.

Female.—Length, 9 to 10 mm.; expanse, 22 to 24 mm.; rather robust, shining; head and thorax not pubescent; antennæ as long as head and thorax, uniform in width, scarcely tapering, flagellum slightly narrowing on basal joints, third joint not much longer than fourth; claws minutely and evenly cleft at extreme apex, inner ray nearly as long as outer; sheath rather narrow, regularly rounded at apex; one discal cell in hind wings. Color of body and wings resinous yellow; compound eyes, black; antennal joints 3 to 5, dark brown, joint 5 paling somewhat apically; veins of wings for the most part yellowish; subcostal vein infuscated basally and apically; veins below stigma for the most part brownish, stigma entirely light yellow.

Type.—No. 3818, U.S.N.M.

Described from two females. (Gifu Mountains), (No. 3).

3. *PTERONUS JAPONICUS*, new species.

Male.—Length, 8 to 9 mm.; expanse, 16 to 18 mm.; robust, abdomen broad, depressed, surface smooth, shining, without pubescence; clypeus distinctly circularly emarginate; ridges about anterior ocellus strongly raised, with lateral branches extending to compound eyes; fovea breaking through frontal crest; antennæ slender, tapering, very elongate, at least two-thirds as long as body, joints 3 to 5 subequal, fourth slightly longest; procidentia scarcely prominent or projecting, slightly keeled; claws deeply and finely notched, inner ray nearly as large as outer; vena-

tion normal, third cubital nearly twice as long as wide; sides parallel; stigma regularly rounded, somewhat elongate but not acuminate. Color black; legs yellowish ferruginous; venter inclined to same color, distinctly so in one specimen; extreme tip of posterior tibiæ and the tips of joints of posterior tarsi brown; antennæ fulvous beneath; wings with basal two-thirds strongly infuscated, apical third hyaline; veins and stigma dark brown, the latter reddish on apical half.

Type.—No. 3819, U.S.N.M.

Described from two specimens (Ibuki), (No. 4).

4. BLENNOCAMPA RELIGIOSA, new species.

Female.—Length, 9 mm.; expanse, 20 mm.; very robust; abdomen much broader than thorax; surface smooth, shining, without pubescence; dorsum of thorax and abdomen glistening; vertex and head with coarse and not very close punctures; clypeus nearly truncate; ocellar basin breaking broadly into very broad antennal fovea; antennæ short, joint 3 considerably longer than 4; claws bifid, inner ray large, nearly equaling outer; sheath very narrow, somewhat elongate, tip somewhat pointed. Color, orange yellow and black; compound eyes, spot about ocelli, antennæ, except basal joint, meso- and metanotum and sheath, black; extreme apex of tibiæ and the tarsi, except base of first joint, brownish; wings strongly infuscated on basal three-fifths, balance nearly hyaline; veins and stigma, black; pectus, infuscated.

Type.—No. 3820, U.S.N.M.

Described from three specimens. (Gifu cemetery and Ari-tera—name of temple), (No. 7).

5. MACROPHYA IGNAVA Smith.

Macrophya ignava SMITH, Trans. Ent. Soc. Lond., 1874, p. 379, female.

Macrophya ignava KIRBY, List Hym. Brit. Mus., 1882, I, p. 266, female.

Five females and one male. (Gifu zuzushi), (No. 17).

6. MACROPHYA JAPONICA, new species.

Female.—Length, 10 mm.; expanse, 20 mm.; rather elongate, shining; without noticeable pubescence; clypeus very long, deeply and angularly notched, lobes rounded, clothed with sparse whitish hairs; antennæ clavate, joint 3 twice as long as 5, 4 but little longer than 5; sheath narrow, slightly tapering; claws bifid. Color, black shining; labrum, and large oval spot on posterior coxæ, white; anterior tibiæ and tarsi more or less pallid; line on second tarsal joint and the two following joints of posterior feet, together with base of last joint, whitish; wings nearly hyaline, veins and stigma dark brown.

Type.—No. 3821, U.S.N.M.

Described from one female. (Gifu), (No. 17a).

7. *MACROPHYA NIGRA*, new species.

Female.—Length, 9 mm.; expanse, 20 mm.; robust, not very elongate; head and thorax coarsely and densely punctured, opaque; clypeus large, not very deeply emarginate, lobes somewhat pointed; antennæ nearly filiform, slightly tapering toward tip; joint 3 nearly twice as long as 4, 4 and 5 subequal; sheath narrow, not elongate; claws bifid. Color, dull black; spot on base of mandibles and large oval spot on posterior coxæ, white; anterior tibiæ pallid on front face; red annulus covering basal half of posterior femora not quite reaching base; wings hyaline, veins and stigma dark brown.

Type.—No. 3822, U.S.N.M.

Described from one specimen. (Gifu), (No. 17b).

8. *MACROPHYA FEMORATA*, new species.

Male.—Length, 8 mm.; expanse, 17 mm.; rather slender; head and thorax coarsely punctured, opaque; antennæ rather stout, not longer than head and thorax, filiform; clypeus scarcely emarginate, almost truncate, anterior angles rather squarely produced; joint 3 much longer than 4, 4 and 5 subequal; claws minutely notched at extreme tip, rays scarcely divaricating, equal. Color, black; base of mandibles and apex of clypeus, white; lower face of anterior and middle legs, whitish; red annulus, more or less obscured with black, covering middle third of posterior femora; wings, hyaline; veins, brown.

Type.—No. 3823, U.S.N.M.

Described from two specimens. (Gifu), (17c).

9. *CIMBEX NOMURÆ*, new species.

Female.—Length, 22 mm.; expanse, 50 mm.; robust; head and thorax, and to a less extent, the abdomen, clothed with dense yellowish pubescence; clypeus twice as long as broad at middle, somewhat triangular, truncate and slightly emarginate at tip; labrum very minute; antennæ with six distinct joints, the last one of which forms the beginning of the club, which has three more or less distinct annulations, the basal one of which is more distinct than the others; claws with very minute inner tooth extending almost parallel to inner edge of claw; hind femora simple; sheath inflated broad, regularly rounded at tip; second recurrent interstitial with second cubital vein. Color, yellowish ferruginous and brown; head, except spot about ocelli and suture surrounding clypeus, pronotum, pleura, scutellum, basal plates, and abdomen for most part yellowish ferruginous; legs, except femora, of the general body color, but, together with the abdomen, somewhat darker than the light areas of the head and thorax; pectus and lower faces of coxæ and femora, spot about ocelli and band about clypeus, apex of third joint of antenna and the subsequent joints, mesonotum, metanotum, except as indicated, and spot or band on base of the four basal segments of abdomen, dark brown, almost black; wings strongly

infuscated with brown on upper half of anterior pair; lower half of anterior wings and the hind wings light yellowish brown.

Male.—Length, 25 mm.; expanse, 45 mm.; much more slender and elongate than the female, and with the antennæ slenderer and more elongate but agreeing with the latter in general structure and colorational characters. The femora are distinctly yellowish ferruginous on the upper or wing-side, and the black bands on the basal portions of the abdominal segments are more distinctly defined.

Type.—No. 3824, U.S.N.M.

Described from two females and five males. (Gifu and Nomura.) The name on the label, probably referring to the larva of this insect, designates it as a silkworm. (No. 22.)

10. *CIMBEX TAUKUSHI*, new species.

Female.—Length, 28 mm.; expanse, 56 mm.; very robust, abdomen very much broader than thorax; resembling the previous species somewhat in general appearance—not much larger, but stouter; pubescence on head, thorax, and abdomen dark brown or black, not dense; surface shining; clypeus broadly and distinctly emarginate; antennæ short, five distinct joints before club; club with one distinct annulation near base, and two others very indistinct, indicating four joints; claw with very minute inner tooth, lying close to inner edge and distinguished with difficulty. Color, reddish yellow, coppery and bluish brown; head for the most part, margin of pronotum, sutures of mesonotum lightly, scutellum, and abdomen, except basal segment and bases of following segments, decreasing with each, reddish yellow; the abdomen being much lighter colored, however, than the head and thoracic areas; spot about ocelli, more or less of clypeus meso- and metathorax, basal segment of abdomen above, sutures of the three following segments and most of lower surface of abdomen, together with the pleura, pectus, legs except tibiæ and tarsi, dark brown with distinct purplish metallic reflections; antennæ, tibiæ, and tarsi yellowish; wings mottled with light yellowish brown, posteriors paler; veins reddish brown.

Male.—Length, 33 mm.; expanse, 65 mm.; agrees structurally with the female; in colorational characters it is somewhat darker, the head and pronotum being almost altogether purplish brown. On the lower side of the body the purplish tint is very pronounced and striking; the abdomen beneath in the male being, however, almost altogether light colored except extreme margin of segments.

Type.—No. 3825, U.S.N.M.

Described from two females and one male. (Taukushi), (No. 23).

11. *CIMBEX YOROFUI*, new species.

Female.—Length, 18 mm.; expanse, 36 mm.; in form slender and wasp-like, closely resembling in general appearance one of the smaller *Vespa*s; abdomen narrow, not broader than thorax, head narrower

than thorax; clypeus triangular, as broad as long, tip slightly emarginate near center; labrum broad, spatulate, and in this as in other species often folded beneath mandibles, so as to appear wanting (antennae wanting); claws without an inner tooth, simple. Colors, light lemon-yellow and brown, the latter with bronzy reflections; face below antennae and lower cheeks including clypeus, labrum, and mandibles, pronotum, tegulae, scutellum, band on mesoscutum, basal plate except base, abdomen except central dorsal area, and legs for the most part, yellow; head except as noted, meso- and metanotum for the most part, center of dorsum of abdomen covering nearly all of basal sclerites, pleurae, and pectus, brown with purplish reflections; upper and lower surfaces, particularly basally of coxae, posterior femora except extremities, and more or less of upper edge of anterior parts, brown; wings, hyaline, except narrow fulvous stripe on upper half running from base to apex of the anterior pair.

Type.—No. 3826, U.S.N.M.

Described from a single specimen. (Yorofu), (No. 24).

12. CIMBEX MACULATA, new species.

Female.—Length, 18 mm.; expanse, 36 mm.; rather slender; abdomen not wider than thorax, head not much more than half as wide as thorax; densely clothed with long yellowish pubescence which almost entirely obscures the sutures of the head and thorax and forms a rather striking collar about the neck; clypeus broad, truncate, and slightly emarginate at apex; antennae short, clavate, with five distinct joints before the club; club with one distinct annulation near base and two other indistinct annulations; claws distinctly bifid, inner ray very closely applied to and nearly as long as outer ray. Color of head, meso- and metanotum, pectus and legs, greenish blue with strong metallic reflections; antennae dark brown, almost black; pronotum, pleurae, and abdomen for the most part, lemon yellow; the abdomen inclined to reddish and with a velvety appearance from the fine pubescence in addition to the longer hairs; abdomen marked above with a large purple spot on the center of basal segment and a central and a lateral row on the four following segments; a similar row of spots on the venter on either side near the margin; wings yellowish, veins reddish yellow.

Male.—Length, 15 mm.; expanse, 30 mm.; somewhat more slender than the female, but in structural and colorational characters agreeing very closely with the latter; central row of spots following the large purple one on the abdomen is sometimes almost wanting or the spots are much reduced in size; hirsute clothing of the body is much more pronounced than with the female, and the yellow areas of pronotum and mesopleurae are distinctly clothed with very long yellow hairs, the hairs of the head and rest of thorax, together with those of the legs, being of a lighter whitish yellow.

Type.—No. 3827, U.S.N.M.

Described from two females and three males. (Gifu), labeled "Gifu bee," (No. 26).

13. *ABIA IRIDESCENS*, new species.

Female.—Length, 14 mm.; expanse, 30 mm.; moderately robust, head and thorax strongly punctured, abdomen less coarsely punctured, basal segments glistening, apical segments pubescent, the pubescence of thorax and head long, somewhat scattering; clypeus truncate or but slightly emarginate; antennæ 7-jointed, the three terminal joints constituting a sort of club, but with distinctly marked joints; upper discal cell of hind wings very narrow, exceeding lower cell by about one-third its length; claws coarse and heavy, evenly notched. General color green with coppery reflections, reddish purple in certain lights; antennæ, tibiæ, and tarsi yellowish-brown; wings yellowish, with the upper half of anterior pair brown, sharply limited by the median and cubital veins.

Male.—The male does not differ from the female in any important colorational or structural characters, other than those indicating sex. The center of the third to the sixth dorsal sclerites of the abdomen is depressed and covered with a fine brownish pile.

Type.—No. 3828, U.S.N.M.

Described from two specimens, male and female. (Gifu Mountains), (No. 25).

14. *ABIA LEWISII* Cameron.

Abia lewisii CAMERON, Proc. and Trans. Nat. Hist. Soc. Glasgow, 1885-6, p. 270.

Five examples of this species are included in the collection, four of which are males. (Gifu Mountains), (No. 27).

15. *TREMEX SIMILIS*, new species.

Female.—Length, including sheath of saw, 31 to 34 mm.; expanse, 42 to 45 mm.; head and thorax clothed with rather long and dense yellow hairs; abdomen nearly smooth, hairs much shorter and not particularly noticeable except along sides and on the venter; claws with short, sharp inner tooth, projecting at right angles with claw; antennæ 15-jointed; terminal dorsal segment with a sharp triangular projection, strongly toothed or serrate and as long as wide at base. Color tawny yellow; meso- and metanotum, black; basal segment of abdomen and narrow base of each of following segments increasing posteriorly yellow; terminal sclerite (seventh) yellow, black limited, to a spot covering center; a broad black dash on either side of eighth segment; posterior and middle legs more or less black; posterior legs black except lower edge of tibiæ and tarsi and nearly all of apical joints of the latter; anterior pair reddish, middle pair reddish, infuscated on basal joints; thorax beneath and more or less of the abdomen, dark brown or black; antennæ black, except two or three basal joints; wings resinous yellow; veins yellowish brown.

Type.—No. 3829, U.S.N.M.

Described from three females. (Gifu woods), (No. 28).

16. *SIREX ANTENNATUS*, new species.

Female.—Length, including sheath, 27 to 32 mm.; expanse, 35 to 40 mm.; a slender species; head and thorax clothed with long black hairs; abdomen nearly smooth, very minutely and finely punctured, scarcely shining; apex of terminal segment produced in a spatulate-shaped projection 3 to 4 mm. in length, serrated on the edges on apical half; sheath projecting free from body 9 to 11 mm.; ovipositor proper 15 to 18 mm. long; claws with strong inner tooth projecting nearly at right angles; antennæ 22-jointed. Color, black or very dark brown; face and region beneath antennæ slightly inclined to reddish; large oval spot back of compound eyes, joints 12 to 17 of antennæ, outer half of basal plate, small spot on the side of the sixth abdominal segment, and on base of ninth interrupted centrally, spot on each side of the terminal segment, bases of tibiæ and bases of metatarsal joints, white; wings very slightly yellowish, nearly hyaline, veins dark brown.

Type.—No. 3830, U.S.N.M.

Described from two specimens. (Giba), (No. 29).

17. *RHOOGASTERA VIRIDIS* Linnæus.

Tenthredo viridis LINNÆUS, Syst. Nat., 10th ed., 1758, I, p. 557.

Tenthredo scalaris KLUG, Mag. Ges. naturforsch. Freunde, Berlin, 1814, VIII, p. 194, female and male.

Tenthredo scalaris SMITH, Trans. Ent. Soc. Lond., 1874, p. 382.

Rhogogastera viridis KONOW, Deutsche Ent. Zeit., 1884, XXVIII, p. 338.

Believed by Smith to be identical with the old Linnæus species, which has a very long bibliography. (Collected at Ibuki), (No. 15).

18. *TENTHREDO FLAVIDA*, new species.

Female.—Length, 14 to 15 mm.; expanse, 33 mm.; rather slender, head as broad as thorax, abdomen much constricted basally; clypeus very broadly, deeply, and circularly notched; lateral lobes very narrow and elongate; labrum longer than wide, fringed with long yellow hairs; claws evenly, deeply notched; sheath narrow elongate, regularly rounded at apex. Color, light yellowish, more or less marked with yellowish brown; joints 3 to 6 of antennæ, brown; mesothorax somewhat brownish, also apices of the first segments and all of fourth and fifth and more or less of terminal segments of abdomen; posterior femora yellowish brown except apical third; tibiæ and tarsi also yellowish brown; posterior femora and all tibiæ externally more or less distinctly marked with a line of black or dark brown; sutures of thorax for the most part marked with dark lines; wings nearly hyaline, yellowish; costa and stigma yellow, veins dark brown.

Male.—Length, 13 mm.; expanse, 25 mm.; general characteristics as in female, both in structural and colorational features. The antennæ are, however, wholly brown except the two basal joints.

Type.—No. 3831, U.S.N.M.

Described from three specimens, two females and one male. (No label), (No. 6).

19. *TENTHREDO PLATYCERUS*, new species.

Female.—Length, 15 mm.; expanse, 28 mm.; rather robust, thorax and abdomen of about equal width, the latter scarcely at all narrowed basally; clypeus very narrowly and acutely notched at center, lobes very broad, rounded; antennæ long, much longer than head and thorax; flagellum slightly compressed centrally, joints 3 and 4 subequal; claws very broad, rays nearly equal, parallel. Color, light tawny yellow; antennal joints 5 to 8 for the most part, large spot on vortex, spot on each of the three anterior lobes of mesonotum, small spot just above basal plates, triangular area on dorsal segments 3 to 7, black; pluræ, pectus, and coxæ for the most part, and posterior femora, black; a few dark spots on the venter of abdomen; wings nearly hyaline, slightly yellowish; costa and stigma yellow, other veins for the most part dark brown.

Male.—The male agrees with the female except that the antennæ are longer, sometimes nearly as long as the body and distinctly compressed, and the hind femora are reddish yellow, with more or less of the sides infuscated. The black spot on the metanotum is also wanting; the antennæ are sometimes almost entirely yellow.

Type.—No. 3832, U.S.N.M.

Described from nine specimens, of which seven are males. (Gifu zuzushi and woods), (No. 14).

20. *TENTHREDO PROVIDENS* Smith.

Tenthredo providens SMITH, Trans. Ent. Soc. Lond., 1874, p. 382, female.

Tenthredo providens KIRBY, List Hym. Brit. Mus., 1882, I, p. 304, female.

Represented by seven specimens, five of which are females. (Gifu and Ibuki), (No. 16).

21. *TENTHREDO MORTIVAGA*, new species.

Female.—Length, 12 mm.; expanse, 23 mm.; head wider than thorax, abdomen noticeably constricted basally; clypeus broadly and not very deeply emarginate, lobes somewhat pointed at outer angles; antennæ shorter than head and thorax, third joint nearly twice as long as fourth; inner tooth of claw very close to outer, parallel with it. Colors, black and yellowish-white; transverse band between compound eyes, including bases of antennæ, the clypeus, labrum, and mouth parts, large spot on the cheeks, angles of pronotum, tegulæ, scutellum, with post-scutellum, scutum, and wider margins of basal plates, narrow edge of abdomen above and most of venter, very light yellowish, almost white; legs and antennæ except basal joint yellowish brown; the anterior and middle femora very light yellowish, almost white; posterior femora marked with black on the inner and upper edges; segments of the abdomen above, from the fourth outward, reddish; coxæ black, except at apex; pleuræ and pectus, black; wings nearly hyaline, slightly

smoky beneath stigma, veins, including stigma, dark brown; costa yellowish brown.

Type.—No. 3833, U.S.N.M.

Described from two specimens. (Gifu zuzushi), (No. 19).

22. *TENTHREDO FUSCOTERMINATA*, new species.

Female.—Length, 16 mm.; expanse, 34 mm.; head very large, quadrate, as wide as thorax, abdomen strongly constricted basally; antennae longer than head and thorax, slender, joint 3 nearly one-third longer than 4; clypeus truncate centrally with a narrow projecting lobe at either edge; ocellar basin strongly depressed, roughened, breaking through antennal tubercle; occipital margin of head strongly and sharply produced; claws evenly notched, rays parallel and scarcely divaricating. Color, reddish yellow, more or less obscured, with light reddish brown on the vertex, mesonotum and bases of abdominal segments above; legs and venter somewhat paler; tarsi, especially posterior pair, reddish brown; flagellum of antennae dark brown; the last five segments of abdomen dark brown, almost black; wings light yellowish, nearly hyaline, except apical third of anterior pair, which is sharply and distinctly infuscated.

Type.—No. 3834, U.S.N.M.

Described from two specimens. (Osaka), (No. 20).

23. *TENTHREDO GIFUI*, new species.

Female.—Length, 13 mm.; expanse, 25 mm.; general surface highly polished, shining; thorax, distinctly punctate; head quadrate, wider than thorax; clypeus deeply and broadly emarginate; lateral lobes narrow, produced; labrum half egg-shaped, about as long as wide; antennae reaching to the second segment of the abdomen, slender, joints slightly diminishing in length from the third to last, distinctly enlarged at tips, especially the basal joints; mouth parts clothed with rather long whitish hairs; cheeks, pleura, and legs clothed with fine whitish hairs; claws notched at tip, rays scarcely divaricating, parallel; sheath long, narrow, rounded at tip, not or scarcely projecting beyond abdomen. Color black; two small spots on base of clypeus, all the labrum, mandibles, except tips; small line on posterior upper edge of pronotum; large spot covering the lateral third of metascutellum; spot on meta-epimeron, whitish-yellow; tips of mandibles, palpi and tips of two pairs of anterior femora and the tibia and tarsi reddish yellow; the middle legs much more strongly infuscated than the anterior pair; posterior legs dark brown or black; wings hyaline or slightly resinously infuscate; veins dark brown, almost black.

Type.—No. 3855, U.S.N.M.

Described from nine specimens, labeled Gifu woods (No. 18).

24. *DOLERUS JAPONICUS* Kirby.

Dolerus japonicus KIRBY, List Hym. Brit. Mus., 1882, I, p. 228, female. (Gifu zuzushi), (No. 2).

25. *DOLERUS OBSCURUS*, new species.

Female.—Length, 7 mm.; expanse, 15 mm.; rather robust; head and thorax coarsely punctured, opaque, and with abdomen beneath rather densely clothed with grayish hairs; abdomen smooth, shining; antennæ about as long as head and thorax, joint 3 much longer than 4; claws with very minute inner tooth; sheath rather long, tapering, rounded at tip. Color dull black, pronotum reddish, tegulæ pale, extremely narrow posterior margins of abdominal segments whitish; legs reddish ferruginous; tarsi and tibiæ distinctly and rather uniformly infuscated, coxæ and trochanters black; femora more or less infuscated on upper edge; wings hyaline or nearly so; veins and stigma dark brown.

Male.—Much more slender and elongate than female; antennæ much longer than head and thorax, joint 3 but little longer than 4. Color uniformly dull black; the extreme angles of pronotum together with tegulæ reddish yellow; legs yellowish and infuscated, posterior femora black except basally; extreme tips of posterior tibiæ dark brown, all tarsi and particularly posterior pair infuscated; wings as in female, except that the stigma is somewhat narrower and not so distinctly marked with white at base.

Type.—No. 3835, U.S.N.M.

Described from two specimens. The male was associated with the female by the collector, but differs considerably in color and general appearance; not, however, more than is often seen in this genus. (No locality given), (No. 5).

26. *DOLERUS UMBRATICUS*, new species.

Female.—Length, 11 mm.; expanse, 22 mm.; very robust, abdomen broader than thorax, depressed and with sharp central ridge; head and thorax, particularly the former, very deeply and coarsely rugose; abdomen smooth, shining; clypeus deeply circularly emarginate; antennæ scarcely longer than head and thorax, tapering, joint 3 distinctly longer than 4; claws with rather obtuse and strong inner tooth projecting at right angles to claw; sheath broad, obliquely tapering, covered and margined with rather long curved hairs; stigma narrow. Color of head and thorax dull greenish black and red, the latter confined to the pronotum and anterior and lateral lobes of mesonotum, together with tegulæ; abdomen metallic blue-black; legs black with bluish reflections particularly noticeable on femora; wings hyaline, veins black or very dark brown.

In one specimen the thorax has distinctly greenish reflections and the anterior lobe of the mesonotum has the same greenish-black color as the head and other dark areas of the thorax.

Type.—No. 3836, U.S.N.M.

Described from six specimens. (Gifu zuzushi and Hayashi), (No. 8).

27. *DOLERUS PICINUS*, new species.

Female.—Length, 10 mm.; expanse, 20 mm.; robust, head and thorax coarsely punctured, rugose; abdomen smooth, shining; body, except metanotum and basal dorsal sclerites of abdomen, clothed with fine white sericeous pile, notably on head and thorax; antennæ filiform, considerably longer than head and thorax, joint 3 considerably longer than 4; claw with sharp inner tooth. Color, dull black on head and thorax, shining on abdomen; legs black, anterior tibiæ somewhat reddish basally; wings hyaline, veins black.

Male.—Agrees with the female in general structural and colorational characters; joint 3 of antennæ, however, is not so distinctly longer than 4; the body is very elongate and slender, with a length of 8 mm., and a wing expanse of 15 mm.

Type.—No. 3837, U.S.N.M.

Described from ten specimens, four males and six females. (Gifu and zuzushi), (No. 10).

28. *HYLOTOMA CAPTIVA* Smith.

Hylotoma captiva SMITH, Trans. Ent. Soc. Lond., 1874, p. 376, female.

Hylotoma captiva KIRBY, List Hym. Brit. Mus., 1882, I, p. 62, female.

One female. (Gifu zuzushi), (No. 8).

29. *HYLOTOMA SIMILIS* Vollenhoven,

Hylotoma similis VOLLENHOVEN, Tijdschr. Nederl. Entom. Ver., 1860, III, p. 128, female.

Hylotoma imperator SMITH, Trans. Ent. Soc. Lond., 1874, p. 374, female and male.

Hylotoma similis KIRBY, List Hym. Brit. Mus., 1882, I, p. 61, female and male.

Four females and seven males. (Ibuki Yama and Gifu zuzushi), (No. 11).

30. *HYLOTOMA JAPONICA*, new species.

Female.—Length, 12 mm.; expanse, 25 mm.; robust; claws, simple; stigma, very narrow; acuminate. Color of head and thorax, dark metallic green; head and most of thorax green; metathorax and abdomen bluish with metallic luster; all of body smooth, glistening; legs, greenish, tibiæ pallid, anterior tarsi very slightly infuscated toward tip; middle pair dark brown except most of basal joint; hind pair uniformly dark brown or with only the basal portion of metatarsus pale; hind tibiæ also brown on apical third; wings yellowish, infumated, with distinct transverse band extending across anterior pair from the stigma to the posterior border.

Male.—Agrees with the female except in being smaller; length, 8 mm.; expanse, 17 mm.

Type.—No. 3838, U.S.N.M.

Described from five specimens, two males and three females. (Gifu zuzushi), (No. 12).

31. HYLOTOMA PAGANA Panzer.

Tenthredo pagana PANZER, Faun. Insect. Germ., 1798, V, p. 49, pl. XVI, and a long bibliographic list.

Five females. (Osakura), (No. 13).

32. PACHYPROTASIS PALLIDIVENTRIS, new species.

Female.—Length, 9 mm.; expanse, 16 mm.; rather robust; surface of body shining; head, thorax, and abdomen of about equal width; clypeus very broadly and evenly emarginate; tips narrow, pointed; labrum much broader than long, somewhat emarginate at tip; antennæ very slender, elongate, third joint much longer than fourth; claws deeply and rather evenly notched at tips; sheath very narrow, rather obtusely pointed; general color black, marked on the head, thorax, and lower surface of body and legs with very light yellow, almost white; on the head the white occurs as a narrow line on the inner orbits and bends at right angles posteriorly so as to inclose a large quadrate black spot, including the ocelli, and covering the entire vertex; in front, the white extends from the base of the antennæ anteriorly, including all of the mouth parts and cheeks; on the body, the white is limited to the posterior upper edge of the pronotum, the tegulæ, line about the middle lobe of mesonotum, the mesoscutellum, postscutellum, metascutellum, and the ventral surface of the thorax and abdomen with the exception of a central black band extending along the center of the sternum and the venter of the abdomen; legs, including coxæ and trochanters, for the most part yellowish-white; the anterior pairs of legs have a broad black band on the upper side of the femora, tibiæ, and tarsi; the posterior legs have the outer third of the femora black, and also the tip of the tibiæ and all the tarsi; the basal two-thirds of the posterior tibiæ are yellowish-brown; the extreme tip of the abdomen is whitish and there is a slight line of white on the posterior edge of some of the dorsal terminal sclerites; wings hyaline, or nearly so, with the veins and stigma dark brown or black.

Male.—Much smaller and more slender than the female; length, 7 mm.; expanse, 15 mm.; antennæ as long as body; structural characters in general as in female; color as in female except that the venter of abdomen is entirely white on the apical half of the abdomen and the posterior legs correspond in color with the anterior legs, except that in addition to the band on the upper side of the femora there is a corresponding band on the lower side also; the abdominal segments above are more distinctly marked with white than in the case of the female.

Type.—No. 3856, U.S.N.M.

Described from two females and one male, labeled Gifu zuzushi (No. 21).

33. *LOPHYRUS JAPONICUS*, new species.

Female.—Length, 7.5 mm.; expanse, 16 mm.; very short, robust; antennæ 21-jointed, the joints after the first two armed on the inner edge with two rays, the lower row of rays being much longer than the upper, and the longest of them being longer than the first two joints of the antennæ together; head and thorax coarsely punctured, the general surface, however, shining; the abdomen polished, shining. Color black, with bluish reflections on abdomen; edge of pronotum, scutellum, tibiæ for the most part, and tarsi, pale; apical quarter of posterior tibiæ black: wings hyaline, veins black or dark brown.

Male.—Somewhat smaller than female, and less robust; the rays of the antennæ are very much longer than in the female, and finer, distinctly feathered, the longest rays equaling half the antennæ in length. Color as in female, except that the scutellum is of the general black of the body.

Type.—No. 3839, U.S.N.M.

Described from two females and nine males, mounted in some cases with the brownish silken cocoon, labeled as having been collected or reared on pine. (Gifu), (No. 9).

A CONTRIBUTION TO A KNOWLEDGE OF THE FRESH-WATER CRABS OF AMERICA.—THE PSEUDOTHELPHUSINÆ.

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INTRODUCTION.

The critical study of the Pseudothelphusinae has led to somewhat different conclusions as to their classification and distribution from those published by Dr. Ortmann in his recent revision of the Potamonidae,¹ of which the Pseudothelphusinae form a subfamily. The U. S. National Museum contains the largest collection of Pseudothelphusinae in any museum. Of the 52 species now included in the subfamily, 35 are in the national collection, and are represented by 230 specimens. The material contained in several other large museums has also been examined by the writer, including type specimens of all species excepting *Epilobocera cubensis* Stimpson, *Pseudothelphusa denticulata* (Milne-Edwards), *P. equatorialis* (Ortmann), *P. henrici* Nobili, and *Rathbunia festæ* Nobili.

The comparison of this large amount of material seems to justify the division of the subfamily into four genera: *Pseudothelphusa*, *Potamocarcinus*, *Epilobocera*, and *Rathbunia*; and the evidence goes to show that the species inhabit comparatively restricted areas. The first part of this paper is devoted to a description of the subfamily, genera, and new species, with analytical keys; the second part deals with the distribution of genera and species, comprising all that is known at present regarding the range of these interesting forms. It should not be inferred that the results here published are in any degree complete. The need is felt of larger series of specimens to determine the extent of variation in each species due to age and environment; therefore, in determining specimens the writer has refrained from undue multiplication of species, and it is possible that some differences which have been attributed to age or locality may later, with more individuals for comparison, prove to be specific.

¹ Zool. Jahrb., Syst., 1897, X, pp. 296-329.

DESCRIPTION OF THE SUBFAMILY.

PSEUDOTHELPHUSINÆ Ortmann.

Bosciacca MILNE-EDWARDS, Ann. Sci. Nat., 1853, 3rd ser., Zool., XX, p. 207 [173], (family).

Bosciada SMITH, Trans. Conn. Acad. Sci., 1870, II, p. 146 (family).

Pseudothelphusida RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 649 (family).

Pseudothelphusinae ORTMANN, Zool. Jahrb., Syst., 1893, VII, p. 487.

Potamocaroinine ORTMANN, Zool. Jahrb., Syst., 1897, X, p. 315.

The Pseudothelphusinae are those Potamonidae in which the merus of the endognath is broader than long, and the exognath is short, overreaching the ischium of the endognath but little, if at all.

They may be further defined as follows: The outer margin of the merus of the endognath is either arcuate from the articulation of the ischium to the insertion of the carpus or forms an antero-exterior angle with the anterior margin; posterior margin usually as wide as the anterior margin of the ischium. The form of the merus is either subquadrangular or subtriangular; the carpus is inserted at the anterior inner notch. Ischium without a longitudinal furrow. Exognath considerably shorter than the endognath, never reaching more than half the length of the merus, and often considerably reduced. The palatal ridges reach quite to the anterior margin of the buccal cavity and form two lateral well-marked channels.

Carapace transversely oval; side margins toothed or tuberculate, either distinctly or indistinctly. Epigastric lobes and cervical sutures present. Median furrow usually present. Front inclined, generally bilobed, either straight or slightly arched and with or without a superior margin. An inner suborbital lobe, distinct from the orbital margin, is always present, and is either separated from the front by the width of the flagellum, or, when united with the front, permits the passage of the flagellum behind it into the orbit.

THE GENERA OF THE PSEUDOTHELPHUSINÆ.

ANALYTICAL KEY TO THE GENERA OF THE PSEUDOTHELPHUSINÆ.

- A. Posterior margin of merus of endognath equaling the anterior margin of the ischium, against which it is applied.
- B. Exognath exceeding in length the ischium of the endognath; efferent branchial channel with a tooth or spine projecting from the upper side near the anterior end.....*Epilobocera*
- B'. Exognath not equaling in length the ischium of the endognath; efferent branchial channel without tooth or spine.
- C. Superior margin of front projecting over the surface of the front, which is strongly retreating and not visible in a dorsal view; antero-lateral teeth large and spiniform.....*Potamocaroinus*
- C'. Superior margin less advanced than inferior margin, or about equally advanced with it; antero-lateral teeth small, often tuberculiform.....*Pseudothelphusa*
- A'. Posterior margin of merus of endognath one-half the width of the anterior margin of the ischium, and articulated with the outer half of the latter.....*Rathbunia*

PSEUDOTHELPHUSA Saussure.

- Potamia* LATREILLE, Cours d'Entomologie, 1831, p. 338, name preoccupied. Type, *Thelphusa dentata* Latreille.—DE HAAN, Fauna Japon., 1833, p. 23.—DANA, Amer. Jour. Sci., 1851, 2d ser., XII, p. 131; Crust. U. S. Expl. Exped., 1852, I, p. 293.—SAUSSURE, Mém. Soc. Phys. Hist. Nat. Genève, 1858, XIV, p. 435 [19].
- Boscia* MILNE-EDWARDS, Hist. Nat. Crust., 1837, II, p. 14, name preoccupied. Type, *Thelphusa dentata* Latreille.—MILNE-EDWARDS, Ann. Sci. Nat., 3d ser., Zool., 1853, XX, p. 207 [173].—A. MILNE-EDWARDS, Ann. Soc. Entom. France, 1866, 4th ser., VI, p. 203.
- Pseudothelphusa* SAUSSURE, Rev. et Mag. Zool., 1857, 2d ser., IX, p. 305. Type, *P. americana* Saussure.—SMITH, Trans. Conn. Acad. Sci., 1870, II, p. 146.—RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 649.
- Hypolobocera* ORTMANN, Zool. Jahrb., Syst., 1897, X, pp. 298, 323. Type, *Potamia chilensis* Milne-Edwards and Lucas.
- Potamocarcinus* ORTMANN, Zool. Jahrb., Syst., 1897, X, pp. 298, 315 (part); not *Potamocarcinus* Milne-Edwards.

The genus *Hypolobocera* Ortmann, type and only species, *Potamia chilensis* Milne-Edwards and Lucas, founded on the union of the inner suborbital lobe with a projection of the front and the consequent exclusion of the antenna from the orbit, is open to the objection that the distance between the front and the orbital angle is too variable in the members of a single genus or of a single species in this subfamily to be considered of any importance. In the type specimen of *P. chilensis* in Philadelphia there is a want of symmetry in the antennæ. On both sides the front is united with the orbital lobe. On the left side the second of the fixed joints of the antenna is long, and the third joint is attached to the ventral surface of the second, and is very short; it is followed by a fourth, also very short; the flagellum is absent. On the right side the second joint is shorter than on the left, the following joints are absent, but it is evident that the third joint was never attached as on the left side. In the type¹ figured by Milne-Edwards and Lucas, which is in the Paris museum, a similar though less striking asymmetry exists. On the left the front touches the inner orbital lobe only by a part of its width, the point of contact forming a sort of bridge, for the third article of the antenna appears at the inner angle of the orbital cavity, followed by the fourth, bearing a short flagellum of three articles. On the right side the line of contact of the front and the orbital lobe is much wider; only the first two articles of the antenna are present; the second article is much larger than on the opposite side. In *P. bouvieri*, a closely allied species, similar variations occur, but in all cases the antenna enters the orbit. The antennæ enter the orbits also in every other species of the Pseudothelphusinae. It is reasonable to infer that the disposition of the single antenna for which the genus *Hypolobocera* was created is abnormal.

¹ The antennal region of this specimen has been carefully examined by Professor Bouvier at my request.

ANALYTICAL KEY TO THE SPECIES OF PSEUDOTHELPIUSA.

- A. Front without a superior margin or marginal line.
- B. Outer margin of merus of maxilliped straight or concave, forming an angle with anterior margin.
- C. Spinules of dactyli of ambulatory legs small and numerous, 15 or more in a row *macropa*
- C'. Spinules larger and few, about 5 or 6 in a row.
- D. Cervical sutures arching toward each other. Ambulatory legs very slender *ecuadorensis*
- D'. Cervical sutures sinuous. Ambulatory legs of moderate width.
- E. Merus of maxilliped very wide, width $1\frac{1}{2}$ times the length *plana*
- E'. Merus of maxilliped very little wider than long *lindigiana*
- B'. Outer margin of merus of maxillipeds convex and gradually curving into the anterior margin.
- C. Ambulatory legs very slender.
- D. Lower margin of propodus of the larger cheliped of the female most convex or protuberant at the middle of the palm. Width of carapace less than $1\frac{1}{2}$ times its length *exilipes*
- D'. Lower margin of propodus of the larger cheliped of the female most convex or protuberant below the articulation of the dactylus. Width of carapace more than $1\frac{1}{2}$ times its length *gracilipes*
- C'. Ambulatory legs not slender.
- D. Lower margin of front faintly rimmed *jouyi*
- D'. Lower margin of front strongly rimmed.
- E. Lower margin of front sinuous or trilobed, in a front view *agrestis*
- E'. Lower margin of front convex.
- F. Lateral teeth of carapace obliterated. Inner lobe of abdominal appendage of first segment in male falcate, distant from the appendage *terrestris*.
- F'. Lateral teeth of carapace present, though indistinct. Inner lobe of abdominal appendage not falcate, appressed *americana=dugesi*
- A'. Front with a superior margin or marginal line.
- B. Superior margin of front not keeled.
- C. Superior margin smooth.
- D. Ambulatory legs elongate, the propodi at least twice as long as wide.
- E. Sixth segment of abdomen of male half as long as its proximal width. *aequalialis*
- E'. Sixth segment of abdomen of male less than half as long as proximal width.
- F. Lower margin of larger propodus convex; lower margin of pollex straight *verticalis*
- F'. Lower margin of larger propodus sinuous.
- G. Front low, its width about 12 times its height *belliana*
- G'. Front higher, its width about 9 times its height *montana*
- D'. Ambulatory legs not elongate, the propodi less than twice as long as wide.
- E. Manus with a tubercle at base of fingers *tumimanus*
- E'. Manus without a tubercle at base of fingers *tristani*
- C'. Superior margin of front tuberculate.
- D. Merus of maxilliped narrow, the outer oblique margin making an angle with the anterior margin.
- E. Cervical suture curved *chilensis*
- E'. Cervical suture straight.
- F. Ambulatory legs slender. No outer orbital notch *nobilii*

- F'. Ambulatory legs of moderate width. A well-marked outer orbital notch. *bouvieri*
- D'. Merus of maxilliped with outer margin convex, forming a single curve to the insertion of the palpus.
- E. Exognath reduced to a stump.
- F. Superior frontal margin unilobate. Median suture absent or faintly indicated.
- G. Cervical sutures straight. Carapace finely granulate. *denticulata*
- G'. Cervical sutures curved, arching toward each other. Carapace coarsely granulate *agassizii*
- F'. Superior frontal margin bilobate. A median suture present. *fossor*
- E'. Exognath not reduced to a stump.
- F. Inferior margin of front convex.
- G. Cervical suture markedly sinuous. *dilatata*
- G'. Cervical suture nearly straight *sulcifrons*
- F'. Inferior margin of front not convex, but sinuous or straight.
- G. Ambulatory legs slender. Carapace smooth to the naked eye. *bisuturalis*
- G'. Ambulatory legs not slender. Carapace granulate to the naked eye *xantusi*
- B'. Superior margin of front keeled.
- C. A tubercle on outer surface of manus at base of fingers.
- D. Merus of maxilliped narrow, outer margin very oblique. Dactylus of larger cheliped wide throughout its length *conradi*
- D'. Merus of maxilliped broad, the external and antero-external margin very arcuate.
- E. Exognath reduced to a stump *garmani*
- E'. Exognath not reduced to a stump.
- F. Orbit more than twice the depth of the eye *magna*
- F'. Orbit less than twice the depth of the eye. *tuberculata*
- C'. No tubercle on outer surface of manus at base of fingers.
- D. Exognath reduced to a stump, less than one-third the length of the ischium of the endognath.
- E. Cervical suture straight. *dentata*
- E'. Cervical suture arching forward in anterior half *affinis*
- D'. Exognath at least one-third the length of the ischium of the endognath.
- E. Maxillipeds much wider than the buccal cavity, nearly covering the jugal area *maxillipes*
- E'. Maxillipeds only a little wider than the buccal cavity.
- F. Carapace very convex longitudinally.
- G. Lateral margins of fourth to sixth segments of abdomen of male not arcuate. Exognath reaching distal third of ischium. *convexa*
- G'. Lateral margins of fourth to sixth segments of abdomen of male arcuate. Exognath not reaching distal third of ischium. *reflexifrons*
- F'. Carapace flattened or slightly convex longitudinally.
- G. Cervical suture straight or nearly so. Lateral margin armed with rather large (for the genus) separated teeth. *richmondi*
- G'. Cervical suture curved.
- H. Carapace very wide, more than $1\frac{1}{2}$ times as wide as long. *colombiana*
- H'. Carapace narrower, less than $1\frac{1}{2}$ times as wide as long.
- J. Carapace finely granulate.
- K. A small species, less than 30 mm. wide. Lower margin of front tuberculate *pittieri*

- K'. A large species, more than 70 mm. wide. Lower margin of front not tuberculate *henrici*
- J'. Carapace coarsely granulate.
- K. Merus of maxilliped narrow, subtriangular, outer margin straight or nearly so *peruviana*
- K'. Merus of maxilliped broader, subquadrilateral, outer margin arcuate to the distal extremity.
- L. Sixth and seventh segments of abdomen of male of equal length; appendages of first segment with extremity very large and vertically compressed *bocourti*
- L'. Sixth segment longer than seventh; appendages of the *jouyi* group *lamellifrons*

RELATION OF SPECIES OF PSEUDOTHELPHUSA TO ONE ANOTHER.

The genus *Pseudothelphusa* now contains 42 species, 17 of which are here described for the first time. A key to a genus in which the variations are so slight as in *Pseudothelphusa* is necessarily imperfect. The character of the front offers the most satisfactory basis for a primary division. Even here there are species of doubtful position. For example, *P. verticalis* forms a link between section A, front without a superior margin, and A', front with a superior margin, as, although its front is vertical, the superior margin is not sharply outlined. Under the species with smooth superior margin, *P. tumimanus* shows a transition to species with keeled fronts, as its superior margin is very well marked, approaching a keel. The forms intermediate between section A, front without a superior marginal line, and section A', B, O', superior margin tuberculate, are *P. ecuadorensis* and *P. nobilii*. The former has the surface of the front coarsely granulate, but without a distinct marginal line; the latter has a distinct line, feebly granulate. Under the group with superior margin tuberculate, we have *P. fossor* and *P. xantusi* inclining toward species with keeled fronts.

It is a notable fact that the merus of the maxillipeds of southern species differs from that of northern species. In the former the merus has a subtriangular shape, its outer margin concave or straight or rarely slightly convex and forming an angle with the anterior margin. In the latter the merus is subquadrate, and its outer margin is convex and curves gradually into the anterior margin. The first form of the merus is found in *macropa*, *plana*, *ecuadorensis*, *lindigiana*, *chilensis*, *bouvieri*, *nobilii*, *conradi*, *henrici*, and *peruviana*, all South American species inhabiting Colombia, Ecuador, Peru, and Bolivia. The second form of merus is found in all North American and West Indian species and in the South American species *garmani*, *fossor*, and *denticulata*, which inhabit the northern border of South America (Venezuela and Guiana). Two of this group, *richmondi* and *xantusi*, extend as far south as Colombia. *P. colombiana* has the merus intermediate between northern and southern forms; its range extends northward to Mexico. The meri of *P. reflexifrons* (Upper Amazon) and *P. agassizii* (Para) are also intermediate. That of *aequatorialis* is unknown to me.

It is impossible to correlate this difference in the maxillipeds with

any other character. With regard to the general appearance of the carapace, *reflexifrons*, *agassizii*, and *convexa* are the most convex; *peruviana*, *garmani*, *lamellifrons*, and *bocourti* are most flattened and are coarsely granulate. In the remainder of the species the carapace is moderately convex, often flattened in the middle and posterior portions and gradually deflexed near the anterior and lateral margins. In the following species the exognath is reduced to a short stump: *affinis*, *agassizii*, *bouvieri*, *chilensis*, *conradi*, *dentata*, *denticulata*, *fossor*, *garmani*, and *nobilii*. The following have a tubercle on the outside of the manus at the base of the fingers: *conradi*, *garmani*, *magna*, *tuberculata*, *tumimanus*.

In no two species are the abdominal appendages of the first segment in the male exactly alike, but some species have similar appendages. The different forms may thus be briefly described and the species grouped accordingly:

1. Extremity broad, with at least one tooth or lobe on each side: *americana*, *belliana*, *dilatata*, *jouyi*, *lamellifrons*, *pittieri*, *sulcifrons*, *terrestris*.

2. Two lobes on outer side, vertically compressed, inner extremity curving outwardly over these lobes: *colombiana*, *convexa*, *montana*, *tristani*, *tumimanus*, *xantusi*.

3. One outer lobe, extremity curving outwardly over it: *ecuadorensis*.

4. Compressed laterally; above at extremity a large subquadrate lobe which is toothed or spinous: *bocourti*, *maxillipes*.

5. Extremity thick, slightly compressed laterally, with outward-pointing teeth: *magna*, *richmondi*.

6. Compressed laterally; extremity subtriangular: *agrestis*, *denticulata*, *fossor*, *garmani*.

7. Upper lamina produced at extremity in a slender prominence, curving over broad, lower lamina: *dentata*, *reflexifrons*.

8. Outer margin with a long narrow lobe; terminus truncate, with a short tooth at outer and inner angles: *aequatorialis*, *bouvieri*, *conradi*, *indiana*.

9. Complex; terminal lamina oval, transverse; subterminal lamina oval, longitudinal: *verticalis*.

10. Narrow; extremity small; on outer side, a dentate backward-pointing lobe: *tuberculata*.

11. A deep rounded sinus on outer side near the extremity: *macropa*, *peruviana*.

12. Terminal half much narrower than the basal half; extremity with a transverse rim of backward-pointing spines: *bisuturalis*.

13. Appendages not known to me: *affinis*, *agassizii*, *chilensis*, *exilipes*, *gracilipes*, *henrici*, *nobilii*, *plana*.¹

¹The specimen of *nobilii* in the U. S. National Museum is a female; the type male of *chilensis* in the Paris Museum is dried and so preserved that the removal of the abdomen is not practicable; of the remaining species, only females have been collected.

In addition to the characters given above, one should look for specific differences also in the form of the orbits, size of the eyes, direction and depth of the dorsal sutures, character of the lateral indentations, form of the abdomen of the male, and of the chela and ambulatory legs.

The new species here made are based not on one character but on several.

DESCRIPTIONS OF NEW SPECIES OF PSEUDOTHELPHUSA.

PSEUDOTHELPHUSA EXILIPES, new species.

Front without superior margin; width of carapace less than $1\frac{3}{4}$ times its length; outer margin of merus of maxilliped convex; ambulatory legs slender.

Carapace covered with punctae visible to the naked eye and fine reticulating furrows seen only with the lens; granulate near antero-lateral margins. Cervical suture very broad in its inner half, narrowing outwardly, its posterior margin curved, anterior straight. Epigastric

lobes narrow, separated by a well-marked groove.

Front (fig. 1, b) without a defined upper margin; the outline of the upper portion in a dorsal view is nearly straight; lower border marginate, sinuous, slightly visible in a dorsal view, median and lateral lobes about equally deflexed. The inner half of the orbits is longer than the outer half; the superior margin seen from above slopes outward and forward. Lateral margin finely denticulate, and with a hepatic tooth. Exognath

reaching about three-fourths the length of the ischium of the endognath (fig. 1, a).

Chelipeds very unequal in the female, covered with scaly granules; palm of larger cheliped with very convex margins; fingers slender, gaping, armed with irregular teeth (fig. 1, c); in the smaller cheliped the margins of the palm are slightly convex and the fingers do not gape. The ambulatory legs are very narrow; meri about $3\frac{1}{2}$ times as long as wide; the propodi have straight margins, except in the last pair, where they are slightly convex.

Dimensions.—Female: Length, 14.4 mm.; width, 24.2 mm.

Type.—No. 19488, U.S.N.M.; one mature female; El Coronel, Costa Rica, 700 meters altitude; P. Brolley and E. Fernandez, collectors.

Additional specimens.—Two females, about the size of the type, are in the British Museum, associated with *P. tumimanus*, but without label of locality.

PSEUDOTHELPHUSA AGRESTIS, new species.

Front without superior margin; lower margin sinuous, rimmed; outer margin of merus of maxilliped convex; exognath reaching about one-half the length of the ischium.

Carapace smooth, punctae visible to the naked eye. Cervical suture deep, concave forward for the most part, outwardly straight, not continued to the margin. Median suture deep; epigastric lobes well



FIG. 1.—PSEUDOTHELPHUSA EXILIPES, FEMALE. a. MAXILLIPED, X 24. b. FRONT, NATURAL SIZE. c. LARGER CHELA, NATURAL SIZE.

marked. Lateral denticles very slightly indicated. Front very low; upper boundary blunt, smooth, slightly arched forward in a dorsal view and downward in a front view; lower margin strongly rimmed, sinuous or trilobed (fig. 2, *f*). The appendages of the first segment of the abdomen of the male are laterally compressed (fig. 2, *d, e*). The chelipeds are very unequal, and the large cheliped differs from those of allied species in having the fingers widely gaping and armed with a few long teeth (fig. 2, *a*). Ambulatory legs narrow, but not markedly slender, as in *gracilipes* and *exilipes*.

Dimensions.—Male: Length, 15.9 mm.; width, 26.5 mm.; exorbital width, 8.1 mm.

Types.—One male (No. 19487, U.S.N.M.), one female (Costa Rica Mus.); La Flor, a farm near Torito, Costa Rica, 900 to 1,000 meters high; E. Fernandez, collector.

Additional locality.—El Coronel, 700 meters; P. Biolley and E. Fernandez, one male (Costa Rica Mus.).

PSEUDOTHELPHUSA BELLIANA,
new species.

Front low; superior margin smooth, not keeled; lower margin of larger propodus not sinuous; sixth segment of abdomen of male less than half as long as its proximal width; ambulatory legs elongate, the propodi at least twice as long as wide.

Carapace punctate, granulate near the front and antero-lateral margins.

Lateral and posterior portions covered with short, coarse, black hairs. Cervical suture rather wide, more so inwardly than outwardly, ending a little way from the margin, slightly curved or concave forward. Median suture well-marked, widening toward its posterior end. Seriations of lateral margin small and irregular. Hepatic and cervical teeth very faintly marked, sometimes not evident. Front (fig. 3, *a*) narrow; superior margin deflexed, smooth, save for the general granulation of the surface, very faintly bilobed by the median sinus, the margin as a whole somewhat arcuate as seen from above; seen from in front it slopes downward and inward; lower margin subparallel to the upper and tuberculate; intervening space concave and smooth. Orbits a little wider than half the front; viewed from above, a great part of the margin is nearly transverse; in a front view, the outer half is longer than the inner. Sixth and seventh segments of the male abdomen of equal length (fig. 3, *c*). Appendages (fig. 4, *b, c*), similar to those of *jouyi*. Exognath about two-thirds length of ischium; the latter widening rapidly distally to near the extremity, where it narrows again; merus rather broad and very arcuate on the outer side (fig. 4, *a*).

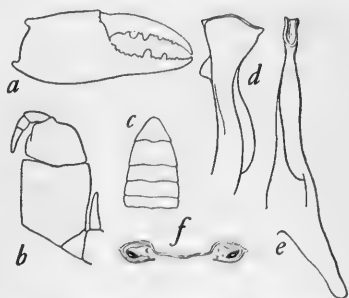


FIG. 2.—PSEUDOTHELPHUSA AGRESTIS, MALE. *a*. LARGER CHELA, NATURAL SIZE. *b*. MAXILLIPED, $\times 2\frac{1}{2}$. *c*. ABDOMEN, NATURAL SIZE. *d*. LEFT ABDOMINAL APPENDAGE, INNER VIEW, $\times 5\frac{1}{2}$. *e*. THE SAME, LOWER VIEW, $\times 5\frac{1}{2}$. *f*. FRONT, NATURAL SIZE.

Chelipeds very unequal in both sexes, but much more so in the male. Lower margin of palm of larger cheliped very convex; pollex stout; both fingers granulate and armed with broad, low teeth. Ambulatory legs slender; meri not much compressed, slightly dilated at the middle; propodi narrow and much shorter than the slender dactyli.

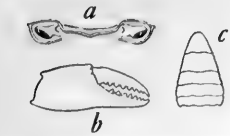


FIG. 3.—*PSEUDOTHELPHUSA BELLIANA*, MALE, NATURAL SIZE. *a*. FRONT. *b*. LARGER CHELA. *c*. ABDOMEN.

Dimensions.—Male: Length, 15.8 mm.; width, 25.3 mm.; superior width of front, 7.5 mm.; inferior width of front, 6.6 mm.; depth of front, 0.8 mm. Female: Length, 19 mm.; width, 33.5 mm.; superior width of front, 9 mm.;

inferior width of front, 8 mm.; depth of front, 1 m. Female: Length, 17.8 mm.; width, 30 mm.

Types.—No 771, Brit. Mus.; No. 20038, U.S.N.M., one male and one female. Xautipa, State of Guerrero, Mexico, not far from Chilpancingo; H. H. Smith, collector.

Named for Prof. F. Jeffrey Bell, of the British Museum, through whose courtesy the writer has described the species.

PSEUDOTHELPHUSA MONTANA, new species.

Allied to P. belliana, but front higher and less advanced, orbits more oval, cervical suture more transverse, merus of maxillipeds longer (fig. 6, a); abdominal appendages of the tristani group (fig. 6, b, c).



FIG. 5.—*PSEUDOTHELPHUSA MONTANA*, MALE, NATURAL SIZE. *a*. FRONT. *b*. LARGER CHELA. *c*. ABDOMEN.

margin smooth and blunt, divided into two slightly convex lobes in a dorsal view, and strongly arched downward in a front view, terminating above the base of the eye-stalks; lower margin sinuous, slightly projecting; front deepest at the outer extremities. Orbits oblong in a front view, upper and lower margins subparallel.

Chelipeds unequal in both sexes; palms with convex margins, scaly granulate, as are also the fingers. Fingers reddish-brown, with teeth alternately large and small (fig. 5, *b*), fitting closely together. Meri of ambulatory legs narrow, but slightly dilated in the middle.



FIG. 4.—*PSEUDOTHELPHUSA BELLIANA*, MALE. *a*. MAXILLIPED, $\times 1\frac{3}{4}$. *b*. LEFT ABDOMINAL APPENDAGE, INNER VIEW, $\times 3\frac{3}{4}$. *c*. SAME, LOWER VIEW, $\times 3\frac{3}{4}$.

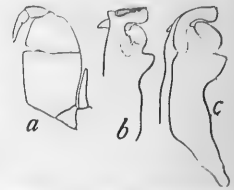


FIG. 6.—*PSEUDOTHELPHUSA MONTANA*, MALE. *a*. MAXILLIPED, $\times 1\frac{3}{4}$. *b*. LEFT ABDOMINAL APPENDAGE, INNER VIEW, $\times 3\frac{3}{4}$. *c*. SAME, LOWER VIEW, $\times 3\frac{3}{4}$.

Dimensions.—Male: Length, 16 mm.; width, 27.5 mm.; exorbital width, 17.5 mm. Female: Length, 18.7 mm.; width, 33.5 mm.; exorbital width, 20 mm.

Types.—No. 19486, U.S.N.M.; two males and two females; Costa Rica: La Palma, 1,500 meters, under trunks of trees; J. Fid Tristan, February, 1896.

PSEUDOTHELPHUSA TUMIMANUS, new species.

Superior margin of front smooth, not keeled; ambulatory legs wide; manus with a tubercle at base of fingers.

Allied to *P. tristani*, but a much larger species. Carapace smooth, densely punctate. Cervical suture wide and nearly transverse in its inner half, then narrowing and curving abruptly forward, becoming obsolete near the margin of the carapace. Median furrow deep, crossing the upper frontal margin. Epigastric lobes marked by deep grooves. Lateral margin of carapace obscurely denticulate; in the largest specimen without additional teeth; in the three smaller specimens one or two teeth are faintly indicated. Front (fig. 7, *a*) with a marginate rim on its lower and lateral borders; lower border sinuous; front deepest near the middle. Orbits similar in shape to those of *tristani*, but wider; eyes much smaller than the orbits. Appendages of first abdominal segment of the male (fig. 7, *e*, *f*) resembling those of *montana*, but the subterminal lobe on the outer side is less thickened, and the posterior lobe less angular, than in that species. The maxillipeds (fig. 7, *c*) differ slightly from those of *tristani*; the meri are broader; their inner edges, instead of being marginate and subparallel, as in that species, are flat, and divergent anteriorly; the outer margins are more oblique than in *tristani*.

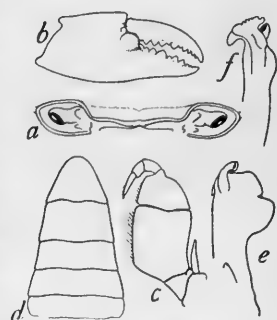


FIG. 7.—*PSEUDOTHELPHUSA TUMIMANUS*, MALE. *a*. FRONT $\times \frac{3}{4}$. *b*. LARGER CHELA, $\times \frac{1}{2}$. *c*. MAXILLIPED, $\times \frac{3}{4}$. *d*. ABDOMEN, $\times \frac{3}{4}$. *e*. LEFT ABDOMINAL APPENDAGE, LOWER VIEW, $\times 1\frac{1}{2}$. *f*. THE SAME, INNER VIEW, $\times 1\frac{1}{2}$.

The chelipeds of the male are heavy and unequal. The teeth on the anterior or inner margin of the merus are very large and blunt, increasing in size distally. Propodus similar in shape to that of *tristani*, but inferior margin more convex, the greatest width of the segment being near the digital end of the palm. Fingers thick, slightly gaping, surface mottled with flattened black granules, scarcely perceptible to the touch; teeth black. There is a large round smooth wart or protuberance on the manus between the digits and in line with the teeth of their cutting edges (fig. 7, *b*).

Dimensions.—Male: Length, 42.2 mm.; width, 70.2 mm.; width of front (lower margin), 18 mm.; greatest depth of front, 3 mm.

Distribution.—This is a Costa Rican species taken in considerable numbers at Cachi, Reyentazón River, 1,300 meters, by Mr. J. Fid Tris-

tan; at La Palma, 1,500 meters, February, 1896, also by Mr. Tristan; and at Pacaca, Rodeo, 785 meters. A series of this species is in the British Museum, without indication of locality.

Type.—No. 19484, U.S.N.M.; one male; Cachi.

Habits.—Mr. J. Fid Tristan, of the National Museum of Costa Rica, writes thus concerning this species:

In La Palma, for instance, I found some in a small pond, near a house, in which the crabs have stationed themselves to feed on the refuse of meals, etc., that are from time to time thrown in. I saw that they showed preference for the cooked maize, and as soon as a morsel is thrown in the water to them they start from their hiding places to secure it, and then return to devour it at home. They also eat soap, which act surprises me, because of the caustic nature of the article.

PSEUDOTHELPHUSA NOBILII, new species.

Pseudothelphusa gracilipes NOBILI, Boll. Mus. Zool. Torino, 1897, XII, No. 275, p. [4]. Not *Boscia gracilipes* A. MILNE-EDWARDS, Ann. Soc. Entom. France, 1866, 4th ser., VI, p. 204.

Superior margin of front tuberculate, not keeled; cervical suture straight; merus of maxilliped narrow, outer margin oblique; ambulatory legs slender.

Differs from *gracilipes* in its narrower carapace; straight cervical suture directed more longitudinally than in *gracilipes*; bilobed superior frontal margin; in the sinuous lower margin of the propodus of the chelipeds, the propodus being widest at the middle of the palm (fig. 8, *b*), and not at the articulation with the dactylus, as in *gracilipes*; in the shorter ambulatory legs; in the reduction of the exognath to a short stump (fig. 8, *c*), while in *gracilipes* it extends three-fourths the length of the ischium.



FIG. 8.—PSEUDOTHELPHUSA NOBILII, FEMALE. *a*. FRONT, NATURAL SIZE. *b*. LARGER CHELA, NATURAL SIZE. *c*. MAXILLIPED, X 2½.

Dimensions.—Female: Length, 16.5 mm.; width, 28.5 mm.; exorbital width, 15.5 mm.

Type.—No. 20041, U.S.N.M.; one female. Guayaquiza, Ecuador; Dr. Enrico Festa.

Additional localities (after Nobili).—Ecuador: Valle del Rio Santiago; San José de Cuchipamba; Valle del Rio Zamora.

This species was sent to the U. S. National Museum by the Museum of Turin, through Mr. Joseph Nobili, who expressed doubts as to the correctness of its identification and has permitted me to include it among the new species here made known.

PSEUDOTHELPHUSA BOUVIERI, new species.

Superior margin of front tuberculate, not keeled; cervical suture straight; merus of maxillipeds narrow, outer margin oblique; ambulatory legs not slender.

Very near *P. chilensis*; differs as follows: Carapace wider than in *chilensis*. Cervical suture straight instead of curved. Front propor-

tionally narrower. Orbits shorter and wider in *bouvieri*, and longer in their outer than their inner half (fig. 9, *a*); in *chilensis* they are of equal length in their outer and inner half. The maxillipeds are similar to those of *chilensis*, except that the merus is wider; its anterior width is about equal to its length measured from the antero-external angle (fig. 9, *b*), while in *chilensis* its anterior width is much less than its length.

Dimensions.—Male: Length, 31.5 mm.; width, 52.3 mm.; exorbital width, 26.5 mm.

Types.—Paris Museum, one male and one female; No. 20056, U.S.N.M., one male. Santa Fé de Bogota, United States of Colombia; M. Lindig.

The specific name is in honor of Prof. E. L. Bouvier, through whose liberality the U. S. National Museum has made many valuable additions to its collection of fresh-water crabs.



FIG. 9.—PSEUDOTHELPHUSA BOUVIERI, FEMALE, NATURAL SIZE. *a*. FRONT. *b*. MAXILLIPED.

PSEUDOTHELPHUSA AGASSIZII, new species.

Superior margin of front tuberculate, not keeled, unilobate; surface coarsely granulate; cervical sutures convex to each other; merus of maxillipeds with outer margin convex; exognath reduced to a stump.

Allied to *P. reflexifrons* and *P. denticulata*. Carapace convex, narrower than in *reflexifrons* or *denticulata*, very coarsely granulate, especially toward the lateral margins. Cervical suture slightly arched forward. The faintest trace of a median groove; branchio-cardiac lines deep. Lateral margin with about 22 distinct tuberculiform teeth; exorbital tooth larger than any other. Superior frontal margin not bilobed, truncate, rounding upward at the extremities; edge tuberculate, not projecting. Inferior border sinuous, margined, somewhat four-lobed (fig. 10, *a*); corners rounding; sides oblique; surface of front inclined downward and backward. Superior margin of orbit slightly sinuous, sloping backward a little, except toward the outer angle. Orbit large, wider than one-half the width of the front; eyes large, not quite filling orbit. Median tooth of epistome very long, produced downward and forward. Maxillipeds much as in *reflexifrons*, the merus having a thickened and strongly beveled outer margin (fig. 10, *b*). Abdomen of female narrow, apparently mature.

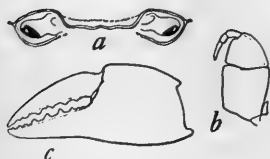


FIG. 10.—PSEUDOTHELPHUSA AGASSIZII, FEMALE, NATURAL SIZE. *a*. FRONT. *b*. MAXILLIPED. *c*. LARGER CHELA.

Chelipeds very unequal, rather stout; surface covered with rough, scaly granules. Lower margin of merus bordered by rather large tubercles or blunt spines; upper surface very rough. Carpal spine sharp. Palm (fig. 10, *c*) stout, both margins convex; fingers not gaping, and with broad triangular teeth. Ambulatory legs rough with spinules and spiniform

granules; meri broad, with very convex upper margins; dactyli very long, considerably exceeding the propodal joints.

Dimensions.—Female: Length, 24.5 mm.; width, 35.6 mm.; exorbital width, 23.5 mm.; width of front above, 10.5 mm.; depth of front, 1 m.

Type.—No. 4915, Mus. Comp. Zool.; one female. Para, Brazil; Agassiz and Bourget, Thayer expedition.

PSEUDOTHELPHUSA FOSSOR, new species.

Boscia dentata GERSTAECKER, Arch. f. Naturg., 1856, XXII, Pt. 1, p. 145. Not *Boscia dentata* Milne-Edwards.

Superior margin of front tuberculate, not keeled, bilobate; surface finely granulate; cervical suture straight; merus of maxillipeds with outer margin convex; exognath reduced to a stump.

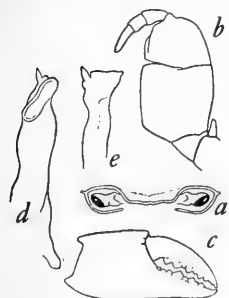


FIG. 11.—PSEUDOTHELPHUSA FOSSOR. a. FRONT, NATURAL SIZE. b. MAXILLIPED, $\times 2\frac{1}{2}$. c. LARGER CHELA, FEMALE, NATURAL SIZE. d. LEFT ABDOMINAL APPENDAGE, MALE, LOWER VIEW, $\times 5$. e. THE SAME, INNER VIEW, $\times 5$.

Carapace about three-fifths as long as wide, convex in both directions, smooth to the eye, finely punctate, faintly granulate along the frontal and lateral margins. Cervical suture very shallow, straight, scarcely distinguishable near the margin of the carapace. There is a shallow depression behind the outer end of the cervical suture. Median suture sufficiently marked; epigastric lobes narrow, distinct. Lateral margins denticulate; a shallow tooth is present at one-third the distance from the orbit to the cervical suture. The frontal region in advance of the epigastric lobes is deflexed. The front itself is perpendicular, about one-fourth the width of the carapace, shallow, deepest near the outer ends (fig. 11, a); lower border marginate, sinuous; upper border tuberculate, straight when viewed from above, inclining slightly toward the middle

when viewed from in front. The orbits belong to the group having a more or less quadrate outline; upper margin nearly transverse, lower margin running downward and outward from the inner angle. The eyes are rather large. The maxillipeds (fig. 11, b) have the outer margin of the merus and ischium of the endognath regularly convex, the ischium having its greatest width at some distance back of the distal end. The merus is not much wider than long. The exognath is much reduced, not reaching more than one-third the length of the margin of the ischium.

Chelipeds very unequal, covered with scabrous granules. Carpal tooth acute. Palm (fig. 11, c) with convex margins; fingers wide, meeting along their cutting edges, tips crossing, teeth white. Ambulatory legs with meral joints dilated in the middle; otherwise long and narrow. Dactyli long and slender, armed with very slender spines.

Dimensions.—Female: Length, 17.6 mm.; width, 28.7 mm.; width of front on lower margin, 6.5 mm.; greatest depth of front, 1 m.

Type.—One female. No. 18818, U. S. N. M. Near La Guayra, Venezuela; Lieut. Wirt Robinson, United States Navy, June 23, 1895.

Additional specimens.—Caracas; Gollmer (No. 375, Berlin Mus., one male; Nos. 378, 384, 385, three females). Venezuela; E. Simon (Paris Mus., one male and four females). 'Antilles' (Kiel Mus., three males).

Of the habitat of this species, Lieut. Robinson says:

About three-fourths of a mile to the eastward of La Guayra a bed of a stream enters the sea. Ascending the valley, or rather canyon, down which this bed runs, there is on the right hand side an acequia, or aqueduct, cut out in the face of the steep hills. This taps the stream a mile above and takes all of its water leaving the bed from this point dry. About three-fourths of a mile back from the sea the canyon grows deeper and narrower and is filled with large buttressed trees. The little acequia winds among these in a semigloom. All along under the roots of these trees and under loose stones to the right and left, these little whitish crabs have burrows and sit at the entrance of them, gliding back under shelter as one passes near.

PSEUDOTHELPUSA DILATATA, new species.

Superior margin of front tuberculate, not keeled; lower margin convex; cervical suture sinuous; merus of maxilliped with outer margin convex; exognath about half length of ischium.

Closely allied to *P. xantusi*. Carapace of similar proportions, with large punctæ, but devoid of the granulation so conspicuous on the frontal and lateral regions of *P. xantusi*. Cervical suture sinuous and deep, very broad in its inner half.

Branchial region very convex anteriorly, as in *P. xantusi*. Median furrow continued to the lower margin of the front. Front narrower than in *xantusi*; lower margin arcuate, most depressed in its central portion (fig. 12, a); in *xantusi* this margin for its entire length is in almost the same horizontal plane; upper margin also arcuate; front slightly deeper toward the outside. Orbits differing from those of *xantusi*; in the latter the upper and lower margins are regularly arcuate; in *dilatata* the orbits are subquadrilateral, the side margin of the front forms somewhat of an angle with the upper margin which is nearly straight for a ways; the lower margin beginning at the inner end slopes outward and downward. Maxillipeds similar to those of *xantusi* (fig. 12, b). The abdominal appendages of the male are akin to those of *jouyi* and *americana*; the outer laminate branch near the extremity is wider distally than proximally; more spreading than in *jouyi* and is 3-toothed; the inner projection is a broad, rounded lobe with a small tooth above its base (fig. 12, e, f). The chelipeds are very unequal in both sexes, but more so in the male. The palm in the larger cheliped widens considerably toward the fingers and is very thick and heavy, its lower margin con-

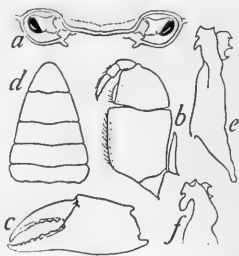


FIG. 12.—PSEUDOTHELPUSA DILATATA, MALE. a. FRONT, $\times \frac{3}{8}$. b. MAXILLIPED, $\times 1\frac{1}{2}$. c. LARGER CHELA, $\times \frac{1}{2}$. d. ABDOMEN, $\times \frac{3}{8}$. e. LEFT ABDOMINAL APPENDAGE, LOWER VIEW, $\times 2$. f. THE SAME, INNER VIEW, $\times 2$.

vex, upper nearly straight (fig. 12, c). Lower margin of palms tuberculate. Fingers widely gaping to the tips in the male, very slightly gaping in the female.

Dimensions.—Male: Length, 34 mm.; width, 56.2 mm.; width of front, lower margin, 13.8 mm. Female: Length, 37 mm.; width, 61.2 mm.; width of front, lower margin, 14.3 mm.

Distribution.—This species was received from the Mexican commission of the World's Columbian Exposition, 1893. The types are from Colima, Mexico; one large male and two large females (No. 18632, U. S. N. M.). There are also one male and three females from Huetamo, State of Michoacan.

PSEUDOTHELPHUSA SULCIFRONS, new species.

Allied to P. dilatata, but front higher, orbits oval, cervical suture straight and more transverse, merus of maxilliped shorter.

Carapace wider than in *dilatata*, smooth; cervical suture straighter and more transverse, deep; median suture very deep, continued to the lower margin of the front. Front (fig. 13, a) of about even depth throughout its width; lower margin an even curve, interrupted at the middle; upper margin obscurely tuberculate. Outline of orbit like that of *P. xantusi*. Abdominal appendage of the first segment in the male (fig. 13, e, f) with the outer laminate process well developed, its outer margin irregularly dentate, posterior tooth the largest, denticulate, and separated by a broad sinus from the following teeth. The lobe on the inner side of the appendage is broader and its basal tooth larger than in *P. dilatata*. Palm of cheliped (fig. 13, c) with its lower margin more convex than in *dilatata*; the palm is widest at a little distance from the base of the dactylus, while in *dilatata* the widest part is at the base of the dactylus. The pollex is shorter than in *dilatata*. Surface of fingers and lower surface of palm covered with squamiform granules.

Dimensions—Male: Length, 22.8 mm.; width, 39.5 mm.; width of front, lower margin, 9.8 mm.

Type.—One specimen only, a male (No. 19482, U. S. N. M.), was collected at Yalalag, Oaxaca, Mexico, July 4, 1894, by E. W. Nelson and E. A. Goldman while making biological explorations for the U. S. Department of Agriculture. It was found in a spring on the mountain side at about 3,500 feet elevation.

PSEUDOTHELPHUSA GARMANI, new species.

Superior margin of front keeled; carapace depressed, granulate; exognath of maxillipeds reduced to a stump; hand with a tubercle at base of fingers; front low.

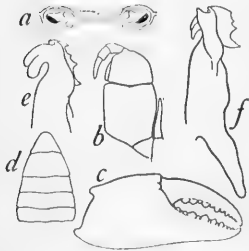


FIG. 13.—PSEUDOTHELPHUSA SULCIFRONS, MALE. a. FRONT, x $\frac{3}{4}$. b. MAXILIPED, x $1\frac{1}{2}$. c. LARGER CHELA, x $\frac{3}{4}$. d. ABDOMEN, x $\frac{3}{4}$. e. LEFT ABDOMINAL APPENDAGE, INNER VIEW, x 3. f. SAME, LOWER VIEW, x 3.

Carapace slightly convex; the gastric region is a little elevated, the branchial less so. The protogastric lobes are prominent and are continued laterally in a faint ridge to a point behind the base of the eye-stalk (fig. 14, *b*). The depressions defining the anterior part of the mesogastric region are distinct. Median furrow very deep. Cervical groove straight, deep, and continued nearly to the lateral margin. Anterior and lateral portions of the carapace covered with coarse scabrous granules. Lateral margins finely dentate, with traces of two larger indentations between the orbit and the cervical suture. Front low (fig. 14, *a*); superior margin convex, bilobed, tuberculate, slightly projecting over the vertical surface, and in a front view slightly concave or depressed in the middle; lower margin prominent, tuberculate, sinuous, partially visible in a dorsal view in small specimens. Orbit nearly filled by the eyes and with tuberculate margins, the superior margin sinuous. The outer margin of the endognath of the maxillipeds is convex (fig. 14, *g*); the ischium is narrower at its distal end than behind that point; the merus is rather short and broad, and has a regularly arcuate antero-lateral margin. The exognath is very short, being reduced to a stump.

The merus of the chelipeds is rugose above, the inner margin is armed with stout teeth graduated in size; the lower and distal margins of the inferior surface are marked by small and regular bead granules. Carpus rugose; inner tooth acute. Larger prop-

odus stout (fig. 14, *f*), upper margin slightly convex; lower margin convex except for a slight sinus beneath the base of the pollex; surface covered with scattered scabrous granules; a large irregular tubercle at the base of the union of the fingers. Fingers broad, deeply punctate, punctae in longitudinal rows; prehensile edges in contact or nearly so, and furnished with broad teeth. The smaller propodus differs in having the margins subparallel, and in having less heavy teeth on the fingers. Merus joints of ambulatory legs flattened, with upper margins convex and sharply denticulate. Superior margin of carpal and both margins of propodal joints spinulose. These joints in the last pair are rather broad. The dactyli are slender.

Dimensions.—Type, female: Length, 17.1 mm.; width, 26.8 mm.; exorbital width, 17.1 mm.; width of front below, 7 mm.; above, 8 mm.; depth, 0.7 m. Female, Antilles: Length, 38 mm.; width, 63 mm.; exorbital width, 35 mm.; width of front below, 15.8 mm.; above, 17.7 mm.;

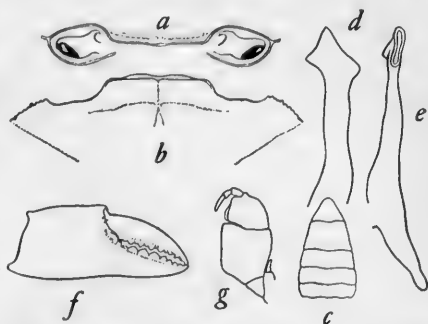


FIG. 14.—*PSEUDOTHELPHUSA GARMANI*. *a*. FRONT, X 13. *b*. ANTERIOR OUTLINE, X 13. *c*. ABDOMEN, MALE, NATURAL SIZE. *d*. LEFT ABDOMINAL APPENDAGE, MALE, INNER VIEW, X 10. *e*. THE SAME, LOWER VIEW, X 10. *f*. LARGER CHELA, FEMALE, X 13. *g*. MAXILLIPED, X 13.

depth, 2.2 mm. Male, Caracas: Length, 22.7 mm.; width, 35.2 mm. Female, Caracas: Length, 49 mm.; width, 78 mm.

Type.—No. 5101, Mus. Comp. Zool.; one immature female. Trinidad; S. Garman, April 6, 1879.

Additional localities.—Venezuela: Near Caracas (Copenhagen Mus.; one small male, one small female, one young). Caracas; Gollmer (Nos. 1387, 1388, 2122, Berlin Mus.; one male and three females). A large female labeled "Antilles, Dr. Claudius, 1858," is in the museum at Kiel.

This crab is very closely related to *P. dentata* of the Windward Islands and *P. fossor* also of Venezuela. It is easily distinguished from either by its lower, wider front, from *dentata* by the tubercle on the manus and the wider merus of the endognath, and from *fossor* by its rougher, flatter carapace and projecting frontal margin.

PSEUDOTHELPHUSA AFFINIS, new species.

Potamocarcinus dentatus ORTMANN, Zool. Jahrb., Syst., 1897, X, p. 318 (part).
Not *Pseudothelphusa dentata* (Latreille).

Allied to P. dentata; carapace wider; front wider and lower; cervical sutures convex to each other in their anterior half.

This species differs from *P. dentata* as follows: The carapace is wider; the cervical suture, although nearly straight, is slightly convex forward in its anterior half; median suture and epigastric lobes very faintly indicated. Lateral margins, although distinctly denticulate, are not broken by an epibranchial or other large tooth. Front wider and much less high than in *P. dentata*, the height between the tubercles being about one-twelfth the greatest width of the front, measured inside the tubercles of the lateral margin. The lower margin of the palm is very convex, the width of the palm being nearly equal to the superior length.

Dimensions.—Female: Length, 22.4 mm.; width, 38.8 mm.; superior width of front, 10.7 mm.; entire height of front, 1.3 mm.; superior length of palm, 13.5 mm.; width of same, 12.5 mm.; length of dactylus, 16.5 mm.

Type.—No. 128, Mus. Phila. Acad. Nat. Sci.; one female, dried. Cuba; Guérin; Dr. T. B. Wilson collection.

PSEUDOTHELPHUSA MAXILLIPES, new species.

Superior margin of front keeled; maxillipeds unusually wide; exognath about three-fourths the length of the ischium of the endognath.

Carapace of medium width, obscurely granulate on the frontal and lateral regions, finely punctate. Cervical suture shallow, nearly straight. Lateral margin denticulate, interrupted by a small tooth at the cervical suture. Front (fig. 15, *a*) of slight depth and vertically concave; lower edge strongly marginate, more depressed in the center than outwardly; the two halves slightly sinuous; upper margin tuberculate, the lobes nearly straight and transverse in a dorsal view and

inclined downward toward each other in a front view. Margins of orbits similar to those of *dilatata*, in that the upper and lower margins are nearly straight and parallel; just below the outer sinus, however, the margin is produced in a shallow obtuse tooth in addition to the regular crenulation of the margin. The last two segments of the abdomen of the male (fig. 15, *d*) are rather long, and their margins partly concave. The appendages of the first segment (fig. 15, *e, f*) are more like those of *richmondi* than any other species; distally they are much compressed in a vertical direction, and on the upper margin have three teeth, the anterior of which is on the inner side of the appendage, the two posterior on the outer side; the posterior of these teeth is large, acute, directed upward and backward; on the outer surface near the extremity there is a small slender spine directed outward. The outer maxillipeds (fig. 15, *b*) are wider than in any other described species; the ischium of the endognath much wider at its distal than its proximal end; outer margin of the merus with a very convex arch.

Chelipeds very unequal. The larger propodus (fig. 15, *c*) is very deep; upper margin slightly convex, lower margin convex, forming a single curve to the end of the pollex; fingers slightly gaping; teeth very irregular; the largest tooth occurs at about the middle of the pollex in both chelipeds; in the greater one, this tooth is strongly developed and outwardly protuberant, an effect probably due to injury. The upper margin of the smaller hand is slightly convex; lower margin convex proximally, concave distally. The inner surface of the hands and fingers shows numerous scabrous tubercles or granules, especially on the margins; these are present, though much less distinct, on the outer surface.

Dimensions.—Male: Length, 37.5 mm.; width, 59 mm.; width of front on lower margin, 14.2 mm.; depth of front, 1.7 mm.

Type.—No. 19481, U.S.N.M.; one male. Tuxtla, Vera Cruz, Mexico, 1,000 feet elevation; E. W. Nelson and E. A. Goldman, May 16, 1894, Biological Survey, U. S. Department of Agriculture.

PSEUDOTHELPHUSA CONVEXA, new species.

Superior margin of front keeled; carapace very convex longitudinally; lateral outline of fourth to sixth segments of abdomen of male not arcuate (fig. 16, d); appendages of the first segment similar to those of P. tristani; exognath reaching distal third of ischium of endognath.

This species resembles *P. reflexifrons* and *P. agassizii* in being very convex antero-posteriorly. Carapace smooth, except along the postero-

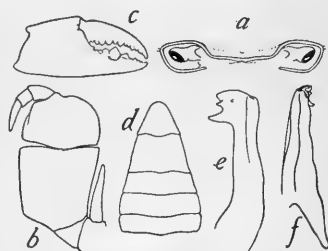


FIG. 15.—PSEUDOTHELPHUSA MAXILLIPES, MALE. *a*. FRONT, $\times \frac{2}{3}$. *b*. MAXILLIPED, $\times 1\frac{1}{2}$. *c*. LARGER CHELA, $\times \frac{1}{2}$. *d*. ABDOMEN, $\times \frac{2}{3}$. *e*. RIGHT ABDOMINAL APPENDAGE, OUTER VIEW, $\times 1\frac{2}{3}$. *f*. LEFT ABDOMINAL APPENDAGE, LOWER VIEW, $\times 1\frac{2}{3}$.

lateral margins. The cervical suture is sinuous, wider, and deflected slightly backward in its inner half, becoming obsolete near the margin, and ending in a transverse depression. Lateral margin for the most part sharply and irregularly denticulate, the denticles becoming smaller and more obtuse anteriorly, where there is a shallow tooth between the orbital angle and the cervical suture. Median sulcus well marked, cutting the superior frontal margin. Epigastric lobes faintly indicated. Front (fig. 16, *a*) shallow, concave in a vertical direction; lower border conspicuously marginate, sinuous, the front being deepest near the middle; upper margin depressed, projecting forward in a tuberculate crest, which is divided into two slightly convex lobes. The orbits are of the same order as in *dilatata*, the lower margin sloping downward from the inner angle. The male abdominal appendages of the first

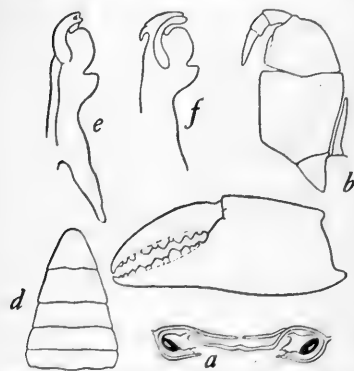


FIG. 16.—*PSEUDOTHELPHUSA CONVEXA*, MALE.
a. FRONT, NATURAL SIZE. *b*. MAXILLIPED, X 2. *c*. LARGER CHELA, NATURAL SIZE.
d. ABDOMEN, NATURAL SIZE. *e*. LEFT ABDOMINAL APPENDAGE, INNER VIEW, X 3.
f. THE SAME, LOWER VIEW, X 3.

segment (fig. 16, *e*, *f*) are of the same class as those of *P. tristani* and *P. tumimanus*; of the two lobes on the outer margin, the anterior is much more thickened and deflexed than in those species; as in *tristani*, the posterior lobe is reduced and subquadrate instead of triangular and acute. The merus of the maxillipeds (fig. 16, *b*) is narrower than in *tristani*, its greatest length exceeding its anterior width. The exognath extends to the distal third of the ischium of the endognath.

The chelipeds are distinguished by the slender, acuminate carpal spine. The propodus (fig. 16, *c*) is slightly convex above and convex below the

palmar portion. The inner and upper surfaces are marked with small tubercles, most abundant near the margins. The fingers do not gape, and are tuberculate on both inner and outer surfaces. The ambulatory legs are rather narrow.

Dimensions.—Male: Length, 25 mm.; width, 39.6 mm.; width of front along lower margin, 9.5 mm.; greatest depth of front, 1.2 mm.

Type.—No. 19483, U.S.N.M.; one male received from the National Museum of Costa Rica. Palmar, Costa Rica, 20 meters; George K. Cherrie.

Additional locality.—One male was also received from Mr. H. Pittier, who collected it at Santo Domingo, Gulf of Dulce, Costa Rica, April, 1896.

PSEUDOTHELPHUSA PITTIERI, new species.

Small species; superior margin of front keeled; carapace finely granulate; abdominal appendages of the jouyi group.

Carapace flattened, granulate anteriorly and laterally. Cervical

suture strongly curved, concave forward, as in *bocourti*, but more transverse than in that species. Front (see fig. 17, *a*). Orbits (fig. 17, *a*) nearly transverse in a front view, suboval. Abdominal appendages similar to those of *jouyi*, *americana*, *terrestris*, etc. (fig. 17, *d*); extremity with a large, rounded, inner lobe, and a pointed tooth directed forward at the antero-external angle. Fingers of chelipeds slightly gaping (fig. 17, *b*). Meral joints of ambulatory legs dilated in the middle.

Dimensions.—Male: Length, 12.3 mm.; width, 19.5 mm. Female: Length, 17 mm.; width, 27.5 mm.

Habitat.—Costa Rica: Agua Buena, type locality; Java, one female. The specimens are the gift of Mr. H. Pittier, director of the Physical-Geographical Institute of Costa Rica, for whom the species is named.

Types.—No. 21243, U.S.N.M.; two males, two females; Agua Buena.

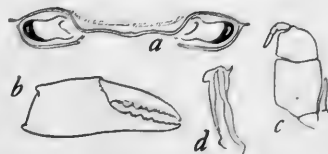


FIG. 17.—*PSEUDOTHELPHUSA PITTIERI*, MALE. *a*. FRONT, X 1 $\frac{1}{2}$. *b*. LARGER CHELA, X 1 $\frac{1}{2}$. *c*. MAXILLIPED, X 2. *d*. LEFT ABDOMINAL APPENDAGE, LOWER VIEW, X 3.

PSEUDOTHELPHUSA PERUVIANA, new species.

Superior margin of front keeled, carapace coarsely granulate; merus of maxilliped subtriangular; abdominal appendages horizontally compressed.

A narrow species, with advanced front. Carapace covered with depressed, crowded granules, larger near the margin; punctae inconspicuous. Cervical suture a single curve, concave forward. Antero-lateral teeth well marked, but small. Median suture very deep, cutting the superior frontal margin. This margin is arcuate in a single curve, ending above the base of the eyestalks, tuberculate; in a front view it bends down toward the middle (fig. 18, *a*).

Lower margin projecting beyond the upper, tuberculate, strongly sinuous, three-lobed, the middle lobe reaching farther down than the lateral lobes, which are subtriangular. Side margins of front nearly vertical. Orbits about as wide as one-half the front, rather deep, nearly filled by the eyes. Abdominal appendages twisted, terminal third lamelli-form, compressed horizontally (fig. 18, *e*). Maxilliped (fig. 18, *c*) with exognath short, about one-half length of ischium. The ischium is a little narrower at the distal end than behind that point; merus subtriangular, outer margin very slightly convex. Chelipeds granulate, not very unequal. Merus strongly

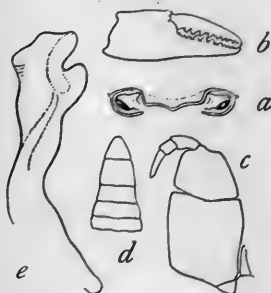


FIG. 18.—*PSEUDOTHELPHUSA PERUVIANA*, MALE. *a*. FRONT, X 1 $\frac{1}{2}$. *b*. LARGER CHELA, X 1 $\frac{1}{2}$. *c*. MAXILLIPED, X 3 $\frac{1}{2}$. *d*. ABDOMEN, X 1 $\frac{1}{2}$. *e*. LEFT ABDOMINAL APPENDAGE, LOWER VIEW, X 4.

toothed on inner margin; feebly tuberculate on lower and distal margins of inner surface. Hands convex above and below. Teeth of fingers subtriangular, as a rule large and small alternating and dove-

tailing into each other so that the fingers do not gape (fig. 18, *b*). Ambulatory legs not very long; meri flat, widening slightly toward the middle; carpi rather wide; propodi short and broad; dactyli about as long as posterior margin of propodi.

Dimensions.—Male: Length, 23.5 mm.; width, 34.3 mm.; width of front above, 10.7 mm.; below, 9.8 mm.; greatest depth, about 1.6 mm.

Types.—No. 74-53, Brit. Mus.; two males; Moyombamba, Peru; Purdi Higgins.

POTAMOCARCINUS Milne-Edwards.

Potamocarcinus MILNE-EDWARDS, Ann. Sci. Nat., 3d ser., Zool., 1853, XX, p. 208 [174]; Arch. Mus. Hist. Nat. Paris, 1854, VII, p. 174. Type, *P. armatus* Milne-Edwards.—RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 655.—ORTMANN, Zool. Jahrb., Syst., 1897, X, pp. 298, 315 (part).

Kingsleya ORTMANN, Zool. Jahrb., Syst., 1897, X, pp. 298, 324. Type, *Potamia latifrons* Randall.

I have set apart under the name *Potamocarcinus* those species which have the superior frontal margin overhanging the front, which is rapidly retreating; the orbits very deep, the margins above and below making deep, semicircular incisions in the carapace, and having below two angular sinuses, and the antero-lateral teeth large and spiniform.

To this genus I refer *P. armatus* Milne-Edwards (type species), *P. nicaraguensis* Rathbun, and *P. latifrons* (Randall)=*Potamia schomburgkii* White, 1847,¹ nomen nudum (type examined).²

I have not adopted the genus *Kingsleya* Ortmann for the following reasons: The genus is established on two characters, namely, the union of the inner orbital angle with the front, and the reduction of the exognath of the third maxilliped. An examination of the species of *Pseudothelphusa* having a very short exognath (p. 513) will convince one that this is but a specific character. As to the union of the front and the orbital angle, this character is open to the objection stated under *Hypotobocera* (p. 509). Even in the type specimen of *Potamia latifrons* Randall (*Kingsleya* Ortmann), the two sides are not symmetrical. On the right side the front unites with the orbital margin, but on the left it does not, there being between them a hiatus in which lies the flagellum. The inner suborbital lobe is present on both sides, but is almost entirely hidden. *Kingsleya* is therefore considered a synonym of *Potamocarcinus*.

ANALYTICAL KEY TO THE SPECIES OF POTAMOCARCINUS.

- A. Exognath reduced to a stump, less than one-third the length of the ischium of the endognath *latifrons*
- A'. Exognath more than one-third the length of the ischium.
 - B. Carapace more than $1\frac{1}{2}$ times as wide as long (including spines) *nicaraguensis*
 - B'. Carapace less than $1\frac{1}{2}$ times as wide as long (including spines) *armatus*

¹List Spec. Crust. Coll. Brit. Mus., p. 30.

²*Potamocarcinus denticulatus* Stimpson, Proc. Acad. Nat. Sci. Phila., 1861, XIII, p. 373, from the River Atrato, United States of Colombia, is indeterminable from the brief description. The type is not extant, and specimens have not since been collected from the same locality. It is probably a *Pseudothelphusa*, and if so, the name *Ps. denticulata* is preoccupied for another species described by Milne-Edwards.

EPILOBOCERA Stimpson.

Epilobocera STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1860, VII, p. 234. Type, *E. cubensis* Stimpson.—SMITH, Trans. Conn. Acad. Sci., 1870, II, p. 150.—RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 657.—ORTMANN, Zool. Jahrb., Syst., 1897, X, pp. 298, 321.

Opisthocera SMITH, Trans. Conn. Acad. Sci., 1870, II, p. 148. Type, *O. gilmanii* Smith.

In the genus *Epilobocera* are included those species in which the exognath exceeds the ischium of the endognath, and is sometimes at least provided with a palpus, and in which there is a tooth or spine in the efferent branchial channel. There is also a subcervical suture, bordered on the posterior side by a granulated line. The spines on the dactyli of the ambulatory legs are longer and more slender than in *Pseudothelphusa*, and also more numerous than in any species of that genus except *P. macropa*. The principal character assigned by Stimpson to this genus, the union of the inner suborbital lobe with the front, is not constant. This lobe is usually separated from the front by the width of the flagellum.

I believe that the first description of an *Epilobocera* was made by Herbst under the name *Cancer fluviatilis*.¹ Herbst confused several species in the synonymy, but his figure was borrowed from the manuscript of Plumier's 'Zool. Americ.', and the description is evidently based on the figure and not on the animal itself. No locality is given. Plumier made three voyages to the West Indies and the neighboring continent. Among the islands visited were Guadeloupe, Martinique, and Santo Domingo. The species *Cancer fluviatilis* approaches nearest to *E. cubensis* Stimpson, but its identity can not be determined with certainty. Latreille named it *Thelphusa serrata*.²

As above defined, the genus *Epilobocera* contains six species: *E. cubensis* Stimpson (type species), *E. sinuatifrons* (A. Milne-Edwards), *E. armata* Smith, *E. gilmanii* (Smith, as *Opisthocera*), *E. haytensis* Rathbun, and *E. granulata* Rathbun.

Dr. Ortmann³ rejects the name *cubensis* for that species because Stimpson in his specific diagnosis, "Superior frontal crest . . . not projecting beyond the inferior one," contradicts his generic diagnosis, "*Potamocarcino carapacem frontemque similis*," and also Professor Smith's statement that "the superior frontal crest projects considerably beyond the inferior." The truth is that different individuals of this species vary in the amount of projection of the front. In large specimens (about 52 by 84 mm.) the superior margin of the front is considerably projecting, while in small specimens (about 20 by 31.3 mm.) the superior margin projects scarcely at all over the surface of the front.

Considering the correspondence in locality, there seems to be little

¹Natur. Krabben u. Krebse, 1785, I, p. 183, pl. x, p. 61.

²Nouv. Dict. Hist. Nat., 1819, XXXIII, p. 504.

³Zool. Jahrb., Syst., 1897, X, p. 322.

doubt that Stimpson's species is the same as the *cubensis* of von Martens. One of von Martens's types, a half-grown specimen, I have compared with the specimen of equal size in the museum of the Philadelphia Academy, from Cuba, labeled by Dr. Ortmann *E. gilmanii* (Smith), and find them identical.¹ To *E. cubensis* von Martens, Dr. Ortmann gives the name *E. haytensis* Rathbun, considering them synonymous; but the identity of the species is disproved by the fact that a specimen of true *E. haytensis* Rathbun in the museum of the Philadelphia Academy is labeled "*Potamocarcinus sinuatifrons* (A. Milne-Edwards)."² This specimen agrees with the one figured in Proceedings of the U. S. National Museum, 1893.³ Moreover, it is impossible for species to be synonymous which have maxillipeds so different in shape as those shown in figures 5 and 6 of the plate cited.

The specimens of *E. haytensis* Ortmann,⁴ from Guantanamo, Cuba, are *E. armata* Smith. I have compared them directly with one of the types. The locality of the type specimens is unknown, though thought by Professor Smith to be the Bahamas. It is not, however, known that any of the Pseudothelphusinae inhabit the Bahamas. *E. cubensis* is quite convex and evenly so, both in an antero-posterior and a transverse direction. *E. armata* is less convex, the cervical suture deeper, the tubercles of the superior frontal margin are very prominent and form a distinct ridge, well marked in the young male as well as in the adult female, which measures 29.8 by 46.6 mm., with the superior width of the front 13 mm. The outer angle of the orbit has one or two prominent spiniform tubercles, and the teeth of the antero-lateral margin are spiniform. There are, however, tubercles or granules near the lateral margins of the carapace which are wanting in the types, these being much larger specimens than the female in the Philadelphia Academy.

The six species of *Epilobocera* may be divided into two groups, according to the form of the merus of the endognath. In the first group belong those species having the merus very broad and regularly arcuate from the postero-external angle to the insertion of the palpus; the second group includes those species having the merus narrower and subquadrate, the outer margin forming a blunt angle with the distal margin. *E. armata*, *cubensis*, *granulata*, and *gilmanii* belong to the first group. *E. gilmanii* is set apart from the others by its much narrower and more convex carapace, more advanced front, projecting considerably beyond the line of the outer orbital angles and by the smoothness of the front. *E. armata* and *cubensis* are of about equal width, small specimens being narrower proportionally than large ones. The difference between these two species is given in a preceding paragraph. *E. granulata*, founded on young specimens, is much wider than either of its allies, and its frontal crest is strongly marked, as in young *armata*. The inferior margin differs from that of *armata* in being sinuous and in projecting beyond the superior.

¹ See Zool. Jahrb., X, p. 323.

³ Vol. XVI, pl. LXXVII, figs. 4, 5.

² Zool. Jahrb., X, p. 318.

⁴ Zool. Jahrb., X, p. 322.

The second group, with quadrate meri, embraces *E. haytensis* and *E. sinuatifrons* (*E. portoricensis*, manuscript, Berlin Mus.). *E. haytensis* is much flatter than any other member of the genus, and is narrower than *sinuatifrons*, with strikingly larger eyes and strongly protruding inferior frontal margin; this margin is not visible in a dorsal view of *sinuatifrons*.

ANALYTICAL KEY TO THE SPECIES OF EPILOBOCERA.

- A. Front without superior crest; exognath considerably overlapping merus of endognath; spine of efferent channel narrow.....*gilmanii*
- A'. Front with superior crest; exognath slightly overlapping merus of endognath; tooth of efferent channel short and broad.
- B. Merus of endognath broad, its outer and anterior margin arcuate.
- C. Width varying from 1.56 times the length in small specimens to 1.64 times the length in large specimens.
- D. Antero-lateral teeth spiniform.....*armata*
- D'. Antero-lateral teeth dentiform.....*cubensis*
- C'. Wider; width of small specimens 1.7 times length.....*granulata*
- B'. Merus of endognath narrower, subquadrate, with an antero-external angle.
- C. Inferior margin of front projecting beyond the superior.....*haytensis*
- C'. Inferior margin of front not projecting beyond the superior....*sinuatifrons*

RATHBUNIA Nobili.

Rathbunia NOBILI, Boll. Mus. Zool. Torino, April 16, 1896, XI, No. 238, p. [1]; March 15, 1897, XII, No. 280, p. [2], text figure.

This genus is allied to *Pseudothelphusa*, but differs from it and also from all other members of the subfamily in the form of the outer maxilliped (see text figure cited above), the merus of which is very narrow posteriorly. Its posterior margin is articulated with the outer half of the anterior margin of the ischium.

The genus was founded on a single specimen (female) from Darien, in the museum at Turin, *Rathbunia festæ*. It is one of the largest of the *Pseudothelphusinae*, being equaled only by *Pseudothelphusa magna* and *henrici*, *Potamocarcinus nicaraguensis*, and *Epilobocera sinuatifrons*.

DISTRIBUTION OF THE PSEUDOTHELPHUSINÆ.

The genus *Epilobocera*, with six species, is confined to the West Indian Islands.

The genus *Potamocarcinus*, with three species, is continental, so far as known, ranging from Nicaragua to Guiana.

The genus *Rathbunia*, one species only, inhabits Darien.

The genus *Pseudothelphusa* embraces many more species than any of the above, and ranges throughout the West Indies and on the continent from the States of Jalisco and Guanajuato in Mexico to Peru and Bolivia on the west, and Para, Brazil, on the east. There is no indisputable evidence of its occurrence in Chile. The *Potamonidæ* are represented in Brazil, Argentina, Paraguay, Uruguay, and Chile by the *Trichodactylinae*, which, however, are not confined to those countries, but inhabit nearly the whole of South America and extend into Nica-

ragua. The single American *Potamon*, *P. (Geothelphusa) chilensis* (Heller), inhabits Chile.

The evidence goes to show that each species of the Pseudothelphusinae inhabits a limited area, and that closely related species inhabit adjacent areas. The only instances of the same species inhabiting both continent and island are *Ps. garmani*, in Venezuela and Trinidad, and *Ps. americana* and *Ps. terrestris*, both of which are found in Cuba and Central Mexico. Each species of *Epilobocera* is restricted to a single island or to two adjacent islands, as, for example, *E. cubensis* and *E. armata* to Cuba, *E. gilmanii* to the Isle of Pines, *E. haytensis* to Haiti, and *E. sinuatifrons* to Porto Rico and Santa Cruz, which are connected by a ridge at about 900 fathoms depth. The home of *E. granulata* is not known, further than that it is West Indian. The species of *Pseudothelphusa* inhabiting the Greater Antilles do not extend farther east than Santa Cruz, being replaced in the Windward Islands by *P. dentata*.

Of continental species those having the greatest range are *Ps. macropa*, extending from Colombia to Bolivia; *Ps. xantusi*, from Mexico (?) to Venezuela; *Ps. richmondi*, from Nicaragua to the Isthmus; *Ps. colombiana*, from Mexico to Colombia, and *Ps. tuberculata*, from Guatemala to Costa Rica.

Costa Rica has yielded the greatest number of species of any one region. This is due not to the superabundance of species in this State, but to the diligence of collectors, Mr. J. Fid Tristan and his colleagues of the National Museum of Costa Rica, at San José, and Mr. H. Pittier, of the Physical-Geographical Institute of Costa Rica, also at San José.

It is worthy of note that in spite of the researches in Jamaica for many years past, no fluviatile crab of the family Potamonidæ has as yet been recorded from the island.

Following is a list of the species of Pseudothelphusinae, with the localities where each is found; also a list of localities, with the species found in each. Among the localities are given a few of doubtful value, as "Antilles" and "Chile," both of which are left out of consideration in the above remarks.

LIST OF THE SPECIES OF PSEUDOTHELPHUSINÆ, WITH LOCALITIES FOR EACH.

Genus PSEUDOTHELPHUSA Saussure.

æquatorialis (Ortmann).

Ecuador (Strasburg Mus.).

affinis Rathbun.

Cuba (Mus. Phila. Acad. Nat. Sci.).

agassizii Rathbun.

Brazil: Para (Mus. Comp. Zool.).

agrestis Rathbun.

Costa Rica: La Flor, Torito, 900-100 meters (U. S. Nat. Mus., Costa Rica Nat. Mus.); El Coronel, 700 meters (Costa Rica Nat. Mus.).

americana Saussure (type species of the genus) = *dugesi* Rathbun.

Cuba¹ (Geneva Mus.).

Haiti (type locality).

Mexico:

State of Morelos: Cuernavaca, type locality of *dugesi* (U. S. Nat. Mus., Turin Mus.);

State of Guanajuato: Guanajuato (U. S. Nat. Mus.);

State of Puebla: Chigahuapan (U. S. Nat. Mus., Paris Mus.);

State of Guerrero: Amula (Brit. Mus., U. S. Nat. Mus.);

State of Oaxaca: Oaxaca (Paris Mus.).

belliana Rathbun.

Mexico: State of Guerrero: Xautipa (Brit. Mus., U. S. Nat. Mus.).

bisuturalis Rathbun.

Guatemala: Streams of St. Augustine near Atitlan, on Pacific slope (Paris Mus., U. S. Nat. Mus.).

Locality unknown (Brit. Mus.).

bocourti (A. Milne-Edwards).

Guatemala: Coban, Vera Paz (Paris Mus.).

bourieri Rathbun.

United States of Colombia: Santa Fé de Bogota (Paris Mus., U. S. Nat. Mus.).

chilensis (Milne-Edwards and Lucas).

Peru: Lima² (Paris Mus., Mus. Phila. Acad. Nat. Sci.).

colombiana Rathbun.

United States of Colombia:

River David, Chiriqui, 4,000 feet, type locality (U. S. Nat. Mus.);

Chiriqui (Berlin Mus.).

Mexico, 300 meters (Brit. Mus., U. S. Nat. Mus.).

conradi Nobili.

Ecuador:

Gualaquiza (Turin Mus.);

Valley of the Rio Santiago (Turin Mus.);

San José de Cuchipamba (Turin Mus.);

Exact locality not given (U. S. Nat. Mus.).

Peru:

Cutervo (Brit. Mus., U. S. Nat. Mus.);

Tambillo (Brit. Mus.).

convexa Rathbun.

Costa Rica:

Palmar, 20 meters, type locality (U. S. Nat. Mus.);

Santo Domingo, Gulf of Dulce (U. S. Nat. Mus.).

dentata (Milne-Edwards) = *tenuipes* Pocock.

Guadeloupe (Paris Mus.).

Dominica, type locality of *tenuipes* (Brit. Mus., U. S. Nat. Mus., Mus. Comp. Zool.).

Martinique, type locality (Paris Mus., U. S. Nat. Mus., Mus. Comp. Zool.).

St. Lucia (U. S. Nat. Mus.).

? ? Chile (Brit. Mus.).

denticulata (Milne-Edwards).

Guiana:

Surinam (Mus. Comp. Zool.);

Cayenne, type locality (Paris Mus.).

¹The only specimens of *P. americana* in the museum at Geneva are labeled "Cuba."

²The type female from Guérin's collection in the Museum of the Philadelphia Academy of Sciences is marked on the abdomen "rivière de Lima."

dilatata Rathbun.

Mexico:

State of Colima: Colima, type locality (U. S. Nat. Mus.);

State of Michoacan: Huetamo (U. S. Nat. Mus.).

ecuadorensis Rathbun.

Ecuador:

Near Quito, type locality (Paris Mus., U. S. Nat. Mus.);

Tinubaco, north of Quito, 9,000 feet (Brit. Mus.).

exilipes Rathbun.

Costa Rica: El Coronel, 700 meters (U. S. Nat. Mus.).

Locality unknown (Brit. Mus., U. S. Nat. Mus.).

fossor Rathbun.

Venezuela:

Near La Guayra, type locality (U. S. Nat. Mus.);

Caracas (Berlin Mus.);

Exact locality not given (Paris Mus.).

"Antilles" (Kiel Mus.).

garmani Rathbun.

Trinidad, type locality (Mus. Comp. Zool.).

Venezuela:

Near Caracas (Copenhagen Mus.);

Caracas (Berlin Mus.).

"Antilles" (Kiel Mus.).

gracilipes (A. Milne-Edwards).

Guatemala: Mountains of Haute Vera Paz (Paris Mus.).

henrici Nobili.

Ecuador: Valley of Rio Santiago (Turin Mus.).

jouyi Rathbun.

Mexico:

State of Jalisco:

Lake Chapala, 5,000 feet, type locality (U. S. Nat. Mus., Paris Mus.,
Turin Mus., Mus. Comp. Zool.);

Juanacatlan, Falls of Rio San Juan (U. S. Nat. Mus., Mus. Comp. Zool.);

River of Zapotlanejo, Guadalajara (U. S. Nat. Mus., Paris Mus.).

State of Guanajuato: Near Valle de Santiago (U. S. Nat. Mus.).

lamellifrons Rathbun.

Mexico:

State of Vera Cruz: Cordoba (Brit. Mus., Geneva Mus., U. S. Nat. Mus.);

State of Oaxaca: Santa Domingo (U. S. Nat. Mus.);

Isthmus of Tehuantepec, type locality (U. S. Nat. Mus.).

indigiana Rathbun.United States of Colombia: Santa Fé de Bogota, type locality (Paris Mus.,
U. S. Nat. Mus.).

Ecuador: Milligalli, 3,000 feet (Brit. Mus., U. S. Nat. Mus.).

macropa (A. Milne-Edwards).

Bolivia, type locality (Paris Mus.).

United States of Colombia:

Santa Fé de Bogota (Paris Mus., U. S. Nat. Mus.);

Near Bogota (Mus. Comp. Zool.).

magna Rathbun.

Costa Rica:

Pozo Azul, 800 or 1,000 feet, type locality (U. S. Nat. Mus.);

Rio Maria Aguilar (U. S. Nat. Mus.);

San José, Rio Maria Aguilar (Costa Rica Nat. Mus.);

San José, Rio Torres (Costa Rica Nat. Mus.).

maxillipes Rathbun.

Mexico: State of Vera Cruz: Tuxtla, 1,000 feet (U. S. Nat. Mus.).

montana Rathbun.

Costa Rica: La Palma, 1,500 meters (U. S. Nat. Mus.).

nobilis Rathbun.

Ecuador:

Gualaquiza, type locality (Turin Mus., U. S. Nat. Mus.);

Valle del Rio Santiago (Turin Mus.);

San José de Cuchipamba (Turin Mus.);

Valle del Rio Zamora (Turin Mus.).

peruviana Rathbun

Peru: Moyombamba (Brit. Mus.).

pittieri Rathbun.

Costa Rica:

Agua Buena, type locality (U. S. Nat. Mus.);

Java (U. S. Nat. Mus.).

plana Smith.

Peru: Paiti (Yale Univ Mus.).

reflexifrons (Ortmann).

Upper Amazon, type locality (Mus. Phila. Acad. Nat. Sci.).

"Antilles" (Berlin Mus.).

richmondi Rathbun.

Nicaragua: Escondido River, 50 miles from Bluefields, type locality (U. S. Nat. Mus.).

Costa Rica: Santa Clara Jiménez, 250 meters (Costa Rica Nat. Mus.).

United States of Colombia:

Darien: Rio Cucunati (*teste* Nobili, Turin Mus.);

Isthmus of Panama: San Pablo (Mus. Comp. Zool.).

sulcifrons Rathbun.

Mexico: State of Oaxaca: Yalalag, 3,500 feet (U. S. Nat. Mus.).

terrestris Rathbun.

Cuba (Mus. Phila. Acad. Nat. Sci.).

Mexico:

State of Jalisco:

Atamajac, 3 miles west of Guadalajara, type locality (U. S. Nat. Mus.);

Barranca Ibarra, near Guadalajara, 3,700 feet (U. S. Nat. Mus., Paris Mus., Turin Mus., Mus. Comp. Zool.);

Etzatlan (U. S. Nat. Mus.).

Tepic Territory:

San Diego (U. S. Nat. Mus.);

Pedro Pablo (U. S. Nat. Mus.).

Exact locality not given (Berlin Mus.).

tristani Rathbun.

Costa Rica:

North of San José (Costa Rica Nat. Mus.);

La Mina, Rio Torres, 1,130 meters, type locality (U. S. Nat. Mus.);

Pacaca, Rodeo (U. S. Nat. Mus.);

Exact locality not given (Brit. Mus.).

tuberculata Rathbun.

Guatemala:

Streams of St. Augustine, near Atitlan, on Pacific slope, type locality (Paris Mus., U. S. Nat. Mus.);

Coban, 5,000 feet (Brit. Mus.).

Costa Rica: Boruca (U. S. Nat. Mus.).

tumimanus Rathbun.

Costa Rica:

Cachi, Reventazón River, 1,300 meters, type locality (U. S. Nat. Mus.);

La Palma, 1,500 meters (U. S. Nat. Mus.);

Pacaca, Rodeo, 785 meters (U. S. Nat. Mus.);

Locality unknown (Brit. Mus., U. S. Nat. Mus.).

verticalis Rathbun.

Mexico: State of Oaxaca: Tehuantepec (U. S. Nat. Mus.).

xantusi Rathbun.

? Mexico, type locality (U. S. Nat. Mus.).

Costa Rica: Boruca (U. S. Nat. Mus.).

United States of Colombia: Darien (*teste* Nobili, Turin Mus.).

Venezuela: La Guayra, Rio de Macuto (*teste* Nobili, Turin Mus.).

Genus POTAMOCARCINUS Milne-Edwards.

armatus Milne-Edwards, type species.

Locality unknown (Paris Mus.).

latifrons (Randall)=*schomburgkii* (White).

Guiana:

British Guiana, type locality of *schomburgkii* (Brit. Mus.);

Cayenne (Paris Mus.);

? Surinam, type locality (Mus. Phila. Acad. Nat. Sci.).

nicaraguensis Rathbun.

Nicaragua:

Lake Nicaragua (U. S. Nat. Mus.);

Near Greytown, type locality (U. S. Nat. Mus., Paris Mus., Mus. Comp. Zool.);

Rio San Juan (Copenhagen Mus.).

Costa Rica:

Rio Frio (U. S. Nat. Mus.).

Genus EPILOBOCERA Stimpson.

armata Smith.

Cuba: Guantanamo (Mus. Phila. Acad. Nat. Sci.).

? Cuba, type locality (Boston Soc. Nat. Hist.).

cubensis Stimpson.

Cuba:

Santiago (type not extant);

Guantanamo: Yateras River (Berlin Mus., U. S. Nat. Mus.);

Exact locality not given (Paris Mus., Mus. Phila. Acad. Nat. Sci.).

gilmanii (Smith).

Cuba: Isle of Pines, type locality (Boston Soc. Nat. Hist.).

granulata Rathbun.

West Indies (U. S. Nat. Mus.).

haytensis Rathbun.

Haiti:

Jeremie (Mus. Comp. Zool.);

Exact locality not given (type, U. S. Nat. Mus.).

San Domingo (U. S. Nat. Mus.).

sinuatifrons (A. Milne-Edwards)=*portoricensis* (manuscript, Berlin Mus.).

Porto Rico (Berlin Mus., U. S. Nat. Mus.).

Santa Cruz (Copenhagen Mus.).

Locality unknown (type, Paris Mus.).

Genus RATHBUNIA Nobili.

festæ Nobili.

United States of Colombia: Darien: Laguna della Pita (Turin Mus.).

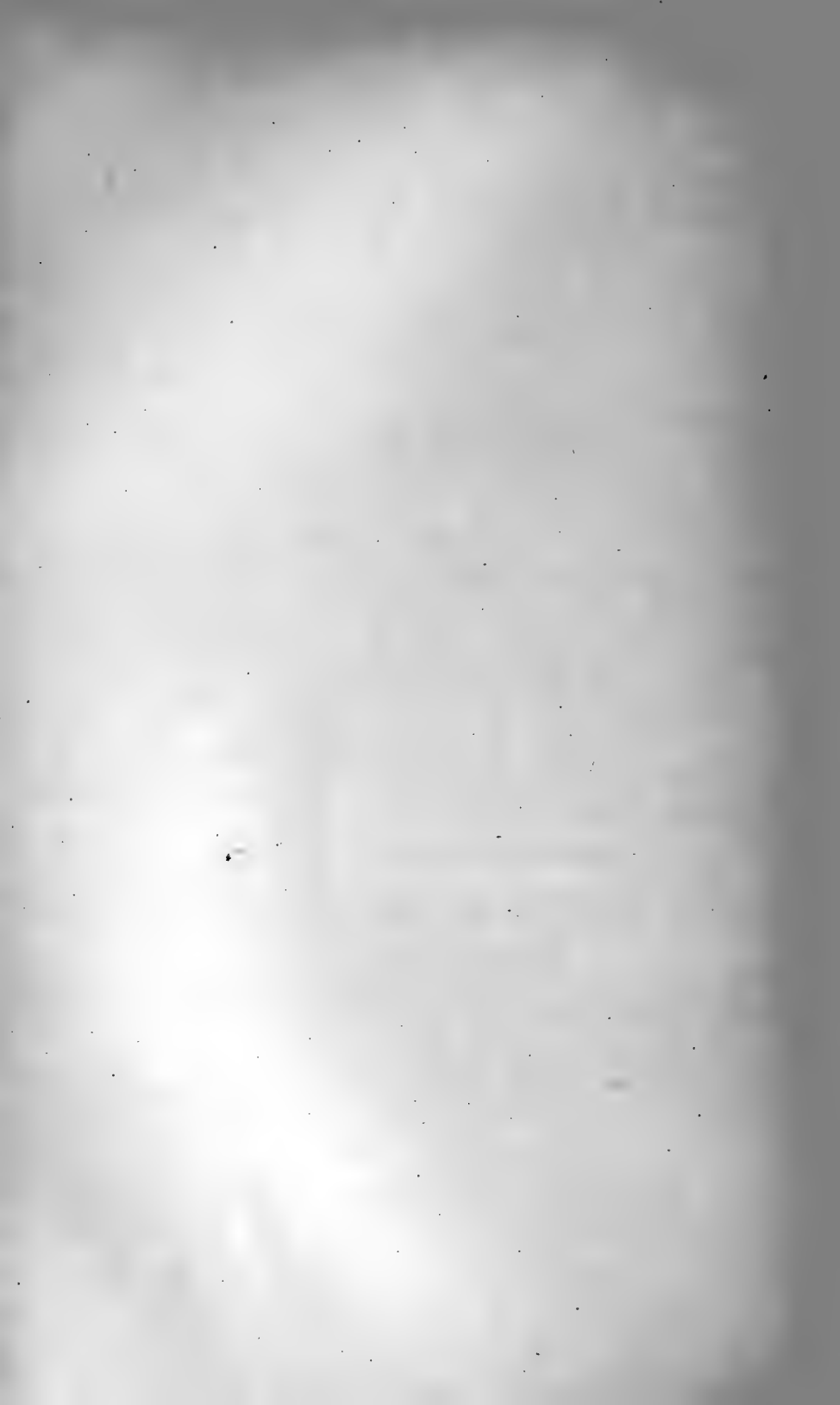
LIST OF LOCALITIES, WITH SPECIES FOUND IN EACH.

West Indies:

Cuba: *Pseudothelphusa affinis*, *americana*, *terrestris*, *Epilobocera cubensis*, *armata*?Isle of Pines: *E. gilmanii*.Haiti: *Ps. americana*, *E. haytensis*, *sinuatifrons*.Porto Rico: *E. sinuatifrons*.Santa Cruz: *E. sinuatifrons*.Guadeloupe: *Ps. dentata*.Dominica: *Ps. dentata*.Martinique: *Ps. dentata*.St. Lucia: *Ps. dentata*.Trinidad: *Ps. garmani*."Antilles:" *Ps. reflexifrons*, *fossor*.Locality not given: *E. granulata*.

Mexico:

Tepic Territory: *Ps. terrestris*.State of Jalisco: *Ps. jouyi*, *terrestris*.State of Guanajuato: *Ps. americana*, *jouyi*.State of Colima: *Ps. dilatata*.State of Michoacan: *Ps. dilatata*.State of Vera Cruz: *Ps. lamellifrons*, *maxillipes*.State of Puebla: *Ps. americana*.State of Morelos: *Ps. americana*.State of Guerrero: *Ps. americana*, *belliana*.State of Oaxaca: *Ps. americana*, *lamellifrons*, *sulcifrons*, *verticalis*.Locality not given: *Ps. colombiana*, *xantusi*.Guatemala: *Ps. bisuturalis*, *bocourti*, *gracilipes*, *tuberculata*.Nicaragua: *Ps. richmondi*, *Potamocarcinus nicaraguensis*.Costa Rica: *Ps. agrestis*, *convexa*, *exilipes*, *magna*, *montana*, *pittieri*, *richmondi*, *tristani*, *tuberculata*, *tumimanus*, *xantusi*, *Pot. nicaraguensis*.United States of Colombia: *Ps. bouvieri*, *colombiana*, *lindigiana*, *macropa*, *richmondi*, *xantusi*, *Rathbunia festæ*.Venezuela: *Ps. fossor*, *garmani*, *xantusi*.Guiana: *Ps. denticulata*, *Pot. latifrons*.Brazil: *Ps. agassizii*.Ecuador: *Ps. æquatorialis*, *conradi*, *ecuadorensis*, *henrici*, *lindigiana*, *nobili*.Upper Amazon: *Ps. reflexifrons*.Peru: *Ps. chilensis*, *conradi*, *peruviana*, *plana*.Bolivia: *Ps. macropa*.? Chile: *Ps. dentata*.



NOTES ON A COLLECTION OF FISHES FROM MEXICO, WITH
DESCRIPTION OF A NEW SPECIES OF PLATYPÆCILUS.

By BARTON A. BEAN,
Assistant Curator, Division of Fishes.

During the years 1892 and 1894, while exploring for the U. S. Department of Agriculture, Messrs. E. W. Nelson and E. A. Goldman collected eighteen species of fishes in various parts of Mexico. One of the species is here described as new; the others are interesting on account of localities, as are Mr. Nelson's observations on *Anableps* from Tehuantepec.

The collection here recorded was transmitted to the Museum April 20, 1897, forming accession 31947. In 1897 the same collectors procured several additional species of fishes in Mexico, including *Agonostomus nasutus*, *Chirostoma humboldtianum*, *Heros beani*, and *Gobius banana*.

PIMELODUS PETENENSIS Gunther.

Three specimens from Santa Maria. No. 45480, U.S.N.M.

SYMBRANCHUS MARMORATUS Bloch.

A single individual was obtained at Santa Maria, February 14, 1894. No. 45481, U.S.N.M.

NOTROPIS (HUDSONIUS) ALTUS Jordan.

Two specimens, 8 and 9 inches long, collected in the Rio Quitzeo, August 5, 1892. No. 48212, U.S.N.M.

LEUCISCUS NIGRESCENS Girard.

Two specimens were obtained in Lake Quitzeo, Michoacan, August 5, 1892, by E. W. Nelson.

This is the form described by Girard as *Tigoma pulchra*, his specimens being from the Chihuahua River. The two here noted are 6½ inches long and contain well-developed eggs. No. 48211, U.S.N.M.

DOROSOMA MEXICANUM (Gunther).

D. 14; A. 22-24; scales 39, transverse 11; scutes 15-16 plus 9-10. The length of the head is slightly less than one-third that of the body, without caudal; the depth of the body equals one-third of the length;

the eye is longer than snout, its length being contained three and one-half times in that of the head.

Ten examples, measuring from $2\frac{7}{8}$ to 4 inches in length, were obtained by Messrs. Nelson and Goldman in Lake Catemaco, south of Vera Cruz, May 9, 1894. This lake has an elevation of 1,500 feet. No. 48213, U.S.N.M.

CHIROSTOMA JORDANI Woolman.

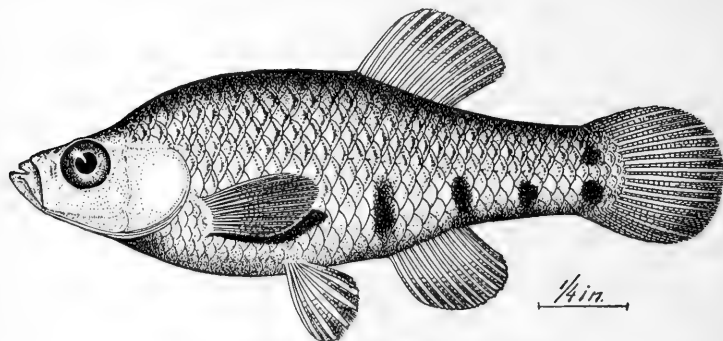
Three specimens, $1\frac{3}{4}$ inches long, were obtained at Lake Quitzeo, August 5, 1892. No. 48210, U.S.N.M.

AGONOSTOMA MONTICOLA (Bancroft).

One specimen, collected at Santa Maria, February 14, 1894. No. 45482, U.S.N.M.

PLATYPECILUS QUITZEOENSIS, new species.

D. 13; A. 13; scales 30, transverse 10. Body compressed, back elevated, head small and depressed, flat on top; snout short. The greatest depth of the body is contained two and four-fifths times in the length to origin of middle caudal rays; the head three and one-half times in



* *PLATYPECILUS QUITZEOENSIS*, NEW SPECIES.

this length; the long diameter of eye three and one-fourth times in length of head; width of interorbital space two and two-thirds times in length of head. Mouth small, cleft oblique, the lower jaw heavy, projecting; teeth conic, those in the upper jaw in an irregular series, those in the lower jaw very small, apparently irregularly arranged, close-set teeth. Dorsal origin in advance of that of the anal, being midway between the tip of the upper jaw and the end of the caudal rays; the first ray of the anal is under the sixth ray of the dorsal. Color of alcoholic specimen light brown, with traces of darker on back; interorbital space and edge of scales dark brown; three dark bars on posterior part of body, the first extending from median line to origin of anal, the second from median line to end of anal base, the third midway between end of anal and origin of caudal; two dark spots on end of caudal peduncle; fins all pale.

This interesting little fish, $1\frac{7}{8}$ inches long, was obtained by Mr. Nelson in Lake Quitzeo, August 5, 1892.

Type.—No. 48209, U.S.N.M.

FUNDULUS ROBUSTUS Bean.

D. 14; A. 15; scales 38, transverse 15.

An individual $3\frac{3}{4}$ inches long was obtained in Lake Quitzeo, Michoacan, August 5, 1892. No. 48208, U.S.N.M.

GOODEA ATRIPINNIS Jordan.

An individual representing the deeper form of the species, having the depth contained in length of body three and one-fourth times instead of four times as in the types, was obtained in Lake Quitzeo, August 5, 1892. No. 48207, U.S.N.M.

PÆCILIA MEXICANA Steindachner.

Six specimens were obtained at Santa Maria, February 14, 1894. No. 45483, U.S.N.M.

PSEUDOXIPHOPHORUS BIMACULATUS Heckel.

Four males and 24 females, taken at Mirador, February 11, 1894. No. 45489, U.S.N.M.

ANABLEPS DOVII Gill.

Twenty-two fine specimens, measuring from $6\frac{1}{2}$ to $8\frac{1}{2}$ inches, were obtained in the river about 3 miles above the city of Tehuantepec, or about 18 miles from the sea, April 6, 1896. No. 48214, U.S.N.M. One specimen, $5\frac{3}{4}$ inches long, April 28, 1895. No. 48215, U.S.N.M. Another example, 5 inches long, was taken April 23, 1895, at Tequisistlan, about 40 miles from the sea. No. 48216, U.S.N.M.

Mr. Nelson tells me that the species is found in the river all seasons of the year. The larger specimens are usually found near the mouth of the river in the current of the main stream. Small specimens were observed in shallow lagoons and ponds communicating with the river, occurring all along from 3 to 50 miles above the sea. Breeding fish were taken about 3 miles above the city of Tehuantepec, or 18 miles from the sea.

HEROS MACULIPINNIS Steindachner.

Heros maculipinnis STEINDACHNER, Beitrage zur Kenntniss der Chromiden Meji-co's und Central-Amerika's, Wien, 1864, p. 13, pl. iv, fig. 2.

Three examples, collected at Santa Maria, February 14, 1894, show the following characters: D. XVI, 9-10; A. VII-VIII, 8; scales 6-29-11. No. 45488, U.S.N.M.

HEROS FENESTRATUS Gunther.

Chromis fenestrata GUNTHER, Proc. Zool. Soc., 1860, p. 318.

Three examples, collected at Santa Maria, February 14, 1894. These have the Dorsal XVIII, 11; Anal VI, 10; scales 5-30-13; and the gill-rakers 3-8, very short, club shaped, and rather widely separated. No. 45487, U.S.N.M.

SICYDIUM PLUMIERI (Bloch).

D. VI-I, 10; A. I, 10; scales about 76, transverse 23 to 25. Scales ctenoid; each scale with a brown area covering the exposed portion except the serratures, which are whitish. The general color is dark brown, with numerous blotches of darker forming cross bands lighter underneath; pectorals, caudal, and margins of dorsal and anal, blackish. In the small example, $3\frac{1}{4}$ inches long, there is a black lateral band; traces of this appear in a few of the larger examples, but with age the lateral band seems to break up into cross bands.

Seventeen specimens, ranging in length from $3\frac{1}{4}$ to $5\frac{1}{4}$ inches, were obtained at Santa Maria, Mexico, February 14, 1894. No. 45486, U.S.N.M.

CHONOPHORUS MEXICANUS Gunther.

One fine specimen, $8\frac{1}{4}$ inches long, obtained at Santa Maria, February 14, 1894. No. 45485, U.S.N.M.

GOBIOMORUS DORMITATOR Cuvier and Valenciennes.

D. VI, 11; A. 11; scales 57, 21 in a transverse series. Interorbital space narrower than in typical species from Dominica.

An individual $7\frac{1}{2}$ inches long was obtained at Santa Maria, February 14, 1894. No. 45484, U.S.N.M.

THE LEECHES OF THE U. S. NATIONAL MUSEUM.

By J. PERCY MOORE, .

Instructor in Zoology, University of Pennsylvania.

Through the courtesy of the curators the collection of leeches contained in the U. S. National Museum has been placed in my hands for study and determination. Though small, and much of it poorly preserved, the collection has proved an interesting one. None of the forms had previously been identified; several have been found to be undescribed, several others have been mentioned in the literature but once or twice, and many are here recorded from new localities more or less remote from those previously known. The material has been drawn from various parts of the world, but it is to be regretted that our own American leeches are so poorly represented. Our fauna is a rich one, but is, perhaps, well known to but one person, who has as yet shared but little of his knowledge with the scientific public. We are still in nearly complete ignorance of the number and distribution of the species, and many interesting morphological questions remain to be elucidated. But one attempt has been made to systematize our knowledge—that of Prof. A. E. Verrill twenty-five years ago—and that upon very inadequate material from comparatively few localities. It is to be hoped that a greater interest will be taken in making well-preserved collections, and that our National Museum will soon have gathered together a complete series, not alone of leeches, but of annelids generally and other worms as well.

This is perhaps not the most suitable occasion to enter upon a discussion of any of the broader or more theoretical problems of morphology upon which the collection throws light. There is, however, one matter of especial interest to the systematic student to which some reference may profitably be made. I refer to the annulation of the somite. My observations on this subject accord perfectly with the views expressed by Whitman (5 and 6) and later by Lang (4) and Blanchard for the Glossiphoniidæ, Hirudinidæ, and Herpobdellidæ, and I am pleased to be able to extend them to the Ichthyobdellidæ also, which has, I believe, not previously been done. Apathy (1), who has made the most important recent contributions to the external morphology of the latter family, takes a precisely opposite view to that of

Whitman. He regards the multi-annulate somite as primitive. The view here supported is that the primitive typical leech somite consisted of three annuli. These primary annuli can readily be recognized in all families and most species of leeches which I have examined. When the primitive tri-annulate character of the somite is lost this may take place by (*a*) reduction, which has occurred as a result of coalescence of the primary rings at the anterior and posterior ends of nearly all leeches and in the genital regions of some, or (*b*) by elaboration, which has taken place in the somites of the middle body region, especially of the Gnathobdellidæ, Herpobdellidæ, and Ichthyobdellidæ. The increase in the number of annuli by which this elaboration is expressed externally seldom if ever occurs by the actual intercalation of new rings, but only by the growth and lesser or greater subdivision of the three primary rings. This subdivision seems to follow a regular law, which is that any number or all of the primary rings may become secondarily bi-annulate, the secondary annuli similarly biannulate and the tertiary again divided for the fourth time, and any one of these subdivisions may be in various degrees partial or complete, and may affect one or more annuli of any order. The theoretical completeness of the process is expressed in the following table, which also presents a system of nomenclature for the maximum possible number of annuli of each order, up to the fourth, of a complete somite, enabling the structure of a typical somite of any genus to be expressed by a simple formula.

Table of annulations.

First order.	Second order.	Third order.	Fourth order.
Somite. <div style="display: inline-block; vertical-align: middle;"> $\left. \begin{array}{l} a1 \\ a2 \\ a3 \end{array} \right\}$ </div>	$b1$	$c1$	$d1$
		$c2$	$d2$
		$c3$	$d3$
	$b2$	$c4$	$d4$
		$c5$	$d5$
		$c6$	$d6$
	$b3$	$c7$	$d7$
		$c8$	$d8$
		$c9$	$d9$
	$b4$	$c10$	$d10$
		$c11$	$d11$
		$c12$	$d12$
Total.3	6	12	$d13$
			$d14$
			$d15$
			$d16$
			$d17$
			$d18$
			$d19$
			$d20$
			$d21$
			$d22$
			$d23$
			$d24$

I give a few illustrations of the application of the system. *Protolepsine* and many other Glossiphoniidæ have a simple tri-annulate somite $a1 + a2 + a3$. Many of the larger species of *Glossiphonia* show a slight subdivision of the second and third primary annuli, which becomes strongly expressed in *Hementaria*, $a1 + a2 (b3 b4) + a3 (b5 b6)$.

In the Hirudinidæ generally this tendency is complete, and the five annuli resulting are practically equivalent so far as size, etc., is concerned, $a1 + b3 + b4 + b5 + b6$ or $a1 + b3-6$. *Trachelobdella* has all three of the primary annuli subdivided, thus: $b1 + b2 + b3 + b4 + b5 + b6$ or more simply $b1-6$. But in some of the species the divisions are incomplete, while in others those of the third order have set in, facts which may be expressed by the use of brackets, as shown above for *Hamentaria*. In *Dina* the third actual (fourth secondary) annulus is widened and distinctly bi-annulate, expressible thus: $a1 + b3 + b4$ ($c7$ $c8$) $+ b5 + b6$. The greatest complexity is found among the Ichthyobdellidæ, of which *Cystobranchus* has the six secondary annuli, the third or sometimes the fourth being subdivided. $b1 + b2 + c5 + c6 + b4 + b5 + b6$ or $b1-2 + c5-6 + b4-6$. *Piscicola* varies somewhat, but the most frequent arrangement is that in which the full number of annuli of the third order is developed, and two of these, namely, $c5$ and $c8$, are divided into annuli of the fourth order, making in all fourteen annuli, expressed by the formula $c1-4 + d9 + d10 + c6 + c7 + d15 + d16 + c9-12$. In some species the fourteen annuli become perfectly equivalent in size and the plan of their formation obscure. No cases are known in which the whole twenty-four of the possible annuli of the fourth order are developed, or in which annuli of the fifth order are more than very slightly indicated.

Partial or complete unions of adjacent annuli of neighboring somites frequently occur, and possibly entire somites may be absorbed, or simulations of new ones formed in the prostomial region. All of these conditions can be expressed in the formula, which could also be adapted to indicate whether any given condition has arisen by simplification or elaboration. The desirability of some more exact method of defining the annulation of the Ichthyobdellidæ must be obvious to anyone who has noted the great confusion which reigns in this group as to the number of annuli of each somite, and the scope of the genera. Different authors have each usually attended to but one of the several orders of division of the somite, and thus we have *Piscicola* (*Ichthyobdella*) described with seven, twelve, or fourteen rings, each of which expresses a part of the truth.

By combining the somite formula with the Roman numerals by which the individual somites are indicated, we can describe any annulus desired with the greatest precision. As to the order of the elaboration of the annuli in the Ichthyobdellidæ I have little light, except that the process begins in the middle primary annulus, and there also proceeds the farthest. There are good physiological and mechanical reasons for this; but I hope soon to have sufficient data for a fuller discussion of the external morphology of this family. This preliminary account is presented here in the hope that students of the Hirudinea will find this scheme of sufficient value to test and perfect it. The systematic portion of the paper follows.

Family GLOSSIPHONIDÆ.

PROTOCLEPSINE, new genus.

This genus exhibits primitive external characters in the retention of the full number (3) of annuli in all of the anterior somites, and in the elevation of the eyes upon papillæ which stand in serial relation to the dorsal median segmental papillæ of the succeeding somites. The sexual pores occupy the usual positions in somites X and XI.

The type species has three pairs of eyes situated on somites I, II, and III; and the posterior somites XXII to XXVI are reduced.

1. PROTOCLEPSINE SEXOCULATA, new species.

(Plate XL, fig. 1.)

Unfortunately there is but a single much contracted specimen of this interesting species. The prostomium is curled ventralward and the specimen is probably immature, so that the following measurements have a relative value only:

	mm.
Length	5.1
Greatest width (XIXth somite)	2.5
Depth at somite XIX	1.2
Width at genital region	2.2-2.4
Depth at genital region	About 1
Diameter of acetabulum	1.5

In its contracted condition the body is truncated at both ends, the prostomium being curled under at the anterior end (corrected in the drawing, fig. 1), and the acetabulum drawn closely up at the posterior end. Consequently the body appears almost quadrate, with its greatest width far back. It is strongly convex above and slightly concave below. The acetabulum is large and circular, with thickened margins. The anterior sucker is wide, with thickened crenulated margins, formed posteriorly by annulus 5; its interior and the mouth opening are hidden by the infolded prostomium. A deep median and three pairs of small lateral sulci divide the free margin of the prostomium into eight lobes, of which the four middle ones bear as many small papillæ. Dorsally it consists of a larger anterior and a smaller posterior annulus.

The somites I to XXI, inclusive, are complete, each consisting of three annuli; XXII and XXIII are biannulate; XXIV and XXV biannulate at the margins and undivided mesially; and XXVI consists of a single annulus. On each side of the middle line are three series of dorsal and four series of ventral papillæ, situated on the first annulus of each somite on which alone papillæ are evident. Of the dorsal series the innermost are widely separated, leaving a broad median area; the outermost are supra-marginal, and the remaining series halfway between these. All of the papillæ are smooth and rather inconspicuous. On the first, fourth and seventh rings behind the prostomium

the papillæ of the innermost dorsal series are transformed into deeply pigmented eyes, but still retain their character as papillæ, being quite as elevated as the succeeding members of the series, with which they continue in perfect serial relation of position. Were any further evidence required to demonstrate Whitman's view of the homology of the eyes and segmental papillæ of leeches, this species would supply it. Annuli one and four lack the marginal but retain the intermediate papillæ. The former begin on annulus seven and continue to somite XXV. The intermediate series ceases at somite XXIII, while the innermost continues to the post-anal annulus.

The ventral papillæ begin on annulus seven, which is united with six. They are a marginal, a mesial ventral, and two intermediate on each side. The most mesial pair are widely separated and about opposite to the mesial dorsal series. All are small, and in this specimen can be detected with certainty on only a portion of the somites.

The individual described is probably immature, as the genital pores, although not difficult to detect, are very small, and their lips not swollen or glandular. The male pore is situated between annuli twenty-nine and thirty and the female between thirty-one and thirty-two. The color is probably much changed in preservation, being a nearly uniform bronze-brown. The eyes are black. Nothing is known of the internal anatomy.

Type.—No. 4320, U.S.N.M. Bering Island, Commander Islands, Siberia. Leonhard Stejneger, August 5, 1882, No. 1405. One specimen.

GLOSSIPHONIA Johnson.

2. GLOSSIPHONIA MOLLISSIMA.

(Plate XL, fig. 2.)

Clepsine mollissima GRUBE.

This species was described by Grube (3) from specimens collected at Lake Baikal, Siberia. The following notes will serve to supplement Grube's description. The first pair of eyes are very small, deeply set, and sometimes united to the second pair. They appear to be undergoing degeneration and absorption. The annulation of the first four somites is shown in the following table:

Annulation of somites of Glossiphonia mollissima.

Somite.	Annuli.	Organ.
	<i>Prostomium.</i>	
I.....	1} partly united.	First pair of eyes.
II.....	2}	Second pair of eyes.
III.....	3}	Third pair of eyes.
	4} united.	
	5}	
IV.....	6} united.	
	7}	
	8}	

The prostomium consists of a single partial ring. The united third and fourth rings form the posterior margin of the anterior sucker. Somites III to XXII are complete, XXIII consists of annuli sixty-three and sixty-four, XXIV of sixty-five, which is double at the margins, XXV of sixty-six and XXVI of sixty-seven, behind which is the anus. The male pore is placed at $Xa\frac{2}{3}$, or between the annuli twenty-five and twenty-six; the female at $XIa\frac{1}{2}$, or between twenty-seven and twenty-eight.

Character is given to the papillation by the great development of the dorsal median series, the papillæ of which are very large, and in some specimens the only ones distinctly developed. They become conspicuous on annulus fifteen, and are found on the first annulus of every complete somite thereafter, and on the annuli sixty-three, sixty-five, sixty-six, and sixty-seven. In the best preserved material they may be traced as far forward as annulus six. The mates are separated at the middle line by about one-fourth of the width of the body. The dorsal inner-lateral papillæ are also well marked on most specimens, and are found on the eye-bearing annuli, as well as on all those bearing the dorsal median ones. The outer lateral papillæ have become reduced to almost total suppression and were unnoticed by Grube. Very minute members of this series may usually be found on the eye-bearing and several succeeding papilliferous annuli. Besides the serial papillæ, very minute variable ones are found on the dorsum of all of the annuli. There are 10 or 12 small papillæ on the ventral surface of the first ring of each somite.

On the accompanying label Dr. Stejneger gives the following description of the colors of this species during life:

Olive green, margins more brownish, two series of large whitish knobs along the back, and several smaller and less conspicuous spots between these and the margins. Along the back a regular system of narrow brownish longitudinal stripes.

This species closely resembles the *Clepsine elegans* of Verrill, from which it may be distinguished by the much larger dorsal median papillæ.

No. 4259, U.S.N.M. Bering Island, Commander Islands, Leonhard Stejneger. 1882-83. Twenty-two specimens.

3. GLOSSIPHONIA PARASITICA.

Hirudo parasitica SAY.

Clepsine ornata VERRILL (in part).

I have not yet acquired sufficient material to satisfy myself of the status of Verrill's species of *Clepsine*; but it is certain that both *C. ornata* and *C. papillata* are composite and in part synonymous. The types should be again studied and compared. I think that the forms here included can safely be regarded as conspecific with those forming the basis of Verrill's original description of *Clepsine ornata*, and their identity with Say's species was established by the examination of the supposed types in the collection of the Philadelphia Academy of

Natural Sciences. The following examples are included in the U. S. National Museum collection.

No. 5025, U.S.N.M. Vicinity of Fort Huachuca, Arizona. Dr. T. E. Wilcox, U. S. A. Five specimens.

No. 4025, U.S.N.M. Currant River, Shannon County, Missouri. R. Ellsworth. One specimen.

No. 5026, U.S.N.M. Pine Ridge Agency, South Dakota. Dr. Leonard Stejneger, 1894. One specimen.

No. 823, U.S.N.M. North Red River, British America. R. Kennicott. One specimen.

No. 4694, U.S.N.M. Wheatland, Indiana. On *Chelydra serpentina*. Fourteen specimens.

No. 4602, U.S.N.M. Keel-Foot Lake, Obion County, Tennessee (from a small creek emptying into lake near Idlewild Hotel), May 30, 1882. E. Palmer. One specimen, very badly dried up and shrunken, but apparently a large example of this species.

No. 5027, U.S.N.M., 50 miles from Bluefields, Nicaragua. C. W. Richmond. On turtle. Five specimens.

4. GLOSSIPHONIA LINEATA.

Clepsine papillata VERRILL var. *lineata*.

In many respects this species resembles *G. triserialis* E. Blanchard, but differs from this and resembles *G. bridgei* O. F. Müller in the position of the genital pores, which are separated by but one annulus. The external male orifice is situated at $\frac{X}{XI}$, ($\frac{2\frac{1}{5}}{\frac{2}{5}}$), the female at $XI\ a\frac{1}{2}$, ($\frac{2\frac{5}{6}}{\frac{2}{6}}$), the latter being the usual position. The white patches which flank the black papillæ appear to be more conspicuously developed in the Mexican specimens, making this a very beautiful species.

No. 4101, U.S.N.M. D'eau douce de la Canada de Marfil, Mexico. Prof. A. Dugès, February 8, 1882. Nineteen adult and numerous young specimens.

5. GLOSSIPHONIA STAGNALIS.

Hirudo stagnalis LINNÆUS.

Clepsine modesta VERRILL.

This species is very common and widely distributed over the United States. No characters have been found which serve to distinguish it from the well-known European form.

No. 1038, U.S.N.M. Woods Hole, Massachusetts, September 16, 1883. William Nye, jr.; fresh-water ponds. Six specimens.

No. 808, U.S.N.M. Woods Hole, Massachusetts, September 24, 1883. William Nye, jr.; fresh-water pond. Many specimens.

PLACOBDELLA R. Blanchard.

6. PLACOBDELLA MEXICANA, new species.

(Plate XI, fig. 3.)

This species is close to *Placobdella plana* (Whitman) R. Blanchard, but the annulation differs in several respects. The body is broad and depressed, and rather ovoid in outline. The largest specimen measures 14.7 mm. in length and 6 mm. in breadth at the widest part. The acetabulum is small and weak, and about 2.5 mm. in diameter.

The prostomium is undivided. It is followed by a rather wide ring, which bears the single pair of eyes on its posterior part, and the first pair of dorso-inner-lateral papillæ on its anterior part. A plain narrow ring follows, then a broad double one bearing the second pair of dorso-inner-lateral papillæ on its anterior half. A narrow ring completes with this double one somite III. Somite IV is in one specimen similarly constituted of a broad double ring and a narrow one; in the others it is constructed like the following somites of three rings, the first of which bears papillæ. Somite XXII is the last complete one; XXIII has two annuli, XXIV a single annulus, double at the margin, and XXV and XXVI each a single papillate annulus. The male pore is situated between the twenty-fourth and twenty-fifth, the female pore between the twenty-sixth and twenty-seventh, and the anus between the sixty-sixth and sixty-seventh annuli.

The dorso-median and dorso-inner-lateral papillæ are large and conspicuous, but low, smooth, and rounded. The former begin on annulus eight (somite V) and continue with the latter to somite XXVI. The outer lateral are small; they begin on annulus eleven, the first of somite VI, and continue to annulus fifty-nine (somite XXII). The second annulus also of each somite of the middle region of the body bears six series of small papillæ which lie mesiad to the corresponding ones of the first annulus.

The color of the alcoholic specimens is a rich chocolate brown blotched with lighter and darker brown, a branched figure of the latter color corresponding very closely with the branches of the intestine, and the pale spots in general with the papillæ. A median white line appears at the anterior and posterior ends of the body. Beginning anteriorly in a triangular area which includes the eyes, it is more or less interrupted and broken at the first annulus of each somite to the seventh, where the band fades out. On the second annulus of each of these somites the pale area runs out laterad in transverse bars, which on V reach nearly to the margins of the body. At the posterior end a similar narrow pale area extends forward from the anus to somite XXI. Marginal white spots occur metamerically on each somite. The posterior sucker is marked with alternating rays of brown and white, the latter being confined mainly to the marginal half.

Types.—No. 5028, U.S.N.M. Mexico; P. G. Jouy; No. 384. Three specimens.

HÆMENTARIA De Filippi.

7. HÆMENTARIA OFFICINALIS De Filippi.

No. 1478, U.S.N.M. Guanajuato, Mexico; Prof. A. Dugès. Two specimens.

Family ICHTHYOBDELLIDÆ.

TRACHELOBDELLA Diesing.

8. TRACHELOBDELLA VIVIDUS.

(Plate XL, fig. 4.)

Cystobranchus vividus VERRILL.

This species bears a striking resemblance to a *Cystobranchus*, but the annulation and the position of the sexual pores are characteristically that recently attributed by Blanchard to *Trachelobdella*.

The two regions of the body are sharply distinguished. The anterior, which contains the first eleven somites, is somewhat sunken into and embraced by the first somite of the posterior region. Somites IX, X, and XI are narrowed to form the clitellum, in front of which the body is slightly expanded laterally. The anterior region includes twenty distinct primary annuli posterior to the expanded "head," which latter, with the first five annuli, constitute five somites. Somite VI is composed of three primary annuli, each of which is clearly biannulate. Somite VII is as large as the eight preceding annuli. Each of the primary annuli is divided into two and these again halved dorsally, so that twelve annuli of the third order may be counted on the dorsal side. The middle primary annulus (*a* 2) of this somite is large, and its two secondary annuli (*b* 3 and 4) have almost the value of the adjacent primary annuli. Somite VIII is similarly annulated, but shorter. The somites IX, X, and XI are the clitellar somites and are each reduced to two primary annuli, which, with the exception of the last, are obscurely biannulate. The male pore is located on the anterior margin of somite X, or between this and the preceding annulus (16). On the ventral side annuli sixteen and seventeen are much enlarged and partly fused with fifteen and eighteen, respectively. The female pore is between the eighteenth and nineteenth annuli, having the same relation to somite XI as the male pore has to X. The twentieth annulus is obscure, being united with and retracted within somite XI.

The posterior body region is broad and depressed, the transverse and vertical diameters being about as two to one. The constriction shown in the figure in the posterior third of the body is probably the result of an accident of preservation. The somites of this region are characterized by the six secondary annuli, those of the second primary annulus (*a* 2) being largest and on the dorsal side again divided into the tertiary annuli, thus: *b* 1-2 + *c* 5-6-7-8 + *b* 5-6. This latter character is lost in the posterior somites. Somite XXII is the last complete

one, behind which there are four additional obscurely biannulate pre-anal annuli.

There are eleven pairs of well-developed lateral vesicles, which diminish in size each way from the sixth. Behind the eleventh pair are two pairs of rudimentary vesicles, indicated by opaque whitish lateral thickenings of the rings. The well-developed vesicles occupy the sides of *b* 1 and *b* 2 of their somites, except the first, which extends onto the last ring of somite XI. There are indications of annulation of the anterior sucker, but too obscure in this specimen to be described.

No. 242, U.S.N.M. Woods Hole, Massachusetts; V. N. Edwards. One specimen.

9. *TRACHELOBDELLA MACULATA*, new species.

(Plate XL, fig. 6.)

The two body regions are well marked, the anterior slender and terete, the posterior broad, flattened, and racket-shaped. The posterior sucker is small, little if at all directed ventralward, and is contracted to a slit-like opening.

There are thirteen pairs of respiratory vesicles, with a posterior rudimentary fourteenth. The anterior ones are indistinct and the largest (the ninth and tenth pairs) at the widest part of the body. This region is concave below and convex above from side to side. The anterior region is somewhat retracted within the posterior. The head (in the contracted specimen) is scarcely expanded, and its margin only slightly oblique. Its free margin tends to fold into four lobes, dorsal, ventral and two lateral.

As in most other species of the genus, the annulation of the anterior region is irregular and difficult of interpretation. In this specimen the difficulty is increased owing to the integument being gathered up at several spots, as it were, into loose tufts, which disturb the arrangement of the annuli. After a careful study I have fixed on the interpretation shown in the figure; but this needs to be confirmed by a study of more and better material. The clitellar region is sufficiently distinct. Six annulations are observable on the dorsal side of the head. Then follow two narrow rings in the constriction behind the head. Behind these follow, apparently, four complete somites (V to VIII) of three rings each, of which the first corresponds closely to the transverse bands of orange, the second and third to the ashy spots described below. The primary rings of somite VIII, as here provisionally identified, are subdivided into six secondary rings. The clitellum consists of the two primary partly orange-colored rings of somite IX, the two primary (divided into four secondary) uncolored rings of somite X, and the similarly constituted somite XI, of which the last ring is united with the first of somite XII. The male pore is between the two secondary rings of annulus seventeen (the first of somite X), and the female pore

between the two secondary rings of annulus nineteen (the first of somite XI). They are consequently separated by four small secondary annuli.

The somites of the posterior region are hexamerous, but the three primary annuli are easily recognized; and the first and second of each somite, except XII, are undivided at the margins, where they are occupied by the paired respiratory vesicles. The vesicles, as in the species to be described next, extend over the first and second primary rings of each somite, though in many cases the second is only partly occupied. Anteriorly the vesicles are collapsed and, except for their color, indistinct, but posteriorly they become much more prominent. Traces of a rudimentary fourteenth pair are found just anterior to the anus.

The color pattern of this species is interesting, and has probably been derived from the breaking up and partial shifting of an annular pattern, which still persists to some extent in the anterior region. The general color above is a rich bright orange anteriorly, becoming faded to a pale yellow posteriorly, where it extends over much of the ventral surface also. The ventral surface of the anterior region, the greater part of the clitellum, and the head are of a pale ashy color, which spots the dorsal surface also. These ashy spots show a distinct tendency to become arranged in three longitudinal rows on the posterior region. They are mostly large and of irregular shapes, and very nearly correspond to the somites, but those of the middle series have shifted more or less toward the posterior end and sometimes become confluent with neighboring blotches. All are edged by a very narrow border of reddish brown. A few similar irregular blotches are seen on the ventral surface. A small orange patch surrounds the male pore, and there is a similar one on each side of the clitellum. On each side of the dorsal surface of the head is a large bright orange spot, leaving a median ashy area. In the figure the orange-colored parts are stippled, the ashy plain. The hexamerous structure of the posterior somites is represented only in XIX and XX, but the others are similar.

The single specimen measures:

	mm.
Length	13.5
Greatest breadth.....	4.2
Length of anterior region.....	3
Breadth at male pore.....	.9
Breadth of anterior sucker.....	1
Diameter of posterior sucker.....	1.5
Depth of posterior region of body.....	1

Type.—No. 1314, U.S.N.M. Steamer *Albatross*. Locality unknown.

10. TRACHELOBDELLA RUGOSA, new species.

(Plate XL, fig. 5.)

The adult specimens of this species have the broad depressed form shown in the figure; a young individual is terete, with the vesicles appended to the sides of the body, and connected by a broad lateral cutaneous fold lodging the marginal sinus, by the metameric enlarge-

ment of which the vascular sacs of the vesicles are formed. The anterior region of the mature as well as of the young specimen is depressed, as in *T. maculata*, instead of terete, but the annulation, although obscured by cutaneous folds, appears to be the same. Exclusive of the three obscure annulations observable on the dorsum of the head there are twenty prevesicular annuli, of which the last is united with and retracted into the border of somite XII.

Three complete antecitellar somites are recognizable, owing to the presence on their first and second primary rings (namely, six and seven, nine and ten, and thirteen and fourteen) of peculiar cutaneous projections just dorsal to their lateral margins. These are usually, but not invariably, united into a single pair on each somite, and are probably of the nature of rudimentary respiratory vesicles, or at least homodynamous structures. They lie somewhat dorsal to the plane of the functional vesicles.

The clitellum consists of two relatively large annuli, which are united together and bear a pair of cutaneous appendages in strictly marginal position, and four narrow biannulate annuli, of which the first contains the male and the third the female orifice, thus agreeing with *T. maculata*. The last, and frequently the female ring also, is contracted within the following somite.

In the posterior region the integument, which must have been very loose in life, is much wrinkled and thrown into folds in contraction. This condition is less marked in the young example, in which the three primary annuli are readily recognized, and the first and second are seen to be occupied by the remarkably large respiratory vesicles. Each of the primary annuli of the adults is marked by four more or less distinctly marked transverse folds, which are divided by longitudinal furrows, into quadrangular tile-like and slightly raised areas, giving to the entire surface a rugous tessellated appearance.

The respiratory vesicles are very large and conspicuous. They occupy the margins of the first and second primary annuli of each somite, and are connected by a cutaneous fold which is continuous along the margins of the body from the first to the twelfth or last pair of functional vesicles. Delicate irregular cutaneous wrinkles roughen the surface of both the vesicles and the marginal fold.

The posterior sucker is small, straight, and shallow; the anterior is closed in contraction to a vertical slit. No pigment remains in the bodies of any of the specimens, which have faded to a uniform clay color. A few brown pigment cells are arranged in a zone across the head anterior to the annulations. There are no eyes.

The specimen figured has the following measurements:

	mm.
Length complete.....	23
Length of anterior region.....	3.3
Width of clitellar region.....	1.3
Width at first pair of vesicles.....	2.4
Width at ninth pair of vesicles.....	5.8

Types.—No. 5035, U.S.N.M. From red snapper. Six specimens.

CYSTOBRANCHUS Diesing.

11. CYSTOBRANCHUS species?

No. 1594, U.S.N.M. Albatross station 2737. One specimen.

PISCICOLA Blainville.

The genus *Piscicola* as here used is composite and requires subdivision, but no adequate system has yet been proposed.

12. PISCICOLA GEOMETRA (Linnæus) Blainville.

No. 237, U.S.N.M. Washington, District of Columbia, February 3, 1883. On German carp (probably introduced with these fish). Three specimens.

13. PISCICOLA SEXOCULATA.

Platybdella sexoculata MALM.

No. 4850, U.S.N.M. St. Pauls Island, Bering Sea, June, 1890; William Palmer, from Sculpin. Five specimens.

14. PISCICOLA SCORPII.

Hirudo scorpii FABRICIUS.

Platybdella scorpii MALM.

Piscicola multistriata GRUBE.

No. 5029, U.S.N.M. St. Pauls Island, Bering Sea; William Palmer, June, 1890, from Sculpin. Six specimens.

No. 3944, U.S.N.M. From Sculpin. One specimen.

15. PISCICOLA ZEBRA, new species.

This species has the slender, somewhat depressed, nearly linear form of *P. geometra*, but the posterior sucker is nearly circular, and much less excentrically fixed, the anterior is smaller, the annulation shows some peculiarities, and the color is very different. In these specimens no respiratory vesicles are visible.

The anterior body region contains twenty-one primary annuli, of which the first five are undivided, six to fifteen are distinctly broader and biannulate, and the secondary rings often again biannulate, making four minor or tertiary rings to each primary annulus. Then begins the clitellar region with annuli sixteen to eighteen narrower and less distinctly biannulate. The male pore is in the posterior part of eighteen, and is bounded behind by a narrow fold. In contracted specimens this pore appears to be between eighteen and nineteen, owing to the suppression of the fold. Nineteen and twenty are similar, with the female pore behind the latter. Twenty-one and the following annuli are again distinctly and doubly biannulate. The posterior region begins with twenty-two.

The typical somites of the posterior region have fourteen annuli of the third and fourth orders; the first and third primary annuli have

four each, the second six of these, as shown in the formula $c1-4+d9-10+c6+c7+d15-16+c9-12$, and in some cases $d13$ and 14 are developed. The annuli from fifty-seven to sixty-three (the last), inclusive, become simplified and are either undivided or faintly biannulate. The anus is between sixty-one and sixty-two.

I describe the color somewhat fully. The pattern is made up of irregular and often confluent blotches of brown on a yellowish ground, disposed differently in each specimen, but with a strong tendency to assume the annular or banded arrangement in all, except on the middle dorsal region, where the inner portions of the brown spots tend to become confluent into a pair of longitudinal stripes separated by a narrow but conspicuous median yellow stripe. The head is characteristically colored. The anterior two-thirds is yellowish, the posterior third marked by a conspicuous band of dark brown which in the three larger specimens extends two-thirds of the way around and on the smallest only one-half, leaving an uncolored ventral area. Dorsally, the dark band is interrupted by a narrow median line of bright yellow. Two pairs of dark brown eyes (separated by two-thirds of the width of the head) are situated at the angles of a parallelogram whose anterior and posterior sides correspond with the boundaries of the dark band. The anterior eyes are the larger. In some of the specimens the angles of the band, where broken dorsally, show an intensification of the pigment, which in one specimen bears a superficial resemblance to two additional pairs of eyes. In all of the specimens the dark ring is succeeded by a pale one which occupies the last cephalic and first and second post-cephalic annuli. Then follow eighteen more or less distinctly marked irregular brown rings, of which four are anteclellial, two clitellial, and the remainder postclitellial. Brown, more or less conspicuously, predominates to the twelfth ring, posterior to which the pale background increases. Several annuli in the neighborhood of the anus are always pale.

The four preclitellial rings show a strong tendency to fuse both dorsally and ventrally (more particularly the latter), sometimes the first three, sometimes the last three, or all four being thus united. The dorsal pigmentation then tends to split up into three yellow and two brown longitudinal lines, the latter being usually predominant. There is always a complete white ring just anterior to the clitellum. The clitellum is heavily pigmented above; and below, especially in the middle region, is almost devoid of color. The pattern is longitudinal. There is a rather broad median yellow stripe, a brown stripe (composed of two brown and one yellow lines), a very narrow yellow stripe, and then heavy brown blotches which cover the sides. A pale postclitellial ring is usually well defined and complete.

In the posterior region the blotches are large, well defined, irregular, and assymetrical, and not distinctly metameric in arrangement. A tendency is manifest on the ventral surface to break up into a median series of confluent blotches, on each side of which is a narrow, ill-

defined, yellow, longitudinal line. Laterally the blotches are enlarged, dorsally they are narrower, but on each side of the middle line are again drawn out and frequently become longitudinally confluent. Except in one specimen, the dorsal median yellow line is scarcely interrupted. The twelfth brown annulus is continuous across it in all four specimens, and the following ones show somewhat of a similar tendency. In two specimens the paired dorsal brown stripes may be traced almost without break for the animal's entire length, and it is in one of these that the median yellow stripe is interrupted at almost every brown band. The posterior sucker is heavily pigmented dorsally, less so or almost unpigmented ventrally. The marginal zone is pale, with about fourteen dark and irregular brown rays extending toward it and terminated by as many dark eye spots.

	mm.
Length	19
Breadth	1.8
Length of anterior region	4.
Length of head (above) .....	.5
Breadth of head .....	.7
Diameter of acetabulum	1.6
Breadth of clitellum	1.5

Types.—No. 4818, U.S.N.M. Arichat, Cape Breton, Nova Scotia; W. A. Stearns, 1890, from lips of lamper eel (*Petromyzon marinus*). Four specimens.

16. PISCICOLA RECTANGULATA Levisen.

No. 4705, U.S.N.M. Alaska; Lieut. G. M. Stoney; "fish parasite." Eight specimens.

17. PISCICOLA ANARRHICHÆ.

Ichthyobdella anarrhichæ DIESING.

Ichthyobdella anarrhichæ VAN BENEDEN and HESSE.

Not *Platybdella anarrhichæ* MALM.

Piscicola marina LEUCKART, 1849.

Piscicola marina GRUBE.

Not *P. marina* JOHNSON.

No. 3958, U.S.N.M. Point Barrow, Alaska. U. S. Signal Service; J. Murdoch; gills of *Lycodes*. Twenty-six specimens.

18. PISCICOLA RAPAX.

Pontobdella rapax VERRILL.

No. 5030, U.S.N.M. Menemsha Bight, Vineyard Sound, Massachusetts. U. S. Fish Commission, 1883; August 28; exterior of *Pleuronectes dentatus*. Four specimens.

PONTOBDELLA Leach.

19. PONTOBDELLA MURICATA (Linnæus) Moquin-Tandon.

No. 175, U.S.N.M. (no further data). One specimen.

No. 773, U.S.N.M. Cedar Keys, Florida; Henry Hemphill, December, 1883; from tongue of large shark. One specimen.

Family HERPOBDELLIDÆ.

DINA R. Blanchard.

20. DINA ANOCULATA, new species.

Behind the genital region the body is much flattened, and both width and depth remain nearly constant from the clitellum nearly to the posterior sucker. Toward the posterior end it becomes slightly narrower, and then the margins approach in a curve and pass into the broad acetabular peduncle. The margins of the body are rather obtuse, except on this posterior curve, where they are sharp and compressed. The acetabulum is small, less than one-half the greatest width of the body, and faces ventrad. From the genital region the body decreases in breadth and increases in relative depth toward the anterior end, which is quite terete. The mouth is very large, the opening in the individual measured being nearly, if not quite, 1 millimeter. It is round and, owing to the shortness of the prostomium, scarcely oblique. It is bounded by the prostomium, the first and second annuli.

The prostomium consists of a larger lip and a narrower posterior incomplete annulus. It presents a median lobe beneath, bounded by a pair of sulci. There are in all one hundred and five annuli behind the prostomium. The second one is complete and bounds the mouth posteriorly; its free margin is crenulated. The first three somites consist of a single annulus each, the fourth and fifth of three annuli each, while somites VI to XXIII are complete, consisting of five annuli each. In all of these the third or middle annulus is enlarged, and shows evidences of subdivision into two tertiary annuli, though this character is less obvious than in *D. quadristriata*. The annulus anterior to the male pore, and occasionally other annuli, show a similar biannulation. Somite XXIV has three annuli, and XXV and XXVI one or incompletely two. The anus is situated between somites XXIV and XXV, or annuli one hundred and two and one hundred and three.

The male pore lies between annuli thirty-four and thirty-five (somites X and XI). It is a conspicuous opening, surrounded by a circle of papillæ, situated at the summit of a prominent, broadly conical elevation which affects three annuli in front and as many behind. Annulus thirty-four is biannulate. The inconspicuous female pore is situated between annuli thirty-six and thirty-seven.

The ground color of alcoholic specimens is dull yellow, immaculate below and on the margins, but largely replaced above by four longitudinal stripes of grayish or dull black, of which the outer pair are submarginal, duller in color, and narrower than the more distinct inner pair, which are well separated by a median stripe of the ground color. Anterior to the clitellum the two stripes on each side become confluent, but at the same time more diluted with the ground color, and finally broken and replaced by the widening middle stripe. This anterior expansion of the median stripe is clear yellow and peculiar in the distinctness with which the longitudinal muscle fibers are there visible.

In many specimens, perhaps in a majority, the two dark stripes are partly or wholly confluent behind as well as in front of the clitellum. In such the lateral light stripes become merely a succession of more or less confluent small spots, or are entirely wanting. All degrees of transition between the two and four striped varieties are found, the former giving the impression of light, the latter of dark, colored worms. The median and marginal light stripes are always well marked. Posterior sucker yellow. There are no pigmented eyes.

One of the larger specimens measures as follows:

	Mm.
Length	12.5
Greatest breadth (about the same for the posterior half of the body)	3.7
Depth of posterior region, about	1
Breadth at male pore	3.3
Depth at male pore (including genital elevation)	2.5
Breadth at somite VI	1.8
Depth at somite VI	1.3
Breadth at anterior sucker	1.5
Depth at anterior sucker	1.5
Breadth at anus	2.7
Breadth of posterior sucker	1.5

No. 4844, U.S.N.M. Mountains of San Diego County, California; C. R. Orcutt. Forty-three specimens. Eleven of these were selected as types for the above description.

No. 5031, U.S.N.M. San Diego, California; in fresh water; C. R. Orcutt. One specimen.

21. DINA species?

Nephelis quadristriata VERRILL.

This is our most abundant eastern nephelid, and is very widely distributed. It differs greatly from *D. quadristriata* Grube, as determined by Blanchard, and seems to be without a name. With us it varies in color with the greater or less development of the black dorsal stripes. The eyes are usually reduced, as stated by Verrill, to three pairs, owing to the union of the anterior two pairs.

No. 5032, U.S.N.M. Current River, Shannon County, Missouri; R. Ellsworth. One specimen.

22. DINA QUADRISTRIATA (Grube) Blanchard.

Nephelis quadristriata GRUBE.

Nephelis mexicana E. DUGÈS.

No. 4941, U.S.N.M. Mexico; A. Dugès (No. 176). Twelve specimens.

No. 4809, U.S.N.M. Mexico; A. Dugès. Four specimens.

HERPOBDELLA Blainville.

23. HERPOBDELLA PUNCTATA.

Nephelis punctata LEIDY.

No. 666, U.S.N.M. Yellowstone Park; Hayden's expedition, 1872. One specimen.

Family HIRUDINIDÆ.

HAEMOPIS SAVIGNY.

24. HAEMOPIS MARMORATIS.

Hirudo marmorata SAY.

Not *Nepheleis marmorata* VERRILL.

Aulastomum lacustre LEIDY.

Semiscolex grandis VERRILL.

This determination was made by the examination of what are probably Say's types, recently discovered in the collection of the Philadelphia Academy. Say's species differs from *H. sanguisuga* Linnaeus chiefly in the constitution of somite VI, which in the latter species has, according to Whitman's figure (7), the three annuli of equal size and without indication of subdivision. *H. marmoratis*, on the other hand, has the second and third annuli (twelve and thirteen of the entire series) much wider than the first, and each completely divided into two by a distinct sulcus. The genital pores vary slightly in position, as indicated by the conflicting descriptions of Leidy and Verrill. The male pore is usually situated at the anterior border of annulus thirty-one and the female in thirty-six.

No. 5033, U.S.N.M. Yellowstone Park; C. Hart Merriam; Hayden's expedition, 1872. Eleven specimens.

No. 670, U.S.N.M. Havre de Grace; Milner, 1877. Three specimens. This is var. *trigris* Verrill.

No. 5034, U.S.N.M. Marsh, Leavenworth County, Kansas; Orsen Pattee. One specimen.

No. 4498, U.S.N.M. Bristol Bay, Alaska; C. L. McRay, September 27, 1883. One specimen.

25. HAEMOPIS LATERALIS.

Hirudo lateralis SAY.

Semiscolex terrestris FORBES.

The type of Say's species was recently discovered in the collection of the Philadelphia Academy.

The sixth somite of *H. lateralis* consists of five annuli; the sexual pores are consequently two annuli further back than in *H. marmoratis*. Say's specimens were all aquatic, Forbes's all terrestrial.

No. 4102, U.S.N.M. Olney, Illinois; July, 1885; J. and C. Walker. One specimen.

No. 625, U.S.N.M. Keelfoot Lake (small creek), near Idlewild Hotel, Obion County, Tennessee; Ed. Palmer; 1882. One specimen.

LIMNOBDELLA R. Blanchard.

26. LIMNOBDELLA MEXICANA R. Blanchard.

No. 202, U.S.N.M. Quanajuata, Mexico; Prof. A. Dugès. Three specimens.

MACROBDELLA Verrill.

Not *Macrobdella* PHILIPPI.

Verrill's use of *Macrobdella* seems to have priority, his paper having been published in February, 1872, while Philippi's was not published until October of that year.

27. MACROBDELLA DECORA (Say) Verrill.

Hirudo decora SAY.

Hirudo decora LEIDY.

No. 4599, U.S.N.M. Wytheville, Virginia; Col. M. McDonald, U. S. Fish Commission. Two specimens.

No. 4503, U.S.N.M. Fulton Lakes, Adirondacks; Fred. Mather, July 2, 1882. Thirteen specimens.

PHILOBDELLA Verrill.

Verrill established *Philobdella* as a subgenus of *Macrobdella*, though he inclined to raise it to the rank of a full genus, which is undoubtedly its proper systematic value. The most remarkable character of the genus is that the ducts of both male and female organs open externally within the limits of somite XI. The sexual adhesive organs are arranged around these pores.

28. PHILOBDELLA FLORIDANA Verrill.

The chief points in the annulation of this species are shown in the following table:

Annulation of Philobdella floridana.

Somites.	Annuli.	Organs.
<i>Prostomium.</i>		
I	1	First pair of eyes.
II	2	Second pair of eyes.
III	3}	Third pair of eyes.
	4}	
IV	5}	Fourth pair of eyes.
	6} united ventrally.	
	7} united ventrally.	
V	8}	Fifth pair of eyes.
	9	
	10	
VI	11}	
	12}	
	13}	First pair nephridiopores on posterior margin of 13.
VII	14 to 18	Second pair nephridiopores on posterior margin of 18.
VIII to X	19 to 33	Third to fifth pairs of nephridiopores on 23, 28, and 33.
	34	Male pore on 34.
	35	
XI	36	
	37	Female pore on 37.
	38	Sixth pair of nephridiopores on 38.
XII to XXII	39 to 93	Seventh to seventeenth and last pair of nephridiopores on 43 to 93.
	94	
XXIII	95	
	96	
XXIV	97	
	98	
XXV	99	
	100	
XXVI	101} partly united	Anus.
	102}	
Not defined externally.	.....	Posterior sucker.

Unfortunately no material is available for a study of the internal reproductive organs. The external arrangement is as follows: The median region of annuli thirty-four and thirty-five is pushed in to form a deep pit, which at its mouth is about 2 mm. across. It inclines cephalad and narrows toward the fundus. In one specimen it is at least 2.5 mm. deep. In the front wall, which corresponds to the inturned part of annulus thirty-four, is an orifice which appears to be the male pore. This is located more than a millimeter from the mouth of the pit and between a pair of glandular folds or papillæ, which, like those described below, has each a pore at its summit. Five additional adhesive organs are related to the male pore. A pair is located on the posterior margin of thirty-three, close to the median line. The papillæ are low and wide, and the pores large, oblique, and crescentic. A second pair is placed at the sides of the pit, just within its mouth and close to the posterior wall. A fifth and unpaired organ is placed on the posterior wall of the pit at a higher (more dorsal) level than the pair.

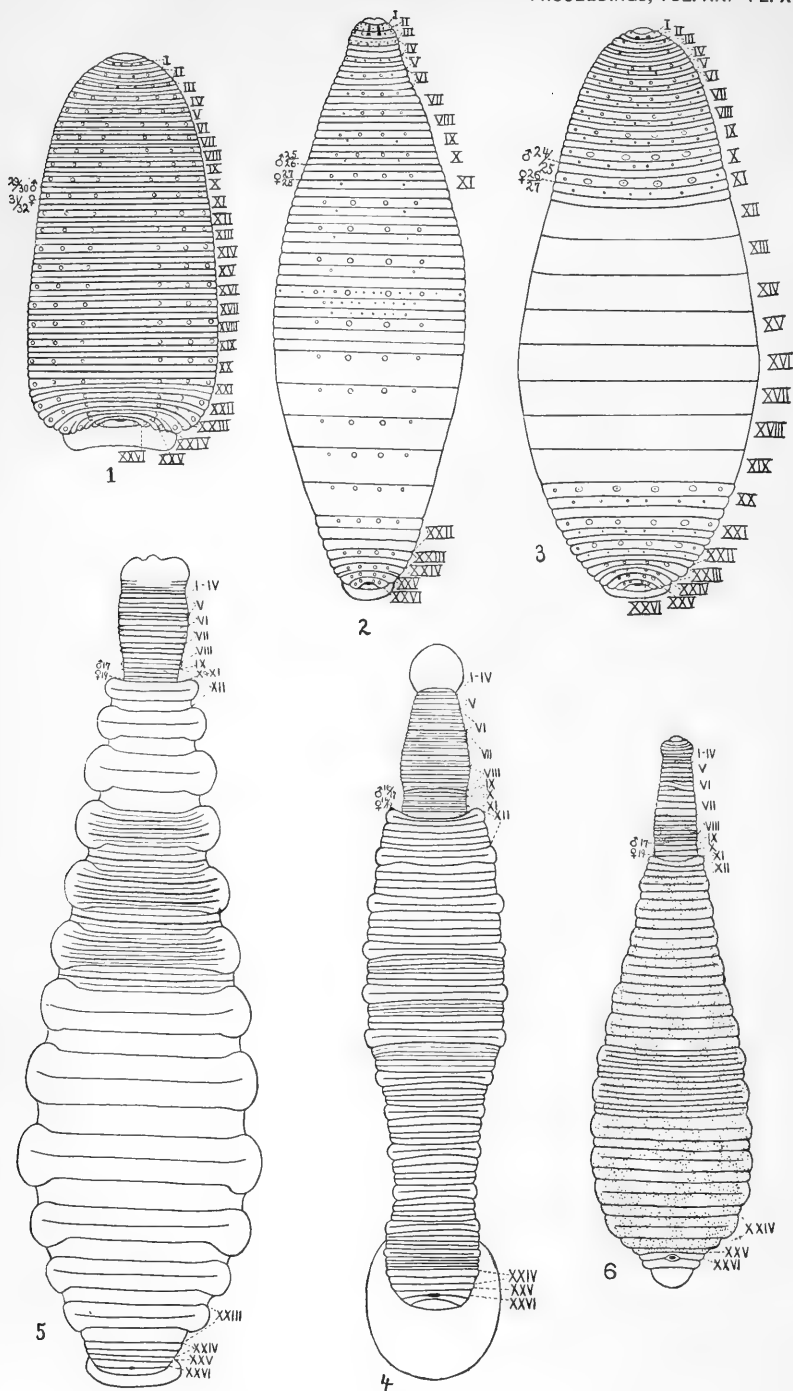
Behind the male pit a large, conical, sugar-loaf-shaped papilla rises from annuli thirty-six, thirty-seven and thirty-eight. At its slightly pointed summit is the female pore, within the limits of the thirty-seventh annulus. The papillæ incline slightly toward the posterior end of the body. On each side of the female pore and rather toward the posterior face of the papilla is an adhesive organ which in copulation would meet one of the pair between which the male pore is situated. Three more, a pair at the base and a single median one higher up, are found on the anterior face of the papilla, and in copulation would attach to the three in the posterior region of the male pit. Another pair is located on annulus thirty-eight, just outside of the base of the papilla, and corresponds to the male pair on annulus thirty-three. In addition to these there is a conspicuous pair farther out on thirty-eight, and on the posterior portion of thirty-nine (or on thirty-nine and forty of one specimen) a bilobed papilla with two pores on one side, and a linear trilobed one with three pores on the other side of the middle line, which have no visible counterpart in the male system. This last group alone probably corresponds to the similar organ of *Macrobdella*, the others being unrepresented in that genus.

All of these organs consist essentially of more or less prominent papillæ containing glandular sacs which open by apical pores, and whose cavities frequently contain hardened masses of mucus.

No. 4103, U.S.N.M. New Orleans, Louisiana; Dr. R. W. Shufeldt (No. 593), 1883, one specimen.

No. 4104, U.S.N.M. New Orleans, Louisiana; April, 1883; Dr. R. W. Shufeldt (No. 1140), one specimen.

No. 791, U.S.N.M. New Orleans, Louisiana; April, 1883; Dr. R. W. Shufeldt (No. 1139), one specimen.



EXTERNAL MORPHOLOGY OF LEECHES.

FOR EXPLANATION OF PLATE SEE PAGE 563.

GEOBDELLA Whitman.

Not *Geobdella* BLAINVILLE.

Chthonobdella GRUBE (in part).

The earlier use of *Geobdella* by Blainville to designate a different group of leeches will of course prevent its general use by systematists in the connection proposed by Whitman.

28. GEOBDELLA LIMBATA (Grube Whitman.

No. 173, U.S.N.M. New Zealand; U. S. Exploring Expedition; one specimen.

No. 174, U.S.N.M. New Zealand; U. S. Exploring Expedition; one specimen.

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7. WHITMAN.....Leeches of Japan. Quar. Jour. Mic. Sci., (1886), XXVI, pp. 315-416, 5 plates.

EXPLANATION OF PLATE.

Plate XL.

- Fig. 1. *Protoclepsine sexoculata*. General morphology of dorsal surface. x 10. The segmentation and arrangement of the papillæ is shown for all the somites.
2. *Glossiphonia mollissima*. General morphology of dorsal surface. x 5. The annuli are omitted from several of the somites of the middle region. The characteristic and principal sensory papillæ are shown for all of the somites, but the smaller and variable ones fully on somite XVI only.
 3. *Placobdella mexicana*. General morphology of dorsal surface. x 5. The characters of the anterior and posterior ends of the body only are shown.
 4. *Trachelobdella ravidus*. General morphology of dorsal surface. x 5. The tertiary annuli are shown for somites XV-XVII.
 5. *Trachelobdella rugosa*. General morphology of dorsal surface. x 5. The integumental secondary and tertiary annuli of the middle region are shown only in somites XV-XVII.
 6. *Trachelobdella maculata*. General morphology of the dorsal surface. x 5. The stippled areas are yellow. Secondary annuli shown in somites XIX and XX.

ON THE OCCURRENCE OF CAULOLEPIS LONGIDENS GILL, ON THE COAST OF CALIFORNIA.

By CHARLES HENRY GILBERT, PH. D.,
Professor of Zoology, Leland Stanford Junior University.

This peculiar deep-sea Berycoid has been hitherto known only from the single type specimen taken by the *Albatross* off the coast of New Jersey, at a depth of 1,346 fathoms. A second specimen, which seems to agree in most respects with the published descriptions and figure of the type,¹ was dredged by the *Albatross*, April 13, 1896, at Station 3627 (latitude, north 32° 44'; longitude, west 119° 32'), near Cortez Bank, Southern California, at a depth of 776 fathoms. Comparing this specimen with the figure above cited, it was at once apparent that the scales are much larger and less closely crowded than is there represented. My friend, Mr. Barton A. Bean, has kindly reexamined the type at my request, and states that there are, however, but twelve rows of scales between the dorsal base at origin and the lateral line, counting downward and backward, instead of about thirty rows as in the figure. Mr. Bean also states that the scales are more distinct in the type than in the drawing, and appear under a lens plate-like (that is, separate, not overlapping). With these statements our Pacific specimen entirely agrees. For comparison, I append the following table of measurements of the latter:

Length from tip of snout to base of caudal.....inches.. 3.6

The following measurements are expressed in hundredths of length:

Body:

Greatest depth.....	hundredths.. 50
Greatest width.....	do.... 18
Least height of tail.....	do.... 10

Head:

Greatest length (to tip of preopercular spine).....	do.... 40
Greatest width.....	do.... 20
Width interorbital area.....	do.... 12.5
Length of snout.....	do.... 11
Length of upper jaw.....	do.... 31.5
Length of mandible.....	do.... 32
Diameter of orbit.....	do.... 8.25

¹ Goode and Bean, *Oceanic Ichthyology*, p. 184, fig. 204.

Dorsal:

Distance from snout hundredths.. 50

Length of base.....do.... 40

Anal:

Distance from snout.....do.... 73

Length of base.....do.... 10.5

Distance from pectoral to snout.....do.... 37.5

Distance from ventral to snout.....do.... 47

The distance from ventral to snout is erroneously given for the type by Goode and Bean¹ as 27 hundredths. In the Pacific specimen the fins are injured so that we can not distinguish between spines and soft rays. The dorsal contains in all 19 rays, the anal 9.²

¹Oceanic Ichthyology, p. 185.

²In the type the distance from the snout to ventral equals 47 hundredths of the length of the fish without caudal fin. The Pacific form agrees with the type in the structure of the opercular bones and in dentition, but the scales as noted by Dr. Gilbert are more distinct.—B. A. BEAN.

THE BRACHYURA COLLECTED BY THE U. S. FISH COMMISSION STEAMER ALBATROSS ON THE VOYAGE FROM NORFOLK, VIRGINIA, TO SAN FRANCISCO, CALIFORNIA, 1887-1888.

By MARY J. RATHBUN,

Second Assistant Curator, Division of Marine Invertebrates.

The *Albatross* left Norfolk, Virginia, November 20, 1887, and arrived at San Francisco, California, May 15, 1888. The principal shore stations visited were as follows: Port Castries, St. Lucia; Bahia and the Abrolhos Islands, Brazil; Montevideo, Uruguay; seven places in Magellan Strait; five places on the west coast of Patagonia, or Magallanes territory, Chile; Lota and Tome, Chile; Panama; eight of the Galapagos Islands; Acapulco, Mexico; Pichilingue Harbor, in La Paz Bay, Magdalena Bay, Abreojos Point, and Cerros Island, Lower California; and San Clemente Island, California. During the voyage, 91 hauls of the trawl and dredge were made and 31 casts of the tow net.

Prof. Leslie A. Lee, of Bowdoin College, was assistant in charge of the scientific staff during the expedition. It was his intention to report upon the Brachyura collected, but the pressure of other duties has delayed his studies on this group from year to year until in the autumn of 1897 he kindly transferred the collection to the writer.

The Brachyura number 151 species, of which 31 are new. Twenty-four other species were undescribed at the time of the expedition, but have been made known from other cruises during the past ten years. With one exception the new forms are from the Pacific, and nearly all are from the coasts of Lower California.

The range of many West Indian shallow-water forms is extended southward to Cape St. Roque, Brazil; while from station 2762, in the latitude of Rio de Janeiro, and at a depth of 59 fathoms, we have the uncommon species, *Tetraxanthus bidentatus* (A. Milne-Edwards), *Micropanope xanthiformis* (A. Milne-Edwards), and *Chasmocarcinus typicus* Rathbun, known otherwise only from the West Indian region. At station 2763, 671 fathoms, latitude 24° 17' south, occur *Geryon quinquedens* Smith and *Ethusina abyssicola* Smith, species inhabiting the deep waters off the eastern coast of the North American continent.

Another fact in the distribution of the Brachyura which needs to be emphasized is the increasing number of species common to western America and Japan. In a former paper I have alluded to the existence of *Chorilia longipes* Dana off the coast of Japan. Dr. Calman has recently recorded *Philyra pisum* De Haan from Puget Sound. In the U. S. National Museum there is a large specimen of *Chionæetes opilio*, supposed to be Japanese. Dr. Walter Faxon says that in the Museum of Comparative Zoology are examples from Japan of *Telmessus cheiragonus* (Tilesius), which is distinct from *T. acutidens* Stimpson. To these may be added two Japanese species of *Cancer* (= *Trichocarcinus*), *C. gibbosulus*, and *C. amphictus*, as noted below. The former stretches, on the American side, from Lower California to Alaska, while the latter has not yet been collected north of San Diego Bay.

The intimate relationship existing between the Caribbean and west American faunas is accented by the discoveries made on this voyage. The subspecies, *Ethusa mascaronæ americana*, is found to be common to both coasts. Among the new species described are many which have close relatives on the Atlantic side of the continent. They are arranged in the following list approximately according to the degree of resemblance between the allied species:

<i>Pacific coast.</i>	<i>Atlantic coast.</i>
<i>Osachila levis.</i>	<i>Osachila tuberosa</i> Stimpson.
<i>Hemus analogus.</i>	<i>Hemus cristulipes</i> A. Milne-Edwards.
<i>Collodes tumidus.</i>	<i>Collodes inermis</i> A. Milne-Edwards.
<i>Medæus lobipes.</i>	<i>Medæus spinimanus</i> (Milne-Edwards).
<i>Lissa aurivilliusi.</i> }	<i>Lissa bicarinata</i> Aurivillius.
<i>Lissa tuberosa.</i> }	
<i>Actæa angusta.</i>	<i>Actæa bifrons</i> Rathbun.
<i>Thyrolambrus crosus.</i>	<i>Thyrolambrus astroides</i> Rathbun.
	{ <i>Palicus dentatus</i> (A. Milne-Edwards).
<i>Palicus lucasii.</i>	{ <i>Palicus faxoni</i> Rathbun.
	{ <i>Palicus alternatus</i> Rathbun.
<i>Calappa saussurei.</i>	<i>Calappa angusta</i> A. Milne-Edwards.
<i>Portunus (Achelous) angustus.</i>	<i>Portunus (Achelous) ordwayi</i> (Stimpson).
<i>Chasmocarcinus latipes.</i>	<i>Chasmocarcinus typicus</i> Rathbun.

In this report only the general localities and depths are given. Full details in regard to the dredging stations may be found in the Report of the U. S. Fish Commissioner for 1887 [1891], pp. 422-424.

MAIIDÆ.

1. STENORYNCHUS DEBILIS (Smith).

Leptopodia debilis SMITH, Ann. Rept. Peabody Acad. Sci. for 1870, 1871, p. 87.

Magdalena Bay, Lower California; off Cape St. Lucas; southern part of Gulf of California; Panama Bay; 7 to 31 fathoms (stations 2798, 2799, 2823, 2824, 2825, 2826, 2828, 2829, 2831). In a male from station 2798, Panama Bay, the rostrum is about $1\frac{2}{3}$ times the length of the carapace; in specimens from all other stations the rostrum is short.

2. PODOCHELA HEMPHILLII (Lockington).

Microrhynchus hemphillii LOCKINGTON, Proc. Cal. Acad. Sci., February 7, 1876, 1877, VII, p. 30. Bay of San Diego.

Inachoides (Microrhynchus) hemphillii LOCKINGTON, Proc. Cal. Acad. Sci., July 17, 1876, 1877, VII, p. 75 (13).

Podocheila tenuipes RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 224.

Southern part of Gulf of California; off Cape St. Lucas and Magdalena Bay, Lower California, 10 to 31 fathoms (stations 2828, 2829, 2831).

Mr. Samuel J. Holmes has examined the type of *Microrhynchus hemphillii* Lockington and pronounces it the same as *Podocheila tenuipes*.

3. COLLODES GRANOSUS Stimpson.

Collodes granosus STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1860, VII, p. 194, pl. II, fig. 4.

Southern part of the Gulf of California, 10 fathoms, station 2828.

4. COLLODES ROSTRATUS A. Milne-Edwards.

Collodes rostratus A. MILNE-EDWARDS, Crust. Rég. Mex., 1878, p. 179; 1879, pl. XXXII, fig. 2.

Off the Rio de la Plata, 10½ fathoms, and off the Gulf of San Matias, Argentina, 52 fathoms (stations 2766 and 2767).

5. COLLODES TENUIROSTRIS Rathbun.

Collodes tenuirostris RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 230.

Magdalena Bay, 51 fathoms, and off Abreojos Point, Lower California, 48 fathoms (stations 2833 and 2834).

6. COLLODES TUMIDUS, new species.

(Plate XLI, fig. 1.)

Allied to C. inermis; carapace with four elevated tubercles forming a cross near the middle.

This species is the Pacific representative of *C. inermis*, from which it differs only slightly, and with the type of which it has been compared. The carapace bears near its middle four tubercles, of which two are on the median line, one gastric and one cardiac, and the other two are at the inner angles of the branchial regions. These tubercles are at the most elevated portions of the carapace, the gastric region being intermediate in height between the cardiac and branchial. In the female, the cardiac tubercle is longer and appears like the base of a stout spine which has been broken off. In *C. inermis* the inner angle of the branchial region is depressed. In *tumidus* the granulation of the posterior and lateral regions is less extensive than in *inermis*, there being almost no granules on the cardiac region.

The front, like that of *inermis*, is furnished with two blunt teeth near together. The postorbital tooth is subtriangular and slightly curved.

The basal joint of the antenna is wider than in *inermis*; the lobes of the outer margin are larger. The sternum of the male is granulated; the abdomen of both sexes is nearly smooth; the first segment has a median tubercle.

Chelipeds smooth; fingers gaping widely to near the tips; dactylus with a short truncate tooth near its base; pollex with a large tooth at one-third the distance from the proximal end. Ambulatory legs stouter and shorter than in *C. inermis*.

Dimensions.—Male: Length, 11.6 mm.; width, 9.5 mm. Female: Length, 10.3 mm.; width, 8 mm.

Type.—No. 21571, U.S.N.M. One male from Magdalena Bay, Lower California, 12 fathoms, station 2831.

Additional specimen.—A female of this species was taken in the southern part of the Gulf of California, 10 fathoms, station 2828.

7. BATRACHONOTUS NICHOLSI Rathbun.

Batrachonotus nicholsi RATHBUN, Proc. U. S. Nat. Mus., 1894, XVII, p. 55.

Off the west coast of Lower California, from Cape St. Lucas to Abreojos Point, 12 to 51 fathoms, stations 2829, 2831, 2833, and 2834.

This species was founded on two small dried females. The present specimens are larger, show both sexes, and indicate that the species is very closely related to *B. fragosus* Stimpson of the West Indies. It differs chiefly in the longer postorbital tooth, which is as long as the eye; in the more elevated preorbital border, which at its highest point forms a tooth, or in some specimens a spine; in the coarser granulation of that part of the sternum of the male between the chelipeds; and in the evenly toothed fingers of the male, while in *fragosus* the pollex has a larger tooth at its middle. The female is narrower than the male. The tuberculated portions of the different regions are more extensive than in the types.

Dimensions.—Male: Length, 9 mm.; width, 7.9 mm. Female: Length, 6.5 mm.; width, 5.4 mm.

8. DASYGYIUS DEPRESSUS (Bell).

Microrhynchus depressus BELL, Proc. Zool. Soc. London, 1835, III, p. 88.

Southern part of the Gulf of California, 21 and 26½ fathoms, stations 2822 and 2823.

9. DASYGYIUS TUBERCULATUS (Lockington).

Inachus tuberculatus LOCKINGTON, Proc. Cal. Acad. Sci., February 7, 1876, 1877, VII, p. 30.

Microrhynchus (Inachus) tuberculatus LOCKINGTON, Proc. Cal. Acad. Sci., July 17, 1876, 1877, VII, p. 64.

Neorhynchus mexicanus RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 233.

Panama Bay, 7 and 16 fathoms, stations 2800 and 2802.

The identity of my species and that of Lockington has been determined by Mr. S. J. Holmes, who has examined the types of both.

10. INACHOIDES MAGDALENENSIS Rathbun.

Inachoides magdalenensis RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 228.

Southern part of Gulf of California, and off west coast of Lower California, from Cape St. Lucas to Abreojos Point, $5\frac{1}{2}$ to 66 fathoms, stations 2823, 2824, 2830, 2831, 2832, and 2835.

11. EURYPODIUS LATREILLII Guérin.

Eurypodius latreillii GUÉRIN, Mém. Mus. Hist. Nat. Paris, 1828, XVI, p. 351, pl. XIV.

From off Gulf San Matias, Argentina, to Magellan Strait, 10 to 61 fathoms, stations 2768, 2770, 2771, 2773 to 2779; also at Gregory Bay and Sandy Point, in Magellan Strait, and Mayne Harbor and Latitude Cove in Magallanes Territory, Chile.

12. ANAMATHIA CORNUTA, new species.

(Plate XLI, fig. 2.)

Rostrum longer than the postfrontal portion of the carapace; lateral margin with two long spines; dorsal surface with nine short spines.

Surface closely covered with tuberculiform cutaneous vesicles, among which are a few curved hairs. Tubercles and spines of the carapace as follows: Gastric region with three short, one median, the lateral in advance of the median; cardiac and intestinal regions each with one, short and conical; branchial region with two short, the posterior smaller and nearer the median line; hepatic and branchial regions each with a long, slender marginal spine directed outward, upward, and forward. Rostral horns very long and slender, nearly equaling or exceeding one-half the entire length of the carapace, and extending nearly to the base of the rostrum; they are slender, widely divergent, slightly arched. Preorbital spine short, slender, not reaching the base of the rostral horns; postorbital tooth rounded. Basal joint of antenna with a short tooth or spine at the antero-lateral angle. Pterygostomian ridge with three or four tubercles. A blunt rounded tooth at the angle of the buccal cavity.

Chelipeds slender. Merus triangulate; outer face with a low blunt ridge; upper margin with a sharp terminal spine, and a broad subacute tooth near the proximal end. Carpus with a superior longitudinal uneven crest, and a tubercle on the outer surface near the distal end. Propodus compressed, with a thin upper edge; dactylus more than one-half the superior length of the propodus. Fingers with a narrow gape along their basal third; prehensile edges crenate. Meral joints of ambulatory legs with a short spine, which decreases in size and acuteness from the first to the fourth pair, where it is a blunt lobiform prominence.

Dimensions of Anamathia cornuta.

Sex.	Length from tip of horns to middle of posterior margin.	Length from base of horns.	Length of horns.	Width exclusive of spines.	Length of branchial spine.
	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
Male.....	35.9	19	17.8	14.5	6.2
Female (ovig.)...	50.2	25	26.5	20.2	9.0

Types.—No. 21572, U.S.N.M.; five males and two females, from north-east of Indefatigable Island, Galapagos Islands, 392 fathoms, station 2818.

13. *CHORILIA LONGIPES* Dana.

Chorilia longipes DANA, Amer. Jour. Sci., 1851, 2d ser., XI, p. 269; Crust. U. S. Expl. Exped., 1852, I, p. 91; 1855, pl. I, fig. 5.

Hysterois longipes MIERS, RATHBUN.

North of San Clemente Island, California, 414 fathoms, station 2839.

14. *LEUCIPPA PENTAGONA* Milne-Edwards.

Leucippa pentagona MILNE-EDWARDS, Ann. Soc. Entom. France, 1833, II, p. 517, pl. XVIII, B, figs. 1, 2 (*pantagona*). Chile.

Leucippa ensenadae MILNE-EDWARDS and LUCAS, D'Orbigny's Voy. l'Amér. Mérid., 1843, VI, Pt. 1, p. 9; 1847, IX, pl. v, fig. 3. Patagonia.

Leucippa laevis DANA, Amer. Jour. Sci., 1851, 2d ser., XI, p. 273; Crust. U. S. Expl. Exped., 1852, I, p. 135; 1855, pl. VI, fig. 5. Rio de Janeiro.

I believe that *L. pentagona*, *ensenadae*, and *laevis* are one and the same species, as a large series of specimens in the collection from off the Rio de la Plata (10½ to 11½ fathoms, stations 2764–2766) and from off the Gulf of San Matias, Argentina (52 fathoms, station 2767), show a great amount of variation in the breadth of the carapace, prominence of the lateral teeth, and in the acuteness and divergence of the rostral horns. The average individuals are similar to that figured as *L. ensenadae* by Milne-Edwards and Lucas. A single small specimen is labeled "Station 2833," which is in Magdalena Bay, Lower California, 51 fathoms.

15. *EPIALTUS DENTATUS* Milne-Edwards.

Epialtus dentatus MILNE-EDWARDS, Hist. Nat. Crust., 1834, I, p. 345.

Port Otway, Magallanes Territory, Chile.

16. *EPIALTUS NUTTALLII* Randall.

Epialtus nuttallii RANDALL, Jour. Acad. Nat. Sci. Phila., 1839, VIII, p. 109, pl. III (*Libinia nuttallii*).

Ballenas Bay, Lower California.

17. *TYCHE LAMELLIFRONS* Bell.

Tyche lamellifrons BELL, Proc. Zool. Soc. London, 1835, III, p. 173; Trans. Zool. Soc. London, 1836, II, p. 58, pl. XII, fig. 3.

Southern part of the Gulf of California, 7 fathoms, station 2825.

18. TYCHE EMARGINATA White.

Tyche emarginata WHITE, Ann. Mag. Nat. Hist., 1847, XX, p. 206.

Off Cape St. Roque, Brazil, 20 fathoms, station 2758.

19. LEUROCYCLUS TUBERCULOSUS (Milne-Edwards and Lucas).

Salacia tuberculosa MILNE-EDWARDS and LUCAS, D'Orbigny's Voy. l'Amér. Mérid., 1843, VI, Pt. 1, p. 13; 1847, IX, pl. II.

Off the Rio de la Plata, $10\frac{1}{2}$ to $11\frac{1}{2}$ fathoms, stations 2764, 2765, 2766.

20. CHIONÆCETES TANNERI Rathbun.

Chionæcetes tanneri RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 76, pl. IV, figs. 1-4.

North of San Clemente Island, California, 414 fathoms, station 2839.

21. HEMUS ANALOGUS, new species.

Outer margin of first movable joint of antenna strongly arcuate.

This species is so closely allied to *Hemus cristulipes* A. Milne-Edwards of the Caribbean region that the differences are only comparative. The carapace is higher at the cardiac region and slopes more abruptly down toward the front. The hollow in *cristulipes* on the posterior part of the branchial region on either side of the cardiac region is replaced in *analogus* by a slightly convex surface. The side margins of the rostrum are convex; in *cristulipes* straight. The rostral teeth are nearer together in *analogus* and terminate in a sharp spinule; in *cristulipes* they terminate in a stout tubercle. The preorbital angle is rounded, with sides rectangular; in *cristulipes* the anterior margin of this angle is oblique. The outer margin of the first movable joint of the antenna is curved, while in *cristulipes* it is straight, or nearly so, being parallel to the sides of the rostrum. The meral joints of the ambulatory legs are narrower and their marginal denticles stronger than in the Atlantic species.

Dimensions.—Female: Length, 8.2 mm; width, 6.5 mm.

Type.—No. 21573, U.S.N.M. An adult female from the southern part of the Gulf of California, 10 fathoms, station 2828.

Additional specimen.—One immature female was taken at the same locality.

22. PELIA ROTUNDA A. Milne-Edwards.

Pelia rotunda A. MILNE-EDWARDS, Crust. Rég. Mex., 1875, p. 74, pl. XVI, fig. 4.

Off Cape St. Roque, Brazil, 20 fathoms, and off the Rio de la Plata, $10\frac{1}{2}$ to $11\frac{1}{2}$ fathoms, stations 2758, 2764, 2765, 2766.

23. PELIA PACIFICA A. Milne-Edwards.

Pelia pacifica A. MILNE-EDWARDS, Crust. Rég. Mex., 1875, p. 73, pl. XVI, fig. 3.

Magdalena Bay, Lower California, 12 fathoms, station 2831.

24. *LIBINIA SETOSA* Lockington.

Libinia setosa LOCKINGTON, Proc. Cal. Acad. Sci., July 17, 1876, 1877, VII, p. 68.

Magdalena Bay, 12 to 51 fathoms, and off Abreojos Point, Lower California, 5½ fathoms, stations 2831, 2832, 2833, and 2835.

All the specimens are young. The four branchial spines forming a rhomboid are rather long, as are also three of the median spines, namely, the posterior of the gastric spines, the anterior cardiac and intestinal. The posterior gastric spine of adults is wanting in the young and the tubercle on either side of the anterior cardiac spine is much reduced.

25. *LIBINIA SPINOSA* Guérin.

Libinia spinosa GUÉRIN, Icon. R. Anim., Crust., pl. IX, fig. 3.—MILNE-EDWARDS, Hist. Nat. Crust., 1834, I, p. 301.

Off the Rio de la Plata, 10½ fathoms, station 2766.

26. *LIBINIA COCCINEA* (Dana).

Libidoecia coccinea DANA, Amer. Jour. Sci., 1851, 2d ser., XI, p. 268; Crust. U. S.

Expl. Exped., 1852, I, p. 88; 1855, pl. I, fig. 3.

Libinia coccinea MIERS, Challenger Rept., Zool., 1886, XVII, p. 73.

Off Gulf of San Matias, Argentina, 52 fathoms, station 2767.

27. *LIBINIA SMITHII* Miers.

Libinia smithi MIERS, Challenger Rept., Zool., 1886, XVII, p. 73, pl. IX, fig. 1.

Libinia hahni A. MILNE-EDWARDS, Miss. Sci. Cap Horn, 1891, VI, Crust., p. 5, pl. I, figs. 1-6.

Magellan Strait, 369 fathoms, and off Magallanes Territory, Chile, 61 to 1,050 fathoms, stations 2780, 2783, 2784, 2787, and 2788.

28. *LISSA TUBEROSA*, new species.

(Plate XLI, fig. 3.)

Branchial region with two large protuberances; postlateral margin sinuous; two crests on the carpal joints of the ambulatory legs.

Carapace with two median tuberculated prominences, the gastric higher than the cardiac, the latter continued backward along the median line to the posterior margin. A ridge running obliquely backward from the gastric prominence is almost entirely occupied by two protuberances, one at its middle and one at the postero lateral angle of the carapace, which presents a rounded or obliquely truncate outline. The sinus of the postero lateral margin is more shallow than in *L. bicarinata* Aurivillius. Margin of hepatic region with a tubercle; of branchial region with several tubercles and a blunt tooth at its middle. Hepatic region nearly vertical. Front with a shallow median emargination, from which the margin slopes obliquely backward or is almost transverse; outer corners with a slight tooth, most produced in young specimens. Pre-orbital tooth subacute or obtuse.

Chelipeds heavy in the male. Ischium with a tooth on its inner margin; merus with a tridentate crest on the superior margin. Carpus with surface uneven, a tubercle at the inner angle. Hands broad, compressed, widening distally, inner surface tuberculate; lower margin of propodus with a sinus near its middle. Dactylus with an acute upper margin. Fingers gaping for their basal half. Chelipeds of female much smaller than of male.

Ambulatory legs cristate as in *bicarinata*. The crest on the meral joints has a thin triangular tooth at the distal end; carpal joints with two triangular crests side by side, divergent from each other, and forming a cup on the upper surface. Propodal joints with a single triangular superior crest, a tubercle on the anterior and posterior surfaces, and with swellings at the articulation with the dactylus.

The surface of this crab is covered with a dense, short, vascular pubescence.

Dimensions.—Male, station 2828: Length, 13.6 mm.; width, 13 mm. Male, station 2824: Length, 16.9 mm.; width, 15.8 mm. Female, station 2825: Length, 14.1 mm.; width, 14.5 mm. Female, station 2828: Length, 12.3 mm.; width, 11.5 mm.

This species is distinguished from *L. bicarinata* by the wider rostrum, with a median emargination instead of a deep cut, by the shallower postlateral sinuses, by the large protuberance at the middle of the branchial ridge, and by the double crest on the carpal joints of the ambulatory legs.

Types.—No. 21574, U.S.N.M. Two males, station 2824, 8 fathoms.

Distribution.—This species was taken at four stations in the southern part of the Gulf of California in 7 to 10 fathoms, stations 2824, 2825, 2826, and 2828.

At two stations outside the Gulf of California were taken two specimens of *Lissa*, which appear specifically distinct from the above and are more closely allied to *L. bicarinata*. These I have named—

29. *LISSA AURIVILLIUSI*, new species.

(Plate XLI, fig. 4.)

Branchial ridge narrow; postlateral margin concave; carpal joints of first three pairs of ambulatory legs with one crest.

In this species the male and female are wider than long. The gastric prominence is small and angular; the oblique ridges leading from it are sharp and finely tuberculate, with only a shallow tooth at the middle in place of the round knob in *tuberosa*, and terminate in a raised tooth at the postlateral angle. The cardiac hump is small, and the median ridge extending back from it is narrow. Lateral margins tuberculate, with a shallow tooth at the middle and one farther back. Postlateral margin not sinuous as in the other two American species, but presenting a single shallow sinus extending the entire length of the margin. Median notch of the front shallow; outer teeth prominent. The cheli-

peds present no distinctive characters. The ambulatory legs are most like those of *bicarinata* in having only one crest, the posterior, on the carpus of the first three pairs of ambulatory legs, the anterior crest of *tuberosa* being represented by a tooth.

Dimensions.—Male: Length, 12.5 mm.; width, 13 mm. Immature female: Length, 9.8 mm.; width, 10 mm.

Type.—No. 21575, U.S.N.M. One male from off Cape St. Lucas, 31 fathoms, station 2829.

Additional specimen.—An immature female was taken in Magdalena Bay, 12 fathoms, station 2831.

This species resembles *L. bicarinata*, and differs from *L. tuberosa* in its narrow ridges and in the single crest of the carpus of the ambulatory legs. It differs from both in its greater width and in the outline of the postero-lateral margin.

30. LEPTOPIISA SETIROSTRIS Stimpson.

Tiarinia setirostris STIMPSON, Bull. Mus. Comp. Zool., 1871, II, p. 114.

Leptopisa setirostris STIMPSON, Bull. Mus. Comp. Zool., 1871, II, p. 114, in text.

Macrocaloma tenuirostra RATHBUN, Proc. U. S. Nat. Mus., 1892, XV, p. 252, pl. XXXIII, fig. 1.

Off Cape St. Roque, Brazil, 20 fathoms, station 2758.

31. MACROCÆLOMA TRISPINOSUM (Latreille).

Pisa trispinosa LATREILLE, Encyc. Méth., Hist. Nat., Entom., 1825, X, p. 142.

Macrocaloma trispinosa MIERS, Jour. Linn. Soc. London, 1879, XIV, p. 665.

Port Castries, St. Lucia.

32. MACROCÆLOMA DIACANTHUM (A. Milne-Edwards).

Pericera dicantha A. MILNE-EDWARDS, Crust. Rég. Mex., 1875, p. 57 (*dicantha*), pl. XV, fig. 3 (*diacantha*).

Macrocaloma diacantha MIERS, Jour. Linn. Soc. London, 1879, XIV, p. 665.

Off Cape St. Roque, Brazil, 20 fathoms, station 2758.

33. MACROCÆLOMA HEPTACANTHUM (Bell).

Pericera heptacantha BELL, Proc. Zool. Soc. London, 1835, III, p. 173; Trans. Zool. Soc. London, 1836, II, p. 61, pl. XII, fig. 6.

Macrocaloma heptacantha MIERS, Challenger Rept., Zool., 1886, XVII, pp. 79, 81.

Panama Bay, 18 fathoms, station 2798; off Cape St. Lucas, 31 fathoms, station 2829.

34. MACROCÆLOMA CONCAVUM Miers.

Macrocaloma concava MIERS, Challenger Rept., Zool., 1886, XVII, p. 81, pl. x, fig. 2.

Off Cape St. Roque, Brazil, 20 fathoms, station 2758, one female, intermediate between the type as figured by Miers and the specimen

referred by me to *M. eutheca*.¹ The true *M. eutheca* (Stimpson) is, I believe, distinct from *M. concavum*.²

35. *STENOCIONOPS CONTIGUA* Rathbun.

Pericera contigua RATHBUN, Proc. U. S. Nat. Mus., 1892, XV, p. 247, pl. XXXII, fig. 2.

Southern part of Gulf of California, 8 to 10 fathoms, stations 2824, 2826, 2827, and 2828.

36. *STENOCIONOPS TRIANGULATA* Rathbun.

Pericera triangulata RATHBUN, Proc. U. S. Nat. Mus., 1892, XV, p. 246, pl. XXXII, fig. 1.

Panama Bay, 51½ fathoms, station 2805; off Abreojos Point, Lower California, 48 fathoms, station 2834.

37. *MICROPHRYS BICORNUTUS* (Latreille).

Pisa bicornuta LATREILLE, Encyc. Méth., Hist. Nat., Entom., 1825, X, p. 141.

Microphrys bicornutus A. MILNE-EDWARDS, Nouv. Archiv. Mus. Hist. Nat. Paris, 1872, VIII, p. 247.

Abrolhos Islands, Brazil.

38. *MICROPHRYS BRANCHIALIS*, new species.

(Plate XLI, fig. 5.)

Microphrys, species, RATHBUN, Proc. U. S. Nat. Mus., 1892, XV, p. 254.

Postero-lateral angle with one spine; antero-lateral margin unarmed; anterior branchial region swollen.

Carapace triangular. Anterior portion of the branchial region covered by an oblique oblong protuberance, highest in its posterior portion, sloping gradually downward anteriorly and covered with tubercles. Gastric region with three tubercles on the median line, a cluster of three on each side anteriorly, and a transverse row at the posterior end. One tubercle on the genital region; ten on the cardiac, of which two are median. Posterior branchial region with several tubercles, the chief of which are arranged in two longitudinal rows; postero-lateral angle with a spine curving upward. A row of blunt tubercles above the posterior margin. Margin of the hepatic region with only a small tubercle; vertical side of the branchial region with scattered tubercles, and two lines of tubercles continued to the pterygostomian region. Anterior and lateral regions hairy. Rostrum deflexed, with two flattened, triangular, acute horns, pointing directly forward, and separated by a V-shaped sinus reaching one-half the length of the rostrum. Pre-orbital tooth blunt, denticulate. Two superior orbital fissures on either side of a rounded lobe; postorbital tooth blunt. The basal antennal joint bears at its antero-lateral angle a long, broad, blunt spine or

¹ Proc. U. S. Nat. Mus., 1892, XV, p. 251.

² Bull. Labor. Nat. Hist. State Univ. Iowa, 1898, IV, p. 257.

tooth, curved inward and upward and with crenulated outer margin; a short, blunt tooth at the base of the second joint; a tooth on the outer margin, forming part of the wall of the orbit, and two laminate teeth between the outer sinus and the buccal cavity.

Chelipeds one and one-third times the length of the carapace in the male. Upper surface of the merus and carpus with some scattered tubercles; outer surface of merus with a longitudinal row; also two or three tubercles at the proximal end of the outer lower margin. Palm long and narrow, margins parallel, superior length twice the width and more than one and a half times the length of the dactylus. Pollex not bowed downward as in *M. platysoma* Stimpson. The chelipeds of the female differ in being more slender and about nine-tenths the length of the carapace. First pair of ambulatory legs reaching half the length of the palm of the chelipeds in the male and equaling the chelipeds in the female. Meral joints of ambulatory legs armed with spines and tubercles on the superior and outer or posterior surfaces; carpal joints with two or three spines; margins hairy.

Dimensions.—Male: Length, 15.3 mm.; width, including spines, 14 mm.; excluding spines, 11.8 mm. Female: Length, 15 mm.; width, including spines, 14 mm.; excluding spines, 11.5 mm.

Types.—No. 21576, U.S.N.M. One male, two females, Magdalena Bay, Lower California, 12 fathoms, station 2831.

Additional localities.—Off Abreojos Point, Lower California, 48 fathoms, station 2834; Gulf of California, northwest of Guaymas, 22 fathoms, station 3012.

39. MICROPHRYS TRIANGULATUS (Lockington).

Mithraculus triangulatus LOCKINGTON, Proc. Cal. Acad. Sci., July 17, 1876, 1877, VII, p. 73.

Mithrax triangulatus KINGSLEY, Proc. Boston Soc. Nat. Hist., 1879, XX, p. 149.

Southern part of the Gulf of California, 7 to 10 fathoms, stations 2824 to 2828, inclusive.

This species, according to the structure of the orbits and antennae, is a *Microphrys*. The shape and protuberances of the carapace are also similar to species of that genus. The rostrum is short, as in many species of *Mithrax*.

40. PITHO QUINQUEDENTATA Bell.

Pitho quinquedentata BELL, Proc. Zool. Soc. London, 1835, III, p. 172.

Southern part of Gulf of California, 10 fathoms, station 2828.

41. PITHO LHERMINIERI (Schramm).

Othonia lherminieri SCHRAMM, Crust. Guadeloupe, 1867, p. 20.

Pitho lherminieri RATHBUN, Ann. Inst. Jamaica, 1897, I, p. 8.

Off Cape St. Roque, Brazil, 20 fathoms, station 2758.

42. *MITHRAX HEMPHILLI* Rathbun.

Mithrax hemphilli RATHBUN, Proc. U. S. Nat. Mus., 1892, XV, p. 263, pl. XXXVII, fig. 2.

Abrolhos Islands, Brazil.

43. *MITHRAX HISPIDUS* (Herbst).

Cancer hispidus HERBST, Natur. Krabben u. Krebse, 1790, I, p. 247, pl. XVIII, fig. 100.

Mithrax hispidus MILNE-EDWARDS, Mag. Zool., 1832, II, Cl. VII.

Abrolhos Islands; off Cape St. Roque, Brazil, 20 fathoms, station 2758.

44. *MITHRAX SINENSIS*¹ Rathbun.

Mithrax sinensis RATHBUN, Proc. U. S. Nat. Mus., 1892, XV, p. 266, pl. XXXVIII, fig. 2.

Southern part of Gulf of California, 7 to 10 fathoms, stations 2824 to 2828, inclusive.

45. *MITHRAX FORCEPS* (A. Milne-Edwards).

Mithraculus forceps A. MILNE-EDWARDS, Crust. Rég. Mex., 1875, p. 109, pl. XXIII, fig. 1.

Mithrax forceps MIERS, Challenger Rept., Zool., 1886, XVII, pp. 87, 88.

Abrolhos Islands, Brazil.

46. *MITHRAX CORYPHE* (Herbst).

Cancer coryphe HERBST, Natur. Krabben u. Krebse, 1801, III, Pt. 2, p. 8.

Mithrax coryphe RATHBUN, Ann. Inst. Jamaica, 1897, I, p. 11.

Abrolhos Islands, Brazil.

47. *MITHRAX NODOSUS* Bell.

Mithrax nodosus BELL, Proc. Zool. Soc. London, 1835, III, p. 171; Trans. Zool. Soc. London, 1836, II, p. 53, pl. XI, fig. 1.

Charles Island, Hood Island, and Duncan Island, all of the Galapagos group.

PARTHENOPIDÆ.

48. *THYROLAMBRUS EROSUS*, new species.

(Plate XLII, fig. 1.)

Surface tuberculate and eroded; posterior margin transverse and bordered by blunt teeth or lobes; hand dentate or lobate, not spinate.

This species, although possessing a strong resemblance to *T. astroides*, differs noticeably in the shape of the carapace and the character of the surface. The carapace is longer, the outline more pentagonal; the lateral and posterior margins, instead of being thin and

¹From "*sinus*," a gulf or bay, not "*Sina*," China.

acutely dentate as in *astroides*, are thick, and the posterior margin is bordered by small but prominent lobes. This margin is almost transverse, the posterior border of the branchial expansion not being inclined forward as in *astroides*. The lateral margin of the branchial region is much longer than in *astroides*, and the hepatic region is much more prominent. The general elevations and depressions of the carapace are similar to those of *astroides*. The surface is covered with small irregular pits, separated by low, smooth, reticulating ridges. The higher portions of the carapace bear at intervals tubercles covered with depressed granules. Under the lens the entire surface is seen to be densely and finely punctate.

The merus of the chelipeds is less thick than in *astroides*, and is armed with blunt tubercles or spines, as follows: A large tubercle on the distal third of the posterior margin; three or four rather slender blunt spines on the proximal half of the same margin; three prominent tubercles on the proximal half of the anterior margin; three low tubercles on the inferior margin; one tubercle on the superior surface. The hands are broader than in *astroides*, and broader at the base of the fingers than elsewhere, the upper margin of the outer surface being concave. The fingers are thick, especially the pollex. The armature is less striking than in *astroides*; instead of the elongated spines in that species, there are triangular, acute, and spinulous teeth. Of these there are five or six on the lower margin of the propodus, three being on the pollex; they are directed obliquely inward. The upper surface is deeply concave, and is bordered inwardly by three teeth, the median large and rounded. Dactylus with three small spines on the superior border of the inner surface. The surface of the chelipeds is similar to that of the carapace, except that the hands are rougher and more spinulous. The meral joints of the ambulatory legs are bordered by spinulous lobes or teeth; the propodi and dactyli are covered with spinules; surface of meri and carpi relatively smooth.

Dimensions of three specimens of Thyrolambrus erosus from station 2829.

Sex.	Length.	Posterior width.	Width at anterior angles of branchial region.
	mm.	mm.	mm.
Male	17.9	24.7	22
Male	14.2	19.2	17
Female	18.4	25	23.5

Types.—No. 21577, U.S.N.M. Two males, two females, from off Cape St. Lucas, 31 fathoms, station 2829.

Distribution.—Southern part of Gulf of California and off Cape St. Lucas, 8 to 31 fathoms, stations 2824, 2828, 2829.

49. LAMBRUS EXILIPES Rathbun.

Lambrus (*Parthenolambrus*) *exilipes* RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 234.

Lambrus hassleri FAXON, Bull. Mus. Comp. Zool., 1893, XXIV, p. 152; Mem. Mus. Comp. Zool., 1895, XVIII, p. 14, pl. III, figs. 1, 1a.

Panama Bay, $51\frac{1}{2}$ fathoms, station 2805; off Charles Island, Galapagos Islands, $78\frac{1}{2}$ fathoms, station 2816; off Cape St. Lucas, 31 fathoms, station 2829.

50. MESORHCEA GILLI Rathbun.

Mesorhcea gilli RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 235.

Panama Bay, $51\frac{1}{2}$ fathoms, station 2805; southern part of Gulf of California, 21 fathoms, station 2822; Magdalena Bay, 12 fathoms, station 2831; and off Abreojos Point, Lower California, 48 fathoms, station 2834.

51. HETEROCRYPTA MACROBRACHIA Stimpson.

Heterocrypta macrobrachia STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1871, X, p. 103.—A. MILNE-EDWARDS, Crust. Rég. Mex., 1878, p. 167, pl. XXIX, fig. 3.

Magdalena Bay, Lower California, 12 and 51 fathoms, stations 2831 and 2832.

CANCRIDÆ.

52. CANCER PLEBEJUS Poeppig.

Cancer plebejus POEPPIG, Arch. f. Nat., 1836, II, Pt. 1, p. 134.

Lota, Chile; Port Otway, Magallanes Territory, Chile.

53. CANCER POLYODON Poeppig.

Cancer dentatus BELL, Proc. Zool. Soc. London, 1835, III, p. 87; Trans. Zool. Soc. London, 1836, I, p. 339, pls. XLV, XLVII, figs. 4, 5; not *C. dentatus* HERBST, Natur. Krabben u. Krebse, 1785, I, p. 186, pl. XI, fig. 66.

Cancer polyodon POEPPIG, Arch. f. Natur., 1836, II, Pt. 1, p. 133.

Lota, Chile.

54. CANCER GIBBOSULUS (De Haan).

Corystes (*Trichocera*) *gibbosula* DE HAAN, Faun. Japon., 1835, p. 45, pl. II, fig. 4; pl. XIII, fig. 3.

Trichocarcinus gibbosulus MIERS, Proc. Zool. Soc. London, 1879, p. 34.

Magdalena Bay, Lower California, 51 fathoms, station 2833.

There are specimens in the U. S. National Museum from Granite Cove, Port Althorp, Alaska (W. H. Dall); off Cape Orford, Oregon, 35 fathoms (station 3094); San Francisco, California (D. S. Jordan); Monterey (Dr. C. A. Canfield); Monterey Bay, 13 and 19 fathoms (stations 3138 and 3142); Catalina Harbor, 30 to 40 fathoms (W. H. Dall); San Diego, 10 fathoms (H. Hemphill); San Diego Bay, $6\frac{1}{2}$ fathoms (station 3621); San Geronimo Island, Lower California, 7 fathoms (A. W. Anthony); and from Japan (H. Loomis).

55. *CANCER AMPHICETUS*, new name.

Trichocarcinus dentatus MIERS, Proc. Zool. Soc. London, 1879, p. 34.

Magdalena Bay, Lower California, 12 fathoms, station 2831; off Cerros Island, 44 fathoms, station 2838. Three specimens, too young to be identified with certainty, were taken off Abreojos Point, in 5½ fathoms, station 2835.

In subsequent cruises of the *Albatross*, this species has been taken at four stations in the Gulf of California, 12 to 36 fathoms (stations 3012, 3018, 3032, 3033); in San Diego Bay, California, 4½ fathoms (station 3591); in Hakodate Bay, Japan, 11½ and 15½ fathoms (stations 3656 and 3659); and in the Gulf of Tokio, 169 fathoms (station 3661). The species was also collected at Fusan, Korea, by Mr. P. L. Jouy.

56. *ACTÆA ANGUSTA*, new species.

(Plate XLII, fig. 2.)

Carapace narrow, posteriorly lobulated; lateral lobes dentiform; fingers rough.

Carapace narrow, slightly convex, lobulate on the posterior as well as the anterior half; lobules granulous. The posterior half of the mesogastric region is long, and its sides are distinctly convergent backward; the depressions which form its lateral borders are continued posteriorly in divergent lines, thus forming a figure the shape of an hour-glass. On either side of this there is a large branchial lobule, not distinctly limited posteriorly. Front slightly deflexed, its margin visible in a dorsal view; lobes oblique, nearly straight, separated by a broad V-shaped notch. Lateral lobes four, besides the orbital, dentiform, the first very short, the second twice as long, the third much the longest. Inner suborbital lobe rounded, prominent.

Chelipeds covered with spiniform tubercles, the carpus deeply grooved, the tubercles on the hands arranged in longitudinal rows. Fingers deeply grooved, the intervening ridges rough with spiniform tubercles. Ambulatory legs granulate.

Dimensions.—Female: Length, 4.5 mm.; width, 6 mm.

Type.—No. 21578, U.S.N.M. One immature female, off Hood Island, Galapagos Islands, 20 fathoms, station 2812.

This species resembles *A. setigera* (Milne-Edwards) and *A. dovii* Stimpson in the ornamentation of the carapace and in the chelipeds; it differs from them in being narrower and posteriorly areolated, and having dentiform lateral lobes. It resembles *A. bifrons* Rathbun in its proportions and lateral lobes, and differs in its front, posterior areolations, and roughened and grooved fingers.

57. *ACTÆA INORNATA*, new species.

(Plate XLII, fig. 3.)

Carapace narrow, granulate, pubescent, not lobulate.

Carapace rather narrow for the genus; very convex antero-posteriorly, slightly so transversely; entire surface of crab covered with a short, dense pubescence, which must be removed to see the character of the surface beneath. The regions of the carapace are faintly outlined, and are not lobulated as in typical *Actæa*, although there are traces of shallow furrows on the branchial region. The surface is sparsely ornamented with fine granules, most numerous along the lateral margins. These margins are cut by three shallow notches into four lobes. A median furrow extends from the gastric region down to the front, which is divided by a slight emargination into two slightly sinuous and oblique lobes. The basal joint of the antenna does not reach as far forward as the inner angle of the orbit.

The chelipeds are nearly equal. The carpus and manus are covered with depressed granules larger than those of the carapace. The fingers are furrowed, granulate, and white; their prehensile teeth are irregular. The dactylus is longer than the superior margin of the propodus; the pollex is not deflexed. The single specimen taken is a female, apparently adult.

Dimensions.—Female: Length, 4.3 mm.; width, 5.6 mm.

Type.—No. 21579, U.S.N.M. One female, from off Cape St. Roque, Brazil, 20 fathoms, station 2758.

58. *OZIUS VERREAUXII* Saussure.

Ozius verreauxii SAUSSURE, Rev. Mag. Zool., 1853, 2d ser., V, p. 359, pl. XII, fig. 1.

James Island, Chatham Island, and Indefatigable Island, of the Galapagos.

59. *OZIUS AGASSIZII* A. Milne-Edwards.

Ozius agassizii A. MILNE-EDWARDS, Crust. Rég. Mex., 1880, p. 279, pl. LV, fig. 1.

Duncan Island, Galapagos.

60. *MEDÆUS LOBIPES*, new species.

(Plate XLIV, fig. 1.)

Ambulatory legs with lobate crests.

Carapace shorter and broader than in *M. spinimanus* Milne-Edwards; lobules similar in shape and position to those of that species. In the largest specimen the tuberculation of the lobules is less extensive than in smaller specimens, and also less extensive than in the somewhat larger individual of *M. spinimanus*, with which it is compared. Posterior half of mesogastric region divided by a median sulcus into two lobules. Cardiac region also distinctly divided in the same way. Front less advanced, and lobes less oblique than in *M. spinimanus*. The lateral teeth and the chelipeds offer no differences worthy of note. The

ambulatory legs are, however, very distinct. They are shorter than in *M. spinimanus*. The meral joints are armed on the upper or anterior margin with spiniform teeth, as in that species; the tubercles of the upper surface of the last pair are more depressed. The carpal and propodal joints are ornamented with lobate crests, of which there are three on the carpal joints of the first, second, and third pairs, and two on the propodal joints and on the carpal joint of the fourth pair. The middle crest of the carpal joints (the anterior crest in the last pair) is most prominent, and is composed of three rounded lobes, the interspaces as wide as the lobes. Ambulatory legs hairy, the dactyli densely so.

Abdomen of male with the first three segments tuberculous; anterior margin of each segment, including the coalesced segments, marked by a transverse band of pubescence. Posterior half of sternum tuberculous; anterior half punctate or pitted.

Dimensions.—Male, type: Length, 17 mm.; width, 25.6 mm. Female with eggs, station 2812: Length, 8.5 mm.; width, 12.3 mm.

Type.—No. 21580, U.S.N.M. One male, from Panama Bay, 33 fathoms, station 2796.

Additional specimens.—Panama Bay, 5½ fathoms, station 2805, two small males; off Hood Island, Galapagos, 20 fathoms, one female; off Cape St. Lucas, 31 fathoms, station 2829, one male.

LIPÆSTHESIUS, new genus.

(Λειπῶ, to be wanting; αἰσθησῖς, perception by feeling.)

Allied to Glyptoxanthus, Medæus, and Carpoporus. Basal antennal joint excluded from the orbit; flagellum and peduncular joints wanting; antero-lateral margin of the carapace terminating at the angle of the buccal cavity.

Carapace in shape resembling *Glyptoxanthus*; that is, the antero-lateral margin is arcuate, the postero-lateral is deeply concave, the anterior half of the carapace is very convex longitudinally, the posterior half is flattened. The antero-lateral margin, however, is thinner than in *Glyptoxanthus*, and runs obliquely downward to the angle of the buccal cavity, as in *Medæus*. Front deflexed, forming a projecting hood over the antennulæ. Orbits circular. Basal antennal joint less advanced than the orbital angle; its anterior margin articulates with the lower corner of the front, as does also the inner corner of the lower orbital margin (Plate XLII, fig. 5). The antennæ proper, including the peduncular joints and the flagellum, are absent. Only the flat lower surface of the basal joint is exposed to view, and there is no socket to hold an antenna. Epistome with a deep transverse invagination through its entire width. Abdomen of male with the third, fourth, and fifth segments anchylosed. Chelipeds concave on their inner side to fit closely against the carapace. Last pair of ambulatory legs fitting into the postero-lateral sinus of the carapace.

61. *LIPÆSTHESIUS LEEANUS*, new species.

(Plate XLII, figs. 4, 5.)

Surface granulate and eroded; color of pollex running back on the hand.

Carapace with mesogastric and cardiac regions depressed. Protogastric region forming an elevated protuberance; a similar but smaller protuberance is at the middle of the branchial region; in front of this, two tubercles. Hepatic region inclined. Antero-lateral margin subacute, with about four tubercles at intervals. Surface covered with coarse granules arranged to form a network or an eroded surface; gastric sutures smooth. Front strongly deflexed, thin, emarginate, and with a short closed median fissure; lobes oblique, sinuous, bent down at the outer angles to meet the antennal joint. The inferior surface of the crab, excepting the abdomen and the portions against which the legs are applied, is granulous and eroded. Abdomen almost smooth. The palpus of the endognath is folded above the preceding joint, and is only slightly visible in a ventral view.

Chelipeds subequal, thick, outer surface eroded. Fingers gradually curved downward, very rough with granulation; prehensile edges toothed, not gaping; color brown, that of the pollex running back on the hand, further on the inner surface than on the outer. Dactylus longer than the superior margin of the palm. The ambulatory legs are short and are ornamented with granulations similar to those of the carapace.

Dimensions.—Male: Length, 8.4 mm.; width, 11.4 mm.

Types.—No. 21581, U.S.N.M. Two males, from the southern part of the Gulf of California, 10 fathoms, station 2828.

Named in honor of Prof. L. A. Lee, of Bowdoin College, who was chief naturalist of the *Albatross* during the cruise around the Horn.

62. *PILUMNUS SPINULIFER*, new species.

(Plate XLII, figs. 6-8.)

Carapace rough, nearly naked; larger hand half smooth; smaller hand entirely rough outside; a subhepatic tooth or spine.

Carapace wide, convex, deeply areolated, surface nearly naked, having only a short, scattered pubescence, not concealing the spiniform granules covering the surface. These granules are very small posteriorly, but anteriorly they are larger and along the antero-lateral margin many of them are developed into spinules. Median sinus of the front very large and V-shaped, forming the inner margins of the two large lobes; the outer margins are also oblique but longer; outer angles of front rectangular; margin thin and granulate. Superior margin of orbit spinulous, inferior margin armed with slender spines; inner sub-orbital tooth prominent, spinulous, and sharp. Antero-lateral margin

with four spines, bordered by smaller spines or spinules; the greatest interval is between the second and the first or orbital; below this space may be seen a subhepatic spine, similar in character but less produced than the marginal spines. Lower surface of carapace rough and similar to the upper.

Meral joints of chelipeds granulate on outer surface; margins armed with spines and spinules, those of the upper surface increasing in size distally. Carpi spinous. The upper and proximal half of the outer surface of the palm of the larger cheliped is covered with stout spinules, which have a tendency to form longitudinal rows and become smaller and more granuliform toward the lower and distal margins; the spinules cover the upper surface and extend a little on the inner surface. The smaller palm is roughened on the entire outer surface with spinules or spiniform granules; upper surface with two rows of spines; inner face granulous, except near the fingers. Dactyli of both chelipeds a little roughened near the base. Meral joints of ambulatory legs armed on the anterior margin with a row of slender spines; posterior margin spinulous; carpal and propodal joints armed above, below, and anteriorly with a row of spines. Legs sparingly pubescent.

Dimensions.—Male: Entire length, 8.8 mm.; width, including spines, 12.5 mm.

Types.—No. 21582, U.S.N.M. Two males, off Cape St. Lucas, 31 fathoms, station 2829.

63. PILUMNUS, species.

One young specimen, undetermined, from Magdalena Bay, Lower California, 51 fathoms, station 2832.

64. PILUMNOIDES PERLATUS (Poëppig).

Hepatus perlatus POEPPIG, Arch. f. Natur., 1836, II, Pt. 1, p. 135, pl. IV, fig. 2.

Pilumnoides perlatus MILNE-EDWARDS and LUCAS, D'Orbigny's Voy. l'Amér.

Mérid., 1843, VI, Pt. 1, p. 21; 1847, IX, pl. IX, fig. 1.

Off the Rio de la Plata, $10\frac{1}{2}$ to $11\frac{1}{2}$ fathoms, stations 2764 to 2766; Magellan Strait, $29\frac{1}{2}$ fathoms, station 2775.

65. XANTHO GAUDICHAUDII Milne-Edwards.

Xantho gaudichaudii MILNE-EDWARDS, Hist. Nat. Crust., 1834, I, p. 396.

Port Otway, Magallanes Territory, Chile.

66. HOMALASPIS PLANA (Milne-Edwards).

Xantho planus MILNE-EDWARDS, Hist. Nat. Crust., 1834, I, p. 397.

Homalaspis planus A. MILNE-EDWARDS, Ann. Sci. Nat., 1863, 4th ser., XX, p. 279.

Port Otway, Magallanes Territory, Chile.

67. XANTHIAS POLITUS Rathbun.

Micropanope polita RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 238.

Xanthias politus RATHBUN, Bull. Labor. Nat. Hist. State Univ. Iowa, 1898, IV, p. 271.

Off Hood Island, Galapagos, 20 fathoms, station 2812; off Cape St. Lucas, Lower California, 31 fathoms, station 2829.

68. MICROPANOPE XANTHIFORMIS (A. Milne-Edwards).

Panopeus xanthiformis A. MILNE-EDWARDS, Crust. Rég. Mex., 1880, p. 353, pl. LIII, fig. 4.

Micropanope xanthiformis RATHBUN, Bull. Labor. Nat. Hist. State Univ. Iowa, 1898, IV, p. 274.

Off Cape Frio, Brazil, 59 fathoms, station 2762.

69. MICROPANOPE NITIDA, new species.

(Plate XLII, fig. 9.)

General appearance smooth; frontal lobes rounded; second and fifth lateral teeth reduced; color of pollex not running back on hand.

Carapace broad, convex in both directions; regions very faintly indicated; surface minutely granulate or almost smooth, covered with very minute punctæ, with here and there a larger one. Front inclined, granulate; edge thin, median sinus V-shaped; lobes sinuous, convex for their inner two-thirds. Orbits with two V-shaped sinuses on the superior margin. Lateral teeth five; the first or orbital small and dentiform, the second low and rounded and connected with the first by a shallow sinus; third and fourth large, with arcuate outer and concave inner margins and acute curved tips; fifth very small and postero-lateral. The outer suborbital fissure is deep, narrow at the base, with convex sides; the inner tooth is low and blunt. The second segment of the abdomen of the male is wide, and at its outer distal corners leaves exposed a very small piece of the sternum. The third segment has a very broad base with angular corners, reaching the coxæ of the fifth pair of feet. The penultimate segment is short and widens distally. Terminal segment triangular and blunt.

Chelipeds strong and unequal, with surfaces finely granulate; upper margin of merus granulate or denticulate. Carpus with a short sharp inner tooth or spine, with a blunt tooth beneath it, and an anterior groove; granules having a tendency to form slight rugæ. Large hand strong, with convex margins; upper surface broad and flattened; in smaller specimens having two blunt crests; fingers bent downward, slightly gaping, with punctate impressed lines; prehensile teeth low. Smaller hand resembling the larger, but about two-thirds as wide. Color of fingers dark brown, the color line on the pollex running obliquely downward from the proximal end of the prehensile margin and parallel to the proximal end of the palm. Ambulatory legs long

and narrow; meral joints with anterior margins spinulose; last two joints with pubescent margins.

Dimensions.—Male: Length, 8.1 mm.; width, 11.5 mm.

Types.—No. 21583, U.S.N.M. Two males, eight females. Southern part of Gulf of California, 8 fathoms, station 2824.

Distribution.—Gulf of California, 7 to 10 fathoms, stations 2824 to 2828, inclusive.

70. MICROPANOPE AREOLATA, new species.

Carapace arcuate; frontal lobes rounded; second and fifth lateral teeth reduced; color of pollex running back on palm.

This species is closely allied to the preceding, and is associated with it. It is distinguished by its carapace being slightly narrower, areolate, more distinctly granulate, and slightly pubescent, by the greater roughness of the carpi of the chelipeds, and, above all, by the dark color of the pollex extending well backward and upward on the palm.

Dimensions.—Male: Length, 6.7 mm.; width, 8.9 mm.

Types.—No. 21584, U.S.N.M. Four males, one female. Head of Gulf of California, 11 fathoms, station 3024.

Distribution.—Gulf of California, 9½ to 11 fathoms, stations 2826, 2827, 2828, 3024.

71. LOPHOPANOPEUS MACULATUS, new species.

(Plate XLII, figs. 10, 11.)

Carpus slightly rough; ambulatory legs slightly cristate; meral joints spinulose; terminal segment of abdomen of male wider than the preceding joint.

Carapace hexagonal, moderately convex, deeply areolated. Surface covered with very fine, depressed, scabrous granules. Front narrow, advanced, thickened, emarginate, with a short, closed, median fissure; margin sinuous, granulate, the outer angle being truncate and obtuse. Lobe between the superior orbital fissures truncate, not produced. Exorbital tooth small; second tooth well marked, though not prominent, rounded; third, fourth, and fifth teeth dentiform, subacute, the fifth a little the smaller. Sinuses separating the second, third, fourth, and fifth teeth continued by grooves on the carapace. The inferior regions of the carapace are granulous and there is a suborbital tubercle. The inner tooth of the inferior orbital margin is produced, thickened, and obtuse; the outer fissure is large and V-shaped. Proximal angles of third abdominal segment of male acute and overlapping the coxæ of the fifth pair of feet. Penultimate segment nearly as long as wide, increasing in width distally. Last segment wider than the preceding and arcuate.

Chelipeds nearly equal, heavy. Merus trigonal, as broad as long, superior margin denticulate. Carpus slightly rugose, with an anterior groove and two blunt inner teeth, one above the other. The palm of

the larger cheliped is wider than its superior length, and the upper margin is somewhat flattened. The inferior margin of the propodus is slightly sinuous. The surface is punctate with large and small punctæ, and finely granulate, the granules becoming larger and rougher on the broad upper surface. The fingers are wide and gape slightly. They are crossed by a few impressed, punctate lines. The dactylus is arched and has a large basal tooth, followed by about seven small teeth. The pollex has about six large teeth. The lesser cheliped is missing in the type male. In a smaller specimen, however, this cheliped is seen to differ from the larger one in being a little narrower, with fingers bent down a little more. All the prehensile teeth are small. The meral joints of the ambulatory legs are narrow, with anterior margins spinulose. The next joint is subcristate, having a deep groove near its anterior margin; the propodi have convex margins.*

Dimensions.—Type male: Length, 7.1 mm.; width, 9.9 mm. Ovigerous female, station 2831: Length, 4.4 mm.; width, 6 mm.

Color.—In alcohol, the carapace shows ten or twelve dark blue spots; chelipeds reddish, fingers with white tips and teeth; merus joints of ambulatory legs with a dark band at the center.

Types.—No. 21585, U.S.N.M. One male, one female. Southern part of Gulf of California, 8 fathoms, station 2824.

Distribution.—Gulf of California, 7 to 17 fathoms, and Magdalena Bay, Lower California, 12 fathoms, stations 2824, 2825, 2828, 2831, 3002.

72. *XANTHODIUS LOBATUS* (A. Milne-Edwards).

Leptodius lobatus A. MILNE-EDWARDS, Crust. Rég. Mex., 1880, p. 271, pl. XLIX, fig. 4.

Charles Island and Duncan Island, Galapagos.

73. *LEPTODIUS FLORIDANUS* (Gibbes).

Chlorodius floridanus GIBBES, Proc. Amer. Assoc. Adv. Sci., 1850, III, p. 175.

Leptodius floridanus A. MILNE-EDWARDS, Crust. Rég. Mex., 1880, p. 268, pl. XLIX, fig. 2.

Abrolhos Islands, Brazil.

74. *LEPTODIUS OCCIDENTALIS* (Stimpson).

Chlorodius occidentalis STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1871, X, p. 108.

Leptodius occidentalis A. MILNE-EDWARDS, Crust. Rég. Mex., 1880, p. 269.

Pichilique Bay, Lower California; Galapagos Islands.

75. *EURYTIUM AFFINE* (Streets and Kingsley).

Panopeus transversus LOCKINGTON, Proc. Cal. Acad. Sci., September 4, 1876, 1877, VII, p. 102; not *P. transversus* Stimpson.

Panopeus affinis STREETS and KINGSLEY, Bull. Essex Inst., 1877, IX, p. 106.

Eurytium affine A. MILNE-EDWARDS, Crust. Rég. Mex., 1880, p. 334, pl. LX, fig. 1.

Pichilique Bay, Lower California.

76. *CYCLOXANTHOPS DENTICULATUS* (White).

Xantho denticulatus WHITE, Ann. Mag. Nat. Hist., 1848, 2d ser., II, p. 285.

Cycloxanthops denticulatus RATHBUN, Ann. Inst. Jamaica, 1897, I, p. 14.

Abrolhos Islands, Brazil.

77. *TETRAXANTHUS BIDENTATUS* (A. Milne-Edwards).

Xanthodes bidentatus A. MILNE-EDWARDS, Crust. Rég. Mex., 1880, p. 353, pl. LIII, fig. 5.

Tetrazanthus bidentatus RATHBUN, Bull. Labor. Nat. Hist. State Univ. Iowa, 1898, IV, p. 275.

Off Cape Frio, Brazil, 59 fathoms, station 2762.

78. *ERIPHIA GONAGRA* (Fabricius).

Cancer gonagra FABRICIUS, Sp. Ins., 1781, p. 505.

Eriphia gonagra MILNE-EDWARDS, Hist. Nat. Crust., 1834, I, p. 426, pl. XVI, figs. 16, 17.

Abrolhos Islands and Bahia, Brazil.

79. *ERIPHIA SQUAMATA* Stimpson.

Eriphia squamata STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1859, VII, p. 56.

Pichilique Bay, Lower California.

80. *PSEUDERIPHIA HISPIDA* (Stimpson).

Eriphia hispida STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1860, VII, p. 218.

Pseudieriphia hispida A. MILNE-EDWARDS, Crust. Rég. Mex., 1880, p. 340, pl. LVI, fig. 1.

Albemarle Island, Galapagos.

GRAPSILLIDÆ.

81. *QUADRELLA NITIDA* Smith.

Quadrella nitida SMITH, Proc. Boston Soc. Nat. Hist., 1869, XII, p. 288.

Off Cape St. Lucas, Lower California, 31 fathoms, station 2829, two males, two females, one bearing eggs.

Dimensions of Quadrella nitida.

Sex.	Total length.	Width.
	mm.	mm.
Male.....	8.9	9.6
Male.....	5.5	5.6
Female with eggs.....	7.4	8
Female.....	6.6	6.7

By Dr. Ortmann this species is united with *Q. coronata* Dana. I have not seen specimens of the latter. *Q. nitida* has only one carpal spine instead of the two in *coronata*. The sinuses separating the median from the next pair of frontal teeth are more shallow than represented in Dana's figure, and the lateral margins are much more convex.

ECTÆSTHESIUS, new genus.

('Εκτός, external, and αἰσθησις, perception by feeling.)

Allied to Grapsillus; orbital fissure closed; sides two-toothed.

Carapace smooth; wider and sides more arcuate than in *Grapsillus*; furnished with two large teeth on the antero-lateral margin, one at the lateral angle, and one between that and the orbital angle. Postero-lateral margins converging. Front broad, slightly bilobed. Orbits shallow, entire; inner fissure closed by the union of the lower orbital margin with the front (Plate XLII, fig. 13); orbit otherwise entire. Peduncular joints of antennæ short; the second joint just reaches the lower corner of the front; the third joint attains the frontal margin. Palatal ridge partially developed, anteriorly obsolete. The antero-external angle of the merus of the outer maxillipeds is laterally produced, and the antero-internal angle emarginate (Plate II, fig. 14). Chelipeds unequal, smooth, not enlarged; merus short, margins entire; carpus unispinous; fingers elongate, acute. Ambulatory legs short, last three joints setose; dactyli rather stout.

82. ECTÆSTHESIUS BIFRONS, new species.

(Plate XLII, figs. 12-14.)

Carapace slightly convex in both directions, about three-fourths as long as wide, antero-lateral margin arcuate, postero-lateral margins sinuous and rapidly converging. Surface smooth, except near the front and lateral teeth, where fine granulation may be detected with the lens. Front nearly half the width of the carapace, slightly arcuate, almost imperceptibly bilobed, edge thin, retreating at the outer angles. Just above, behind, and parallel to the margin, at a distance of about 0.2 of a millimeter, is a sharp ridge which is slightly interrupted at the median line. Orbit less than half the width of the front; outer angle inconspicuous, not advanced beyond the general outline of the orbital margin. The tooth at the lateral angle of the carapace is situated a little in front of the middle of the length of the carapace and is subacute. The first tooth of the antero-lateral margin is about one-third the distance between the orbital angle and the lateral tooth and is obtuse. The abdomen of the mature female is narrow; third, fourth, and fifth segments subequal in length as well as in width; sixth of the same width, but longer; seventh narrower, length and breadth subequal, extremity rounded. Peduncular joints of antennæ short.

Merus of chelipeds extending but little outside the carapace, trigonal, widest near the middle. Carpal tooth large and sharp. Manus with the inner surface swollen toward the proximal end, as in *Grapsillus*; margins smooth and rounded; superior margin slightly convex, inferior margin sinuous, that of the pollex being concave. Dactylus longer than the superior margin of the palm. Fingers not gaping, marked with a few lines of punctæ; dactylus without teeth; pollex of the larger cheliped

with one low tooth on basal half and two teeth and a few denticles on terminal half; in the smaller cheliped the teeth of the pollex are all on the terminal half. The ambulatory legs are of the same nature as those of *Grapsillus*; dactyli nearly as long as the propodi.

Dimensions.—Ovigerous female: Length, 7 mm.; width, 9.7 mm.; width of front, 4.4 mm.; exorbital width, 7.2 mm.

Type.—No. 21586, U.S.N.M. One ovigerous female. Off Chatham Island, Galapagos Islands, 45 fathoms, station 2809.

PORTUNIDÆ.

83. PORTUNUS SAYI (Gibbes).

Lupa sayi GIBBES, Proc. Amer. Assoc. Adv. Sci., 1850, III, p. 178.

Neptunus sayi A. MILNE-EDWARDS, Arch. Mus. Hist. Nat. Paris, 1861, X, p. 317, pl. XXIX, fig. 2.

Portunus sayi RATHBUN, Ann. Inst. Jamaica, 1897, I, p. 22.

Latitude 31° 16' north, longitude 71° 50' west, surface.

84. PORTUNUS PANAMENSIS (Stimpson).

Achelous panamensis STIMPSON, Ann. Lye. Nat. Hist. N. Y., 1871, X, p. 112.

Neptunus panamensis A. MILNE-EDWARDS, Crust. Rég. Mex., 1879, p. 219; not *Amphitrite paucispinis* Lockington.

Panama Bay, 33 and 18 fathoms, stations 2797 and 2798.

85. PORTUNUS TRANSVERSUS (Stimpson).

Achelous transversus STIMPSON, Ann. Lye. Nat. Hist. N. Y., 1871, X, p. 111.

Neptunus transversus A. MILNE-EDWARDS, Crust. Rég. Mex., 1879, p. 220.

One adult female and one small immature male were taken at station 2800, Panama Bay, 7 fathoms. The male is about the size of Stimpson's type from Manzanillo, which is not extant, and agrees with his brief description. The adult, however, possesses more strongly marked characters.

This species has, as Stimpson has remarked, the aspect of a *Callinectes*. The carapace is very broad, and the antero-lateral margins are little arched. The depressions separating the areolations are deep; the branchial ridge is oblique and slightly curved; the inner branchial lobes are very well marked. The front is little advanced, the four middle teeth are triangular, blunt, their tips equidistant, the median pair narrower and more advanced than the next pair. The two teeth above the antennae are well separated from each other and equally advanced, although the outer is wider than the inner. The supra-orbital sinuses are open anteriorly. The eight lateral teeth are subequal, becoming gradually more acute from the first to the eighth. The first or orbital tooth is equally advanced with the outer of the four median frontal teeth. The lateral spine is directed obliquely forward, and is as long as the width of the four preceding teeth. The posterior margin is slightly concave at its middle in the adult. The inner sub-

orbital tooth is much more advanced than the front, and is separated by a notch from the adjacent orbital margin.

The merus of the left cheliped (the right is missing), is armed on the anterior margin with seven acuminate spines; the proximal is very small, the size increasing from the first to the fourth; the fourth, fifth, and sixth are subequal; the distal or seventh spine is longest, and is separated from the next by the greatest interval. In the young, the three proximal spines of the adult are absent. Outer margin terminating in a well-marked spine. The carpus is armed with two spines, a small outer, and an inner spine between two and three times the length of the outer. There are two propodal spines, the posterior in the customary position, and a spine near the distal end of the upper margin. The posterior distal angle of the merus of the last pair of feet is armed with a spine.

Dimensions.—Female: Length to tips of teeth, 34 mm.; width, 75.6 mm.; width between posterior sinuses of antero-lateral margin, 55.5 mm. Young male: Length, 11.5 mm.; width, 26.3 mm.; width between posterior sinuses, 18.8 mm.

86. PORTUNUS XANTUSII (Stimpson).

Achelous xantusii STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1860, VII, p. 222.

Neptunus xantusii A. MILNE-EDWARDS, Arch. Mus. Hist. Nat. Paris, 1861, X, p. 429.

From Abreojos Point to Magdalena Bay, Lower California, 5½ to 48 fathoms, stations 2831, 2834, 2835; Gulf of California.

87. PORTUNUS (ACHELOUS) BREVIMANUS (Faxon).

Achelous spinimanus FAXON, Mem. Mus. Comp. Zool., 1895, XVIII, p. 23 (not *Portunus spinimanus* Latreille).

Achelous brevimanus FAXON, Mem. Mus. Comp. Zool., 1895, XVIII, p. 23, in text.

Near Cocos Island, 66 fathoms.

The characters presented by a series of specimens from the Pacific seem to justify their specific separation from *P. spinimanus*. *P. brevimanus* is less pubescent and has a much more uneven surface; the anterior branchial ridge is more strongly arched forward and the two short branchial ridges are more oblique than in typical *spinimanus*. In *brevimanus* the median lobe of the superior orbital margin is strongly produced at its outer angle; in *spinimanus* this angle is advanced very little, if at all, beyond the inner. The inner carpal spine of the chelipeds is noticeably longer, and also the merus joint of the swimming feet, than in *spinimanus*. Some of the specimens collected are mature, but all are smaller than the type. None have the small spine at the distal end of the palm, and only one spine is present at the posterior distal corner of the merus of the swimming feet.

Off Hood Island, Galapagos, 20 and 40 fathoms, stations 2812 and 2813; Albemarle Island, Galapagos.

88. PORTUNUS (ACHELOUS) ANGUSTUS, new species.

(Plate XLIV, fig. 2.)

Front advanced, 8-toothed; lateral teeth alternately large and small; lateral spine only slightly longer than seventh tooth; a spine at posterior distal angle of merus of swimming feet.

Carapace narrow, pubescent except upon the transverse granulated lines; in shape resembling *P. ordwayi* (Stimpson). Front advanced; four middle teeth subacute, the outer pair broader at base than the inner, and separated from the inner pair by wider sinuses than the median sinus, and from the supra-antennal angle by a deep V-shaped sinus. Supra-antennal lobe bidentate; teeth acute. Antero-lateral teeth alternately large and small, the last tooth or lateral spine very little longer than the seventh. The inner suborbital tooth is acute and equally advanced with the second pair (reckoning from the middle) of frontal teeth; there are no teeth on either side of the outer orbital fissure.

The merus of the cheliped of the type specimen, a female, has four spines on its inner margin, graduated from a large one near the distal end to a small one near the ischium; a very small spine on the outer margin at the distal end. Carpus with a small external distal spine and a long inner spine reaching, when the arm is flexed, to the spine next to the smallest on the merus. The hand has two large spines, one next the carpus and one on the superior margin at one-third its length from the dactylus. The ridges on the carpus, propodus, and dactylus are very coarsely granulated with acorn-shaped granules. The depressions are pubescent. The extero-superior surface of the merus is crossed by a longitudinal ridge. The inferior margin of the merus of the left natatory foot is armed with a sharp spine near the distal end; on the right foot there are two smaller spines in the same position.

Color.—Although this crab has been for a long time in alcohol, it seems to be of a reddish hue. The basal half of the fingers is red, the next quarter is white, the remainder is brown, except the tips, which are white.

Dimensions.—Female: Total length of carapace, 25.5 mm.; total width, 37.2 mm.; width between the last sinuses, 33.5 mm.; exorbital width, 21 mm.

Type.—No. 21587, U.S.N.M. One female; off Hood Island, Galapagos, 20 fathoms, station 2812.

This species has considerable resemblance to *Charybdella* (= *Cronius*), but the basal antennal joint is not so strongly produced as in that genus. It can also be told by its narrower carapace and frontal teeth, and few spines on the hand.

89. PORTUNUS (ACHELOUS) ORDWAYI (Stimpson).

Achelous ordwayi STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1860, VII, p. 224.*Neptunus ordwayi* A. MILNE-EDWARDS, Crust. Rég. Mex., 1879, p. 217, pl. XL, fig. 2.

Abrolhos Islands.

90. PORTUNUS (ACHELOUS) AFFINIS (Faxon).

Achelous affinis FAXON, Bull. Mus. Comp. Zool., 1893, XXIV, p. 155; Mem. Mus. Comp. Zool., 1895, XVIII, p. 23, pl. IV, fig. 1.

Panama Bay, at station 2795, 33 fathoms; station 2803, 26 fathoms; and surface station 24 (young).

91. PORTUNUS (ACHELOUS) MINIMUS, new species.

(Plate XLIV, fig. 3.)

Front eight-toothed; second, fourth, and sixth lateral teeth reduced; lateral spine twice as long as eighth tooth; merus with four spines on anterior margin; spinules at posterior distal margin of swimming feet.

This is a very small species, as adults average about 15 mm. in width. Surface pubescent; ridges fairly well marked; the inner portion of the transverse branchial ridge is advanced to a point in line with the sixth lateral teeth. Front very wide; four median teeth, obtusely rounded, separated by rounded sinuses; the median pair of teeth narrower than the lateral and more advanced; the lateral sinuses as deep as the median and much wider. Supra-antennal teeth less advanced, two in number, subacute, separated by a shallow sinus. Of the superior orbital fissures, the inner is a narrow slit, the outer is V-shaped. The outer orbital tooth is less advanced than any of the frontal teeth, is rather large, and obtusely rounded. The other lateral teeth are acute. The second, fourth, and sixth are smaller than the others, and themselves diminish in size in the order named. The lateral spine is curved upward and forward and equals in length the width of the two preceding teeth. The inner suborbital tooth is produced to the line of the second pair of frontal teeth. Outer sinus of the suborbital margin V-shaped.

Merus of the chelipeds with three anterior spines, of which the proximal is the smaller, the others subequal; posterior margin terminating in a small spine. Carpus with a small outer spine and a large inner one about three times the length of the outer. Manus with two spines, one next the carpus and one near the distal end of the upper margin. Postero-distal margin of merus of swimming feet armed with fine spinules, but without a single long spine.

Dimensions.—Male, station 2827: Total length, 10.2 mm.; width, 17 mm.; width between last antero-lateral sinuses, 14.1 mm.; exorbital width, 10 mm. Female, station 2826: Total length, 9.4 mm.; width, 15.7 mm.; width between last sinuses, 12.8 mm.

Type.—No. 21588, U.S.N.M. One adult male, three adult females, one ovigerous. Station 2827, 10 fathoms.

Habitat.—Southern part of the Gulf of California, 9½ to 10 fathoms, at the following stations: 2826, one ovigerous female; 2827, type locality; 2828, one young male, six adult females (three ovigerous).

92. *PORTUNUS* (*ACHELOUS*) *TUBERCULATUS* (Stimpson).

Achelous tuberculatus STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1860, VII, p. 223.

Neptunus tuberculatus A. MILNE-EDWARDS, Crust. Rég. Mex., 1879, p. 221, pl. xxxix, fig. 1.

Panama Bay, 18 and 29½ fathoms, stations 2798 and 2799.

93. *ARENÆUS* *CRIBRARIUS* (Lamarck).

Portunus cribrarius LAMARCK, Hist. Nat. Anim. sans. Vert., 1818, V, p. 259.

Arenæus cribrarius DANA, Crust. U. S. Expl. Exped., 1852, I, p. 290; 1855, pl. xviii, fig. 2.

Port Castries, St. Lucia.

94. *CALLINECTES* *ORNATUS* Ordway.

Callinectes ornatus ORDWAY, Boston Jour. Nat. Hist., 1863, VII, p. 571.—RATHBUN,

Proc. U. S. Nat. Mus., 1896, XVIII, p. 356, pls. xv; xxiv, fig. 3; xxv, fig. 2; xxvi, fig. 2; xxvii, fig. 2.

Port Castries, St. Lucia.

95. *CALLINECTES* *DANÆ* Smith.

Lupa dicantha DANA, Crust. U. S. Expl. Exped., 1852, I, p. 272; 1855, pl. xvi, fig. 7 (not *Lupea dicantha* Milne-Edwards, 1834).

Callinectes danæ SMITH, Trans. Conn. Acad. Sci., 1869, II, p. 7.

Port Castries, St. Lucia.

96. *CALLINECTES* *ARCUATUS* Ordway.

Callinectes arcuatus ORDWAY, Boston Jour. Nat. Hist., 1863, VII, p. 578.—RATHBUN,

Proc. U. S. Nat. Mus., 1896, XVIII, p. 362, pls. xx; xxiii, fig. 1; xxiv, fig. 8; xxv, fig. 7; xxvi, fig. 7; xxvii, fig. 7.

Panama; off Taboga Island, Panama Bay.

97. *CALLINECTES* *BELLICOSUS* (Stimpson).

Lupa bellicosa (SLOAT MS.) STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1859, VII, p. 57.

Callinectes bellicosus ORDWAY, Boston Jour. Nat. Hist., 1863, VII, p. 577.

Pichilique Bay, Lower California.

OVALIPES, new genus.

(From *ovalis*, oval, and *pes*, foot.)*Platyonichus* LATREILLE, 1825, part, not *Platyonichus* Latreille, 1818. Type, *Platyonichus ocellatus* (Herbst) Latreille.

In 1897,¹ I showed that *Platyonichus* (Latreille, 1818) is synonymous with *Portumnus* (Leach, 1814), both having as type the species *Cancer latipes* Pennant. At the same time I suggested that *Xaiva* (Mac Leay, 1838) could be used for the species *ocellatus* and *bipustulatus*, which for many years have been included in or have represented the genus *Platyonichus*. It has since been brought to my attention that the type of *Xaiva*, *X. pulchella* Mac Leay, is more nearly related to *Portumnus* than it is to the species *ocellatus* and *bipustulatus*. For these last, therefore, I am obliged to propose a new name. *Ovalipes* differs from *Portumnus* and *Xaiva* in having the last joint of the fifth pair of feet broadly oval, rounded at the extremity, instead of lanceolate and acute; the basal joint of the antennulæ advanced and visible in a dorsal view between the frontal teeth; the chelipeds elongate; the abdomen of the male oblong instead of narrow triangular.

98. OVALIPES BIPUSTULATUS (Milne-Edwards).

Platyonichus bipustulatus MILNE-EDWARDS, Hist. Nat. Crust., 1834, I, p. 437, pl. XVII, figs. 7-10.

Tome, Chile; Lota, Chile.

99. CŒNOPHTHALMUS TRIDENTATUS A. Milne-Edwards.

Cœnophthalmus tridentatus A. MILNE-EDWARDS, Crust. Rég. Mex., 1879, p. 237, pl. XLII, fig. 2 (*Ctenophthalmus*).

Off the Rio de la Plata, 10½-11½ fathoms, stations 2764, 2765, 2766.

ACANTHOCYCLIDÆ.

Genus ACANTHOCYCLUS.

A study of the specimens of *Acanthocyclus* in the U. S. National Museum, collected by the *Albatross* and others, and in the Museum of Comparative Zoology, indicates that there are three distinct species on the west coast of South America. The first species and type of the genus is *A. gayi* Milne-Edwards and Lucas, 1843. The existence of a second species was first recognized by Strahl in 1862, who unluckily applied to it the name *A. gayi*, giving to the form which is the true *gayi* a new name, *A. villosus*, which therefore becomes a synonym. The second species—that is, the *A. gayi* of Strahl—was later taken by the *Magenta* on the west coast of Patagonia, and again named "*A. gay*" by Targioni-Tozzetti.

¹ Proc. Biol. Soc. Washington, XI, p. 158.

Specimens of *A. gayi* in the U. S. National Museum have been identified by comparison with a type in the museum of the Philadelphia Academy of Sciences. Professor Sturany, of the museum in Vienna, has kindly determined as the same species the type specimen of *A. gayi* Heller, 1865 (= *Plagusetes elatus* Heller, 1862). The existence of a third species was discovered by Dr. Walter Faxon, who turned his notes and specimens over to me. The general appearance of the three species is much the same. The differences are constant and can best be expressed in the following table:

Characteristics of species of Acanthocyclus.

1. <i>A. gayi</i> .	2. <i>A. albatrossis</i> .	3. <i>A. hassleri</i> .
Narrow; width 1.05 to 1.08 times length. Lateral teeth intermediate Front entire Dactyli of ambulatory legs short, much curved. End of basal antennal joint swollen in a wide, smooth, round protuberance curving over on to the front. Abdomen of male narrow; sides of fourth, fifth, and sixth segments subparallel.	Width intermediate, 1.08 to 1.12 times length. Teeth prominent, acute..... Front faintly bilobed Dactyli long, little curved..... Antennal joint not swollen at the very end, but furnished with a blunt, projecting tooth, between which and the front a narrow furrow runs. Abdomen wide; sides of the sixth segment convex, of fifth concave, of third and fourth converging distally.	Wide; width 1.16 times length. Teeth appressed. Front entire. Dactylishort, much curved. Antennal joint as in <i>albatrossis</i> . Abdomen intermediate; sides of the sixth segment convex, of fifth straight, of third and fourth converging distally (Plate XLIII, fig. 1). Less hairy.
Both carapace and legs very hairy. Carapace almost smooth Ischium joints of maxillipeds with inner margins subparallel, but leaving a wide hiatus. Merus joints of maxillipeds with their outer margins subparallel and continuous with the outer margins of the ischium joints. Orbit viewed from above less than twice as wide as deep.	Less hairy..... Carapace tuberculate Ischium joints with inner margins in contact. Merus joints divergent, i. e., their outer margins make quite an angle with the outer margin of the ischium joint. Orbit viewed from above less than twice as wide as deep.	Carapace tuberculate. Ischium joints with inner margins diverging anteriorly; gape less than in <i>gayi</i> . Merus joints similar to those of <i>gayi</i> . Orbit viewed from above more than twice as wide as deep.

The synonymy and distribution of the species are given below, so far as known. *A. albatrossis* is the only species represented in the collection which forms the subject of this paper.

ACANTHOCYCLUS GAYI Milne-Edwards and Lucas.

Acanthocyclus gayi MILNE-EDWARDS and LUCAS, D'Orbigny's Voy. l'Amér. Mérid., 1843, VI, Pt. 1, p. 30; 1847, IX, pl. xv, fig. 1. Valparaiso.

Acanthocyclus gayi NICOLET, in Gay's Hist. Chile, Zool., 1849, III, p. 176. (Translation and abbreviation, for the most part, of Milne-Edwards's description.) Valparaiso.

Acanthocyclus villosus STRAHL, Monats. Akad. Wiss. Berlin, July 25, 1861, 1862, p. 713, plate.

Plagusetes elatus HELLER, Verh. Ges. Wien, 1862, XII, Pt. 1, p. 522 [4]. Chile.

Acanthocyclus gayi HELLER, Reise Fregatte *Norara*, 1865, II, Pt. 3, Crust., p. 70. Chile.

Acanthocyclus gayi DANA, Crust. U. S. Expl. Exped., 1852, I, p. 295; 1855, pl. XVIII, fig. 4. Valparaiso. KINGSLEY, Proc. Acad. Nat. Sci. Phila., 1880, p. 37.

? *Acanthocyclus gayi* CUNNINGHAM, Trans. Linn. Soc. London, 1871, XXVII, p. 494. Lota, Chile.

Distribution.—Chile and Peru: Valparaiso (type female and Dana's type female in Mus. Phila. Acad.; Mus. Comp. Zool.); Talcahuano (Mus. Comp. Zool.); Peru (Mus. Comp. Zool.); San Lorenzo Island, Peru (U.S.N.M.).

100. ACANTHOCYCLUS ALBATROSSIS, new name.

Acanthocyclus gayi STRAHL, Monats. Akad. Wiss. Berlin, July 25, 1861, 1862, p. 713, plate. Chile.

Acanthocyclus gayi TARGIONI-TOZZETTI, Zool. Magenta, 1877, I, p. 95, pl. VII, fig. 1, a-f. West coast of Patagonia.

? *Acanthocyclus gayi* MIERS, Proc. Zool. Soc. London, 1881, p. 69. Isthmus Bay, Magellan Strait.

Distribution.—Chile (including Patagonia): Port Otway (types, No. 21589, U.S.N.M.), Latitude Cove (U.S.N.M.), Eden Harbor, and Mayne Harbor (Mus. Comp. Zool.); Talcahuano and San Carlos, Chiloe Island (Mus. Comp. Zool.). The specimens from Isthmus Bay, Magellan Strait, noted by Miers, and cited above, may belong to this species.

ACANTHOCYCLUS HASSLERI, new species.

(Plate XLIII, fig. 1.)

Type.—No. 4889, Mus. Comp. Zool. Valparaiso, U. S. Coast Survey steamer *Hassler*.

Additional locality.—Panama, Capt. John M. Dow (U.S.N.M.).

CORYSTIDÆ.

101. HYPOPELTARIUM SPINULOSUM (White).

Atelecyclus spinulosus WHITE, Ann. Mag. Nat. Hist., 1843, 1st ser., XII, p. 345.

Hypopeltarium spinulosum MIERS, Challenger Rept., Zool., 1886, XVII, p. 211.

Off Gulf of San Matias, Argentina, 43 fathoms, station 2768; Magellan Strait at Gregory Bay, Sandy Point, and Port Churruca, and in 17 to 77½ fathoms at stations 2774, 2776, 2778, and 2779; Port Grappler and off Port Otway, Magallanes Territory, Chile, 61 fathoms, station 2787.

102. TRACHYCARCINUS CORALLINUS Faxon.

Trachycarcinus corallinus FAXON, Bull. Mus. Comp. Zool., 1893, XXIV, p. 156; Mem. Mus. Comp. Zool., 1895, XVIII, p. 26, pl. A.

Off Chatham Island, Galapagos, 634 fathoms, station 2808.

103. BELLIA PICTA Milne-Edwards.

Bellia picta MILNE-EDWARDS, Ann. Sci. Nat., 1848, 3rd ser., IX, p. 192.

Lota, Chile.

POTAMONIDÆ.

104. PSEUDOTHELPHUSA DENTATA (Milne-Edwards).

Thelphusa dentata LATREILLE, Encyc. Méth., Hist. Nat., Entom., 1825, X, p. 564.

Pseudothelphusa dentata SMITH, Trans. Conn. Acad. Sci., 1870, II, p. 147.

Port Castries, St. Lucia.

PALICIDÆ.

105. PALICUS ZONATUS Rathbun.

Cymopolia zonata RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 259.

Palicus zonatus RATHBUN, Proc. Biol. Soc. Washington, 1897, XI, p. 94.

Southern part of Gulf of California, 8 to 10 fathoms, stations 2824, 2827, 2828; off Cape St. Lucas, 31 fathoms, station 2829.

106. PALICUS LUCASII, new species.

(Plate XLIII, fig. 2.)

Length of second ambulatory leg less than twice the width of the carapace. Abdomen and sternum not conspicuously cristate. Antero-lateral teeth two, besides the orbital. Anterior margin of second and third ambulatory legs terminating in an acute or subacute tooth, not spiniform.

Allied to *P. dentatus*, *faxonii* and *alternatus* of the West Indian region.

Carapace broad, subquadrate. The clusters of tubercles on the surface are well marked and distinct from one another; those on the cardiac and intestinal regions have a short transverse crest. The surface between the clusters is covered with granules barely visible to the naked eye. Frontal lobes or teeth four, the median pair small and rounded and separated by a narrow rounded sinus more than twice as deep as those dividing the median from the lateral pair; these last have an oblique arcuate outer margin. The preorbital lobe is slightly bilobed by an indentation at its summit. The two supraorbital teeth are triangular and subacute. The postorbital tooth is directed forward; behind it, on the lateral margin, are two large acute teeth, with straight inner margins; outer margins slightly arcuate. These teeth are followed by one or more denticles. The crest above the posterior margin is cut into four long and three short transversely linear tubercles. Suborbital lobe truncate, not advanced, and separated on either side by a V-shaped fissure. The lobe at the angle of the buccal cavity is triangular, and in a ventral view only partially obscures the truncate inner suborbital lobe. Basal joint of the antenna cut by a deep U-shaped sinus into two lobes, the inner and inferior small and tuberculiform, the outer and superior broad and lobiform.

The right cheliped of the male is very heavy. Merus spinulous. Carpus with about four superior spines and a number of spinules, an inner spine, a spinulous antero-internal crest, a right-angled antero-

external crest. The propodus is very large; its width is nearly equal to its superior length, and its thickness is about half its superior length; it is surmounted by a double crest of irregular spinulous spines or tubercles; inner and outer surfaces granulous, the granules of the outer surface tending to collect in two longitudinal bands, one median, the other at the lower margin. Fingers gaping slightly, for two-thirds of their length deeply grooved, margins uneven but not dentate; pollex not deflexed. The left cheliped is missing in the adult males. In the immature male the right cheliped is much less strong than in the adult; the left propodus is about half as wide as the right. The same is true of the female; the fingers are proportionately longer than in the male, not gaping; pollex somewhat deflexed. Ambulatory legs of moderate length. Meral joints broad, coarsely granulate; terminal tooth of anterior margin in the first pair acute and spiniform, in the second and third pairs acute or subacute. Proximal lobe of anterior margin of carpal joints rounded; terminal teeth acute, excepting the one on the anterior margin of the first pair, which is obtuse. Dactyli with sinuous posterior margins. Last pair of feet reaching a little beyond the merus of the preceding pair.

Dimensions.—Male: Length, 13.5 mm.; width, 15.7 mm.; length of right propodus, measured on lower margin, 10 mm.; on superior margin, 6 mm.; width, 5.4 mm.; thickness, 3.2 mm. Female: Length, 11.3 mm.; width, 13.1 mm.

Types.—No. 21590, U.S.N.M. Three males, four females, from off Cape St. Lucas, 31 fathoms, station 2829.

OCYPODIDÆ.

107. EUCRATOPSIS MACROPHTHALMA, new species.

(Plate XLIII, figs. 3, 4.)

Carapace and orbits very wide; eyes long; three subequal antero-lateral teeth.

Carapace wider than in *E. elata* (A. Milne-Edwards); regions distinct. Carapace very convex longitudinally; transversely nearly level for its middle two-thirds, deflexed toward the margins; marginal teeth directed obliquely upward. Front about one-third the width of the carapace; lobes slightly convex. Orbits wider and eyes longer than in *E. elata*; superior margin of orbit sloping backward and outward. Antero-lateral teeth three, including the orbital, acute, curved slightly forward; postero-lateral margin with a slight tooth or notch. The carapace has more the appearance of *Euryplax nitidus* Stimpson, but the antennæ are not excluded from the orbits, as in that genus.

The merus of the right cheliped (the left is wanting) is granulated toward the margins, which are unarmed. Carpus finely granulated, with an anterior submarginal sulcus and a short blunt inner tooth, which is continued inferiorly in a blunt prominence. The palm is slightly

margined above and below; the fingers are broad and flat, not gaping, with a narrow granulate border on the outer edges; prehensile margins erenate, with a slightly larger lobe near the base of the dactylus, and a three-lobed prominence at the base of the pollex. Lower margin of the propodus slightly sinuous.

Color.—In alcohol, the carapace is marked with patches of dark blue.

Dimensions.—Male: Length, 3 mm.; width, 5.1 mm.

Type.—No. 21591, U.S.N.M. One female, from Panama Bay, 51½ fathoms, station 2805.

This species is placed provisionally in *Eueratopsis*. It may represent a distinct genus, which it is perhaps not advisable to define until the male is known.

108. SPOECARCINUS GRANULIMANUS Rathbun.

Spocarcinus granulimanus RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 242.

Off Cerros Island, Lower California, 23 fathoms, station 2837. One young male.

109. GERYON QUINQUEDENS Smith.

Geryon quinquedens SMITH, Trans. Conn. Acad. Sci., 1879, V, p. 35, pl. ix, figs. 1, 1a, 1b, 2.

Off Cape Frio, Brazil, 671 fathoms, station 2763. One small male, which differs from North Atlantic specimens only in the larger median teeth of the front.

110. CHASMOCARCINUS TYPICUS Rathbun.

Chasmocarcinus typicus RATHBUN, Bull. Labor. Nat. Hist. State Univ. Iowa, 1898, IV, p. 285, pl. vii, figs. 3-5.

Off Cape Frio, Brazil, 59 fathoms, station 2762.

111. CHASMOCARCINUS LATIPES, new species.

(Plate XLIII, fig. 5.)

Orbits directed obliquely forward; sternum and abdomen of female smooth and punctate; ambulatory legs wide.

Length of carapace about two-thirds its posterior width. Front and orbits less than one-half the width of the carapace. Surface covered with large puncta which tend to coalesce; granulate on the posterior half and toward the margins. The branchial region is separated by very deep longitudinal impressed lines from the cardiac and mesogastric regions, by shallow depressions from the intestinal region, and by two pits from the hepatic region. The antero-lateral margin is distinct, though blunt. Front very narrow and faintly bilobed; side margins oblique. Orbit nearly as wide as the front; the superior margin is slightly concave and directed obliquely forward and outward. The eye-stalk is stout and curved as seen from in front and tapers gradually to the cornea. The groove below the hepatic region is similar to that in *C. typicus*. The sternum and abdomen of the female are smooth and punctate.

The chelipeds resemble those of the female of *C. typicus*. The carpus, however, is nearly square, the propodus is less arched, and the fingers taper regularly to the tips. The propodus has a line of granules on its lower margin. The margins of the chelipeds are fringed with hair, which is longest on the upper margin of the merus, where there is a fringe on the proximal half and a tuft near the distal end. Ambulatory legs shorter and broader than in *C. typicus*, hairy, especially on the margins. The dactyli of the first three pairs are similar, broad and thin; in Plate XLIII, fig. 5, the full width of the dactyli of the first and second pairs is shown; those of the third pair are viewed obliquely; in the fourth pair the dactyli are narrow and recurved, as represented in the figure.

Color.—In alcohol the carapace is a bluish gray, chelipeds pale pink, ventral side of crab and ambulatory legs rust-colored.

Dimensions.—Female: Length, 12.5 mm.; width, 17.8 mm.

Type.—No. 21592, U.S.N.M. One female from Magdalena Bay, Lower California, 51 fathoms, station 2833.

112. OCYPODE ARENARIA Say.

Ocypode arenarius SAY, Jour. Phila. Acad. Sci., 1817, I, p. 69.

Port Castries, St. Lucia; Bahia and Abrolhos Islands, Brazil.

113. OCYPODE GAUDICHAUDII Milne-Edwards and Lucas.

Ocypode gaudichaudii MILNE-EDWARDS and LUCAS, D'Orbigny's Voy. l'Amér. Mérid., 1843, VI, Pt. 1, p. 26; 1847, IX, pl. XI, fig. 4.

Panama; Chatham Island, Galapagos.

114. UCA GRACILIS Rathbun.

Gelasimus gracilis RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 244.

Pichilique Bay, Gulf of California.

It is possible that this species is identical with *Gelasimus crenulatus* Lockington, 1877, and this belief is held by Mr. S. J. Holmes, who has examined specimens labeled *G. crenulatus* in Lockington's collection; the types are probably not extant. In the absence of positive proof I hesitate to restore the earlier name. *Uca gracilis* is a very distinct species from *U. stenodactyla* (Milne-Edwards and Lucas) and from the various forms which have been united under the name *U. vocator*. Its nearest ally is *Uca speciosa* (Ives).

115. UCA STENODACTYLUS (Milne-Edwards and Lucas).

Gelasimus stenodactylus MILNE-EDWARDS and LUCAS, D'Orbigny's Voy. l'Amér. Mérid., 1843, VI, Pt. 1, p. 26; 1847, IX, pl. XI, fig. 2.

Gelasimus gibbosus SMITH, Trans. Conn. Acad. Sci., 1870, II, pp. 115, 140, pl. II, fig. 11; pl. IV, fig. 8.

Uca stenodactyla ORTMANN, Zool. Jahrb., Syst., 1897, X, p. 356 (part).

Pichilique Bay, Gulf of California.

GRAPSIDÆ.

116. GRAPSUS GRAPSUS (Linnæus).

Cancer grapsus LINNÆUS, Sys. Nat., 1758, 10th ed., I, p. 630.

Cancer (grapsus) grapsus LATREILLE, Règne Anim. Cuvier, 1817, III, p. 16.

Grapsus grapsus IVES, Proc. Acad. Nat. Sci. Phila., 1891, p. 190.

Port Castries, St. Lucia; Albemarle, Chatham, Duncan, Hood, Indefatigable, and James Island, Galapagos Islands; Margarita Island, Lower California.

117. GEOGRAPSUS LIVIDUS (Milne-Edwards).

Grapsus lividus MILNE-EDWARDS, Hist. Nat. Crust., 1837, II, p. 85.

Geograpsus lividus STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1860, VII, p. 230.

Port Castries, St. Lucia; James Island, Galapagos.

118. PACHYGRAPSUS CRASSIPES Randall.

Pachygrapsus crassipes RANDALL, Jour. Acad. Nat. Sci. Phila., 1839, VIII, p. 127.
San Clemente Island, California.

119. PACHYGRAPSUS TRANSVERSUS Gibbes.

Pachygrapsus transversus GIBBES, Proc. Amer. Assoc. Adv. Sci., 1850, III, p. 181.

Abrolhos Islands, Brazil; Pichilique Bay, Gulf of California.

120. PLANES MINUTUS (Linnæus).

Cancer minutus LINNÆUS, Sys. Nat., 1758, 10th ed., I, p. 625.

Planes minutus WHITE, List Crust. Brit. Mus., 1847, p. 42.

Latitude $31^{\circ} 16'$ north, longitude $71^{\circ} 50'$ west, surface; surface station 18, latitude $1^{\circ} 03'$ north, longitude $80^{\circ} 15'$ west; Gulf of California.

121. HEMIGRAPUS CRENULATUS (Milne-Edwards).

Cyclograpsus crenulatus MILNE-EDWARDS, Hist. Nat. Crust., 1837, II, p. 80.

Hemigrapsus crenulatus DANA, Crust. U. S. Expl. Exped., 1852, I, p. 349; 1855, pl. XXII, fig. 3.

Port Otway and Lota, Chile.

122. HEMIGRAPUS AFFINIS Dana.

Hemigrapsus affinis DANA, Proc. Acad. Nat. Sci. Phila., 1851, V, p. 250; Crust. U. S. Expl. Exped., 1852, I, p. 350; 1855, pl. XXII, fig. 5.

Off the Río de la Plata, $10\frac{1}{2}$ to $11\frac{1}{2}$ fathoms, stations 2764, 2765, 2766; off Gulf of San Matias, Argentina, 52 fathoms, station 2767.

123. SESARMA (HOLOMETOPUS) ROBERTI Milne-Edwards.

Sesarma roberti MILNE-EDWARDS, Ann. Sci. Nat., 1853, 3d ser., XX, p. 182 (148).

Port Castries, St. Lucia.

124. CHASMAGNATHUS GRANULATUS Dana.

Chasmagnathus granulatus DANA, Proc. Acad. Nat. Sci. Phila., 1851, V, p. 251;
Crust. U. S. Expl. Exped., 1852, I, p. 364; 1855, pl. XXIII, fig. 6.

Montevideo, Uruguay.

125. PLAGUSIA TUBERCULATA Lamarck.

Plagusia tuberculata LAMARCK, Hist. Nat. Anim. sans Vert., 1818, V, p. 247.

Panama; one young male.

This specimen is a true *tuberculata*; the lobe above the bases of the ambulatory legs is not dentated, and the terminal segment of the abdomen is broadly semioval and rounded at its distal extremity.

PINNOTHERIDÆ.

126. PINNIXA CALIFORNIENSIS Rathbun.

Pinnixa californiensis RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 249.

Magdalena Bay, Lower California, 51 fathoms, station 2833; one male, without feet.

127. PINNIXA BREVIPOLLEX, new species.

(Plate XLIII, fig. 6.)

Pollex a short spine; *dactyl* transverse; a transverse cardiac crest.

Carapace uneven, punctate, the gastric and hepatic regions bounded by very deep furrows; cardiac region high and crossed by a transverse crest, surmounted in the male by two triangular tubercles, compressed from before backward, and subacute; in the female the crest is lower, blunt, and divided in the middle by a very shallow sinus. Frontal and hepatic regions granulated. Subhepatic region with a small depressed area or tubercle surrounded by a deep groove. Antero-lateral margin of the branchial region armed with from four to six distant blunt spinules beginning at the lateral angle and followed near the hepatic region by smaller tubercles or granules. Inferior margin of the carapace granulated. The margins of the frontal lobes extend obliquely backward from the middle. The antennæ exceed the width of the front. The sides of the male abdomen from the third to the fifth segments, inclusive, converge regularly; those of the sixth joint are still more convergent, joint very short; terminal joint narrowest, broader than long, rounded. The last two joints of the palpus of the maxillipeds are oblong; the terminal joint is articulated near the base of the second joint, and overreaches it considerably, overlapping the sternum and touching the tip of the abdomen in the male.

Chelipeds wanting in the male; in the female they are monodactyl. Propodus very broad, flattened, increasing in width distally, its greatest width equaling the superior length; superior margin slightly convex; lower margin slightly convex for its proximal two-thirds;

deflexed for its distal third and terminating in a short digital spine which serves as the pollex; distal margin transverse and armed with two tubercles, one near the insertion of the dactylus and the other at the middle. Dactylus transverse, a tubercle at the middle of the prehensile margin which fits against the margin of the propodus. The first and second pairs of ambulatory legs are narrow, the second the longer and larger and reaching to the extremity of the propodus of the third pair. The merus of the third pair is very little dilated at the middle. The fourth pair reaches the middle of the carpus of the third pair.

The entire surface of the crab is covered with a dense pubescent coat.

Dimensions.—Male: Length, 5.5 mm.; width, 11 mm. Female: Length, 6.6 mm.; width, 12.5 mm.

Types.—No. 21593, U.S.N.M. One male, two females. Off Gulf of San Matias, Argentina, 43 fathoms, station 2768.

This species bears apparently considerable resemblance to the little-known *Pinnixa monodactylus* (Say),¹ which is a narrower species.

128. PINNIXA AFFINIS, new species.

(Plate XLIII, figs. 7-9.)

Lower margin of palm of female convex; pollex short; posterior margin of merus of third ambulatory leg armed with spinules or small spines.

Allied to *P. californiensis* Rathbun, with which it might easily be confounded.

Female.—Carapace broader than in *californiensis*, regions distinctly indicated, cardiac region crossed by a blunt, transverse, bilobed crest; surface punctate, the punctae largest on the branchial regions. A granulate line marks the antero-lateral border of the branchial region. The front is not advanced beyond the line of the subhepatic region. The third joint of the palpus of the maxillipeds is articulated near the proximal end of the inner side of the second.

The chelipeds are smooth and pubescent; lower margin of palm convex; pollex short, very broad and deflexed, its prehensile edge irregularly dentate, terminating in a short, acute spine; the dactylus has a large tooth at one-third the distance from the base; the fingers when closed do not gape. The first two pairs of ambulatory legs are slender, the margins of the propodal joints subparallel; the first pair reaches to the end of the propodus of the second; the second to the end of the propodus of the third. The third leg is the broadest; the merus is very hairy along the margins; the posterior margin is armed with spinules, those near the middle being larger and spine-like; anterior margin granulous. The fourth pair of ambulatory legs reaches about

¹ Jour. Phila. Acad. Sci., 1818, I, p. 454.

to the end of the carpus of the third pair; the propodus is narrow, as in the first and second pairs.

Dimensions.—Female: Length, 3.4 mm.; width, 7.3 mm.

Type.—No. 21594, U.S.N.M. One female, with eggs. Panama Bay, 26 fathoms, station 2803.

129. *PINNAXODES HIRTIPES* Heller?

(Plate XLIII, figs. 10, 11.)

Pinnaxodes hirtipes HELLER, *Reise Novara*, Crust., 1865, p. 68, pl. vi, fig. 2.

Port Otway, Chile; one male.

This specimen agrees fairly well with Heller's description and figure, but it seems to me that this species is distinct from *P. chilensis* (Milne-Edwards) with which it has been united. In the *Albatross* specimen, which is the only one that I have seen, the carapace is very convex, broader than long, thin, but not soft and yielding, without the longitudinal sulci from the orbits, as figured in *P. chilensis* by Milne-Edwards and Lucas. On either side of the gastric region there is a very short longitudinal groove or dent (about half a millimeter in length). The second segment of the abdomen is more than twice as long as the first. The abdomen tapers regularly from the third to the fifth segment, inclusive; the sixth has concave lateral margins. The last three segments of the maxillipeds resemble those figured by Heller. The under surface of the body and also the legs are pubescent; and the latter are margined with long hair. The fingers of the chelipeds are wide and very little gaping. The ambulatory legs are narrow, much like those figured by Heller, but the meri are proportionately longer, which may be due to the difference in sex.

Dimensions.—Male: Length, 7 mm.; width, 7.6 mm.

TETRIAS, new genus.

Carapace transverse, hard; palpus of maxilliped with joints end to end; ambulatory legs of the second pair the longest.

Carapace transverse, subquadrilateral, with antero-lateral angles rounded; high, sides steep; posterior two-thirds flattened, anterior third deflexed. Abdomen of adult female suborbicular, at base only half the width of the sternum, tip advanced as far as the extremity of the ischium of the maxillipeds. Maxillipeds very large, with the ischium well developed, the merus enlarged at its middle; propodal joint oblong, broadening at the distal end; terminal joint similar and attached on the inner portion of the distal margin of the preceding. Chelipeds stout; fingers longitudinal. Ambulatory legs diminishing from the second to the fourth pair, which is very small; first and third pairs subequal.

This genus resembles *Parapinnixa*, *Pinnaxodes*, and *Pinnotherelia* in having the maxillipeds with a palpus of three joints placed end to end.

It differs from the first named in the very large size of the palpus and in the relative lengths of the ambulatory legs; from the second in the transverse flattened carapace, as well as in the larger palpus; from the third in the broader carapace and buccal cavity and narrower front.

130. *TETRIAS SCABRIPES*, new species.

(Plate XLIII, figs. 12-14.)

Carapace setose; legs rough with tubercles and spinules.

Carapace covered with a short, dense coating of coarse, dark setæ, beneath which the surface is punctate; regions indicated by impressed lines and pits, the deepest that between the cardiac and gastric regions; outer margin of hepatic region bearing a tubercle. Front projecting very slightly beyond the anterior margin of the carapace, and bent down to form the roof of the antennular cavities, as in *Pinnixa*. Abdomen of female fringed with long hair. Maxillipeds bearded with long silken hairs, most noticeable on the margins of the last two palpar joints, and in a transverse line on the merus.

The outer surface of the merus of the chelipeds is triangular and as broad as long; its upper and lower margins are rough with small spines or spinules. The inner angles of the carpus are rectangular; each angle is armed with two or three short spines. Palms broad, with convex subacute margins, and covered with sharp tubercles arranged in longitudinal lines. These tubercles extend to the tips of the fingers, which are finely dentate along their prehensile edges and fit closely together. The meri of the ambulatory legs are narrow, with subparallel margins. The first ambulatory leg reaches to the end of the propodus of the second pair; its merus has the inferior margin denticulate, the superior margin with three spinules at its proximal end; the carpus and propodus short and broad; the dactylus stout and half as long as the propodus. The second or longest ambulatory is a little longer than the width of the carapace; its merus has a spinule at the proximal end of the upper margin, and the lower margin is somewhat roughened; the carpus and propodus are proportionally narrower than in the first leg. The third ambulatory reaches about the middle of the propodus of the second, and the joints resemble those of the second pair, but are unarmed. The last leg is much reduced, and reaches a little beyond the middle of the merus of the preceding pair; the joints are proportionally rather broad; the lower margin of the ischium and merus is armed with spines and spinules; dactylus very small. The legs are covered with setæ like those on the carapace, and fringed with hair.

Dimensions.—Female: Length, 6 mm.; anterior width, 9.2 mm.; greatest width, 9.2 mm.

Type.—No. 21595, U.S.N.M. One egg-bearing female, southern part of Gulf of California, $9\frac{1}{2}$ fathoms, station 2826.

131. DISSODACTYLUS NITIDUS Smith.

Dissodactylus nitidus SMITH, Trans. Conn. Acad. Sci., 1870, II, p. 173.

Off Abreojos Point, Lower California, 5½ fathoms, station 2835; two females, which agree pretty closely with Professor Smith's description of the male. The pollex has the tuft of hair beneath, as in the male.

132. HALICARCINUS PLANATUS (Fabricius).

Cancer planatus FABRICIUS, Sys. Ent., 1775, p. 403.

Halicarcinus planatus WHITE, Ann. Mag. Nat. Hist., 1846, XVIII, p. 178, pl. II, fig. 1.

Off Cape Virgins, Argentina, 10 fathoms, station 2773; Magellan Strait at stations 2775 and 2776, 29½ and 21 fathoms, and at Laredo Bay, Sandy Point, Borja Bay, and Port Churruca; Mayne Harbor, Latitude Cove, and Port Otway, Magallanes Territory, Chile.

CALAPPIDÆ.

133. CALAPPA GALLUS (Herbst).

Cancer gallus HERBST, Natur. Krabben u. Krebse, 1803, III, Pt. 3, pp. 18, 46, pl. LVIII, fig. 1.

Cancer (Calappa) gallus LATREILLE, Règne Anim. Cuvier, 1817, III, p. 24.

Calappa galloides STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1859, VII, p. 71.

Bahia, Brazil.

134. CALAPPA SAUSSUREI, new species.

(Plate XLI, fig. 6.)

Carapace slightly broader than long, greatest width at the antepenult tooth of the lateral margin; tubercles prominent.

This species is analogous to *C. angusta* A. Milne-Edwards of the West Indies in its narrow carapace, but whereas in *C. angusta* the greatest width of the carapace is midway of its length, in *saussurei* the greatest width is between the antepenult teeth of the lateral margin. Carapace slightly broader than long, almost circular, exclusive of the postero-lateral limb, which has a subrectangular outline; two well-marked grooves form the lateral boundaries of the cardiac and gastric regions. Tubercles of the carapace conical, and disposed as follows: Gastric region with two large median and two smaller lateral in advance of these, and about eighteen very small; cardiac with one central larger surrounded by six smaller; branchial region with about fifteen large and more than that number of small; intestinal region with six in two lines diverging posteriorly; hepatic region with five or six very small depressed tubercles. The surface of the tubercles is densely granulated; the space between them is covered with isolated granules. Margins of the front slightly raised; only a shallow groove separates the superior border of the antennular fossæ from that of the orbits. The lateral border of the carapace has five or six small tubercles on

the hepatic region; on the branchial region four to six larger tubercles; behind these are five broad, acute teeth, increasing successively in size, the third most produced outwardly. On the posterior margin there are two teeth next to the postero-lateral, followed by a tubercle; the innermost tooth is the smaller; they reach a little behind the level of the postero-lateral tooth, but not so far as the middle portion of the posterior margin.

The chelipeds have a surface similar to that of the carapace—that is, there are many large tubercles, irregular in size and disposition, and the intervening space is covered, though not crowded, with granules. The manus is considerably longer than high; the four distal teeth of the upper margin are about equally advanced; the immovable finger is very slightly dellexed.

Dimensions.—Male: Length, 20.5 mm.; width at middle, 23.6 mm.; greatest width, 24.4 mm.; width at postero-lateral angles, 22.9 mm.

Type.—No. 21596, U.S.N.M. One male. Southern part of Gulf of California, 26½ fathoms, station 2823.

Additional specimen.—One young specimen was taken near the type locality on a subsequent cruise, off San Josef Island, 40 fathoms, station 2998.

135. *CYCLOES BAIRDII* Stimpson.

Cyclois bairdii STIMPSON, Ann. Lyc. Nat. Hist. N. Y., 1860, VII, p. 237.

Panama Bay, 33 fathoms, station 2796.

136. *PLATYMERIA GAUDICHAUDII* Milne-Edwards.

Platymera gaudichaudii MILNE-EDWARDS, Hist. Nat. Crust., 1837, II, p. 108.—

MILNE-EDWARDS and LUCAS, D'Orbigny's Voy. l'Amér. Mérid., 1843, VI, Pt. 1, p. 28; 1847, IX, pl. XIII, fig. 1.

Platymera californiensis RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 253.

Panama Bay, 47 and 51½ fathoms, stations 2804 and 2805; off Abreojos Point, Lower California, 48 fathoms, station 2834.

MATUTIDÆ.

137. *HEPATUS KOSSMANNI* Neumann.

Hepatus kossmanni NEUMANN, Catalog Pod. Crust. Heidelberger Mus., 1878, p. 28.

Panama Bay, 7 and 14 fathoms, stations 2800 and 2801.

138. *HEPATUS LINEATUS*, new species.

(Plate XLIV, fig. 4.)

Carapace narrow and high; hepatic region smooth; front advanced, thick, truncate; first to sixth segments of abdomen of male tuberculate.

This species differs from all others in its narrower carapace, which is very strongly arched, the height being about one-third the width. As is customary in the genus, there are eight clusters of tubercles. The three posterior groups consist of one large tubercle and from eight to

twelve smaller ones, forming subtriangular patches, with the large tubercle on the anterior margin. The median gastric cluster is similar, with the addition of three small tubercles in front of the triangle. The anterior branchial cluster consists of two or three coalesced tubercles, anterior to which there is a line of from eleven to fourteen tubercles extending obliquely backward and outward. The lateral gastric clusters have a large central tubercle with about eight posterior and lateral smaller tubercles, and anteriorly a double areuate row containing about fourteen tubercles. Hepatic region smooth. Antero-lateral margin edged with prominent tubercles, which form about thirteen shallow lobes. Postero-lateral margin very concave, the anterior portion thickened and bearing a double row of tubercles. The tooth near the posterior margin is much more pronounced than in *H. chilensis* of equal size.

Front advanced considerably beyond the outer orbital angles, truncate, thickened, having a double row of depressed tubercles and a short closed median fissure. The suborbital region is similar in shape to that of *H. chilensis*, although its lower margin in a front view is more strongly arched. The abdomen of the male is narrower than in *chilensis*; the second segment has a transverse row of five to seven tubercles, the third a transverse row of six tubercles, the fourth segment a row of four less prominent; on each of these segments there is a tubercle at the outer distal angle; fifth and sixth segments with a transverse ridge terminating at either end in a low tubercle. Although the third, fourth, and fifth segments of the abdomen are anchylosed, the divisions between them are indicated by deep grooves. Sternum coarsely tuberculate.

The five inferior rows of tubercles on the outer surface of the propodus of the chelipeds are composed of large tubercles, bringing the rows nearer together than in related species. On the superior margin there are four teeth, the two proximal being the larger. The propodal joints of the ambulatory legs are shorter and broader than in *H. chilensis* and *H. kossmanni*; dactyli densely pilose.

Color.—The color of the two specimens of this species differs markedly. In one there are red lines encircling round or oblong areas, which touch one another; in the other the lines border narrow stripes, forming transversely arcuate bands across the carapace, except on the posterior portion, where the patches are more irregular. The specimens have been too long in alcohol for one to determine whether the space inclosed by the red lines is the same color as that without or not.

Dimensions.—Male: Length, 17.6 mm.; width, 22 mm. Male: Length, 16.7 mm.; width, 20.2 mm.

Types.—No. 21597, U.S.N.M. Two males. Off Abreojos Point, Lower California, $5\frac{1}{2}$ fathoms, station 2835.

139. *OSACHILA LEVIS*, new species.

Shape resembling O. tuberosa; surface smooth.

The shape of the carapace is almost exactly like that of *O. tuberosa* Stimpson. The character of the surface is, however, strikingly different. While the protuberances of the carapace are placed similarly to those of *tuberosa*, their surface is entirely smooth and punctate, without suggestion of tuberculation or erosion as in *tuberosa*. The lateral angle of the carapace is farther back in *levis* than in *tuberosa*, the postero-lateral margin is less concave, and the posterior portion of the carapace wider. The protuberances of the dorsal surface are also more depressed, especially noticeable in those of the gastric region. The inferior surface is roughened as in *tuberosa*, although the tubercles are less confluent than in that species. The same is true of the outer surface of the chelipeds. The ambulatory legs are shorter than in *tuberosa*.

Dimensions.—Female: Median length, 19.1 mm.; width, 21.4 mm.

Type.—No. 21598, U.S.N.M. One female with eggs. Off Cape St. Lucas, 31 fathoms, station 2829.

LEUCOSIIDÆ.

140. *SPELÆOPHORUS ELEVATUS* Rathbun.

Spelæophorus elevatus RATHBUN, Bull. Labor. Nat. Hist. State Univ. Iowa, 1898, IV, p. 290, pl. III, fig. 1.

Off Cape St. Roque, Brazil, 20 fathoms, station 2758.

141. *EBALIA CRISTATA*, new species.

(Plate XLIV, fig. 5.)

Carapace octagonal, tuberculate, posteriorly bilobed; front entire; chelipeds cristate; third to fifth segments of abdomen coalesced; penultimate segment spined.

Carapace thick, octagonal; length and breadth subequal. A median ridge extends from the front backward to the intestinal region. Front truncate. Antero-lateral margin with two shallow lobes; below the margin are two teeth, one pterygostomian, the other branchial. Lateral angle of the carapace acute; from this point the postero-lateral margin is straight for half its length, the straight portion terminating in an acute angle. From this angle to the posterior margin the postero-lateral margin is concave. Posterior margin distinctly bilobed. In a side view the intestinal region is seen to have a perpendicular posterior margin. Anterior third of the carapace depressed. From the median gastric ridge an elevated area extends obliquely toward the anterior half of the postero-lateral margin; this is irregularly tumid. The entire surface of the body and legs is covered with tubercles. The third, fourth, and fifth segments of the abdomen of the male are coalesced. The sixth segment has parallel sides and is longer than wide, and

bears at its proximal end a strong acute spine projecting obliquely backward. Terminal segment long and narrow.

Merus of chelipeds cylindrical, length less than twice the thickness. Carpus, propodus, and dactylus with a thin, acute crest. Palm swollen, lower margin very convex; fingers as long as the palm, not gaping. Ambulatory legs armed above with small spinules.

Dimensions.—Male: Length on median line, 9.6 mm.; width, 10 mm.

Type.—No. 21599, U.S.N.M. One male. Off Abreojos Point, Lower California, 48 fathoms, station 2834.

142. LITHADIA CUMINGII Bell.

Lithadia cumingii BELL, Trans. Linn. Soc. London, 1855, XXI, p. 305, pl. XXXIII, figs. 6, 7.

Southern part of Gulf of California, 26½ fathoms, station 2823; one female; Magdalena Bay, Lower California, 51 fathoms, station 2833, one young female.

Bell's description and figures were made from males only. The females are much broader than long, but the elevations and depressions are arranged as in Bell's Plate XXXIII, fig. 7; the ridges are acute; the tubercles in the depressions are flat-topped.

Dimensions.—Adult female: Entire length, 11.7 mm; width 14 mm. Young female: Entire length, 7.5 mm; width, 8.6 mm.

143. PERSEPHONA TOWNSENDI Rathbun.

Myra townsendi RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 255.

Panama Bay, 7 and 14 fathoms, stations 2800 and 2801.

Persephona and *Myra* are separated by too slight characters. There is every gradation between the curved outer margin of the maxilliped of *Myra fugax* and the nearly straight margin in *Persephona punctata*, and also between the elongated chelipeds of the former and the short, partly flattened chelipeds of the latter.

144. PERSEPHONA SUBOVATA Rathbun.

Myra subovata RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 256.

Panama Bay, 33 and 51½ fathoms, stations 2795 and 2805; off Abreojos Point, Lower California, 48 fathoms, station 2834.

145. RANDALLIA ORNATA (Randall).

Ilia ornata RANDALL, Jour. Acad. Nat. Sci. Phila., 1839, VIII, p. 129.

Randallia ornata STIMPSON, Proc. Boston Soc. Nat. Hist., 1857, VI, p. 85; Jour. Boston Soc. Nat. Hist., 1857, VI, p. 471 [31], pl. xx, fig. 3.

Magdalena Bay and off Abreojos Point, Lower California, 5½ to 51 fathoms, stations 2833, 2834, and 2835.

146. *RANDALLIA AMERICANA* Rathbun.

Ebalia americana RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 254.

Southern part of the Gulf of California, $9\frac{1}{2}$ to $26\frac{1}{2}$ fathoms, stations 2822, 2823, and between 2826 and 2828.

147. *RANDALLIA BULLIGERA*, new species.

(Plate XLIV, fig. 6.)

Large bead-like tubercles; five posterior protuberances; margin of efferent branchial channel three-lobed and produced.

Carapace slightly longer than broad, covered except the frontal region with large, smooth, rounded, bead-like tubercles of different sizes and distinctly separated from one another; intervening space pubescent. Intestinal region bounded by a deep suture and having on the median line and a little behind the middle a larger tubercle composed of two or three smaller ones. Hepatic region bounded posteriorly by a deep suture; shallower and less marked sutures divide the branchial from the cardiac and gastric regions. Posterior margin with two lobate projections; a similar projection on the posterior margin of each branchial region. Of these four lobes the middle two are farther from each other than they are from the lateral. Pterygostomian region with a prominent blunt tuberculated projection. Frontal region covered with depressed granules. Front moderately prominent (as in *ornata*), distinctly two-lobed. Sternum and abdomen covered with large tubercles. Maxillipeds with a longitudinal row of tubercles through the middle of the endognath and exognath; anterior half pubescent. Antero-lateral angles of the buccal cavity produced in front of the orbital margin and deeply three-lobed. Exognath not reaching beyond the base of the lobes.

Merus of chelipeds covered with large tubercles; intervening spaces granulate; length about three-fourths the width of the carapace in the male, one-half the width in the female; distal half slightly smaller than proximal. Carpus and propodus granulate. Hands shaped much as in *ornata*; fingers a little shorter than the outer margin of the palm. Ambulatory legs granulate; dactyli with pubescent margins.

Dimensions.—Male: Length on median line, 11.6 mm.; width, 11.5 mm. Ovigerous female: Length, 12.8 mm.; width, 12.6 mm.

Types.—No. 21600, U.S.N.M. One male, two females. Magdalena Bay, Lower California, 12 fathoms, station 2831.

148. *RANDALLIA AGARICIAS*, new species.

(Plate XLIV, figs. 7, 7a.)

Mushroom-like tubercles; four posterior protuberances; margin of efferent branchial channel entire, not produced.

Carapace slightly longer than broad. Posterior two-thirds convex and covered with large tubercles which have slightly convex surfaces

and are mounted on short thickened stalks like mushrooms (Plate XLIV, fig. 7a). On the anterior third there is a median ridge extending from the front across the gastric region; on either side is a hollow; surface covered with depressed granules. Hepatic region convex; pterygostomian region bluntly angular; neither is armed. Intestinal region distinctly outlined. Posterior margin with two broad rounded tuberculate lobes. Postero-lateral margin of the branchial region armed with a smaller tuberculate lobe. The front has a blunt tooth at either end. Abdomen and sternum covered with bead-like tubercles. The maxillipeds are covered with large and irregular tubercles. The anterior angles of the buccal cavity are about equally advanced with the orbital wall and are not incised as in *ornata* and *bulligera*.

Chelipeds covered with tubercles similar to those of the carapace; the largest ones are on the merus and the outer surface of the carpus and propodus. Length of merus about the width of the carapace. The dactylus is less than two-thirds the length of the outer margin of the propodus. The propodus is rather narrow, its width being less than half its exterior length. Ambulatory legs granulate, with marginal rows of mushroom-like granules.

Dimensions.—Male: Median length, 8.5 mm.; width, 8.3 mm. Male: Median length, 9.2 mm.; width, 9 mm. Female: Median length, 8.2 mm.; width, 8.1 mm.

Types.—No. 21601, U.S.N.M. Three males, two females. Off Cape St. Lucas, Lower California, 31 fathoms, station 2829.

DORIPPIDÆ.

149. ETHUSA MASCARONE AMERICANA (A. Milne-Edwards).

Ethusa mascarone ROUX, Crust. Médit., 1828, page without number, pl. XVIII.

Ethusa americana A. MILNE-EDWARDS, Bull. Mus. Comp. Zool., 1880, VIII, p. 30.

Off Cape St. Lucas, Lower California, 31 fathoms, station 2829.

150. ETHUSA LATA Rathbun.

Ethusa lata RATHBUN, Proc. U. S. Nat. Mus., 1893, XVI, p. 258.

Panama Bay, 26 to 62 fathoms, stations 2794, 2803, 2805; southern part of Gulf of California, 26½ fathoms, station 2823; from off Cape St. Lucas to Abrejos Point, Lower California, 48 to 66 fathoms, stations 2830, 2833, 2834.

151. ETHUSINA ABYSSICOLA Smith.

Ethusina abyssicola SMITH, Rept. Commr. of Fish and Fisheries for 1882, 1884, p. 349, [5], pl. II, figs. 1, 1a.

Off Cape Frio, Brazil, 671 fathoms, station 2763.

EXPLANATION OF PLATES.

PLATE XLI.

- Fig. 1. *Collodes tumidus*, male, $\times 2$.
 2. *Anamathia cornuta*, male, $\times 1\frac{1}{2}$.
 3. *Lissa tuberosa*, male, $\times 1\frac{2}{3}$.
 4. *Lissa aurivilliusi*, male, $\times 1\frac{2}{3}$.
 5. *Microphrys branchialis*, male, $\times 1\frac{2}{3}$.
 6. *Calappa saussurei*, male, $\times 1\frac{1}{3}$.

PLATE XLII.

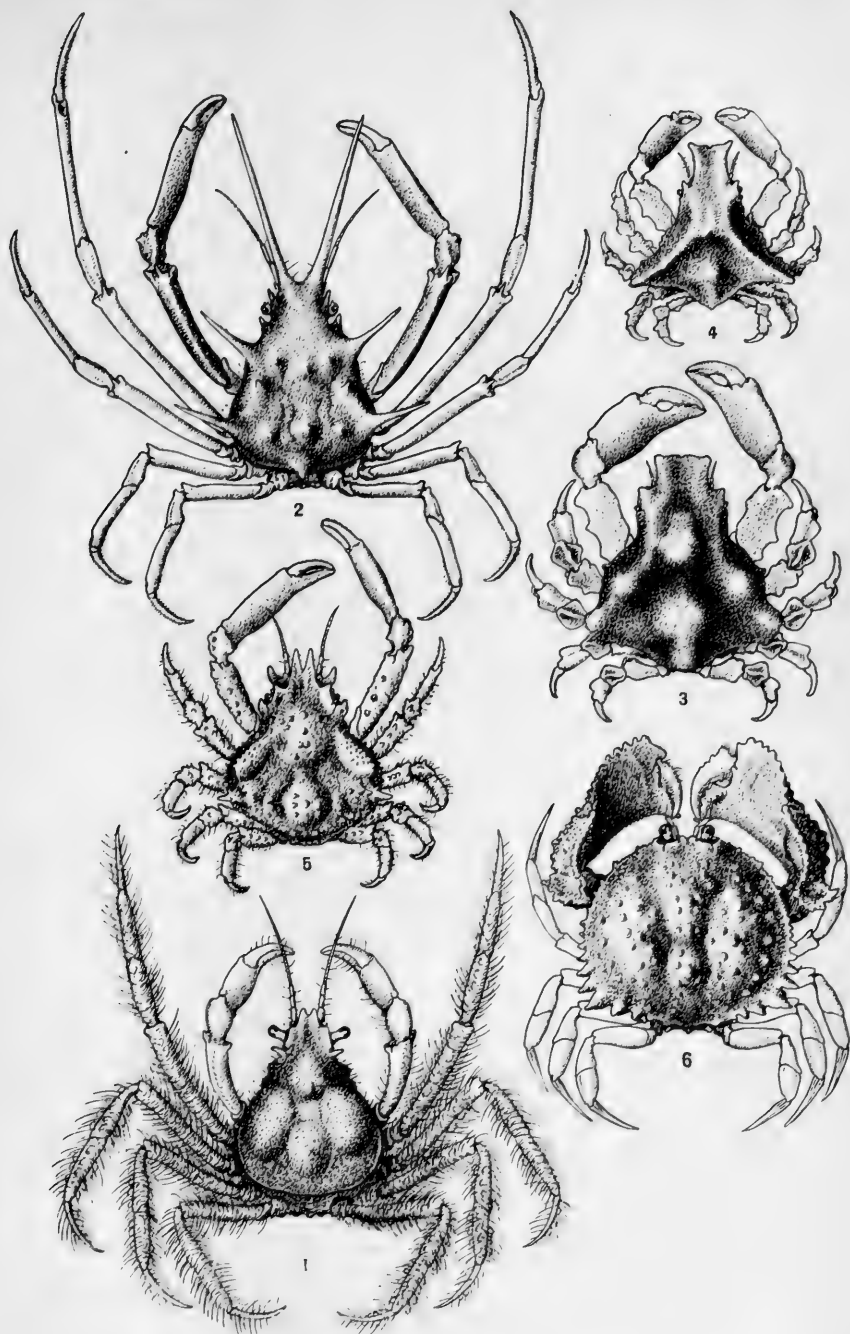
- Fig. 1. *Thyrolambrus erosus*, female, $\times 1\frac{1}{2}$.
 2. *Actea angusta*, male, $\times 4$.
 3. *Actea inornata*, female, $\times 4$.
 4. *Lipasthesius lecanus*, male, $\times 2\frac{1}{2}$.
 5. *Lipasthesius lecanus*, male, front, $\times 4\frac{2}{3}$.
 6. *Pilumnus spinulifer*, male, $\times 1\frac{2}{3}$.
 7. *Pilumnus spinulifer*, male, right hand, $\times 2$.
 8. *Pilumnus spinulifer*, male, left hand, $\times 2$.
 9. *Micropanope nitida*, male, $\times 1\frac{2}{3}$.
 10. *Lophopanopeus maculatus*, male, $\times 2\frac{1}{2}$.
 11. *Lophopanopeus maculatus*, male, abdomen, $\times 4$.
 12. *Ectesthesius bifrons*, female, $\times 2$.
 13. *Ectesthesius bifrons*, female, front, $\times 6\frac{2}{3}$.
 14. *Ectesthesius bifrons*, female, outer maxilliped, $\times 6\frac{2}{3}$.

PLATE XLIII.

- Fig. 1. *Acanthocyclus hassleri*, male, abdomen, $\times 2$.
 2. *Palicus lucasii*, male, $\times 1\frac{2}{3}$.
 3. *Eucratopsis macrophthalma*, female, $\times 4$.
 4. *Eucratopsis macrophthalma*, female, $\times 4\frac{2}{3}$.
 5. *Chasmocarcinus latipes*, female, $\times 1\frac{2}{3}$.
 6. *Pinnixa brevipollex*, female, $\times 2$.
 7. *Pinnixa affinis*, female, $\times 2$.
 8. *Pinnixa affinis*, female, right hand, much enlarged.
 9. *Pinnixa affinis*, female, outer maxilliped, much enlarged.
 10. *Pinnaxodes hirtipes* Heller, male, outer maxilliped, much enlarged.
 11. *Pinnaxodes hirtipes* Heller, male, abdomen, $\times 2\frac{2}{3}$.
 12. *Tetrias scabripes*, female, $\times 2$.
 13. *Tetrias scabripes*, female, outer maxillipeds, $\times 4\frac{2}{3}$.
 14. *Tetrias scabripes*, female, right hand, $\times 3\frac{1}{2}$.

PLATE XLIV.

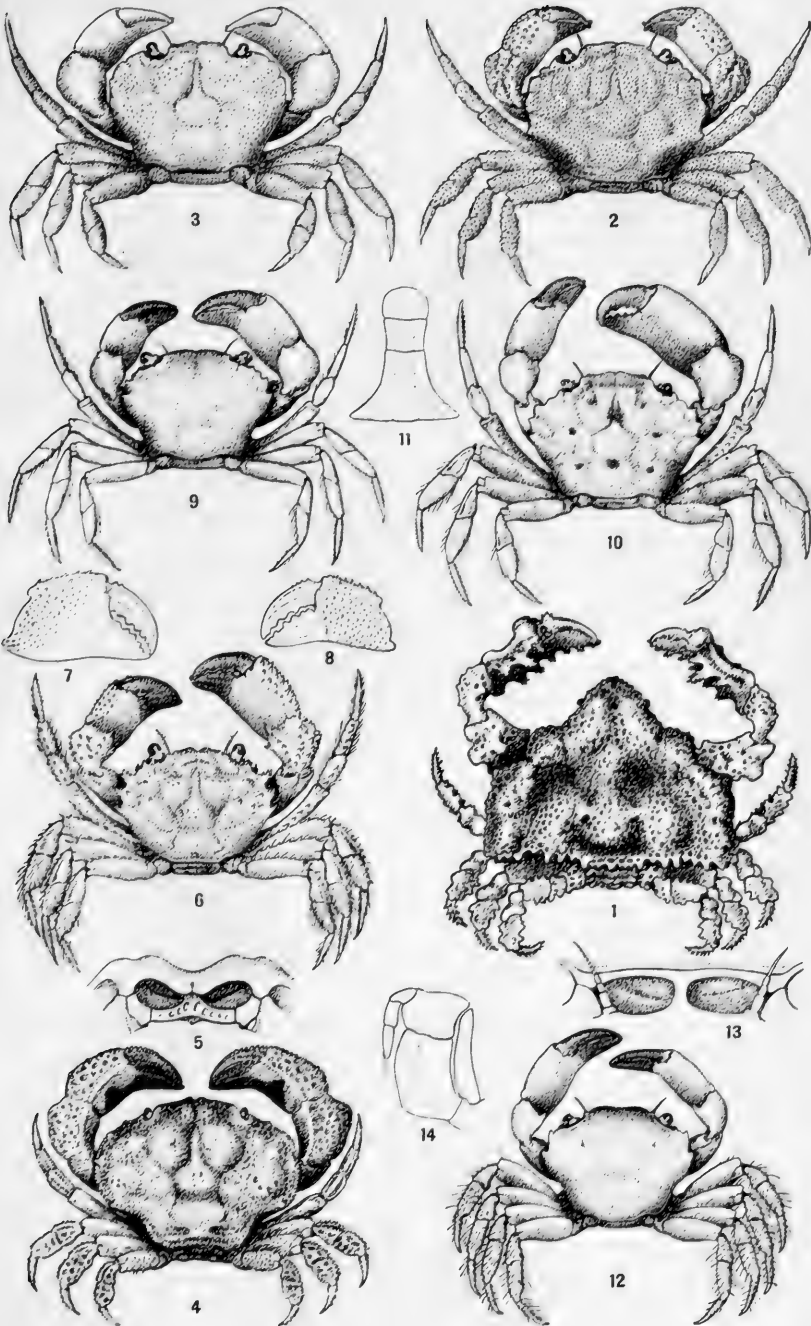
- Fig. 1. *Medæus lobipes*, male, $\times 1\frac{1}{2}$.
 2. *Portunus (Achelous) angustus*, female, $\times \frac{2}{3}$.
 3. *Portunus (Achelous) minimus*, male, $\times 1\frac{2}{3}$.
 4. *Hepatus lineatus*, male, $\times 1\frac{1}{2}$.
 5. *Ebalia cristata*, male, $\times 2\frac{1}{3}$.
 6. *Randallia bulligera*, male, $\times 1\frac{2}{3}$.
 7. *Randallia agaricias*, male, $\times 2$.
 7a. *Randallia agaricias*, side view of two tubercles, enlarged.



BRACHYURA COLLECTED BY THE ALBATROSS.

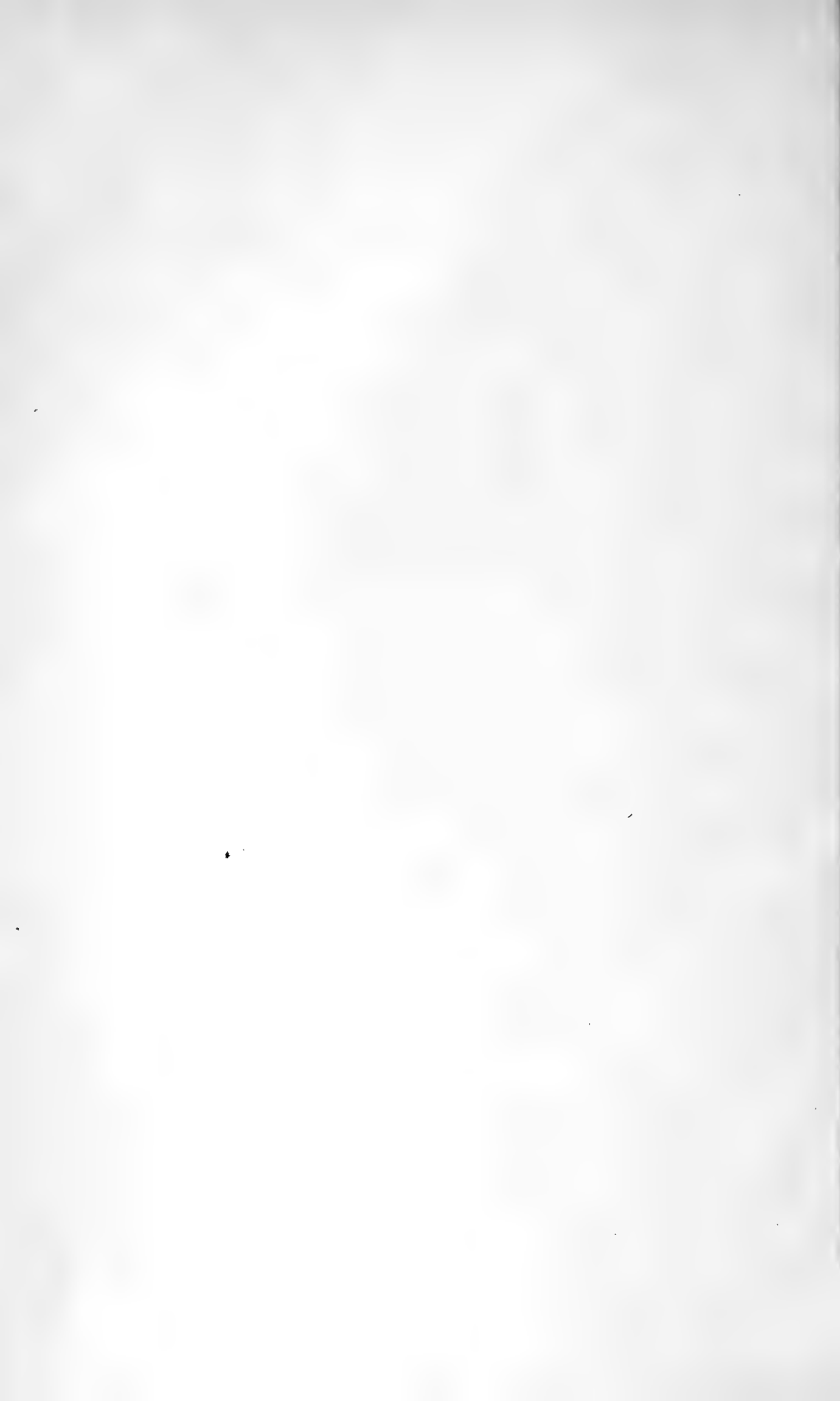
FOR EXPLANATION OF PLATE SEE PAGE 616.

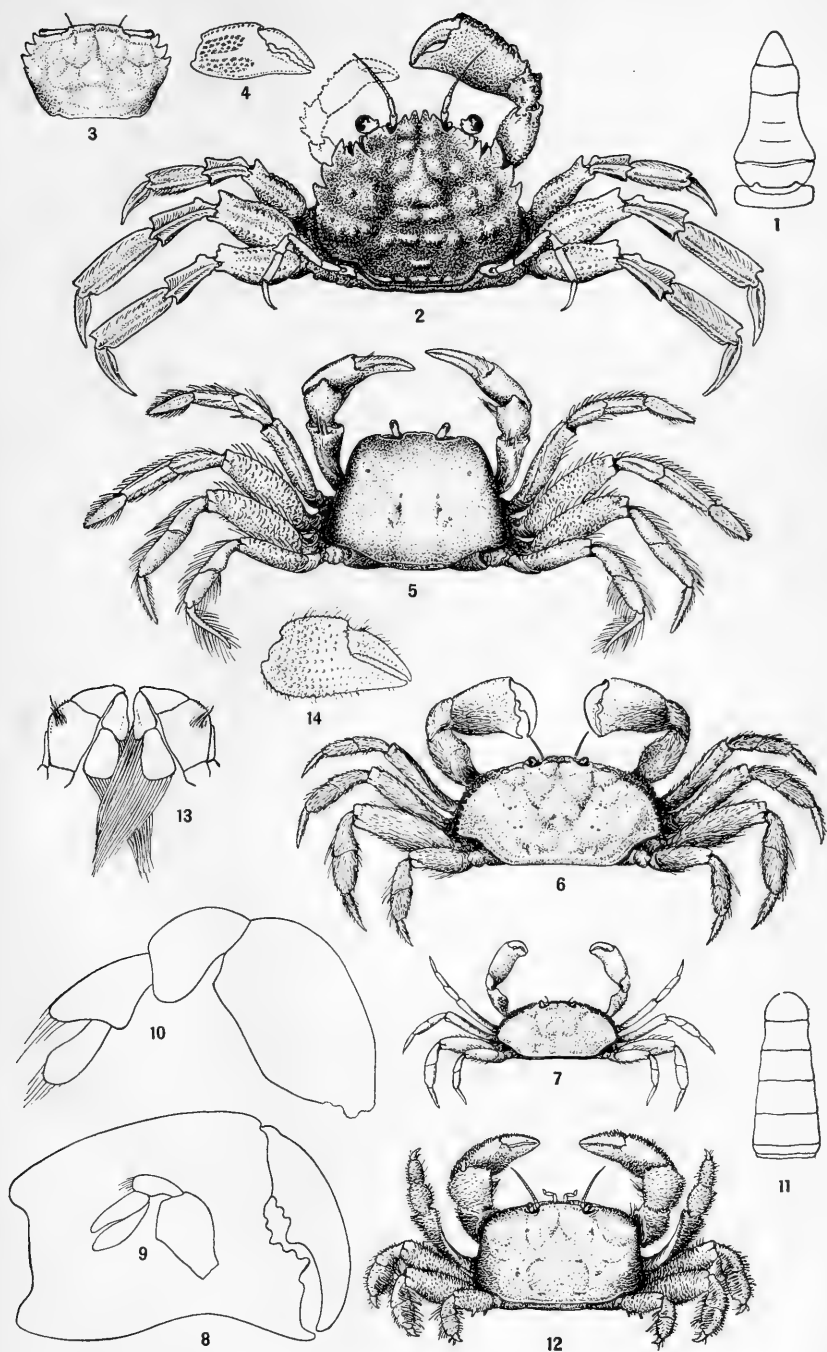




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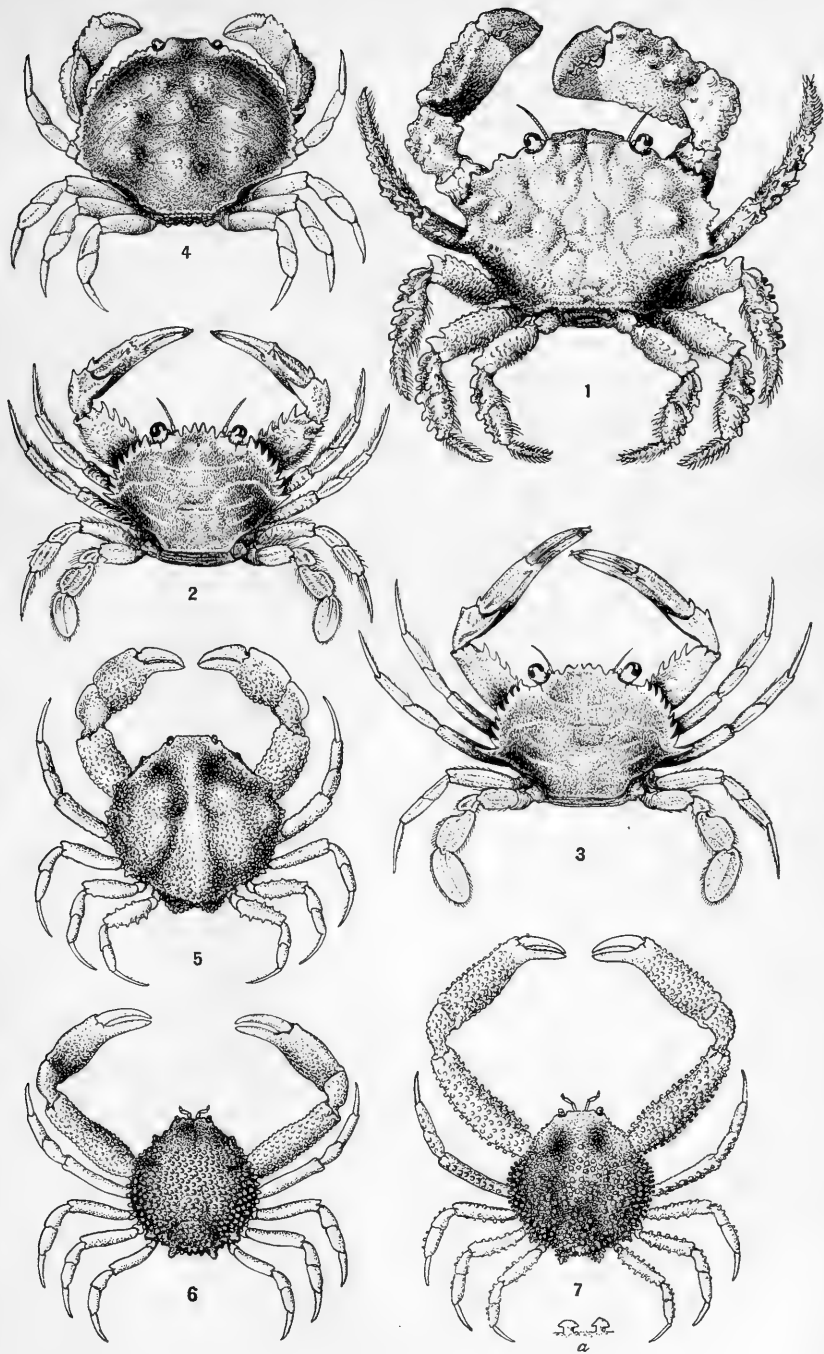
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BRACHYURA COLLECTED BY THE ALBATROSS.

FOR EXPLANATION OF PLATE SEE PAGE 616.



BRACHYURA COLLECTED BY THE ALBATROSS.

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ON THE NOMENCLATURE OF THE WHALEBONE WHALES
OF THE TENTH EDITION OF LINNÆUS'S SYSTEMA
NATURÆ.

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The present paper is intended as an introduction to an inquiry as to the identity of the whalebone whales frequenting respectively the Eastern and the Western Atlantic.

The species inhabiting European waters have been studied by many naturalists for a very long time, and may be said to be well known. Those of the American coasts and of African waters, on the contrary, have received less attention and are much less well understood. As regards North American species, some zoologists have tacitly assumed that they were identical with the European forms, while others have bestowed new names on the various specimens which have come under their observation. The whole subject is, therefore, involved in an uncertainty, which is a hindrance to the progress of cetology in many ways, and especially prevents a correct understanding of the geographical distribution of these huge animals.

As a preliminary step to the investigation of this subject, it has seemed to me desirable that the nomenclature of the European species should be thoroughly established. Taking as the starting point the Tenth Edition of Linnaeus's *Systema Naturæ*, I have endeavored to ascertain whether the names in current use for the species are the correct ones according to accepted canons of nomenclature.

It has to be said that the species of cetaceans in the *Systema* are no more to be certainly determined from the diagnoses than many other Linnaean species. The main reliance has to be placed on the bibliographical references and synonymy, but even with these helps the Linnaean species are not always to be identified beyond peradventure. Nevertheless, the tendency of zoologists in the main is to adopt these names whenever at least a colorable defense of them can be made. This is, undoubtedly, on the whole, a wise course, as the tendency of all nomenclatural investigations is to go back as far as is in anywise warrantable. If one goes no farther back than the earliest fully-established name, there are always those who, taking up the matter anew, will

argue in favor of an earlier though less well-founded name. By falling back at once to the earliest name that, under rules generally accepted, can be adopted with any plausibility whatever, such discussions are cut off, and stability is on the whole promoted.

It will be a fortunate day for zoology when the names of animals are determined by common assent, without regard to history or recourse to argument.

No special originality is claimed for the conclusions reached in this paper, some of which have been hinted at by Sir William Turner and other cetologists. I believe, however, that the fact that the Linnæan names for the finback whales are based exclusively on Martens's and Sibbald's descriptions is now for the first time demonstrated.

The European species of whalebone whales (including the bowhead among the number) now currently recognized are as follows:

1. The bowhead, Greenland or Arctic right whale, known as *Balæna mysticetus*.
2. The black whale, nordcaper or Basque whale, known as *Balæna biscayensis*.
3. The common finback or rorqual, known as *Balenoptera musculus*.
4. The blue whale, known as *Balenoptera sibbaldii*.
5. Rudolphi's whale or rorqual, known as *Balenoptera borealis*.
6. The little piked whale or lesser rorqual, known as *Balenoptera rostrata*.
7. The humpback, known as *Megaptera boops* or *longimana*.

The species of whalebone whales described by Linnæus are as follows:

1. *Balæna Mysticetus*.
2. *Balæna Physalus*.
3. *Balæna Boops*.
4. *Balæna Musculus*.

It is questionable how far Linnæus was personally familiar with specimens representing the species he described.

He states in the *Systema* that he had access to the collections of King Adolphus Frederick and Queen Louise Ulrica of Sweden, Tessin's and De Geer's museums, and the museums of the Upsala and Stockholm academies. There is no mention of specimens of cetaceans in the catalogues of these collections published in Linnæus's time, with a single exception. In the catalogue of the Adolphus-Frederick Museum (p. 51), he records a fœtus of a whale under the name of *Balæna grœnlandica*. It appears to be a Greenland whale, but as we shall presently see, Linnæus afterwards referred it to the finbacks.¹

¹ Van Beneden remarks of the bowhead and nordcaper:

"Du Hamel, Linné, Pierre Camper, and, later Lacépède have occupied themselves successively with these giants of the sea; but Pierre Camper alone had in his hands pieces of the true 'Baleine franche' [*Balæna mysticetus*]; the others only knew them from figures, or from the accounts of explorers." (*Hist. Nat. des Cétacés des Mers d'Europe*, 1889, p. 52.)

THE BOWHEAD OR GREENLAND RIGHT WHALE.

The first species described by Linnæus is *Balæna Mysticetus* (p. 75).

The diagnosis "*B. naribus flexuosis in medio capite, dorso impenni*" is generic, rather than specific. The habitat—"In oceano Grælandico"—points to the bowhead whale. The description is in part erroneous and for the rest consists of generic or supergeneric characters.

The bibliographic references include the works of Artedi, Willoughby, Rondelet, Ray, and Martens, and Linnæus's own writings. I discuss them for convenience in chronological order, as follows:

"Rond. pisc. 475"—RONDELET, *De Piscibus Marinus*, 1554, p. 475.

Rondelet gives the characters, though with some evident inaccuracies, of a species of right whale which occurs "on the coast of the Aquitanian Sea and in India." He states explicitly that it has no fin on the back ("*In dorso nullam habet*").

As the Greenland whale, or bowhead, was unknown to the European naturalists of Rondelet's time, it may be presumed that the species he had in mind was the black whale or nordcaper. Gervais has called special attention¹ to the following sentence, which, in his opinion, points conclusively to the nordcaper: "*Rostro est brevi, fistula caret, corio duro, nigro integitur sine pilis, cui lepadæ et ostrea hærentia aliquando reperiuntur.*"²

Rondelet cites localities and facts indicating that he was familiar with the whale fishery of the Basques in the Bay of Biscay, which had for its object, as Fischer, Van Beneden, and others have shown, the black whale or nordcaper.

Rondelet writes under the heading "*De Balæna vulgo dicta sive de Musculo*," and a large part of the chapter consists of a discussion as to the identity of the *Musculus* of Pliny and other writers.

"Will. icht. 35"—WILLOUGHBY, *Ichthyographia* (or *Historia Piscium*), 1686, p. 35.

Willoughby in this place, under the heading "*Balæna Rondeletii, Gesneri & aliorum*—The Whale," merely repeats the observations of Rondelet, John Faber (the expositor of Hernandez's natural history of Mexico), Polydorus Virgil (Bishop of Bath and Wells, 1502 to 1555), and others, and adds some comments of his own on the various records. These records appear to refer severally to the right whales, the finbacks, and the humpback.

No attempt is made to formulate a diagnosis of any particular species.

¹ *Comptes Rendus*, 5 June, 1871, pp. 666, 667. See also Van Beneden, *Hist. Nat. des Cétacés des Mers d'Europe*, 1889, p. 7.

² *Translation*: It is provided with a short beak; the blowhole is wanting; it is covered with a hard black skin, without hairs, to which barnacles and oysters are sometimes found adhering.

"Raj. pisc. 6" = RAY, *Synopsis Methodica Piscium*, 1713, p. 6.

The nomenclature in this work is polynomial, and we find instead of a specific name the usual brief diagnosis, consisting, however, of generic and supergeneric characters. This is followed by an extended account of the supposed species compiled from early writers. From the localities given it is evident that the bowhead and black whale or nordcaper are confounded. Thus the author mentions a specimen reported by Faber as being stranded in 1624 not far from the maritime fortress of St. Severus, about 30 miles from Rome; of another near Corsica in 1620, and a third stranded in 1532 (according to Polydorus Virgil) at Tynemouth, England. These, if they refer to right whales at all, were the black whale and not the bowhead. On the other hand, Ray quotes from Martens, who observed the bowhead at Spitzbergen.

"Art. gen. 76" = ARTEDI, *Genera Piscium*, 1738, p. 76.

"Syn. 106" = ARTEDI, *Synonymia Nominum Piscium*, 1738, p. 106.

Artedi in the two works cited gives a brief diagnosis without genuine specific characters, and describes a specimen which he himself examined in London, November, 1734. It is highly probable that his description, which appears to indicate clearly that he had before him a right whale or true *Balæna*, relates to the black whale or nordcaper. In the *Genera Piscium*, however, he cites among his bibliographical references Marten's "*Balæna Spitsbergensis*," which was the bowhead or Greenland whale. He also gives "Greenland whale" as the English name of his species, and "Grönlands Hvalfisk" as the Swedish name. It is evident that Artedi did not distinguish between the black whale and the bowhead.

"Faun. suec." 264 = LINNÆUS, *Fauna Suecica*, 1746, No. 264 (p. 98).

This work is polynomial, and at the place cited we find only what is really an attempt at a brief diagnosis, consisting, however, of generic characters, followed by citations of numerous early authors, such as Gesner and Jonston, and the remarks "*Grönlands walfisk* of the Swedes;" "inhabits the Atlantic Ocean, feeding on medusæ."

"Syst. nat. 39, n. i."

I understand this to refer to the ninth edition of the *Systema Naturæ*. The matter, however, is not on page 39 but on page 40. Under No. 1 we have the same references to the *Fauna Suecica* and Artedi's *Synonymia* which we find in the tenth edition of the *Systema Naturæ*, now under consideration. The entire matter is as follows: "1. *Balæna fistula in medio capite, dorso caudem versus acuminato*. Art. syn. 106, Fn. 264. *Mysticetus*. la Balaine."

No new or independent information will be looked for here.

It will be perceived from the foregoing examination of Linnæus's authorities that these writers had no clear notion of the distinction between the black whale and the bowhead, or even in some cases between the different types of whalebone whales, and that it is conse-

quently impossible to arrive at any definite conclusion as to the applicability of Linnæus's name *mysticetus* from a study of their works. We must therefore get what satisfaction we can from Linnæus's own words, and it would seem that even here the only certain indication is to be found in the phrase "lives in the Greenland Ocean." This, as already mentioned, may probably be considered as a sufficient warrant for attaching the specific name "*mysticetus*" to the bowhead. There is, so far as I know, no record of the occurrence of the black whale in Greenland waters, and, furthermore, it is well known that there was an extensive fishery for the bowhead in those waters in Linnæus's time.

THE FINBACK AND HUMPBACK WHALES.

We pass now from the bowhead to the consideration of the other whalebone whales mentioned by Linnæus. These are three in number—*Physalus*, *Boops*, and *Musculus*.

1. BALÆNA PHYSALUS.

Linnæus's diagnosis of this species is as follows: "A whale with the nostrils in the middle of the head; an adipose fin at the end of the back."¹ The only other bit of information is—"lives in the European Ocean."

It is evident that these data, though they suffice to indicate a finback whale, are insufficient to enable us to associate the name *Physalus* with any one of the four European species, and if the matter is to be resolved at all it will be through the help of the authorities cited by Linnæus. Taking these in chronological order, the first we meet with is Rondelet. The citation is as follows:

"Physeter. Rond. pisc. 485"—RONDELET, *De Piscibus marinus*, 1554, p. 485.

The whale which Rondelet describes under the name of *Physeter*, in the work above mentioned, is probably the sperm whale, though the figure which heads the chapter represents an animal having teeth in both jaws and the blowhole on the top of the head, somewhat as in *Orca*. In any event, it can not be counted among the whalebone whales, and Linnæus was in error in citing it under this or any other of his species of *Balæna*.

"*Physalis bellua* s. *Physeter*. Gesn. pisc. 723."

I understand this to refer to Gesner's *Historia Animalium*, Liber IV, and possibly the edition of 1620. I have seen only the first edition of 1558, in which, on page 851, begins a chapter entitled "De (*Physalo bellua*, seu) *physetere*, *rondeletius*." The description here given is quoted verbatim from Rondelet, and the figure which heads the chapter is also from that author. So far as the present species is concerned, therefore, Gesner's work can not be cited as an independent source of information.

¹"*B. naribus in medio capite dorso extremo pinna adiposa*" (p. 75).

"Finfisch. Martens. spitsb. 125. t. q. f. c." = MARTENS, Spitzbergische oder Grönlandische Reise Beschreibung gethan im Jahr 1671. Hamburg, 1675, p. 125, pl. Q, fig. c.

In chronological order, Martens comes next after Rondelet and Gesner among the authors cited by Linnæus. Martens visited Spitzbergen¹ in 1671, and his Beschreibung includes an account of the various marine animals found in the waters thereabouts.

These descriptions are very full for the time in which they were written, and are of especial interest, both because they represent the source from which many later authors drew their information, and because they appear to have been based largely on personal observation.

Martens's description of the "Finfisch" is as follows:

The finfish is equal to the whale [*Balæna mysticetus*] in size.

As to thickness, the whale is, however, three or four times as thick as the finfish.

The finfish is recognized when in motion by the "Flossfedern" or fins, which stand on the back, near the tail.

It is distinguished also by the strong spouting from the right whale, which does not blow so powerfully.

The eminence on its head is divided longitudinally, and this is its blowhole, out of which it blows the water higher and stronger than the whale.

The eminence, however, is not so high as in the whale, and the back is likewise not so deeply furrowed.

The lips of the finfish are of a brownish color and diversified with plaits (*Krausen*), like a line or streak.

On the upper lip hangs the so-called whalebone, as in the whale, but whether it opens and shuts its mouth is variously believed. Some hold that it can not shut its mouth. It is not so, however. It moves (but not always) with open mouth. Its whalebone, like that of the right whale, does not hang out on the sides outside the lips. It can shut its mouth completely when it will.

The inside of the mouth between the whalebone is entirely rough with hairs, like horsehair, which are situated on the inside of the whalebone and on the little whalebone, which develops first, and is blue in color.

The other whalebone is brown in color; also dark brown, with yellow streaks, which is considered the oldest.²

The blue is found in young whales and finfish

In color it [i. e., the finfish] is not velvet black, like the whale, but like the fish called "Schley" [the tench, *Tinca vulgaris*].

The form of the body is long, round, and slender, and has not so much blubber as the whale, on which account one does not particularly care to catch the finfish, as it does not repay one for the trouble.

It is much more dangerous to kill than the whale, because it can move and turn much quicker, for it strikes about it with his tail and from it (*von sich*) with its flippers, called fins, so that one can not come near it with boats, when the lances help most to kill it.³

This description is accompanied by a figure which shows with considerable fidelity the characteristic form of a finback whale, but the furrows of the throat are wanting, a peculiarity which has attracted the attention of many zoologists.

¹ Or East Greenland, as it was then frequently called.

² In describing the Greenland whale, he refers to the whalebone as being "sometimes yellow in color, with parti-colored streaks, like that of the finfish" (p. 99).

³ Spitzbergische oder Groenländische Reise, Beschreibung, 1675, pp. 125, 126.

Martens's description of the form, color, etc., of his finfish, and especially also of the whalebone, corresponds with the common finback, usually known as *Balenoptera musculus*. With the other three species of finbacks known to frequent the waters of northwestern Europe it shows less close agreement. In the present state of knowledge we may, I think, on the basis of the color of the whalebone alone, decide that Martens's description applies to the common finback.

Martens states in his Beschreibung¹ that all the illustrations are from sketches of his own from life. We may believe, therefore, that his description and figuré of the finfish are based on direct observation of specimens. As above mentioned, it is somewhat singular that he neither describes nor illustrates the throat furrows, which are so characteristic of all finback whales. F. Cuvier accounts for this on the ground that Martens did not regard the furrows as an essential character, but this seems hardly sufficient. It is possible that the figure was made by Martens from memory and not with the whale before him.

"*Balæna edentula*, corpore strictiore, dorso pinnato, Raj. pisc. 9" = RAY, Synopsis methodica Piscium, 1713, p. 9.

The description accompanying this polynominal is nothing more than a Latin translation of Martens's account of the "Finfish," somewhat abbreviated and paraphrased. It has in itself therefore no independent value as a means of determining to what species Linnæus's name *Physalus* is to be applied. Ray's species is simply Martens's "Finfish" under another name.

"Will. icht. 41" = WILLOUGHBY, Historia Piscium, 1686, p. 41.

On the page cited Willoughby merely quotes the first part of Rondelet's account of the *Physeter*, leaving out a few words here and there. He adds a few critical remarks regarding the *Physalus* of Oppian and the *Pristis* of Rondelet and Bellon, but nothing of the slightest service in connection with the present inquiry.

Willoughby appears to have known nothing of Martens's Beschreibung.

"Art. gen. 77" = ARTEDI, Genera Piscium, 1738, p. 77.

Two species of whales are described by Artedi in the place cited. The one referred to by Linnæus in the citation quoted above is No. 2—"Balæna fistula in medio capite, tubere pinniformi in extremo dorso."

Artedi merely cites Ray and paraphrases and abbreviates his description, without giving any new information. Ray, as we have seen, copies Martens, and hence we have to fall back again on the latter author in determining with what species Linnæus's name is to be associated.

"Art. Syn. 107" = ARTEDI, Synonymia Nominum Piscium, 1738, p. 107.

Under the heading "*Balæna fistula in medio capite, tubero pinniformi in extremo dorso*," Artedi cites Ray, pp. 9-10, as the principal

synonym, and adds references to ten early authors, Ælian, Pliny, Gesner, etc., with the remark, "These synonyms are seen to pertain to the same species with 'a'" [i. e., Ray].

We have already considered Ray's description, and have concluded that it was copied from Martens, and refers to the common finback.

The descriptions of the earlier authors are for the most part indeterminate, so far as species are concerned, and some relate to entirely different classes of animals. Ælian's *Physalus*, for example, is a small fish of the Red Sea, which has the power of inflating itself and floating on the waves. This was probably a globefish, or *Tetrodon*.

The *Physeter* of Rondelet was very probably the sperm whale, as we have already stated.

"Faun. succ. 265" = LINNÆUS, *Fauna Suecica*, 1746, p. 99, No. 265.

Linnaeus in this place copies Artedi's diagnosis, which the latter in turn took from Ray, and he from Martens. He cites some six of the early authors—Gesner, Jonston, etc.—where whales called "*Physeter*" are mentioned, but some of them at least, as we have already seen, treat of the sperm whale.

Linnaeus adds this independent information: "Lives in the Norwegian sea and is eaten by the natives; tastes nearly like the sturgeon, which was eaten daily by the natives while it migrated by northern Finmark to the highest part of Norway."

As four species of finback whales are known to frequent Norwegian waters, the one particularly referred to in this item can not, of course, be discriminated, though very probably it was the "common" finback.

Here, then, as in the case of Ray and Artedi, we are obliged to turn back to Martens as the only means of determining the proper use of the specific name *Physalus*. We have already decided that Martens's "*Finfisch*" was the common finback, usually called *Balanoptera musculus*.

To sum up the matter, then, it seems necessary to bestow on the common finback the name of *Balanoptera physalus* (Linnaeus).

This is more important than would at first appear, because, as I shall hope to show, the specific name *musculus*, now in common use for this whale, is misapplied. Unless the Linnæan name *physalus* is accepted, it will be necessary to apply some other cognomen. I am of the opinion, however, that *physalus* should be considered applicable.

2. BALÆNA BOOPS.

Linnaeus's diagnosis of his *Balæna Boops* is as follows: "*B. fistula duplici in rostro, dorso extremo protuberantia cornea.*" (A whale with a double blowhole in the snout; a horny protuberance at the end of the back.)

This diagnosis is in no wise specific, but, as we shall see presently, was taken from a description in Sibbald's *Phalainologia*. Linnaeus adds

nothing further but certain synonyms (which we shall consider in order) and the remark "lives in the Northern Ocean."

It is clear that Linnæus's diagnosis is not sufficient for the identification of the species, and if the proper use of the name *boops* is to be ascertained at all it will be through the synonyms, which are as follows:

"Art. gen. 77"=ARTEDI, *Genera Piscium*, 1738, p. 77.

Upon turning to the place cited, we find the following:

3. *Balæna fistula duplici in rostro, protuberantia corniformi in extremo dorso.* Art. *Syn.* 107.

Balæna tripinnis, nares habens, cum rostro [acuto] & plicis in ventre. Sibbald. Ray p. 16.

Anno 1690. d. 17. Novembris in sinum quendam portus Bruntisland, in latere æstuarii Forthæ Boreali in Scotia, ejecta fuit.

Rostrum respectu ad congenes acutum. Plicæ in ventre adsunt. Longitudo 46 pedum.

Fistulæ nasiformes ab apice rostri 6 pedes & 8 pollices longæ & septo divisæ. Oculi exigui.¹

It is evident that this entire matter was extracted from Sibbald's *Phalainologia*. The whale "stranded on the 17th of November, 1690," is one figured and described in detail in that work.

Art. "syn. 107"=ARTEDI, *Synonymia Nominum Piscium*, 1738, p. 107.

The species here referred to is described in full, as follows:

3. *Balæna fistula duplici in rostro, protuberantia cornuiformi in extremo dorso.* Art.

Balæna tripinnis nares habens, cum rostro acuto & plicis in ventre. Sibbald.

Raj. p. 16.

It is evident that this is merely a repetition of the diagnosis given by Artedi in the *Genera Piscium*, and which he extracted from Sibbald's work.

"*Balæna tripinnis nares habens cum rostro acuto & plicis in ventre.* Raj. pisc. 16"=RAY, *Synopsis Methodica Piscium*, 1713, p. 16.

The account given in the place cited above begins thus:

8. *Balæna tripinnis, nares habens, cum rostro acuto & plicis in ventre.*

Anno 1690, Noveemb. 17, in sinum quendam ad occasum Portus Bruntisland dicti, in latere æstuarii Forthæ Boreali ejecta fuit hujusmodi Bellua.

This is likewise an abbreviation, with some paraphrasing, of the account by Sibbald of the whale stranded on November 17, 1690, in the Firth of Forth. Artedi, in turn, in 1738 copied the description of this same whale from Sibbald, as we have seen.

¹ Translation.—3. A whale with a double blowhole in the snout; a horn-shaped protuberance at the end of the back. Artedi, *Synonymia Nominum Piscium*, p. 107.

A whale with three fins, having nostrils; with [an acute] snout and with folds in the belly. Sibbald. Ray, p. 16.

This was stranded on the 17th of November, 1690, in a certain bay of the harbor of Bruntisland, on the north shore of the Firth of Forth, in Scotland.

The snout, in comparison with its congeners, acute. Folds present on the belly. Length, 46 feet.

Nariform blowholes 6 feet from the tip of the snout and 8 inches long and divided by a septum. Eyes small.

"Mus. Ad. Frid. I, p. 50" — LINNÆUS, *Museum Adolphi Friderici Regis*, 1754, p. 50.

Through the kindness of Dr. A. W. Keppel, librarian of the Linnean Society of London, I have received a transcript of the pages in this work which contain matter relating to cetaceans. It is all on pages 51 and 52, and this reference must therefore be regarded as a false one. Whatever the species of which Linnaeus found a specimen in the Adolphus Frederick Museum, it is not likely to have been his *boops*. Furthermore, he makes a correct reference to the work under *musculus*, the species which comes next after *boops*.

This exhausts all of Linnaeus's synonyms and bibliographical citations, and all of the matter referred to¹ has been shown to have its origin in Sibbald's *Phalainologia*. It remains, therefore, to examine this work.

The original edition of Sibbald's *Phalainologia*, published in 1692, is a very rare book. Indeed, I do not know that there is a copy in the United States. It was reprinted in 1773, under the editorship of Thomas Pennant. There is a copy of this reprint in the library of Harvard College, which I have had the pleasure of examining, through the courtesy of the superintendent of circulation, Mr. Thomas J. Kiernan. Another copy is in the library of the Academy of Natural Sciences, Philadelphia.

The full title of the reprinted work (translated) is as follows: "*Phalainologia Nova: or, observations on certain of the rarer whales recently stranded on the coast of Scotland: In which whales recently observed are divided among genera and species according to characters impressed by Nature herself; some now described for the first time; errors in descriptions also disclosed; and brief dissertations given on teeth, spermaceti, and the origin of ambergris.*"²

Excluding the passages relating to writings of classical authors and those containing the description of certain anatomical details, chapter three of this work, beginning page 68, may be translated as follows:

Chapter III. *De Balæna hujusmodi Tripinni quæ rostrum acutum habet, & plicas in Ventre.*

On the seventeenth day of November, 1690, the following whale was cast up in a certain bay to the west of the harbor called Bruntisland, on the north shore of the Firth of Forth: * * *

This remarkable kind of animal was distinguished by the very shining surface of the body (as if it were cast from the most refined brass), which was very long,

¹ With the exception just mentioned.

² PHALAINOLOGIA NOVA; | SIVE | OBSERVATIONES | DE | RARIORIBUS | QUIBUSDAM BALENIS | In SCOTIE LITTUS nuper ejectis: | IN QUIBUS, | nuper conspectæ BALENÆ per Genera & | Species, secundum Characteres ab ipsa | Natura impressos, distribuuntur; | quedam nunc primum describuntur; errores etiam | circa descriptas deteguntur; & breves de Dentium, | Spermatæ Ceti, & Ambre Grise ortu, natura & | usu, dissertationes traduntur. | — | [quotation] | — | EDINBURGI | Typis Joannis Redi, MDCXCII. | Veniunt apud M. ROBERTUM EDWARD, verbi divini ministrum, in | vico dicto, *The Bishop's Land Closs.* | Iterum impressi, LONDINI, | apud BENJ. WHITE, in Vico *Fleet street*, MDCCLXXIII.

8°. pp. 1-1 (unnumbered), 1-105. pls. 1-3.

and appeared more slender in form by the proportion of the thickness to the length. From the extremity of the snout to the tail was 46 feet; near the lateral fins, where the body was thickest, the circumference measured with a cord was 20 feet. It had two fins on the sides, and besides these also on the back toward the tail a certain protuberance like a horn, which Bellon calls a fin, but our sailors *anc pyke*—that is, a spine. The tail was bifurcated, and placed parallel to the horizon. The whole skin of the body was very smooth; black and pellucid in color on the back, white on the belly. On the belly from the navel to the lower jaw and all the way to the lateral fins were very many plicæ or ridges, prolonged to that length which was between the lower jaw and the navel. They were similar to those which we see in that kind of woman's cloak called *Mantoua-gown*. In this animal these folds were 1 inch broad, and the furrows between them in breadth and depth less than an inch, and it appeared to me that the learned Bartholinus knew of this corrugated belly. A fin was located on the breast on each side; the anterior part of the same was 5 feet from the eye. The real fin of the back was $8\frac{1}{2}$ feet from the tail; the girth of the body in the neighborhood of this was 12 feet. The vent was 14 feet from the extremity of the tail. The penis was situated between the umbilicus and the anus, and a little of it hung down; cut out and drawn out by a weight suspended, it attained scarcely 2 feet in length; the sheath from which it hung down was a foot long in the middle; from the penis to the navel was $5\frac{1}{2}$ feet; the aperture of the anus equaled one-half a foot. From the navel to the extremity of the lower jaw was $21\frac{1}{2}$ feet; the navel was the size of a fist. The tail was $9\frac{1}{2}$ feet between the outer points; where narrower (*contractior*), $2\frac{1}{2}$ feet. The tail was placed transversely. The skin, as remarked, was black; the cuticle was like the silk cloth called *taffeta*, very thin, but the skin equaled in thickness the Imperial coin called a dollar, and everywhere black.

The head in this animal held the due proportion to the rest of the body, and was oblong in form, curving gradually to a certain narrowness back of the snout; the snout was of a form between acute and obtuse, neither extended as in *Delphinus* and *Orcæ*, nor obtuse as in *Phocæna*. This animal had no spiracle in the head, but nostrils in the snout, of which more below. The form of the back was like an inverted ship, and the summit of the back was like a keel, with the body receding from this running out into the greater breadth. It was possible to see the whole body, which, floating on the waves, was turned now on one side, now on the other. The breadth of the lower jaw near the middle was $4\frac{1}{2}$ feet, and had such a margin as John Faber describes in the place cited above; indeed, the bony, black, obtund, thick lip of the jaw corresponded to those garlands with which the summits of walls are crowned. Above the lower jaw the tongue reclined, which could be contracted, and was 5 feet long, and near the roots 3 feet broad; in substance, color, and figure clearly like that of an ox, and almost of equal thickness with the breadth. In the upper jaw the nostrils were situated in the higher part of the snout, distant 6 feet 8 inches from the extremity of the upper jaw. They were also 8 or 9 inches long, and divided with a septum, and were shut up against the septum. Further, beginning from the broader basis and gradually contracting to the narrow extremity, the broadest part at the base, with the septum closed, was 6 inches; the extremity was 1 inch narrower. The inside of the aperture was lined with a rugose membrane of a black color, like that seen in the nostrils of a horse. The length of the opening of the mouth was 10 feet; the breadth of the opening was 1 foot 2 inches, in which a fish was lying.

* * * * *

The lateral fins situated in the breast were 5 feet long and $1\frac{1}{2}$ feet wide.

* * * * *

The third or dorsal fin consisted of a certain peculiar glandular substance like that of which the mamme are composed in quadrupeds, but firmer and harder; the spine traversed the middle of this, and it was covered with a black skin.

From the foregoing description we are able to extract the following characters:

Body very long and slender.

Head oblong and neither very acute nor very obtuse.

Color black on the back; white on the belly.

The following measurements are stated:

	Feet.	Inches.
Extremity of snout to flukes	46	0
Circumference of body near insertion of pectoral fins	20	0
Breadth of the ridges of the throat		1
From the eye to the pectoral fin	5	0
From the dorsal fin to the flukes	8	6
Girth of the body near the dorsal fin	12	0
From anus to flukes	14	0
From penis to the navel	5	6
From extremity of the lower jaw to the navel	24	6
Breadth of the flukes	9	6
Breadth of lower jaw near the middle	4	6
Length of tongue	5	0
Breadth of tongue near the roots	3	0
Blowhole to extremity of snout	6	8
Length of blowhole		8 (or 9)
Length of mouth	10	0
Breadth of mouth	4	2
Length of pectoral fins	5	0
Breadth of pectoral fins	1	6

We learn from these characters and measurements that the body was "very long and appeared more slender in form by the proportion of the thickness to the length;" that the dorsal fin was placed very far back, according to the measurements even posterior the commencement of the last fourth of the length of the body; that the pectoral fins were quite short, or about as 1 to $9\frac{1}{2}$, compared with the length of the body; that the lower jaw was moderately long, or about as 1 to $4\frac{2}{3}$, compared with the length of the body.

All these characteristics, especially the emaciated form, point very strongly to the common finback, usually called *Balenoptera musculus*.

From *B. rostrata* it is distinguished by size (total length, 46 feet), backward position of the dorsal fin, longer jaws, and many other characters.

From *B. borealis* it is distinguished also by the backward position of the dorsal fin and by the larger pectoral fins.

In some features, especially the position of the dorsal fin, it coincides closely with the blue whale, *B. sibbaldii*, and might be thought to represent a young individual of that species, but the slender form, the decidedly smaller pectoral fins, and somewhat shorter jaw militate against that identification. Furthermore, Sibbald describes another whale, which, as will be seen presently, is much more likely to have been the blue whale, and is quite different from the present one.

In the matter of color there is an apparent deviation from the common finback, since Sibbald describes his specimen as black on the back

and white on the belly, while Collett, Cocks, and others who have had abundant opportunities to study this species, describe it as "grayish slate," or brownish, on the back. Sibbald's specimen, however, had been dead for at least a day when he saw it, and it is well known that in cetaceans of all kinds grays rapidly turn to black after life is extinct.

Taking into consideration all the facts presented, there is apparently little reason for doubt that Sibbald's specimen was an immature common finback. At all events, the description tallies much more closely with that species than any of the other whalebone whales known to frequent European waters. This being granted, it is obvious that Linnaeus's name, *boops*, which is based entirely on Sibbald's description and the later paraphrases of it by other authors, must be regarded as one of the specific appellations of the common finback, and, as such, a synonym of Linnaeus's *physalus*.¹

European authors, beginning with Rudolphi,² have been disposed to regard Linnaeus's species, *boops*, as representing the humpback (*Megaptera*), but it is entirely certain that the name can not be applied to any species of that genus.

3. BALÆNA MUSCULUS.

The last of Linnaeus's species of whalebone whales is *Balæna musculus*. His diagnosis is as follows: "*B. fistula duplici in fronte, marilla inferiore multo latiore.*" ("A whale with a double blowhole in the forehead, and with the lower jaw much the wider.")

His only comments are: "Lives in the Scotch sea" and "provided this is sufficiently distinct from *Mysticetus*; Mus. Ad. Fr., 51, should be compared."

He cites three works, which will be considered in turn. The first is:

"Art. gen. 78" = ARTEDI, *Genera Piscium*, 1738, p. 78.

The diagnosis here given is the same as that of Linnaeus, the latter having copied it verbatim. Artedi also cites "Ray," page 17, and adds the following remarks: "It was cast up on the southern shore of the Firth of Forth in the month of September, 1692. Length, 78 feet. Lower jaw the wider and of a semicircular form. Blowhole pyramidal in form and divided with a septum toward the forehead. For the rest, see Sibbald."

These statements show conclusively that Artedi has taken his information from Sibbald, who, as we shall see presently, described a whale cast up on the shore of the Firth of Forth in this month and year.

¹Sibbald published a figure of his specimen in the *Phalainologia*, pl. I, but as, like other figures on the same work, it is obviously inaccurate, it can not be used in a critical examination of species.

²Abhandl. K. Akad. Wissensch. Berlin, 1829, p. 133, pls. 1-5.

Art "syn. 107" = ARTEDI, *Synonymia Nominum Piscium*, 1738, p. 107.

The whole matter found under this citation is as follows:

4. *Balæna fistula duplici in fronte maxilla inferiore multo latiore.* Art.

Balæna tripinnis, maxillam inferiorem rotundam, & superiorem multo latiore habens Sibbald. Raj. p. 17.

It will be observed that the first diagnosis, or polynominal designation, is the same as in the *Genera Piscium* and in Linnæus's *Systema Naturæ*.

The second is copied verbatim from Ray's *Synopsis Methodica Piscium*, page 17.

"Raj. pisc. 17" = RAY, *Synopsis Methodica Piscium*, 1713, p. 17.

Ray in this place has only the diagnosis just mentioned, and a paragraph of description condensed from Sibbald, beginning, "In September, 1692, this [whale] was cast up on the southern shore of the Firth of Forth, near the ancient fortress of Abercorn," and ending, "For the rest, see the author" [i. e., Sibbald].

From the foregoing it is clear that Linnæus obtained his information as to *musculus* solely from Ray and Artedi, who in turn obtained theirs from Sibbald. The name *musculus* must, therefore, be applied to the species (if it can be identified) which Sibbald saw in 1692 and described in his *Phalainologia*.

The description which occurs on page 78 of the reprint of his work is very long. It may be summarized as follows:

Chapter IV. *Of the whale with three fins, which has the lower jaw round and much broader than the upper.*

In the month of September of this year (1692), on the south shore of the Firth of Forth, near the ancient fortress of Abercorn, was cast up a male whale 78 feet long. * * *

It was believed that its girth exceeded 35 feet. * * *

It was seen to be of that kind which Purchas (Vol. III, where he treats of whales) called *Gibrata*, except that it had horny plates on the palate, that the color of the back was black, and that it had a fin on the back; but the form of the mouth in this whale was peculiar. The lower jaw was much broader and larger than the upper, and of semicircular shape; whence the head appeared obtuse and rounded. * * *

The length of the lower jaw was 13 feet $2\frac{1}{2}$ inches, and the shape of the opening of the mouth approached an equilateral triangle. From the middle of the palate to the opposite part of the lower jaw the distance was 13 feet 2 inches. * * *

The upper jaw was narrower, and toward the extremity contracted and terminated more to a point, and so was received within the circuit of the lower, which, as already said, was broader and larger. * * *

In the upper jaw the whole palate was seen to be covered with black hairs, or rather bristles, which hung above the tongue, with which, at the sides, equally separated, appeared black, horny plates; and in this particular whale the longest were 3 feet; 1 foot broad where they emerged from the gum of the palate, becoming gradually narrower where they touched the tongue, finally terminating in a filamentose point; in the lower part (which was narrower), furnished throughout their whole length with hairs, the color of which was also black. Where the beak was most slender and narrow, these laminae were scarcely half a foot long and scarcely an inch broad. They were arranged in a bundle (*fasciculus*) and contained in a sort of sheath of the same substance with themselves. * * *

The eye in this beast was located not far from the place where the opening of the mouth began; from this (the eye) to the end of the beak the distance was 13 feet 2 inches. Freed from the cartilaginous substance with which it was covered as with an involucre, and from the muscles surrounding the same, the diameter was 5 inches; but the pupil of the eye was $1\frac{1}{2}$ inches in diameter, and in size and color the inside was like the eye of an ox.

No blowhole was present in this beast, but toward the forehead were to be seen two large apertures approaching a pyramid in shape. Their base was toward the forehead, and toward the narrow part of the beak they were gradually contracted very closely. They were divided by a septum, but the turmoil [of the water] which prevailed did not permit of anything further being noted.

The lateral fin was 10 feet long, $2\frac{1}{2}$ feet broad where widest, and was narrowed up toward the extremity, being there but 3 inches broad. From this (the fin) to the opening of the mouth the distance was 6 feet 5 inches.

Besides the two lateral fins there was a third and smaller fin on the back, about 3 feet long and 2 feet high. From the lower part of this fin, that part of the tail where the bifurcation begins, the length was 12 feet 10 inches. * * *

From the lower jaw to the navel the belly was full of folds or ridges, which were 2 inches broad, and the elevated part and excavated part of these were of equal measure.

The penis, which hung from the body not far from the navel, was 5 feet long, where thicker it was 4 feet in girth, and it gradually diminished to a very narrow extremity. It was placed in an oblique position.

At 5 feet below the penis, opposite the dorsal fin, was placed the anus, distant about 12 feet from the bifurcated tail; the margin was 1 foot long. The tail, from that part in which it was divided into two flukes to the upper extremity, was 10 feet long; the distance between the two extremities of this (the flukes) was $18\frac{1}{2}$ feet.

The blubber on the side was as much as $4\frac{1}{2}$ inches thick, and in the head and in the neck where it was thickest did not exceed 1 foot. The skin was one-half inch thick. The belly was whitish in color.

From this description we extract the following measurements of Sibbald's whale:

	Feet.	Inches.
Total length	78	0
Length of lower jaw	13	$2\frac{1}{2}$
From the eye to the end of the beak	13	2
Length of pectoral fin	10	0
Greatest breadth of pectoral fin	2	6
From pectoral fin to angle of mouth	6	5
Height of dorsal fin	2	0
Length of dorsal fin (about)	3	0
From posterior insertion of dorsal fin to bifurcation of flukes	12	10
Breadth of flukes from tip to tip	18	6
Length of longest whalebone	3	0
Breadth of longest whalebone	1	0

We learn from the description and measurements that Sibbald had before him a finback whale 78 feet long, with the dorsal fin very far back, the pectoral fin about one-seventh the total length, the whalebone having a maximum length of 36 inches, and both the plates themselves and the bristles black.

This combination of characters belongs to the blue whale (*Balaenoptera sibbaldii* Gray), the largest of the known European finback whales. The black whalebone with its black bristles is especially characteristic.

Sibbald mentions the color explicitly and in such a manner as to leave no doubt as to the correctness of his observation. No other finback whale of European waters possesses this peculiarity. In the coalfish whale or Rudolphi's rorqual (*Balenoptera borealis* Lesson) the whalebone itself is black, but the bristles are white.

The fact can not be ignored that Sibbald's description contains some discrepancies. Thus, for example, the lower jaw is shown in the measurements to barely exceed one-sixth the total length. In the blue whale, according to Collett,¹ the length is 1 to 4½. There is, indeed, no European finback in which the jaw is as short as is indicated by Sibbald's measurement. The nearest is the little piked whale, *B. rostrata*, but in this species the total length rarely exceeds 30 feet. The whalebone is white and the external coloration peculiar.²

We may now consider for a moment Linnaeus's question,³ whether his *musculus* may not be the same as his *mysticetus*, and his reference to the "Museum Adolphi Friderici Regis" (p. 51). In the latter work he describes a fœtus which is clearly a right whale, and probably the Greenland whale. Indeed, he names it *Balæna grænlandica*. In his diagnosis he states that the lower jaw is much the broader. Now, this is also the principal character of *musculus*, and was derived by Linnaeus through Ray and Artedi from Sibbald's Phalainologia. Had he but read Sibbald's description he would have found that the whale therein characterized had a relatively short mouth and a fin on the back, which his own *Balæna mysticetus* (and probably identical *B. grænlandica*) had not.

CONCLUSIONS.

As a result of this inquiry I am brought to the following conclusions:

1. That the Linnean names can without violence to the evidence be applied to certain of the European species.
2. That the specific name *mysticetus* should be applied to the bowhead or Arctic right whale, as is now the current practice.
3. That the specific name *physalus* should be applied to the common finback, currently denominated *Balenoptera musculus*.
4. That the whale named *Balæna boops* by Linnaeus was an immature specimen of the common finback, and that the Linnean names *physalus* and *boops* are, therefore, synonymous.
5. That the specific name *musculus* relates to the blue whale, currently called *Balenoptera sibbaldii*.

¹Proc. Zool. Soc. London, 1886, p. 265.

²It is true that in Sibbald's figure the jaw is represented as longer, or about as 1 to 4½. While this is nearer the proportion for the blue whale, it can not be denied that Sibbald's figures are in many respects so inaccurate that they can hardly be brought forward as proof in doubtful points.

It is interesting to note that the figure shows the under side of the pectoral fin white, which is characteristic of the blue whale.

³Syst. Nat., 10th ed., 1758, p. 76.

The list of species will, therefore, stand as follows:

1. *Balæna mysticetus* Linnæus.

The bowhead or Arctic right whale.

2. *Balænoptera physalus* (Linnæus).

The common finback or rorqual.

Synonyms:

Balæna physalus Linnæus.

Balæna boops Linnæus. (Young.)

Physalus antiquorum Gray.

Balænoptera musculus auct.

3. *Balænoptera musculus* (Linnæus).

The blue whale.

Synonyms:

Balæna musculus Linnæus.

Balænoptera sibbaldii (Gray).

While three of the European species of whalebone whales are thus believed to be provided with their proper Linnæan names, four others not included in the *Systema Naturæ* are yet to be considered. These are the black whale, or nordcaper; the lesser rorqual, or little piked whale; Rudolphi's rorqual; and the humpback.

The first of these passes currently under the name of *Balæna biscayensis*, but this appellation was not used in print by Eschricht until 1860.¹ Subsequent to 1758 the first Latin name for this whale, accompanied by a description, appears to be *Balæna glacialis*, which occurs in Bonnaterre's *Cetologie*, 1789.² Comparing it with the bowhead, this author remarks: "This species only differs from the preceding by the color and by the dimensions of the body. * * * It lives in the seas of the North, near the coasts of Norway and of Iceland." In a footnote he remarks: "In France it is called *Nord-Caper*, *Baleine de Sarde*; in Germany, *Nordkaper*; in Norway, *Sildqual*, *Lilie-Hual*, *Nordkaper*."

This would seem to be sufficient for purposes of determination, and the name *Balæna glacialis* should hold, unless discarded on the technical ground that *glacialis* is not a suitable name for a whale which does not live in the ice, or because it may cause the species to be confounded with the bowhead, which lives only in the arctic ice. Those who discard the name for these reasons, will probably adopt Kerr's term *islandica* (1792).³

The little piked whale bears currently the name of *Balænoptera rostrata*. The name *Balæna rostrata* is given for the first time with a

¹ *Revue and Mag. de Zool.*, 2d ser., 1860, p. 229.

² *Tableau Encycl. and Méthod. des Trois Regnes de la Nature*, *Cetologie*, 1789, p. 3. The name *Balæna glacialis* occurs earlier (but subsequently to 1758) in Müller's *Zool. Dan. Prodromus*, 1776, p. 7, but it is a *nomen nudum*.

³ Kerr, *Animal Kingdom*, 1792, p. 357. Kerr divides the "Common Whale," *B. mysticetus*, into three subspecies: 1, *B. mysticetus grænlundica*; 2, *B. mysticetus islandica*; and 3, *B. mysticetus major*.

diagnosis by Müller.¹ The diagnosis is merely "*B. rostrata minima rostro longissimo et acutissimo*." This might apply to a toothed whale. It appears to have been taken from Egede, who gives, under the heading of swordfish, a description which seems to relate partly to that fish, partly to the sawfish, and partly to the orca or killer whale.

The figure which he gives does not accord at all with the main part of the description, as Fabricius long ago pointed out; but as far as it resembles any known animal, appears to represent the killer. It is not worthy of serious consideration.²

The figure of Pontoppidan, which is cited by Müller, is that of a toothed whale and probably *Hyperoödon*, while the common names cited "Nebbe-Hval," "Anderne-Fia," "Dogling," etc., refer also to that genus.

Fabricius, in 1780, introduces under the same name, *Balæna rostrata*,³ a whalebone whale, which in all probability is the species under consideration. As the name is preoccupied in Müller's work, however, it can not be used.

We find our species again under another name for the first time in Lacépède's *Histoire Naturelle des Cétacés*.⁴

It is here called *Balenoptera acuto-rostrata*, and it would appear that this name must hold. The description is very full and fairly accurate, and the figure is unmistakable.

[Since the foregoing was written an article by Mr. Oldfield Thomas on the technical names of British mammals has appeared in the *Zoologist* (March, 1898), in which I observe that he accepts *Balenoptera acuto-rostrata* as the proper name for this species.]

The European humpback is currently designated *Megaptera boops*. We have observed, however, that the *Balæna boops* of Linnæus (1758) is not this animal. On the other hand, the *Balæna boops* of Fabricius (1780) is undoubtedly of the present genus, and if the Greenland animal is the same would be applicable; but in any case, as the name is preoccupied, we shall have to search the later literature for a valid cognomen. This would appear to be found in Bonnaterre's *Balæna nodosa*.⁵ This species, however, is founded on Dudley's account of the whales of New England, and if there is a difference between the humpback of the eastern and that of the western Atlantic, this name would belong to the latter rather than the former.

The next name in chronological order is Rudolphi's *Balæna longimana*, published in 1829 (?).⁶ This was based on a specimen thrown up

¹ *Zoologiæ Danicæ Prodomus*, 1776, p. 7.

² Egede, *A Description of Greenland*, 1745, p. 73, pl. 6 (English translation). I have not seen the original work.

³ *Fauna Grœnlandica*, 1780, p. 40.

⁴ Vol. I, An XII (1803-4), p. 197, pl. 8.

⁵ *Cétologie*, 1789, p. 5.

⁶ *Abhandl. K. Akad. Wissensch. Berlin*, 1829 (1832?), pp. 133-144, pls. I-v. See also Brandt and Ratzeburg, *Medizinische Zoologie*, 1829-33, pp. 122-124, pl. 16, figs. 5-8.

at Vogelsand at the mouth of the Elbe in 1824, and the name is thoroughly valid. For the present purposes, therefore, the European humpback will be styled *Megaptera longimana* (Rudolphi).

The generic name *Megaptera* was bestowed by Gray in 1846.¹

The earliest name for Rudolphi's rorqual is *Balæna rostrata*, employed by Rudolphi in 1822.² This was preoccupied by Müller in 1776, as we have already seen. Cuvier described and figured Rudolphi's specimen in his *Recherches sur les Ossements fossiles*, under the name of "Rorqual du Nord." Lesson in 1828 copied the description under the Latin name *Balenoptera borealis*.³

Though Lesson's work is almost entirely a compilation, the name will hold.

The generic name *Balenoptera* originated with Lacépède in 1803-04.⁴

The complete list of European whalebone whales as now recognized will stand as follows:

1. *Balæna mysticetus* Linnæus.

The bowhead, or Arctic right whale.

2. *Balæna glacialis* Bonnaterre.

The black whale, or nordeaper.

3. *Balenoptera physalus* (Linnæus).

The common finback, or rorqual.

4. *Balenoptera musculus* (Linnæus).

The blue whale.

5. *Balenoptera borealis* Lesson.

Rudolphi's rorqual.

6. *Balenoptera acuto-rostrata* Lacépède.

The little piked whale, or least rorqual.

7. *Megaptera longimana* (Rudolphi).⁵

The humpback.

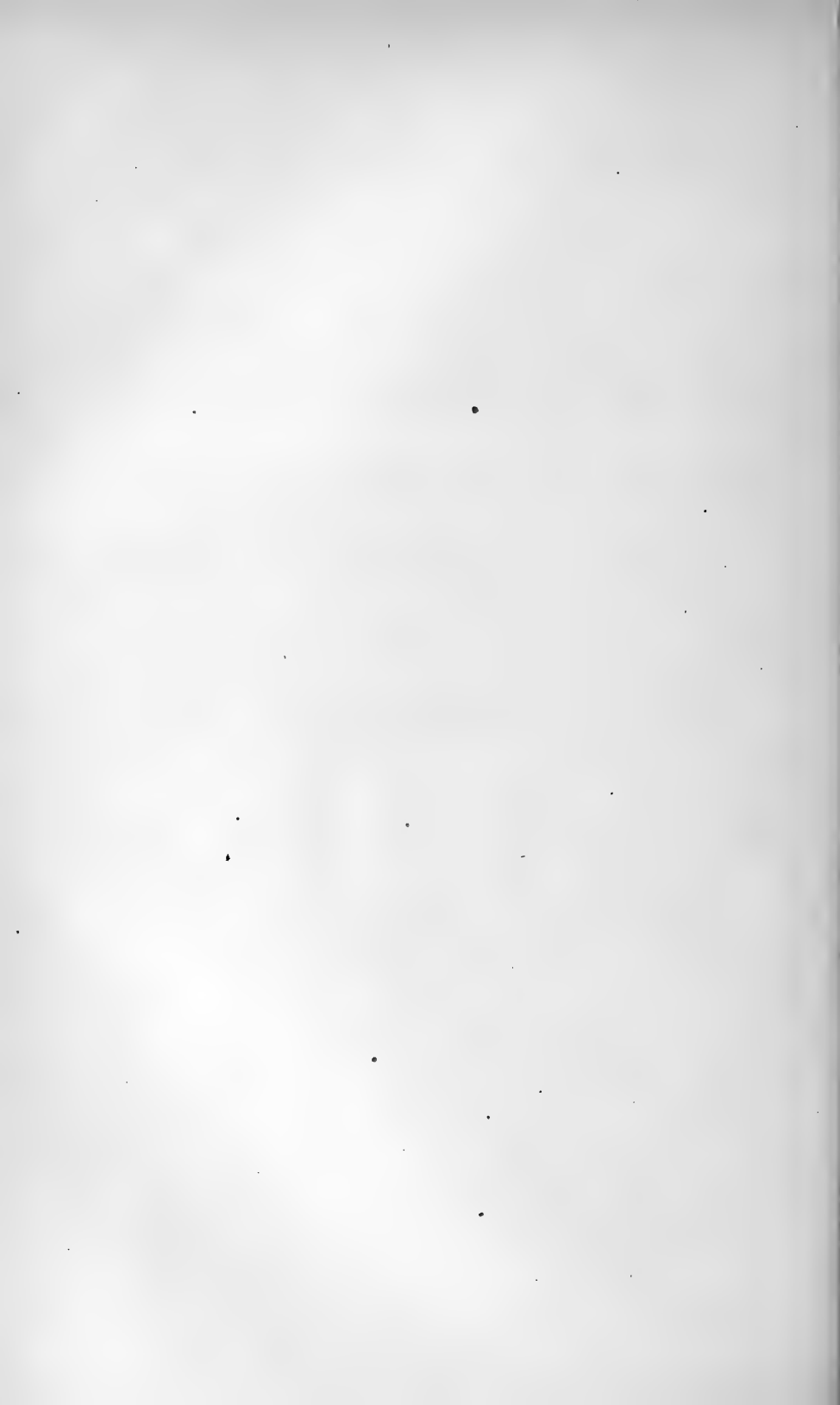
¹ Zoology of the voyage of the *Erebus* and *Terror*, 1846.

² Abhandl. K. Akad. Wissensch. Berlin, 1820-21 (1822), pp. 27-40, pls. 1-5. (*Vide* Allen.)

³ Histoire Naturelle des Mammifères et Oiseaux. Cétacés, 1828, p. 342, pl. 12. The plate is copied from Hunter, and represents *B. acuto-rostrata*.

⁴ Histoire Naturelle des Cétacés, An XII (1803-04), I, p. LIV.

⁵ If the humpback of New England waters is the same species, then *Megaptera nodosa* (Bonnaterre) is the correct name. This can not be taken for granted in the present paper.



A NEW SNAKE FROM THE EOCENE OF ALABAMA.

By F. A. LUCAS,

Curator, Division of Comparative Anatomy.

The name *Pterosphenus schucherti* is proposed for a large snake, indicated by about forty vertebrae from the anterior portion of the body, found associated with remains of *Zeuglodon* in the Eocene of Cocoa, Alabama.

Type.—No. 4047, U.S.N.M.

The most striking feature of the vertebrae, and the one on which the generic name is based, is the prolongation of the metapophysis upward and outward into a wing-like process. This character distinguishes the genus from all others. The species is named in honor of Mr. Charles Schuchert, by whom it was obtained.

The bodies of the vertebrae are slightly shorter than in *Palaeophis* and the spinous processes, as shown by the only perfect example (Plate XLV, figs. 1-3), are very high and their bases coextensive with the neural arch.

The height of the spinous process, however, is but little more than in *Boa* or *Ancistrodon*, although it looks higher from the shortness of the centrum.

Hypapophyses are present or indicated on all the vertebrae. On the foremost, which from its size must be very close to the skull, the hypapophysis, arises as usual from the posterior portion of the vertebra and is directed as usual backward. The next complete hypapophysis, ten or fifteen vertebrae back of the foremost, extends directly downward. All succeeding hypapophyses are directed downward or incline slightly forward, a totally different arrangement from that found in other serpents.

About twenty or twenty-five vertebrae behind the foremost the hypapophyses are doubled in number—one, quite low and pointing forward, arising from the anterior part of the centrum, the second, or principal hypapophysis, being on the posterior part of the centrum. The two processes are connected by a low ridge. The facets for the ribs are pedunculate, as in *Palaeophis*, and, as in that genus, a ridge extends from the anterior zygapophysis to the costal facet.

The sockets are as wide as or in some cases slightly wider than, high. The balls are slightly triangular in outline, although in most cases this is exaggerated by the abrasion of their edges.

The articular faces look more directly backward and forward than they do in modern snakes with which this specimen has been compared, the difference between this species and *Python* being very marked. The zygapophyses agree with those of *Palaeophis* in their slight lateral extent, a feature which gives the body of the vertebra a compact, compressed appearance, and contrasts with the wide-spread facets of *Python*. The facets of the zygosphenes look more or less downward, contrasting very strongly with those facets in *Python* which look obliquely outward, as they do in *Palaeophis*. The facets of the anterior zygapophyses and zygosphenes and those of the posterior zygapophyses and zygantrum lie nearly in parallel planes instead of converging, as in *Python*.

On each side of the zygantrum, just above the facet, is a foramen communicating with a cavity running well up toward the anterior zygapophysis, and this in turn communicates with a cavity at the base of the neural spine and one on each side of the body of the vertebra. (See Plates XLV and XLVI.) This feature exaggerates a character found in *Python*, and other snakes as well, but in *Python* the foramen is minute and the cavities smaller.

This species may be provisionally included in the *Palaeophidae*, although, as we know nothing of the structure of skull of either *Palaeophis* or the present species, the exact relations of both are uncertain.

This species may not have been marine, although found with *Zeuglodon*, for a large Emyd was also found associated with it. It does, however, appear probable that it was aquatic.

The spinous processes are high, as in the semiaquatic *Boa* and *Ancistrodon*, but the force of this is weakened by the fact that in the strictly aquatic *Pelamys* the spinous processes are low. On the other hand, the low point of articulation of the ribs, as in *Pelamys*, and the comparatively high compressed character of the vertebrae generally indicate a correspondingly compressed body, such as would be best adapted for swimming.

From the size of the vertebrae it is evident that the specimen was from 20 to 25 feet in length.

EXPLANATION OF PLATES.

Plate XLV.

Figs. 1-3. Anterior, left lateral, and posterior views of a dorsal vertebra, natural size.

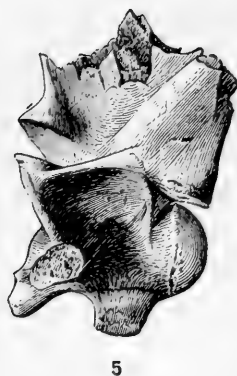
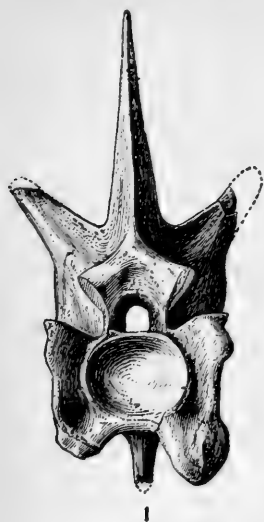
4. Posterior view of a dorsal vertebra, showing the large foramina on either side of the zygantrum, natural size.

5. Left lateral view of a dorsal vertebra, showing the double hypapophysis, natural size.

Drawn by J. C. McConnell.

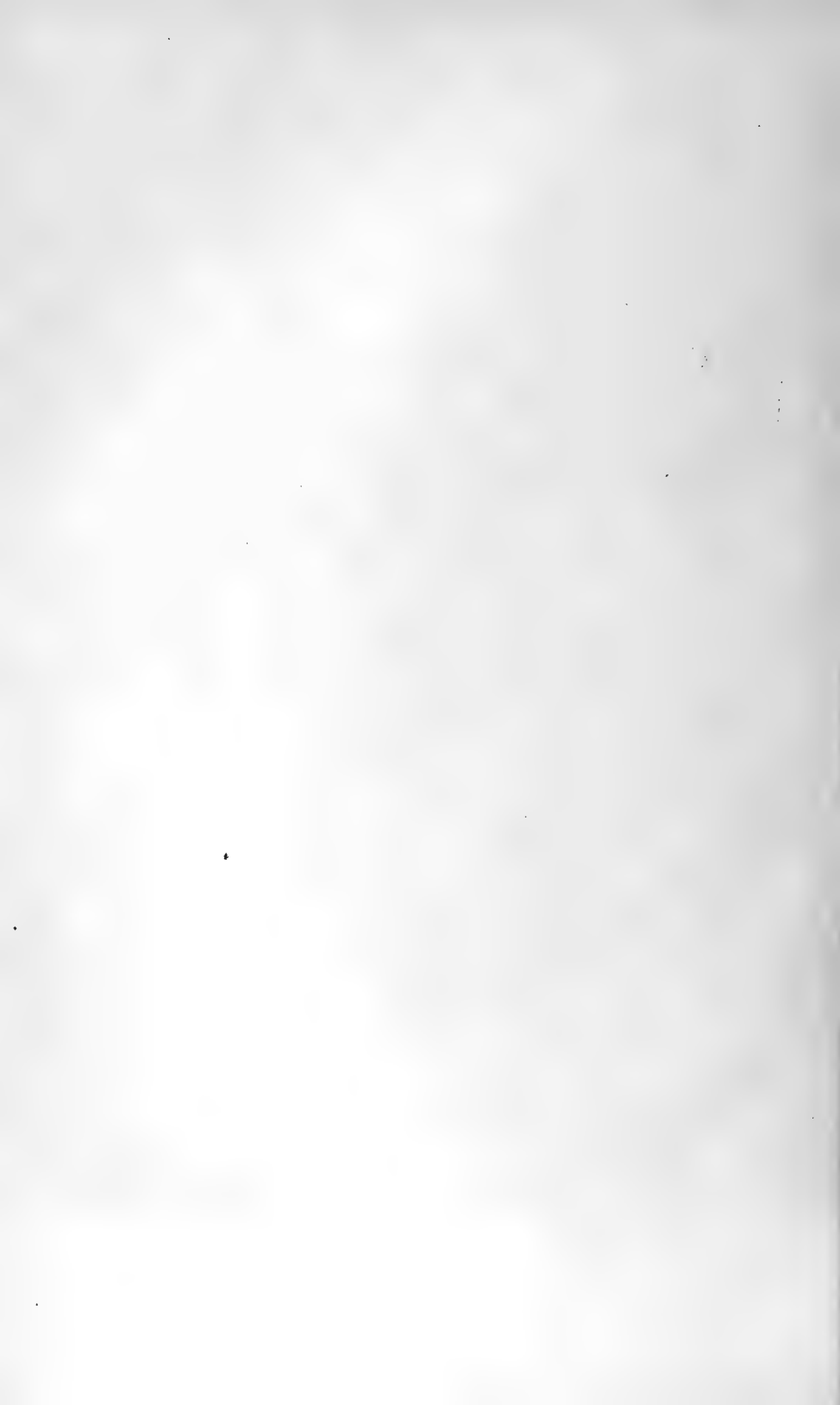
Plate XLVI.

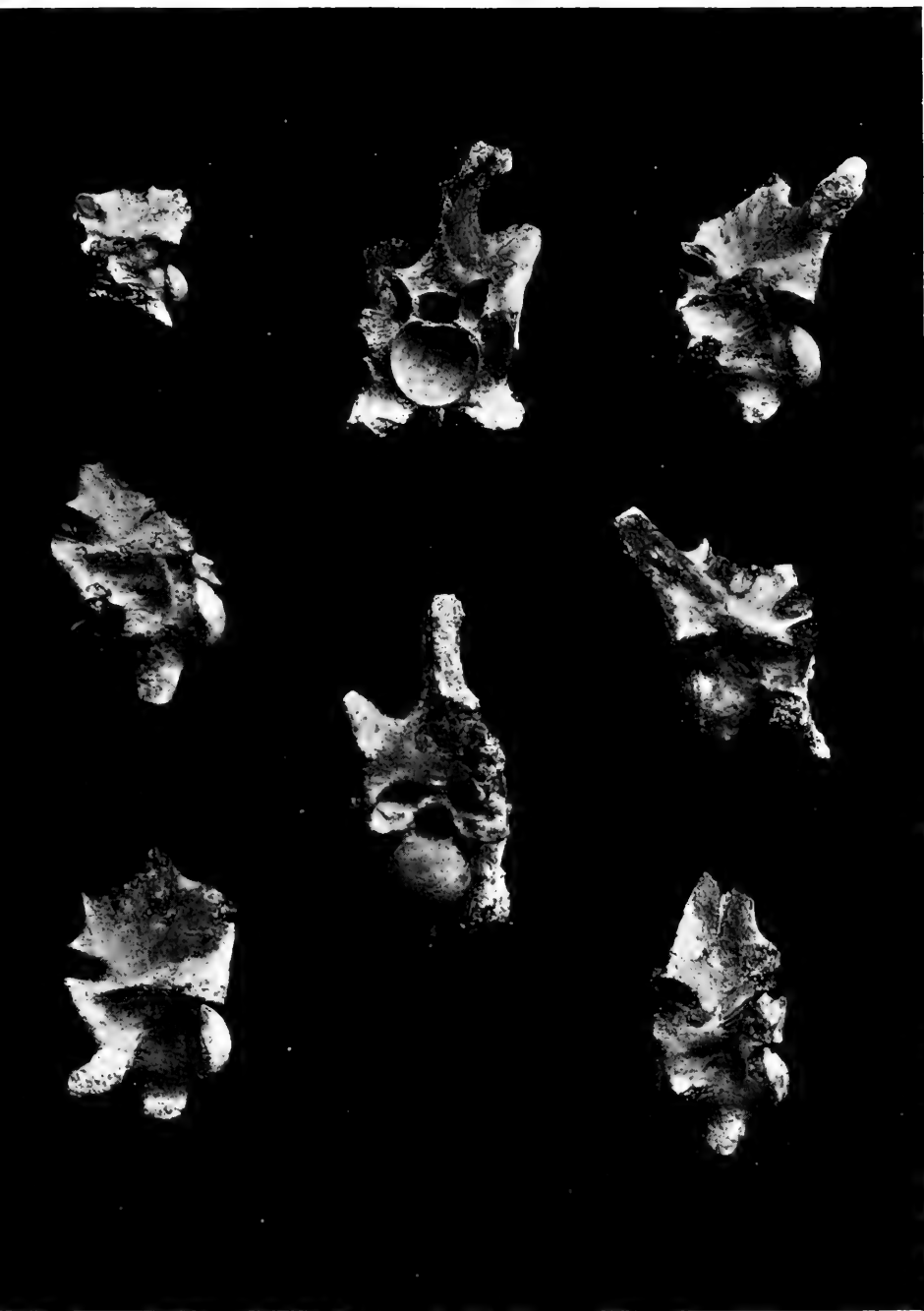
Various views of vertebrae, showing range of size and details of structure, about three-fourths natural size.



VERTEBRÆ OF *PTEROSPHEUS SCHUCHERTI*.

FOR EXPLANATION OF PLATE SEE PAGE 638.





VERTEBRÆ OF *PTEROSPHEUS SCHUCHERTI*.

FOR EXPLANATION OF PLATE SEE PAGE 638.



NOTES ON THE CAPTURE OF RARE FISHES.

By BARTON A. BEAN,
Assistant Curator, Division of Fishes.

Several of the fishes here noticed are, so far as records show, among the rarest forms known to the waters of North America. The berycoid form (*Caulolepis*) is the second example of the genus dredged in the North Atlantic Ocean.¹

The black ruffe (*Centrolophus*) is the second individual recorded from the western Atlantic, and the ragfish (*Acerotus*) is but the second example definitely placed on record.

CAULOLEPIS LONGIDENS Gill.

Caulolepis longidens GILL; Proc. U. S. Nat. Mus., VI, p. 259; Oceanic Ichthyology, p. 185, pl. LV, fig. 204.

The example here recorded is No. 38201 of the U. S. National Museum register. It was obtained at station 2724 by the steamer *Albatross*, being in north latitude $36^{\circ} 47'$ and west longitude $73^{\circ} 25'$, October 23, 1886. The depth of the water at this station was 1,641 fathoms.

Length of specimen, $6\frac{1}{4}$ inches; depth, $2\frac{1}{2}$ inches. Length of head, $1\frac{7}{8}$ inches. The diameter of the orbit is one-fifth length of head. D. 18; A. 8.

This second individual, though considerably larger than the type, exhibits no striking differences in structure. It is slightly longer in comparison with the depth, and is in a better state of preservation.

CENTROLOPHUS NIGER (Gmelin).

BLACK RUFFE.

Although more or less common to the deep water of the coasts of southern Europe, this is only the second example recorded from our side of the Atlantic, the first being a 9-inch individual taken at Dennis, Massachusetts, in 1888, and noticed by Goode and Bean.²

Total length, $12\frac{3}{4}$ inches. Taken in an offshore fish trap at North Truro, Massachusetts, September 6, 1890. Preserved by Mr. Gerrit S. Miller, jr., and presented by him to the U. S. National Museum, September 8, 1898, being part of accession No. 33974.

¹ A third example of this fish has been obtained in the Pacific Ocean.

² Oceanic Ichthyology, p. 214, pl. LXI, fig. 222.

ACROTUS WILLOUGHBYI Bean.

In March, 1898, Mr. J. O. Cates, of Port Townsend, Washington, telegraphed the Smithsonian Institution of the discovery upon the beach of a strange fish, which he thought was an *Acrotus*. In answer to a telegram from the U. S. National Museum Mr. Cates forwarded the fish in ice, through the Seattle Fish Company. The specimen reached here in fair condition and the writer obtained the following measurements and notes:

Length to end of middle caudal rays	feet..	5
Greatest height of body.....	inches..	15
Length of head	do.....	8
Width of interorbital area.....	do.....	3
Diameter of orbit (measurement doubtful).....	do.....	1½
Dorsal from snout (origin doubtful).....	do.....	18
Dorsal base, length of	do.....	29
Dorsal, greatest height (longest rays).....	do.....	1¾
Anal, origin from snout.....	do.....	25
Anal, length of base.....	do.....	21
Anal, length of longest rays.....	do.....	1¾
Caudal, length of middle rays	do.....	4½
Caudal, length of lower external rays.....	do.....	10
Caudal, length of upper external rays	do.....	9
Pectoral base from snout	do.....	9
Pectoral, length of	do.....	7½
Pectoral, width of base of	do.....	2½
Caudal peduncle, length of	do.....	6½
Caudal peduncle tapering from 3¾ to 3¼ inches in height.		

D. 38 or 40; A. 34 or 35; P. 21; C. 36; B. 6. Gills 4, with an opening behind the fourth; gill-rakers seven to ten. The eye is contained seven times in the length of the head.

The dorsal and anal fins end opposite each other; the last ray of the dorsal is contained two and a half times in the longest rays (middle of fin); the last ray of the anal about two times in the longest rays. Lower lobe of caudal longer than the upper.

Color.—Uniform chocolate brown, with purplish cast; pinkish where skin had been rubbed off; fins darker.

From a plaster mold prepared by Mr. William Palmer a very good cast was obtained. The fish has been preserved in alcohol. No. 48872, U.S.N.M.

First described by Dr. T. H. Bean.¹ Made the type of a distinct family by Dr. Theodore Gill.²

¹ Proc. U. S. Nat. Mus., 1887, p. 631.

² Oceanic Ichthyology, p. 217, fig. 225.

THE FEATHER-TRACTS OF NORTH AMERICAN GROUSE AND QUAIL.

By HUBERT LYMAN CLARK, Ph. D.,

Instructor in Zoology, Amherst College.

Some years ago the examination of some of our Eastern game birds aroused my interest in the pterylography of the Gallinæ, and I determined to study the pteryloses of as many of the birds of that group as could be procured, my hope being to examine specimens of every North American species. Accordingly, in the autumn of 1892, a systematic effort to obtain the desired material in the form of fresh or alcoholic birds was begun. It seemed best not to use skins under any circumstances for the main features of the pterylosis, on account of the distortion unavoidable in their preparation. Owing to the rarity of some species and the difficulty of obtaining others, it proved impossible to carry out the original plan, and the examination of all the North American genera has been substituted for it. That a certain measure of success has been possible, is due to the great courtesy and kindness which has been shown by those to whom application for assistance in procuring birds was made. Every person to whom I have written for birds has gone to no little trouble to accommodate me, and in some cases my indebtedness to these friends is greater than can be repaid, and this is the more remarkable, since in nearly every instance my correspondent and I were complete strangers to each other. Under each genus I have credited the material to the persons from whom it was received, and to all of them I herewith extend my hearty thanks. But there are a few to whom I am under peculiar obligations, and to them more especial thanks are due. To Dr. Mortimer Jesurun, of Douglas, Wyoming, I owe not only some of my best material but the most unusual courtesy in details connected with collecting and shipping the birds; to Mr. Frederic A. Lucas and Dr. R. W. Shufeldt, of Washington, I am indebted for important suggestions; to Mr. R. Ridgway and Dr. C. W. Richmond, of the United States National Museum, for many favors connected with the collections of North American Gallinæ; to Dr. J. A. Allen, of New York City, for assistance in synonymy and identification; to Mr. G. W. Mackay, of Boston, Massachusetts, for his efforts to pro-

cure me specimens of *Tympanuchus cupido*; and to Mr. Thomas J. Egan, of Halifax, Nova Scotia, for some interesting notes on ptarmigans and a great deal of useful material. Thanks to the exceptional opportunities thus afforded me, I have had the privilege of examining in the flesh 65 specimens, representing 18 species and all the North American genera. The species I have failed to secure are *Colinus ridgwayi*, *Lagopus leucurus*, *Tympanuchus cupido*, and *Tympanuchus pallidicinctus*. The result of the study of this material has not been in any way extraordinary, but I believe it throws some light on the relationship of the genera, and as the knowledge of pterylography becomes more complete, the facts herein recorded may prove of real value in the classification of the group.

So far as I can ascertain, the only observations which have ever been recorded on the pterylography of the North American Gallinæ are contained in the "System der Pterylographie" of Nitzsch; these relate to only five species and will be considered when I take up the genera to which they belong. So far as the general pterylosis of the group goes, his figures and descriptions do very well, but they are hardly detailed enough to answer the purposes of modern comparative work, while a few of his observations are probably mistakes due to using dried skins as the basis of his work. His preliminary observations on the uniformity of the Gallinine type of pterylosis are only true, as we shall see, of the Alecteropodes, and even among them the Phasianidæ show no little diversity.

The pterylography of our Gallinæ is, however, remarkably uniform, and the generic differences in the fundamental plan are, as a rule, of slight importance. The whole head is uniformly feathered, except for apteria near the eyes and ears. The upper cervical tract is of medium width, but the feathers become larger and fewer as we pass backward, until between the shoulders this tendency reaches its maximum, and here the tract may become more or less forked and often slightly separated from the dorsal tract. The latter is broadest just at the end of the shoulder blades, and from there gradually narrows to the oil gland. The degree of union between the anterior end of the dorsal and the posterior end of the upper cervical tract varies in all the genera and even to a slight extent in individuals. The humeral tracts are always strong and broad, and the parapterum is usually well defined. The femoral tracts are also large and clearly defined, and are one of the most characteristic features of the pterylosis. The feathering of the feet varies markedly in the different genera. The lower cervical tract is usually rather narrow and forks at a variable distance above the furcula. The sternal tracts are very strong and well defined, and are usually connected with the hypoptera by hook-shaped tracts on the sides. The ventral tract is united at the anus, but at a variable distance in front of that point is forked and runs up the breast on either side of the keel of the sternum and may even be more or less united anteriorly with the sternal tracts. Behind the anus is a pteryla formed by the

under coverts, which may be called the post-anal tract. In addition to these major pterylæ there are often minor ones, such as those formed by the crests on the head or the ruffs on the neck. Aftershafts are always present, and are usually large and downy. True down feathers occur sometimes on the neck and wings, while half-down occurs everywhere bordering on the tracts, especially on the fore part of the breast and on the back between the shoulders. Filoplumes are generally long and numerous among the contour feathers. The oil gland is always tufted. The rectrices, of which the middle pair are always longest, the outer ones shortest, vary in number from 12 to 22, but the latter number is very unusual. The wing, always quincubital, is very fully feathered, especially on the upper surface, but there is a large apterium along the humerus near its base, in front of the parapterium. There are usually three rows of major superior secondary coverts and two or three of inferior, while the primary coverts are usually in two rows on both surfaces. The primaries are always 10 in number, the secondaries vary between 13 and 21, and the alula contains 4 or 5 feathers.

One of the most remarkable things about the pterylography of the group is the indifferent specialization of the remiges and, in some species, of the rectrices also. In most birds it is as easy to determine precisely the number of secondaries as of primaries, or perhaps easier; but in the Gallinæ it is not a simple matter to decide where the secondaries end and the coverts begin (on the elbow), so complete is the intergradation. In *Lagopus*, moreover, the middle tail feathers are so strikingly like coverts that one can hardly feel perfectly sure that they are rectrices. The reverse is true to a somewhat less extent in *Centrocerus*, where the middle pair of coverts are much like rectrices. Nitzsch speaks of the eleventh remex as always being very small, but I did not find it notably so in most of our American species.

The above observations will not apply, except in a few particulars, to *Ortalis*, which, as has already been said, differs considerably from the Galline type. Having considered the general characters of that type of pterylosis, we will now pass on to a survey of the genera in detail, beginning with the quails.

ODONTOPHORINÆ.

The quails form a very natural subdivision of the Gallinæ, characterized by several pterylographical features of more or less importance. The dorsal tract is apparently continuous with the upper cervical tract, and as the latter does not seem to be forked there is no dorsal apterium. The lower cervical tract forks very far up on the throat, and on the side there seems to be scarcely a trace of the hook connecting the sternal tract with the hypopterium, which is so evident in some of the grouse. The rectrices are remarkably constant in number, usually only 12 and never more than 14, nor are there more than 16 secondaries. In addition to the 4 feathers of the alula, there is usually present on the thumb

a well-developed claw, which is quite characteristic of the quails, being found in all except *Cyrtonyx*, and reaching its maximum in *Oreortyx*. It consists of a horny sheath covering the terminal phalanx of the pol-

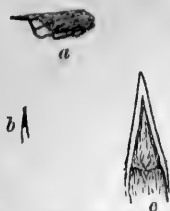


FIG. 1.—CLAW ON THE THUMB, *OREORTYX*. *a*, THUMB, NATURAL SIZE; *b*, CLAW, NATURAL SIZE; *c*, CLAW, X4.

lex, which is here free from the skin. - Its structure will be clearly seen from the accompanying figures. The ten primaries usually rank about as follows, counting from the wrist joint out: 7, 6, 5, 8, 4, 9, 3, 10, 2, 1. That is, the *fifth* is usually longer than the *eighth*, and always longer than the *ninth*; and the *fourth* is much longer than the *tenth*, which is shorter than the *third*. The feet are never feathered at all, the cervical tract always ending at the tibio-tarsal joint. There are no peculiar tracts or apteria on the

sides of the neck, and the head is fully feathered, without apteria over the eyes, and often with special feathers or a crest on the crown, but the nasal fossae are bare. Of the seven quails indigenous to North America I have examined all except the masked bobwhite. They fall very naturally into *five* genera, characterized thus:

ANALYTICAL KEY TO GENERA.

- I. Rectrices 12. Secondaries 14. Head without any crest or peculiar feathers. *Colinus*.
- II. Rectrices 12. Secondaries 15. Head with erect crest of *six*, rarely seven feathers, forming a clearly defined tract in the pteryla of the crown *Lophortyx*.
- III. Rectrices 14. Secondaries 14. Head loosely crested with more than ten long feathers which are not erect and form only an indefinite tract in the pteryla of the crown *Callipepla*.
- IV. Rectrices 12. Secondaries 16. Head with a crest of two very long feathers, extending backward and not erect, forming a characteristic tract in the pteryla of the crown. *Oreortyx*.
- V. Rectrices 12. • Secondaries 14. Head with most of the occipital feathers long and soft, forming a very heavy, short, but not erect crest, not forming a distinct tract in the pteryla of the crown. *Cyrtonyx*.

COLINUS.

(Plate XLVII.)

Material examined: Five specimens of *C. virginianus*. The large series of skins in the U. S. National Museum of *C. virginianus*, *C. v. texanus*, *C. v. floridanus*, *C. graysoni*, and *C. ridgwayi* were examined in respect to the number of rectrices and the presence of a claw on the thumb.

The pterylosis of this genus is typical of the quails and shows very plainly the characteristics already mentioned. Although there is no dorsal apterium, the feathers between the shoulders are fewer and much weaker than farther back or on the neck. There are 14 (sometimes 15) secondaries. The claw on the thumb is well developed. The rectrices are always 12. Nitzsch credits the bobwhite with only 12 or 13 secondaries, but he probably did not have fresh material and it would be almost impossible to determine the number correctly from a skin.

LOPHORTYX.

Material examined: Five specimens of *L. californica* and three of *L. gambeli*, kindly furnished me by Mr. Frederic Hall Fowler, then of Fort Bowie, Arizona, Mr. F. Stephens, Witch Creek, California, and Mr. F. A. Ward of Rochester, New York. The large series of skins in the U. S. National Museum, consisting of fifteen skins of *L. gambeli*, twenty-five of *L. californica*, and *L. c. ralloicola*, and eight of *L. elegans bensoni*, were examined in respect to the number of rectrices and the claw on the thumb and the number of feathers in the crest.

The pterylosis of this genus is in general like that of *Colinus*, but in some specimens there is a trace of a small dorsal apterium, and the ventral tract is somewhat wider before it forks. There is, furthermore, a distinct tract on the crown made by the large feathers of the crest, as shown in fig. 2. This tract consists of six or seven feathers and is somewhat triangular in outline. The number of feathers seems to be very constant, without regard to age or sex; *L. gambeli* and *L. californica* always have six, and *L. elegans* seven. There are 15 (sometimes 16) secondaries. The claw on the thumb is well developed. The number of rectrices is constantly 12, but in two skins of *L. californica* (both females) there were only 10, and in two other females of the same species there were 14. It would be interesting to have a series of several hundred birds examined, and find out how rare these exceptions are.



FIG. 2.—PTERYLOSIS OF THE CROWN. LOPHORTYX.

CALLIPEPLA.

Material examined: Two specimens of *C. squamata*, sent me by Mr. F. H. Fowler, Fort Bowie, Arizona. Twelve skins of *C. squamata* and seven of *C. s. castaneogastris*, in the U. S. National Museum, were examined in respect to crest, rectrices and claw on thumb.

General pterylosis similar to *Colinus*, but the feather-pits between the eyes are somewhat larger and more numerous than elsewhere on the crown. There is, however, no special tract made by the feathers of the crest, which are always more numerous and softer than in the crest of *Lophortyx*. There are only 14 secondaries. The claw on the thumb is present. There are always 14 rectrices.

OREORTYX.

Material examined: Two specimens of *O. pictus*, for which I am indebted to Mr. C. W. Swallow, Willsburg, Oregon. The series of skins in the U. S. National Museum were examined in respect to the feathers in the crest, the rectrices, and the claw on thumb.

General pterylosis similar to *Colinus*, but showing a little tendency toward that of the grouse. The feathers of the posterior part of the upper cervical tract are large and few, so that the continuity between the dorsal and cervical tracts is somewhat interrupted. On the crown

between the eyes is a narrow apterium, in which are placed the *two* feathers of the crest, one behind the other, as shown in fig. 3. The arrangement of the primaries differs from the other quail and approaches *Bonasa*; the *fifth* primary is much longer than the *ninth*, which is a little longer than the *fourth*, while the *tenth* is much shorter than the latter but longer than the *third*. There are 16 secondaries. The claw on the thumb is very well developed. The rectrices are always 12.

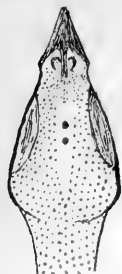


FIG. 3.—PTERYLOSIS
OF THE CROWN.
OREORTYX.

CYRTONYX.

Material examined: One specimen, a beautiful male, kindly sent me by Mr. R. D. Lusk, Fort Huachuca, Arizona. A few skins in the U. S. National Museum were also examined in respect to rectrices and claw on thumb. It was only after five years of effort that I succeeded in getting a specimen of this genus, which has proved much the hardest to obtain of any of our American Gallinae. I am therefore under special obligation to Mr. Lusk.

The dorsal pterylosis is not noticeably different from *Colinus*, but on the ventral surface this genus resembles Nitzsch's figure of *Gallus*. That is, the ventral tract runs up on the breast so far as to connect with the anterior part of the sternal tract by two rows of feathers on each side. The pterylosis of the head is like that of *Colinus*, there being no special tract on the crown. There are 14 secondaries, of which the first is only about two-thirds the length of the second. The claw on the thumb seems to be wanting. The middle pair of the 12 short rectrices is much longer than the outer, but the entire tail is pretty well concealed by the coverts. The tuft on the oil gland is small and of few feathers.

TETRAONINÆ.

The grouse of North America form as clearly defined a group as the quails, although they show more generic variation in the pterylosis. In spite of these variations the distribution of the tracts is very constant and may be easily recognized as distinctive. Although strictly gallinine it differs slightly from that of the quails on the one hand and the turkey on the other, but is nearer the latter. The dorsal tract is usually more or less disconnected from the upper cervical, and as the latter is generally forked the central dorsal apterium, as we may call it, appears. As a rule the lower cervical tract remains single until near the furcula, and the ventral tracts run up so far on the breast as to almost unite with the sternals at that point, so that in an adult grouse there is very little of the ventral surface, which is entirely free from contour feathers, except along the median line. The *pteryle crurales*, or more properly, perhaps, the *pteryle pedales*, vary a great deal from the half-bare shank of *Bonasa* to the completely feathered toes of *Lagopus*. There are no peculiar tracts on the crown due to crests, but there is almost always a large apterium over each eye, and on the

sides of the neck there are usually peculiar tracts or spaces which make good generic characters. The number of rectrices is very variable, some genera having a perfectly constant number, while others are very irregular. Usually there are 16 or 18, but often there are 20, and sometimes 22. In the wing the number of primaries (10) and alula feathers (4) is as in the quails, but there is no claw on the thumb. The secondaries, never less than 16, may be as many as 21. The proportion of the primaries differs from that of the quails, though the exact arrangement is not constant. The wing is pointed by the *sixth*, *seventh*, and *eighth* primaries, which are about the same length; the *fifth* is much shorter than the *eighth* and about equal to the *ninth*; the *fourth* about equals the *tenth*, which is generally much longer than the *third*. Of the 13 species of grouse native in this country I have examined 10. They fall naturally into seven genera, characterized pterylographically in the following key:

ANALYTICAL KEY TO GENERA.

- I. Sides of neck without peculiar tracts or extraordinary apteria.
 1. Feet feathered only to base of toes in front. Dorsal apterium small. Femoral tracts proportionately large. Secondaries usually 18. Number of rectrices very inconstant, 16-22..... *Dendragapus*.
 2. Feet feathered only to base of toes in front. Dorsal apterium long. Femoral tracts proportionately small. Secondaries usually 17. Number of rectrices 16..... *Canace*.
 3. Feet feathered almost to claws in front. Dorsal apterium long. Femoral tracts proportionately small. Secondaries 18 or 19. Number of rectrices 16..... *Lagopus*.
- II. Sides of neck with special tracts or extraordinary apteria.
 4. Feet only feathered a very little way down on the tarsus in front. Special neck tracts on the lateral branches of the *lower* cervical tract. Rectrices 18..... *Bonasa*.
 5. Feet feathered to base of toes. Special neck tracts on sides of *upper* cervical tract. Rectrices 18..... *Tympanuchus*.
 6. Feet feathered to base of toes. No special tracts on neck, but a special apterium on each side. Rectrices 18, of which the middle pair are much the longest..... *Pediocetes*.
 7. Feet feathered to base of toes. Lateral neck spaces almost wanting and replaced on each side by a large elliptical apterium, forming the air sac. Rectrices 16-20..... *Centrocercus*.

DENDRAGAPUS.

(Plate XLVIII.)

Material examined: Six specimens of *D. obscurus*, four from Eadsville, Wyoming, the gift of Dr. Jesurun, and two from Prof. G. S. Thompson, Boulder, Colorado, and one of *D. o. fuliginosus* from British Columbia from Mr. John Fannin. In addition, fourteen skins of *D. obscurus*, twenty of *D. o. fuliginosus*, and nine of *D. o. richardsoni*, chiefly from the U. S. National Museum, have been examined in regard to the number of rectrices.

The general pterylosis of this genus is so clearly shown in the plate that no further explanation is needed. The secondaries seem to be uni-

formly 18. In the number of rectrices we find the most remarkable diversity, as is shown by the following table:

Number of rectrices in Dendragapus.

D. obscurus.	D. o. fuliginosus.	D. o. richardsoni.
2 specimens have 16. 1 specimen has 17. 14 specimens have 18. 3 specimens have 20. 70 per cent have 18. The average number is 18.	1 specimen has 14. 2 specimens have 16. 6 specimens have 17. 12 specimens have 18. 57 per cent have 18. The average number is 17.3.	1 specimen has 19. 6 specimens have 20. 1 specimen has 21. 1 specimen has 22. None have 18. The average number is 20.2.

It is unfortunate that a larger number of specimens was not available for comparison, but it seems clear that *fuliginosus* and *richardsoni* represent opposite extremes in the variation in the number of rectrices. Not having had any specimens of *richardsoni* in the flesh, I can not say whether a similar extreme is shown in other characters or not. If 18 was the number of rectrices characteristic of the ancestor of the tree grouse, then *fuliginosus* shows a tendency to follow *canace* in the loss of a pair, while *richardsoni* has already acquired an additional pair. Further investigation into this question will doubtless prove of interest.

CANACE.

Material examined: Three specimens of *C. canadensis* from Mr. Egan, of Halifax, and one of *C. franklini* from Mr. Fannin, of Victoria, British Columbia. Sixteen skins, chiefly from the U. S. National Museum, have been examined regarding the number of rectrices.

General pterylosis differs from that of *Dendragapus* in having a longer dorsal apterium, femoral tracts much smaller in proportion to the size of the bird, and the ventral tracts more distinctly separated from the sternals. The secondaries are 17 in number. The number of rectrices is uniformly 16, the only exception being one specimen with only 14. I am inclined to think that in this case the loss of one pair was due to an accident. *Canace* approaches *Lagopus* in most respects, and appears to be a sort of connecting link between that genus and *Dendragapus*.

LAGOPUS.

Material examined: Four specimens of *L. lagopus* from Mr. Egan, Halifax, Nova Scotia, and two from Mr. William Clark, Winnipeg, Manitoba; three of *L. rupestris* from Mr. Egan, and two of *L. welchii* from Mr. Egan. The latter were identified for me by Dr. J. A. Allen. All of the specimens Mr. Egan sent me were collected in Newfoundland.

The dorsal apterium is longer than in *Dendragapus*, the femoral tract much smaller proportionately, and the ventral tracts are not so obviously connected with the sternal. The feet are feathered almost to the claws in front, but the tarsus is bare behind. The apterium over the eye was very small or wanting in *welchii*. No other specific differences were observed and there was little individual variation. The secondaries are 18 or 19 in number and the rectrices are 16, though the middle pair

are not easily distinguishable from the long coverts. In general, *Lagopus* approaches quite closely to *Canace*. Nitzsch credits *Lagopus* with 18 rectrices, but he must have mistaken the middle pair of coverts for tail feathers. Coues considers the tail made up "normally of 14" feathers, but adds that the middle pair of coverts are usually reckoned as rectrices. I am confident, however, that this extra pair are not coverts, but true rectrices.

BONASA.

Material examined: Four specimens of our eastern *B. umbellus* and one of *B. u. togata*, the gift of Mr William Clark, of Winnipeg, Manitoba.

In its general pterylosis this genus differs from *Dendragapus* in having the dorsal apterium somewhat larger, and the lower cervical tract forks very much farther up on the throat. The branches of the latter bear the "ruffs," which form a peculiar tract on each side. There is a small apterium on each side at the base of the upper mandible, in front of and below the eye. The feet are only feathered down a short distance in front. The rectrices are always 18 and the secondaries 15 or 16, somewhat fewer than in other grouse. Nitzsch's observations agree entirely with mine.

TYMPANUCHUS.

Material examined: Two fine specimens of *T. americanus*, for which I am indebted to Mr. Carl F. Hemming, of Boone, Iowa.

The general pterylosis is almost precisely like *Dendragapus*, but the dorsal apterium is smaller and the upper cervical tract is very narrow.

The latter bears on each side a conspicuous tuft of about a dozen large feathers, which form a very evident and characteristic tract, underneath which is a large and peculiar apterium. The apteria over the eyes are small. The feet are feathered to the base of the toes. The hook-shaped tract on the side is quite conspicuous. The tail consists of 18 feathers and there are 18 secondaries, as recorded by Nitzsch for *T. cupido*.

PEDIOCÆTES

Material examined: Four specimens of *P. phasianellus columbianus*.

General pterylosis seems to approach that of *Bonasa*, but there are no special tracts on the sides of the neck and the feet are feathered clear down on the toes in front. The tracts on the sides under the

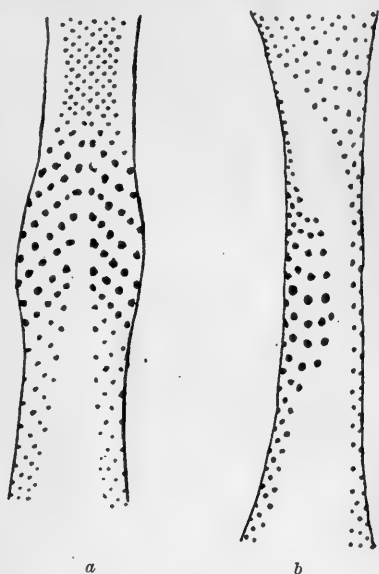


FIG. 4.—SPECIAL NECK TRACTS OF BONASA.
a, SEEN FROM BELOW. b, SEEN FROM THE
SIDE.

wings are conspicuous. The apteria on back and belly are inconspicuous, but those over the eyes are evident. There are 18 secondaries and 18 rectrices.

CENTROCERCUS.

Material examined: One full-plumaged male, two females, and three young birds of *C. urophasianus*, for which I am very deeply indebted to Dr. Mortimer Jesurun, of Douglas, Wyoming. Seven skins in the U. S. National Museum were also examined regarding the number of rectrices.

The pterylosis is quite distinctive, though the dorsal and ventral tracts are much like *Dendragapus*. There are no lateral neck spaces, but the whole neck is thickly feathered, and the sternal, cervical, and humeral tracts are all united on the shoulder. On each side of the neck is a large sharply defined apterium of orange-colored skin, somewhat oval in outline. Between and beneath these the skin is thick and spongy and very densely feathered, especially in the male. There is a rather large apterium over each eye. All of the tracts are very broad and their limits are not easily determined, so that in some specimens the dorsal and femoral tracts seem almost united and the dorsal apterium is very small. The feet are feathered to the toes in front. The secondaries are unusually numerous, 21 in all the specimens. The rectrices vary considerably in number; of 13 individuals examined one has 16, eight have 18, and four have 20, and this diversity is not connected with age or sex.

MELEAGRIDIDÆ.

Since this family is represented by only a single genus, comments on the latter will apply equally well to the former.

MELEAGRIS.

Material examined: One adult male and two females of *M. gallopara*.

General pterylosis has been well figured by Nitzsch. It resembles that of *Dendragapus*, but there is no separation of the upper cervical from the dorsal tract, and the spinal apterium is long and narrow; the ventral tract is not united at the end of the breastbone, but remains divided almost to the anus; and lastly, the head and upper part of the neck being bare, the two branches of the lower cervical tract are nowhere united into one. Half-down is abundant, obscuring the boundaries of the tracts. The wing is pointed by the *sixth* and *fifth* primaries, the *seventh* about as long, the *fourth* a little shorter and nearly equalled by the *eighth* and *third*, while the *ninth* and *second* are somewhat shorter still. There are 18 rectrices and only 18 secondaries, but the alula contains 5 feathers. The feet are feathered only to the tarsal joint. In the male, a special pteryla is formed on the lower part of the throat by a peculiar tuft of long bristles, but there is nothing corresponding to it in the females. My observations accord with those of Nitzsch, except that I found 5 feathers in the alula instead of 4, and the femoral tracts are proportionately broader than in his figure.

CRACIDÆ.

This family is also represented in the United States by a single genus.

ORTALIS.

(Plate XLIX.)

Material examined: Five specimens from Brownsville, Texas, kindly furnished by Mr. Frank B. Armstrong.

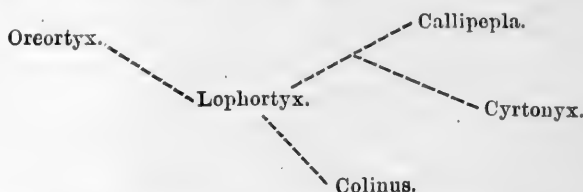
The general pterylosis differs considerably from that of the grouse or quail, and these peculiarities will be seen on examination of the plate. There are large apteria on the cheeks and chin, and the lateral neck spaces are very short. The sternals are long and narrow, while the ventral tract forms a long, slender, hollow triangle, with the apex forward and the base in front of the anus. The femoral tracts are entirely fused with the posterior part of the dorsal, and the latter is not separated from the upper cervical. On the wing there are only two rows of major secondary coverts, but the other coverts are numerous and rather irregularly scattered. The alula consists of five feathers and there is a prominent claw on the thumb. There are no down feathers, the aftershafts are small, the filoplumes short, and the tuft on the oil gland is very small. The legs are feathered down just over the tarsal joint in front. Rectrices 12, long, the middle pair longest. Secondaries 15. Primaries 10, but the outer ones are very short, giving a formula very different from our other Gallinæ, 23456, 1, 7, 8, 9, 10. In most of these particulars *Ortalis* agrees with the genera, *Crax* and *Penelope* as described by Nitzsch, but there seem to be some important differences, particularly in the ventral tract. The lower part of the main shaft of the contour feathers is enlarged and flattened as Nitzsch describes in *Crax*.

CONCLUSIONS.

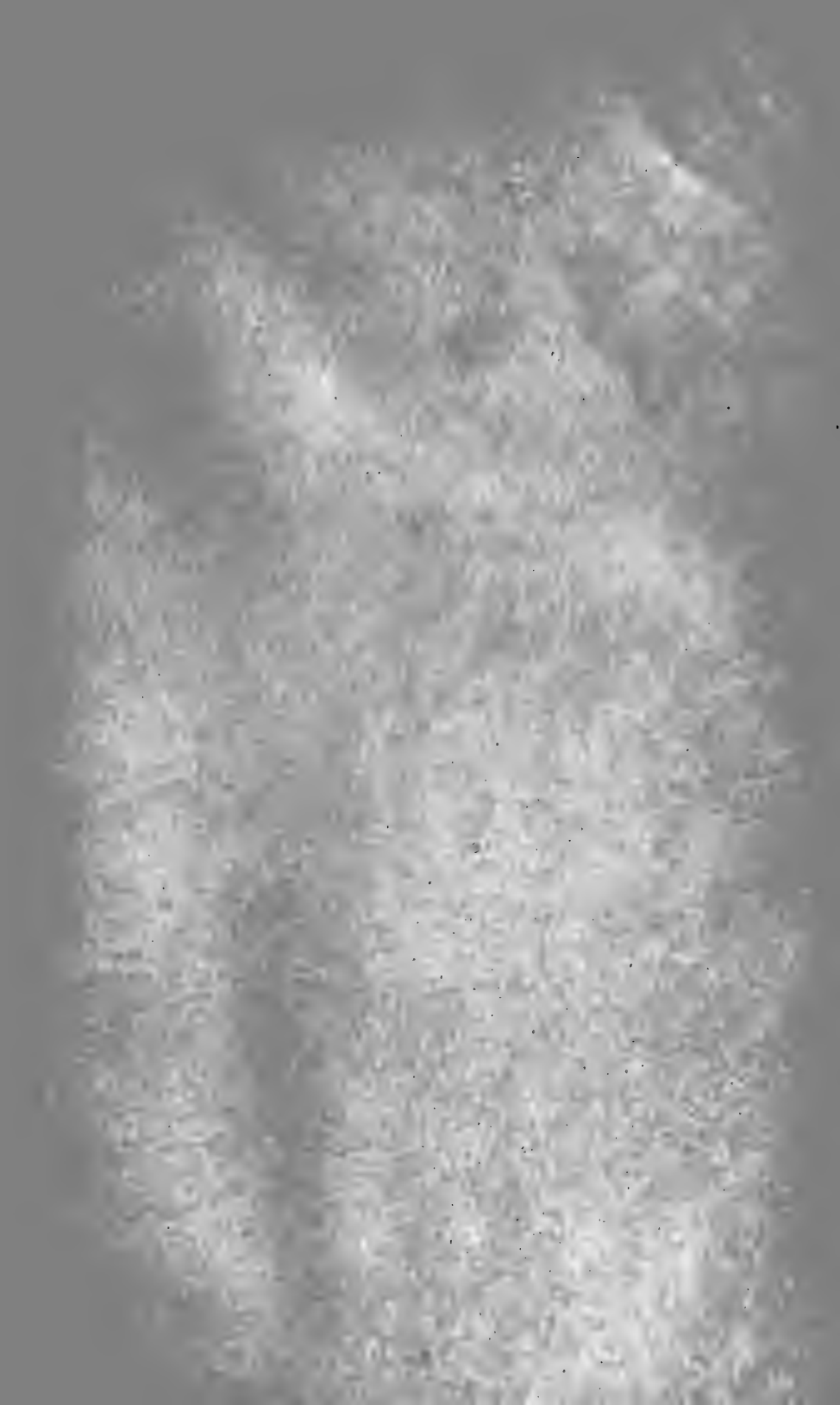
In the light of the foregoing facts it may be possible for us to draw some conclusions on the relationship of the genera, but it must be confessed we shall hardly be justified in going much beyond that. The group is remarkably homogeneous, at least as far as its North American representatives are concerned, but it is probable that a careful examination of the Eastern Phasianidæ, the South American Cracidæ, and the Australasian Megapodidæ will bring to light greater diversity. Our single representative of the Cracidæ is obviously further from the galline type than any of our other species, and without further study of the family it is impossible to draw any conclusions in regard to the relationship of the guans to the other Gallinæ. With the Alecteropodes, however, the case is different, and the relationship of the different genera is at least suggested by these investigations. The position to be given *Meleagris* is a question on which the work so far done throws very little light, but its relation is probably nearest to the Phasianidæ.

The differences between the grouse and the quail are in part at least

due to the greater size of the former, and we may assume that the latter represent more nearly the primitive condition. This assumption is based on the greater simplicity of the dorsal tract and the cervical tracts in the quails and the small number of rectrices. At the same time it must be remembered that it is a pure assumption adopted only for convenience in pointing out the relation of the genera to each other. The common bob white and its allies will serve, then, as a starting point from which to develop the other genera. *Lophortyx* is nearest to *Colinus*, having the same number of rectrices and resembling that genus closely in other ways. But some of the feathers of the crown form a distinct crest tract. From *Lophortyx* may have been derived, on the one hand, by increased size and greater specialization of the crest, the genus *Oreortyx*; and on the other hand, by reverse changes in the crest and increase in the number of rectrices, the genus *Callipepla*. The degeneration of the crest has gone further in *Cyrtonyx* than in *Callipepla*, but the 12 rectrices have been retained, though they have greatly degenerated in size and importance. This arrangement of the genera may be seen at a glance from the accompanying diagram:



Which genus of grouse to use as a starting point is not so easy to decide, but for convenience we will take *Canace*. It must not be supposed, however, that this is meant to imply that that genus is nearest to the quails. But it has the smallest number of rectrices and the simplest pterylosis, and it is easy to show its connection with most of the other genera. *Dendragapus* has developed from *Canace* by increase of size, accompanied by greater development of the femoral tracts, a marked increase in the number of rectrices, and some changes in the dorsal tract. *Lagopus* has been modified from *Canace* only in the greater amount of feathering on the feet and the greater development of upper tail coverts. *Tympanuchus*, *Pediocetes*, and *Bonasa*, form still another branch, of which the first is perhaps nearest the ancestral form, and *Bonasa* the most modified. All three of these genera have an increased number of rectrices and modified cervical tracts or apteria. In *Bonasa* there has been a marked decrease in the amount of feathering on the feet, and the special pterylae on the branches of the lower cervical tract are very noticeable. The position of *Centrocercus* is not easy to determine, as it shows greater specialization than any other genus. This is indicated by the changes in the arrangement of the cervical tracts, in the greater size of the dorsal and femoral tracts, and in the increased number of rectrices. Whether it is the descend-



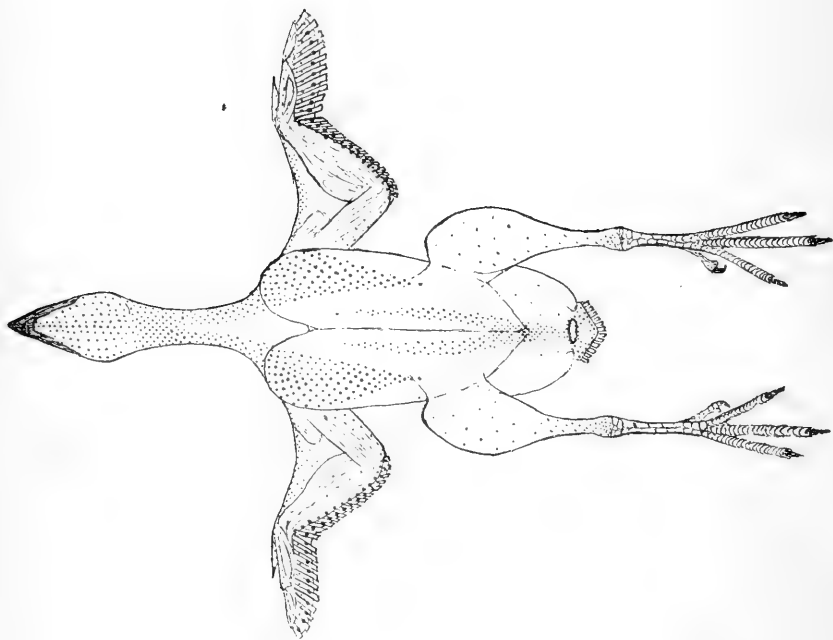


FIG. 1. Ventral view.

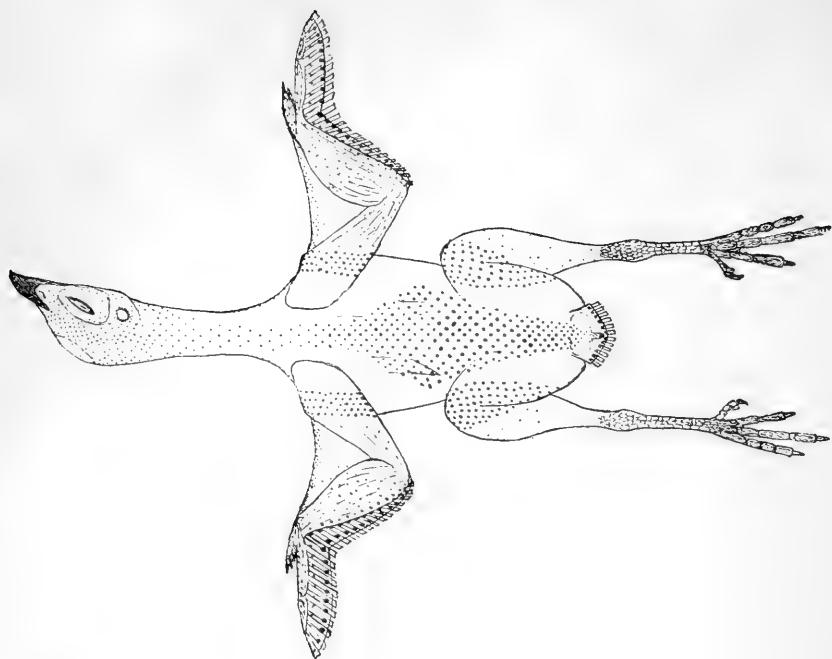


FIG. 2. Dorsal view.

FEATHER-TRACTS OF COLINUS VIRGINIANUS.



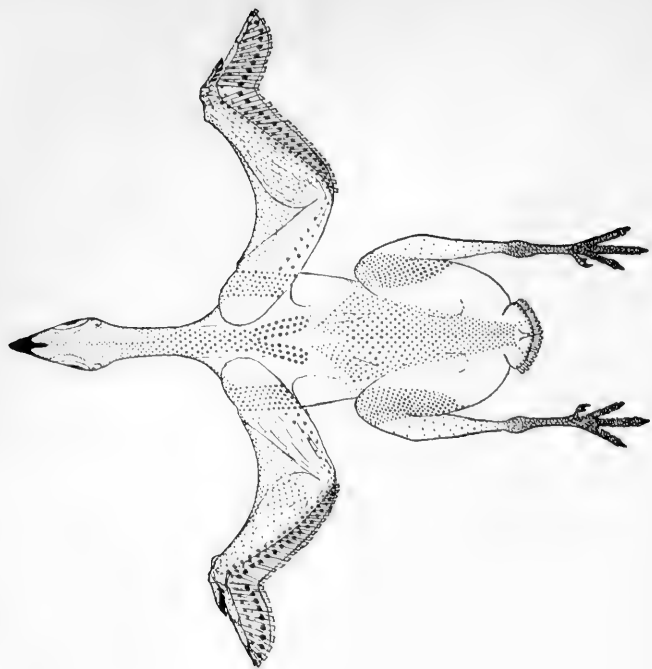


FIG. 2. Dorsal view.

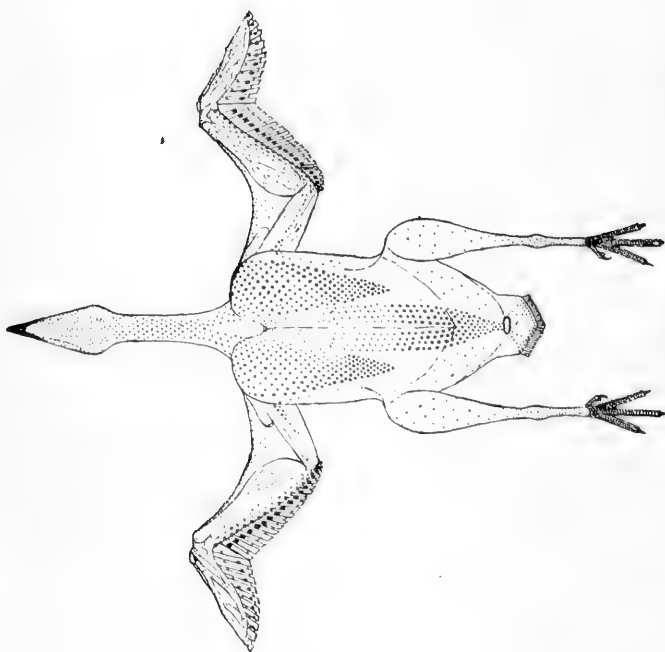
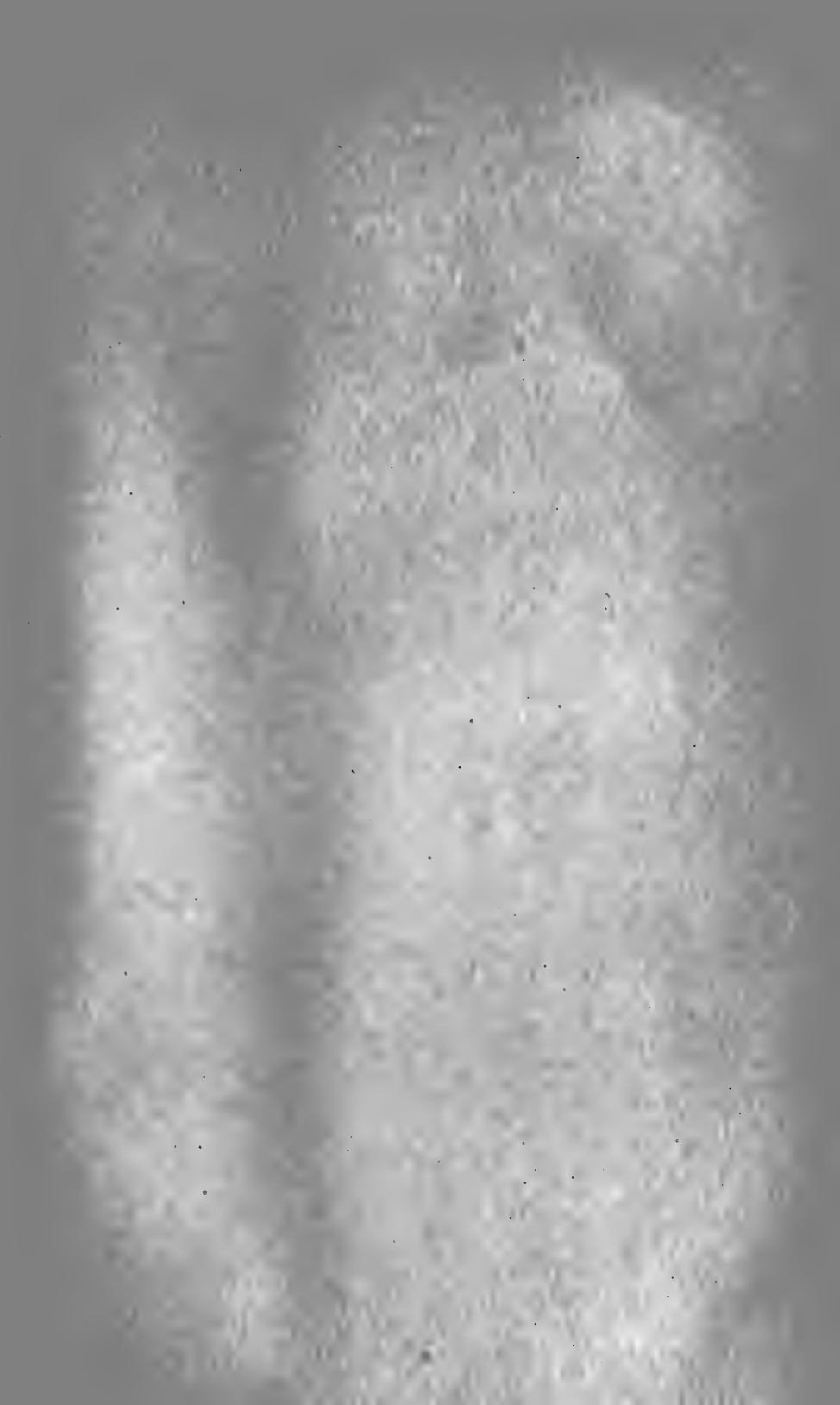


FIG. 1. Ventral view.

FEATHER-TRACTS OF *DENDRAGAPUS OBSCURUS*.



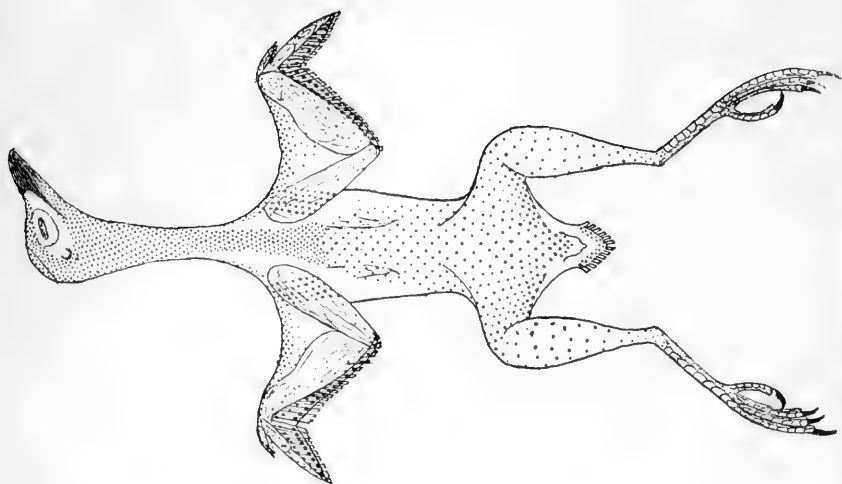


FIG. 2. Dorsal view.

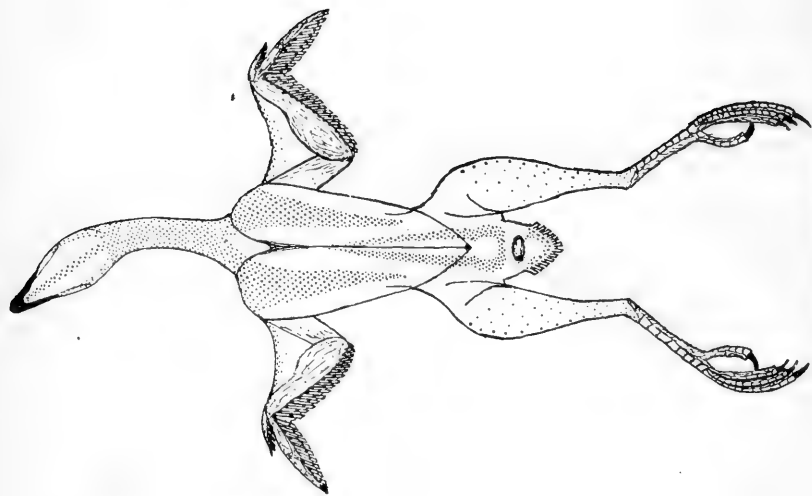
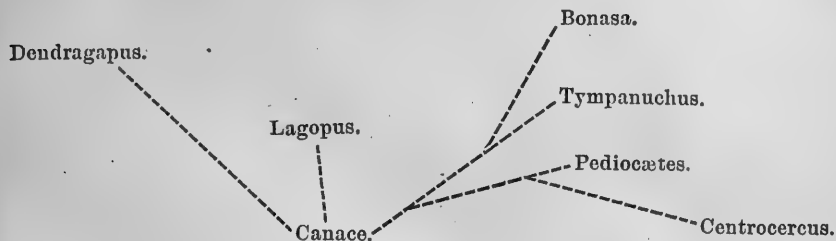


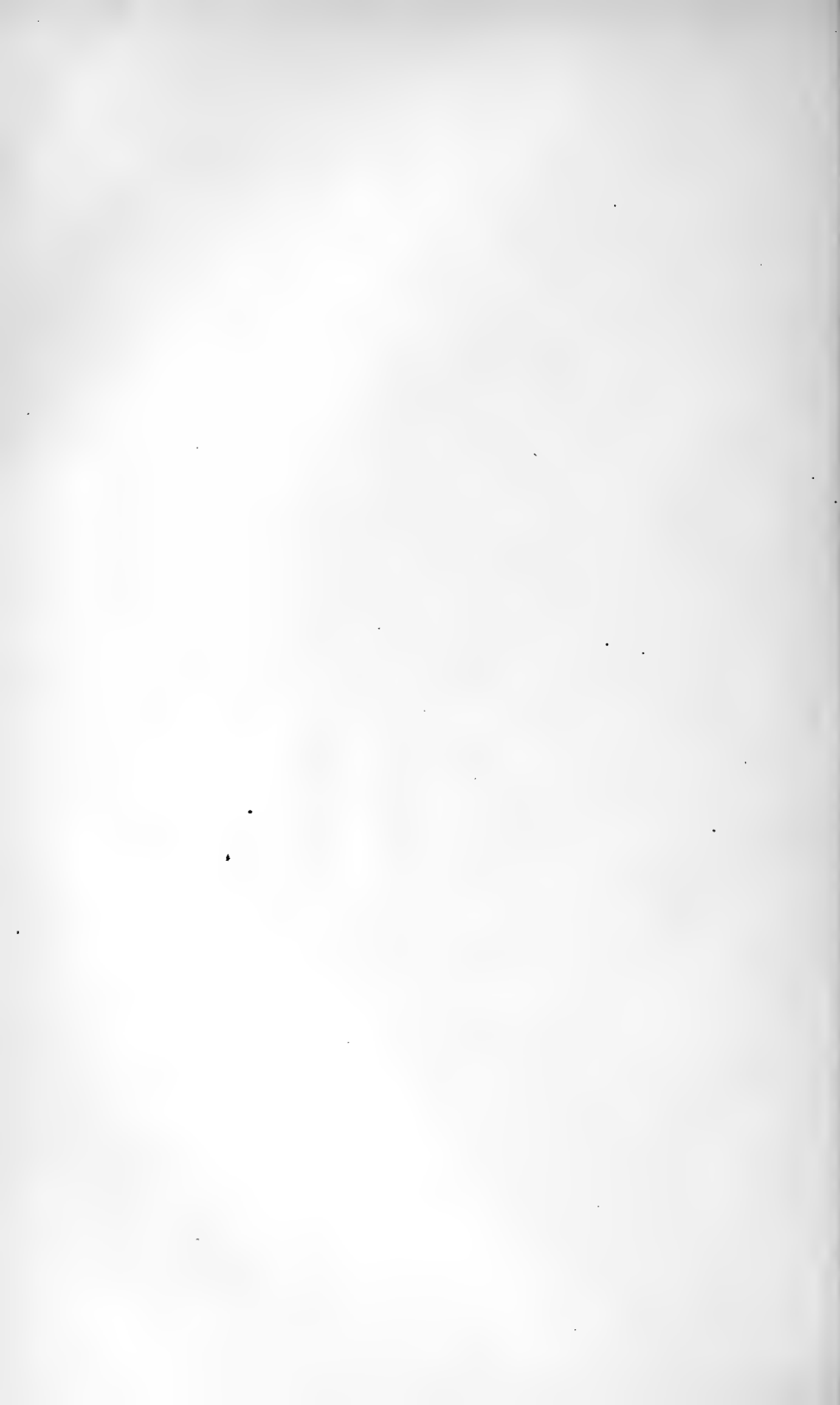
FIG. 1. Ventral view.

FEATHER-TRACTS OF *ORTALIS VETULA* McCALLI.

ant of a *Pediocetes*-like ancestor may be open to question, but it is at least possible that the changes begun in that genus have reached an extreme in *Centrocerus*. These hypothetical relationships will be more readily gathered from the diagram:



As a final conclusion, then, we see that the study of the North American genera alone throws very little light on the origin or relationships of the larger groups, and similar work must be done in the numerous genera of South America and the Eastern Hemisphere before we shall be able to solve those problems. Moreover, we must always bear in mind that the conclusions drawn from a single set of characters are by no means final, and care must be taken not to be misled by superficial resemblances. In attempting to show the facts brought to light by a study of the pterylography of the North American Gallinæ I have not taken into account any of the other characters of the group, and for this reason the relation into which I have brought the genera may not be a correct or natural one. It is a matter of regret that the amount of labor involved in this investigation has not been productive of more considerable results, but I feel sure that the facts here recorded will be of real value when our knowledge of the Gallinæ of other countries and the pterylography of allied forms is more complete.



NOTE ON OXYCOTTUS ACUTICEPS (GILBERT) FROM SITKA AND KADIAK, ALASKA.

By TARLETON H. BEAN,
Honorary Curator, Division of Fishes,
and
BARTON A. BEAN,
Assistant Curator, Division of Fishes.

The genus *Oxycottus*, Jordan and Evermann, based upon *Oligocottus acuticeps* of Gilbert, has been considered as nearly related to *Blennicottus* of Gill. None of the descriptions of *Blennicottus*, so far as we have observed, make mention of the forward insertion of the vent, which is, however, subject to individual variation.

We have examined the typical specimens of *Blennicottus globiceps*, the description and illustration of *Oligocottus embryum*, since referred to *Oxycottus* by Jordan and Evermann, and also a number of specimens of *O. acuticeps* from Sitka and Kadiak, Alaska.

Oxycottus acuticeps differs markedly from *B. globiceps* in the shape of the head and in the structure of the preopercular spine. It is remarkable also for the large size of the genital papilla of the male, which is roughly three-lobed at the extremity, and for the very advanced position of the vent, which is close behind the ventrals. Judging from the illustration accompanying the original description of *Oligocottus embryum* Jordan and Starks, that species appears to be more nearly related to *Blennicottus globiceps* than to *Oxycottus acuticeps*, having a rather short, declivous snout, a thin, flat preopercular spine, and a genital papilla smaller than in *acuticeps* and, apparently, simple at the tip, while its position is less advanced than in *acuticeps*.

The largest examples of *O. acuticeps* so far examined by us are females from Sitka, measuring $2\frac{1}{2}$ inches in length. The only males examined by us are two examples from Sitka; these measure $1\frac{3}{8}$ and $1\frac{5}{8}$ inches. The larger of these males has a genital papilla $\frac{1}{4}$ inch long and more than $\frac{1}{16}$ inch in diameter at the base. It is located almost immediately behind the ventrals. *B. globiceps* has a small, slender papilla.

The U.S.N.M. catalogue numbers of the Alaskan examples are: 24083, Kadiak, W. H. Dall, 3 females; 27515, Sitka, T. H. Bean, 4 females and 1 male; 48873, Sitka, T. H. Bean, 1 male.

The radial formula of the Sitkan examples is as follows: B. VI; D. VIII, 14 to 16; A. 12 to 13; V. 3; P. 13 to 14. Tubes 33.

The synonymy should read:

Oligocottus acuticeps GILBERT, Rept. U. S. Fish Commission, 1893 (1896), p. 432;
Unalaska, Steamer *Albatross*.

Oxycottus acuticeps (GILBERT) JORDAN and EVERMANN, Bull. 47, U. S. Nat. Mus.,
Pt. 2, p. 2015.

AFRICAN DIPLOPODA OF THE GENUS PACHYBOLUS.

By O. F. COOK,

Custodian of Myriapoda.

Throughout tropical Africa from Senegambia to the Congo and Zanzibar are to be found large, robust and heavily armored *Spiroboli* of closely similar form and color pattern, being in life transversely banded with vermilion, the bright color affecting the anterior part of the segmental rings nearly to the level of the repugnatorial pores. Such a species was described from Sierra Leone as *Spirobolus giganteus*¹ by Porat, who later reported and redescribed the same species from Liberia,² in both cases insisting upon its close relationship with *Spirobolus crassicollis* Peters from Mozambique. In 1893 Pocock³ placed this species, together with *ligulatus* Voges and *simillimus* Newport, as synonyms of *pulvillatus* Newport, and adds: "It is extremely common at Lagos." More recently Porat⁴ has adopted this synonymy and added to it *Spirobolus crassicollis* Peters, on the ground that it can no longer be kept separate, as a trace of a marginal sulcus appears in West African forms, this being, in his opinion, apparently the sole difference between the two species.

In reality it will be necessary to revise this entire synonymy. Peters's *crassicollis* is an animal probably generically different from any of the forms in question, and the Lagos species, or at least the type of *ligulatus* Voges, is specifically distinct from specimens from Kamerun, Togo, and Senegambia, and, moreover, these last are different from each other.

The types of Newport's species were from the Gold Coast, and as the Togo colony lies between the Gold Coast and Lagos the presence of the same form in the latter places is rendered antecedently improbable, though there is, of course, no reason why any locality should be limited to one species, even though the material at hand does not show two species from any of the regions mentioned. The individuals from each locality appear to be constant in the features supposed to indicate specific distinctness, but the affinities are not geographical; thus the Togo

¹ Cefvers. Sk. Vet.-Akad. Förbandl., 1872, No. 5, p. 17.

² Ann. Soc. Ent. Belgique, 1888, XXXII, p. 246.

³ Ann. and Mag. Nat. Hist., 1893, 6th ser., XI, p. 249.

⁴ Bih. K. Sv. Vet. Ak. Handl., 1894, IV, No. 5, p. 59. "*Spirobolus pulvillatus*" is also here reported from Kamerun.

species is much nearer to that which appears in Zanzibar than to that of either Kamerun or Lagos. The characters referred to are, as in Diplopoda generally, those of the copulatory legs, more especially the posterior pair, in the structure of which the present group of species differs from its nearest relatives and constitutes a distinct genus which may be called *Pachybolus*, the type being a new East African species *P. tectus*.

Genus PACHYBOLUS Cook.

Pachybolus Cook, Brandtia, 1897, p. 73.

African Anocheta of very large size, with a long cylindrical body and a thick exoskeleton.

Antennæ short and thick, accommodated by a cavity in the sides of the head and partially covered by the first segment; olfactory cones numerous. Labrum with setiferous punctations.

Anterior segments with the ventral parts greatly thickened, concave.

Legs with two penultimate joints subequal; last joint with a broad, oval, concave callus which does not extend beyond a pair of stout subapical bristles.

Copulatory legs with a large sternum mesially projecting ventrad and usually carinate; posterior pair of copulatory long, curved, strongly chitinated.

The type of the genus is *P. tectus* from Zanzibar and its nearest relative is *Hadrobolus*, a genus based on *Spirobolus crassicollis* Peters. The relationship is perhaps too close, but there are several differences of considerable importance, *Pachybolus* being separable from *Hadrobolus* by the distinct median process of the sternum of the copulatory legs, the approximate posterior lamellæ of the anterior copulatory legs, and the longer and distally more strongly chitinated flagella or posterior copulatory legs, which also emerge at the side of the apex of the posterior lamella, and have the seminal opening large and surrounded by a membranous fringe. The legs of males of *Hadrobolus* have the last joint longer and the penultimate joint shorter than in *Pachybolus*, and the fleshy sole produced beyond the pair of subapical bristles, while in *Pachybolus* the sole is broader and does not extend beyond the bristles. The two genera are similar in habit and color pattern, but *Pachybolus* is larger, more robust, and more heavily armored.

ANALYTICAL KEY TO THE SPECIES OF PACHYBOLUS.

Posterior lamina of anterior copulatory legs with a deep notch at the lateral side of the base of the slender apical process; flagella with a large subapical perpendicular tooth and a large leaf-like process some distance below the tooth: *P. laminatus*, new species, Liberia.

Posterior lamina entire, more or less gradually narrowed to a much broader apex, flagellum without perpendicular tooth or laminate process.....

Flagellum slender, attenuate and strongly recurved: *P. ligulatus*, Lagos.....

Flagellum distinctly more robust and shorter, not attenuate and not recurved in more than a semicircle; apex broad, flat, simple, or complicate.....

Anterior lamina of copulatory legs deeply and broadly excised on its mesial edge beyond the apex of the sternum; flagellum somewhat narrowed and rounded at the nearly simple apex, and with a small, somewhat appressed, tooth-like process concealing the large seminal aperture: *P. excisus*, new species, Kamerun.

Anterior lamina mesially emarginate or entire; flagellum expanded or laminate-complicate at apex.....

Sternum of copulatory legs with median process truncate or emarginate, short, broader than long; flagellum distally abruptly and strongly expanded, complicate-diform: *P. brachysternus*, new species, Congo.

Sternum medianly distinctly longer than broad; flagellum gradually and only moderately expanded distad, the apex more simple, somewhat unevenly channeled below, or spoon-shaped.....

Sternum of copulatory legs with median process large and broad, strongly carinate medianly; flagellum at apex with numerous wrinkles and appressed lamellae: *P. macrosternus*, new species, Congo Free State.

Sternum with median process narrower, especially distad, as the sides converge strongly from the base; median carina slight or wanting; flagellum at apex simple and nearly smooth.....

Flagellum stout, the seminal opening located in the larger apical lobe: *P. togoensis*, new species, Togo Hinterland.

Flagellum more slender; the lobe which bears the aperture is exceeded in size by a subapical expansion much larger than the corresponding structure in the preceding species: *P. tectus*, new species, Zanzibar.

Following the descriptions of these species are references to the older names, which, on account of the lack of descriptions or figures of the copulatory legs, it is impossible to identify until the types can be examined with reference to these characters.

PACHYBOLUS LAMINATUS, new species.

(Plate L, figs. 3a-3f.)

Type.—No. 774, U.S.N.M.

Locality.—Liberia.

Length, 150 mm.; greatest diameter of male, 14.5 mm. at segment 6; number of segments, 54 to 56.

Color of alcoholic material dark brown, ringed with red above and sordid whitish below the pores.

Copulatory legs quite distinct in form from those of the other species, being broad, thin, and compressed toward the base, and gradually narrowed to the rather narrow apex, which bears a flattened, sub-triangular, spine-like process which rises from one side of the flattened chitinous blade. Even more remarkable is the large, hatchet-shaped, thin process, nothing similar occurring in the other known species.

Six male and two female specimens are in the Hamburg Museum, one (No. 9519) labeled "Rio Pongo Senegambien, Dr. Ulez." This has 56 segments. The other specimens have 54 segments, with the locality given as "Gabun, H. Petersen, No. 9552." I suspect that one or the other of these labels is incorrect, such a wide distribution appearing unlikely, no diplopod species being yet known to be common to these

two regions. In favor of the Rio Pongo label as correct is the capture of a specimen apparently referable to this species near Suey, a native town about 35 miles inland and northeast from Monrovia. It was collected in a region previously cultivated by the natives, but at that time, April, 1892, covered with a dense growth of vegetation several years old. That it remains the only specimen secured, after opportunities of collecting extending over several years, shows that the species is very rare in Liberia.

In life the creature appeared black in color banded with bright vermillion red. It was slow and rather clumsy in its movements and made little attempt at securing protection by coiling up, in this offering considerable contrast to the large *Spirostrepti*, which are provided with harder shells, stronger muscles and corresponding instincts. The difference between the two groups is also apparent in alcoholic specimens. *Spirostrepti* in this condition are nearly always hard and brittle, while *Spiroboli* frequently remain quite flexible.

The present species would seem in all probability to represent Porat's *P. giganteus*, the type of which was from Sierra Leone, but which was also reported from Liberia as collected by Moddermann. The literature is, however, sufficiently confused already without the hazard of another doubtful determination, and the fact that Porat has admitted the reduction of *giganteus* to *pulvillatus* and has in the same paper referred Kamerun material to the latter species, would seem to show either that species are much more numerous than yet appears or that the synonymy was arranged without reference to the characters of the copulatory legs.

The Liberian specimen is about 160 mm. long, 15.3 mm. thick at segment 6, and has 56 segments.

PACHYBOLUS LIGULATUS (Voges).

(Plate L, figs. 1a-1e.)

Spirobolus ligulatus VOGES, Zeitsch. f. Wissensch. Zool., 1878, XXXI, p. 180, pl. III, figs. 35, 35a.

Type.—Hamburg Museum.

Locality.—Lagos, West Africa.

There are also in the Hamburg Museum six specimens of this species collected at Grand Popo, German colony of Togo, by F. Martinsen. The number of segments is 56.

PACHYBOLUS EXCISUS, new species.

(Plate LI, figs. 1a-1f.)

Type.—No. 1324, Berlin Museum.

Locality.—Kamerun.

Length, 160 mm.; greatest width of male, 15.3 mm. at segment 6; segments, 51 to 52.

Color of alcoholic material dark brown, ringed on the anterior sub-segments with dark cherry-red above the pores, and light brown below.

Copulatory legs resembling those of *P. brachysternus* in the very short, broad, truncate, or emarginate median process of the sternum; anterior laminae deeply excised on their mesial margins, and also narrower than in *P. brachysternus*. Flagella with various folds and wrinkles some distance below the apex, which is nearly simple, and with a tooth-like process below to protect the large opening of the seminal duct.

Seven male specimens of this species are in the Berlin Museum, being Nos. 2060, Kamerun (F. Braun), 2041, Kamerun (Dr. Weissenborn), and 1323-1325, Kribi (Lieutenant Morgen). The four Kamerun specimens have 52 segments each, while the three individuals from Kribi have 51. The type is one of these last, No. 1324.

The present species can hardly be the same as any of the older names, since all of these were founded on material from farther up the coast. The affinity is distinctly with the Congo Valley species, but *P. brachysternus* differs strikingly in the form of the flagellum, and *macrosternus* is scarcely less different in this respect and has, moreover, the much longer sternum.

PACHYBOLUS BRACHYSTERNUS, new species.

(Plate LI, figs. 2a-2d.)

Type.—No. 772, U.S.N.M.

Locality.—Congo.

Length, 130 mm.; width of male, 14.8 mm. at segment 6; number of segments, 50 to 51.

Color of alcoholic specimens dark brown on posterior half of each ring, bright vermilion on the anterior, lighter below, but the red color more pronounced ventrad than in the other species.

Copulatory legs with sternum short, broad, and truncate or emarginate, much as in *P. excisus*; anterior laminae slightly emarginate on the mesial edge; flagella distally strongly expanded and enlarged, very irregular in shape, being made up of numerous plates, ridges, and folds much more numerous and complicated than in the other species.

Two male and one female specimens were collected by the Rev. J. H. Camp in the Congo Free State.

One male and the female have 50 segments, the other male 51. The female, which may possibly not belong here, is strikingly more robust and darker in color than the males, which are closely similar to each other. They are the smallest and most slender known members of the genus, though the difference is slight.

The legs of the female are distinctly shorter and more slender than those of the male, and the body retains its width to near the end, the anterior four or five segments being, however, slightly wider than any of the others, the swollen sixth and seventh segments of the male rendering the difference in habit still more striking.

PACHYBOLUS MACROSTERNUS, new species.

(Plate LI, figs. 3a-3d.)

Type.—No. 773, U.S.N.M.*Locality*.—Congo.

Length, about 135 mm.; width of male, 14.5 mm. at segment 6; number of segments, 52.

Color of alcoholic specimens nearly black, possibly owing to discoloration. The transverse red bands are distinct on examination, but the colors of all the parts seem to be darker than in other species.

Copulatory legs with sternum very large, both longer and broader than in the other species; the form of the flagella is more nearly that of *P. brachysternus*, but they are distally much narrower and more simple than in that species, with a distinct tendency in the direction of *tectus* and *togoensis*, but with numerous folds, wrinkles, and appressed lamellæ which do not appear in those species.

Three male specimens of this species are in the United States National Museum. They were collected by the Rev. J. H. Camp in the Congo Free State, probably in the vicinity of Leopoldville. They were in the same jar with the specimens of the preceding species.

PACHYBOLUS TOGOENSIS, new species.

(Plate L, figs. 2a-2c.)

Type.—No. 2067, Berlin Museum.*Locality*.—Togo Colony.

Length, 155 mm.; greatest diameter of male, 14.5 mm. at segment 6; number of segments, 54.

Color of alcoholic specimens nearly black, the anterior subsegments dark red above, tinged with brown in the vicinity of the pores, but continuing somewhat reddish even on the ventral surface.

Copulatory legs similar in structure to those of *P. tectus* from Zanzibar, but more robust throughout in the posterior pair; the terminal lobe which bears the seminal aperture is also much larger than in that species.

Two male specimens in the Berlin Museum were collected in the wooded region of the interior at Misahöhe (Baumann).

From geographical considerations it might be suggested that *P. togoensis* would be likely to turn out a synonym of one of Newport's species, but the occurrence of *P. ligulatus* at Grand Popo indicates that the latter species is distributed along the coast, as Pocock has implied in his treatment of the synonymy.

The nearest relationship of this species as shown by the form of the copulatory legs is with *P. tectus* from Zanzibar, the apices of the parts in question being quite different from those of other West African species.

PACHYBOLUS TECTUS, new species.

(Plate LII, figs. 1a-1h.)

Type.—No. 2841, Hamburg Museum.*Locality*.—Zanzibar.

Length, about 150 mm.; greatest width of male, 15 mm. at segment 6; number of segments, 55.

Color of alcoholic specimen doubtless faded; dark brown banded with pinkish gray.

Copulatory legs resembling those of *P. togoensis*, especially the posterior pair. The aperture of the duct opens on the margin of a broad distal lobe, which is, however, much smaller than that of *P. togoensis*, and the whole appendage is more slender than in that species.

A single male specimen was examined. It was broken into many pieces, and was labeled "*Spirobolus crassicollis*, Zanzibar."

PACHYBOLUS GIGANTEUS (Porat).

Spirobolus giganteus PORAT, Efvers. K. Vet.-Akad. Förhandl., 1872, No. 5, p. 17; Ann. Soc. Ent. Belgique, 1888, XXXII, p. 246.

This may or may not be the species here described as *laminatus*, as I have seen no material from Sierra Leone, the habitat of the original specimen of *giganteus*. In order to interrupt the series of false identifications proposed by Porat and Pocock it has seemed best to describe and figure as new all the species whose types could not be studied.

Type.—Stockholm Museum.

Locality.—Sierra Leone. Under the second reference the species is redescribed from Liberia, but as Porat has admitted the existence of but one species of this series, it is doubtful whether this reference will hold. The Liberian species is doubtless that here described as *laminatus*. Under the second and more extensive description no mention is made of the Sierra Leone specimens, and in the original description the characters of the copulatory legs are not given. The external characters detailed by Porat are almost entirely generic.

PACHYBOLUS PULVILLATUS (Newport).

Spirobolus pulvillatus NEWPORT, Ann. Nat. Hist., 1844, XIII, p. 268.—POCOCK, Ann. and Mag. Nat. Hist., 1893, 6th ser., XI, p. 249.

Type.—British Museum.

Locality.—Cape Coast Castle, Africa. Also said by Mr. Pocock to be very common at Lagos.

PACHYBOLUS SIMILLIMUS (Newport).

Spirobolus simillimus NEWPORT, Ann. Nat. Hist., 1844, XIII, p. 269.

Type.—British Museum.*Locality*.—Fantee, Africa.

The original specimen was a female, according to Pocock that of *P.*

pulvillatus, which seems very probable, but owing to the unsuspected existence of numerous related species this opinion may possibly need revision.

Genus HADROBOLUS Cook.

Hadrobolus Cook, Brandtia, 1897, p. 73.

This genus is distinct from *Pachybolus* in the following characters:

1. The sternum of the copulatory legs is very broad and short, being scarcely produced in the middle.

2. The posterior lamellæ are widely separated, while in *Pachybolus* they are crowded mesad by the flagella, which emerge outside (laterad) of the apices of the posterior laminae.

3. The flagella are much shorter and more robust, provided near the middle with a large blunt spine; they are also distally fleshy and have a very large seminal aperture surrounded by a finely incised membranous fringe. In *Pachybolus* the seminal aperture is a small round opening in the entirely cornerous and simple apex of the flagellum.

4. The last joint of the legs of males is greatly elongated at the expense of the penultimate, which is thus much smaller than the preceding (fourth) joint. In *Pachybolus* joints 4 and 5 are subequal, and the last joint is relatively shorter; that is, not longer than 4 and 5 taken together.

5. The pad of the last joint of the legs of males is oblong and extends the whole length of the joint, the subterminal bristles being farther apart than in *Pachybolus*, in which the pad is somewhat oval in shape and does not extend beyond these two bristles, which are located a considerable space below the apex of the joint.

6. The pads also probably function in a different manner in the two genera, as in *Hadrobolus* they are fleshy throughout, the sides being scarcely chitinized and the surface being convex or irregularly shrunken.

In *Pachybolus*, on the contrary, the sides of the pad are much more prominent, strongly chitinized, and dark colored, while the surface is also of firm texture and always uniformly and strongly concave. It is not impossible that this surface can be retracted by muscles and thus secure adhesion by suction, so to speak.

Superficially there are comparatively slight differences, such as the somewhat more slender habit and distinctly thinner armor. The antennæ are also distinctly more slender than in *Pachybolus*, and the first segment has laterally its anterior margin defined by a distinct fine sulcus, which on *Pachybolus*, is obsolete or, if traceable, is much closer to the margin than in *Hadrobolus*.

HADROBOLUS CRASSICOLLIS (Peters).

(Plate LII, figs. 2a-2g.)

Spirobolus crassicollis PETERS, Monatsber. k. preuss. Akad. Wiss., Berlin, 1855, p. 79; Reise nach Mozambique, Zoology, 1862, p. 518, pl. XXXIV, fig. 8.

Hadrobolus crassicollis COOK, Brandtia, 1897, p. 73.

Type.—Berlin Museum.

Locality.—Island of Mozambique.

The figures of this species are introduced here to illustrate the points of difference alleged under the preceding discussion of the generic characters. They were drawn from the type specimen at Berlin.

EXPLANATION OF PLATES.

PLATE L.

Pachybolus ligulatus.

Fig. 1a. Copulatory legs, anterior view.

1b. Same, posterior view.

1c. One of the posterior copulatory legs, posterior-mesial view.

1d. Same, complete, turned somewhat more sidewise.

1e. Same, anterior-lateral view.

All the figures from the type specimen in the Hamburg Museum.

Pachybolus togoensis.

2a. Copulatory legs, anterior view.

2b. Same, anterior-mesial view.

2c. One of the posterior legs, posterior-lateral view.

Figures from the type specimen, No. 2067, Berlin Museum.

Pachybolus laminatus.

3a. Copulatory legs, anterior view, drawn from a specimen in the Hamburg Museum, labeled "Rio Pongo, Senegal."

3b. Same, posterior view.

3c. One of the posterior copulatory legs of the same specimen, anterior-mesial view.

3d. Same, posterior-lateral view.

3e. Same, from below, showing the course of the duct.

3f. Posterior view of copulatory legs of specimen labeled "Gabun," Hamburg Museum, No. 26a.

PLATE LI.

Pachybolus excisus.

Fig. 1a. First two segments, lateral view.

1b. Copulatory legs, anterior view.

1c. Same, posterior view.

1d. Same, lateral view.

1e. Same, one of posterior pair, anterior-median view.

1f. Same, posterior-lateral view.

Figures drawn from the type, No. 1324, Berlin Museum.

Pachybolus brachysternus.

2a. Copulatory legs, anterior view.

2b. Same, posterior view.

2c. One of posterior pair, anterior-median view.

2d. Same, posterior-lateral view.

Pachybolus macrosternus.

- Fig. 3a. Copulatory legs, anterior view.
3b. Same, posterior view.
3c. One of posterior pair, anterior-median view.
3d. Same, posterior-lateral view.

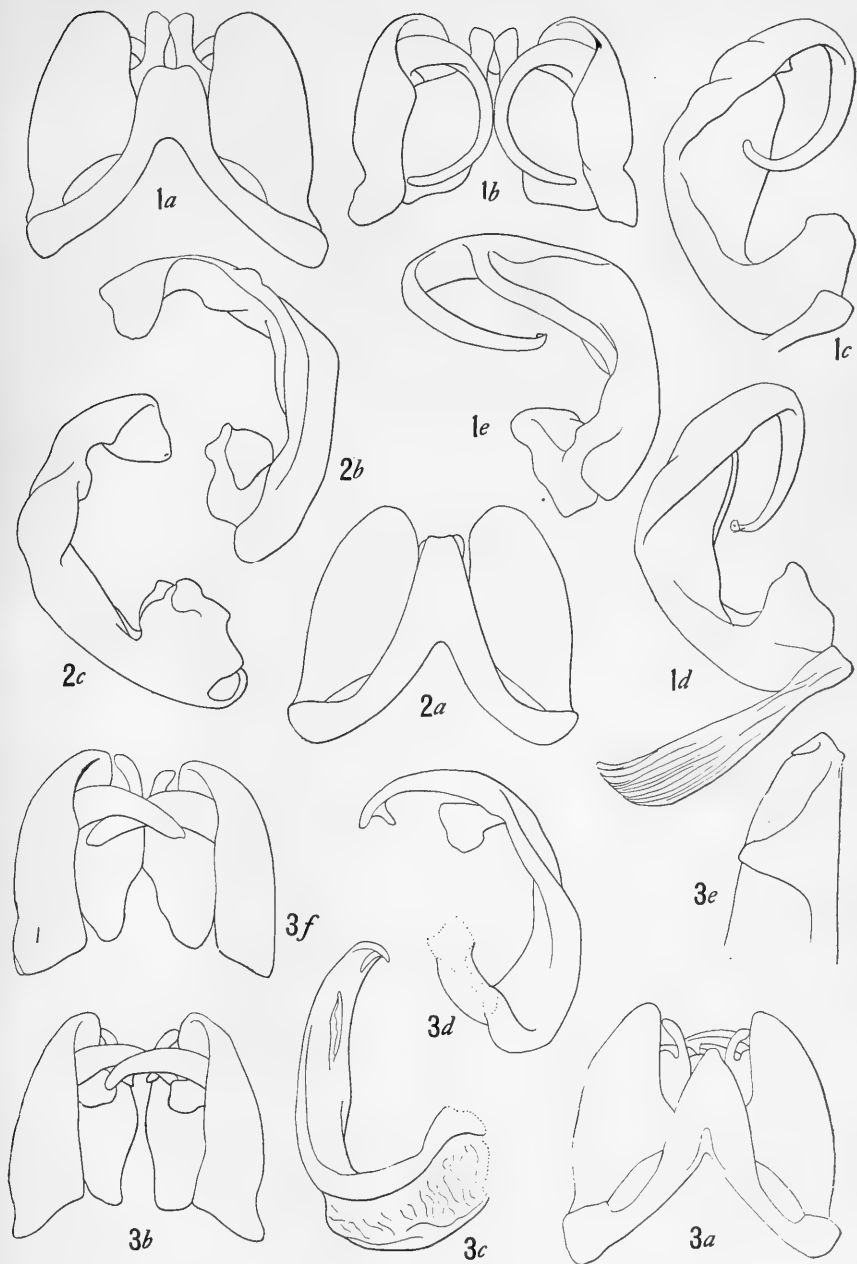
PLATE LII.

Pachybolus tectus.

- Fig. 1a. Head and first six segments, lateral view.
1b. Last segment, lateral view.
1c. Leg of male.
1d. Copulatory legs, anterior view.
1e. Same, posterior view.
1f. Same, lateral view.
1g. Copulatory leg of posterior pair, posterior-lateral view.
1h. Same, anterior-mesial view.

Hadrobolus crassicollis.

- 2a. Copulatory legs, anterior view.
2b. Same, posterior view.
2c. Same, lateral view.
2d. Copulatory leg of posterior pair, anterior-lateral view.
2e. Same, posterior-mesial view.
2f. Leg of male.
2g. First six segments.



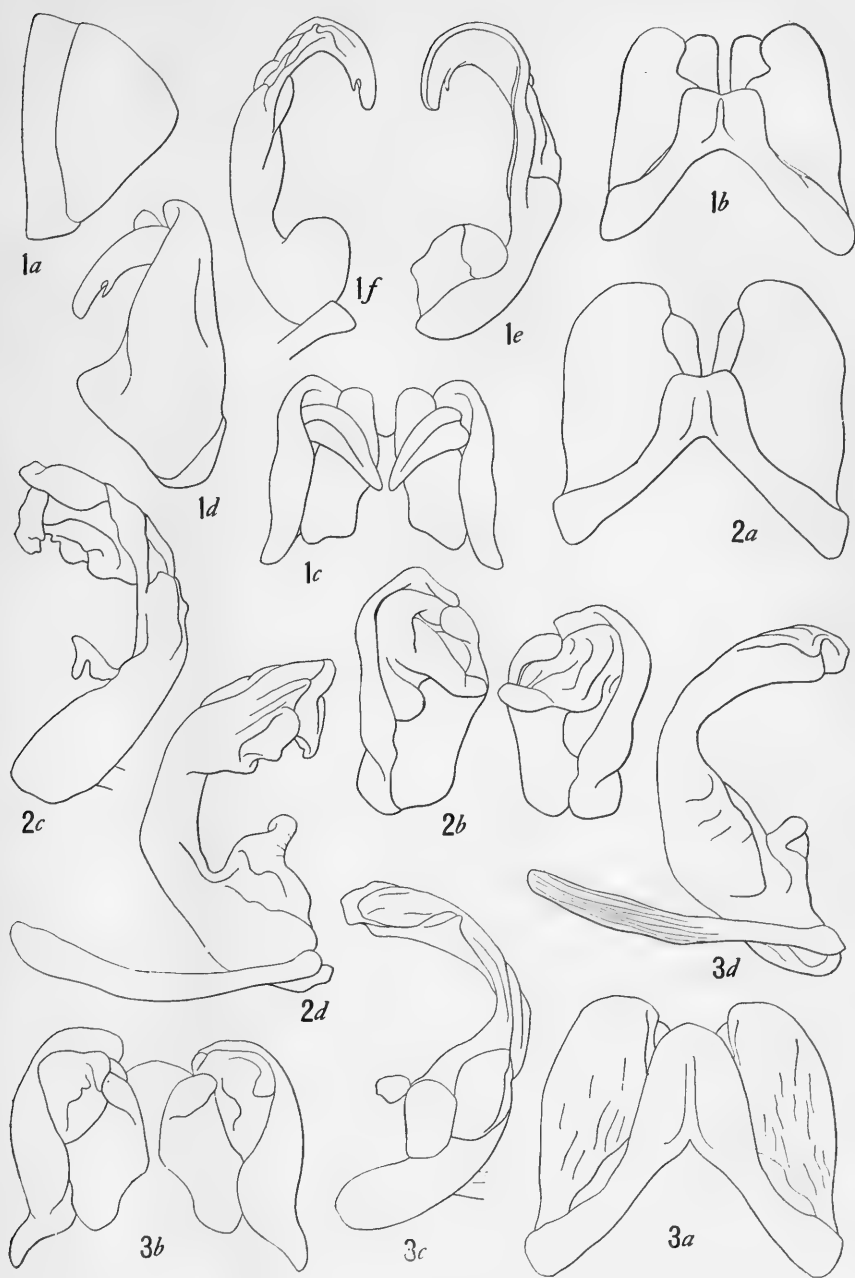
AFRICAN DIPLOPODA.

FIG. 1. *Pachybolus ligulatus*.
FIG. 2. *Pachybolus togoensis*.

FIG. 3. *Pachybolus laminatus*.

FOR EXPLANATION OF PLATE SEE PAGE 665.

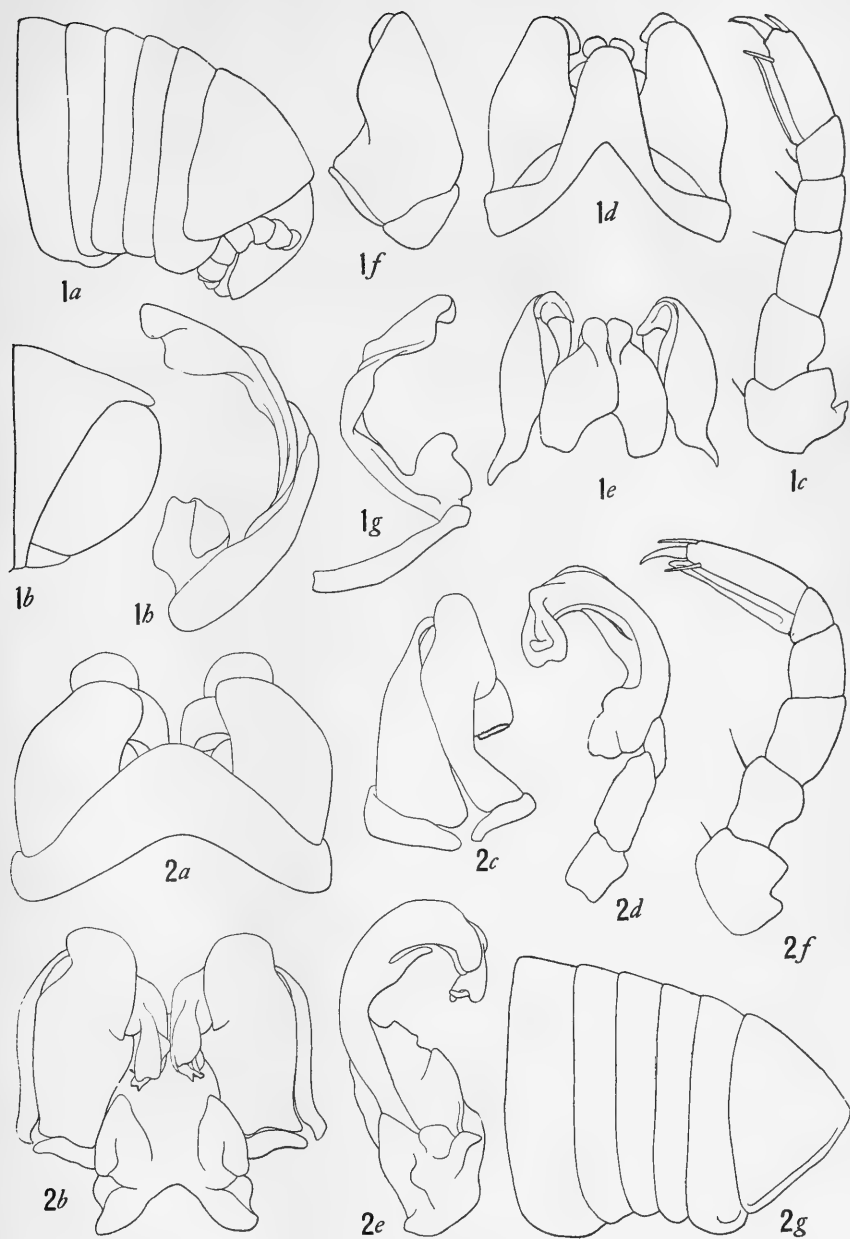




AFRICAN DIPLOPODA.

FIG. 1. *Pachybolus excisus*.FIG. 2. *Pachybolus brachysternus*.FIG. 3. *Pachybolus macrosternus*.

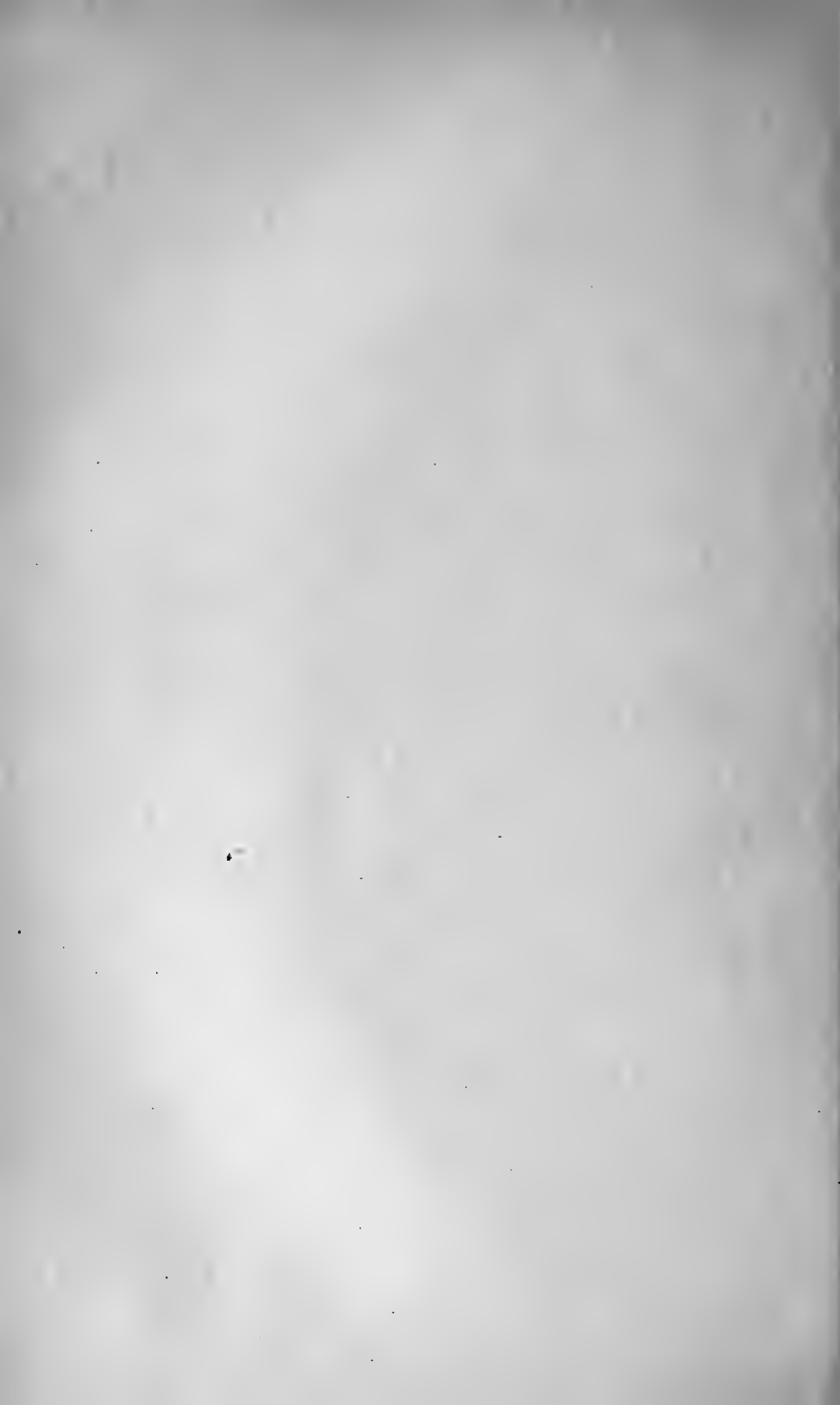
FOR EXPLANATION OF PLATE SEE PAGES 665, 666.



AFRICAN DIPLOPODA.

FIG. 1. *Pachybolus tectus*.FIG. 2. *Hadrobolus crassicollis*.

FOR EXPLANATION OF PLATE SEE PAGE 666.



THE DIPLOPOD FAMILY STRIARIIDÆ.

By O. F. COOK,

Custodian of Myriapoda.

The following descriptions and figures were prepared several years ago, before the publication of the posthumous papers of the late Mr. Bollman. Since that time *Striaria* has been recognized as the type not only of a family but of a distinct suborder. The structural similarities of *Lysiopetalum*, *Chordeuma*, and *Striaria* are so great that the inference of affinity is unavoidable; but it is equally plain that the genera mentioned represent diverging lines, and no forms are yet known which can be looked upon as connecting the three groups. Accordingly, the suborders Lysiopetaloidea, Chordeumatoidea, and Striarioidea have been arranged under the ordinal name Cœlocheta, but as no formal characterization nor synopsis including this order has been published these deficiencies are supplied below.

ANALYTICAL KEY TO THE ORDERS OF CHILOGNATHA KNOWN FROM THE UNITED STATES.

Body composed of not more than 13 distinct segments; males have legs at the posterior end of the body modified to assist in copulation: Order ONISCOMORPHA.

Body composed of at least 19 segments; males have one or both pairs of legs of the seventh segment modified to assist in copulation, the posterior legs being normal

Body composed of 20 (rarely 19) segments, which are complete chitinous rings, all the primitive sclerites being completely fused, even the sutures being obliterated: Order MEROCHETA.

Body composed of 30 (rarely 26 or 28) segments and above; fusion of primitive sclerites less complete, at least the pedigerous laminæ separated by distinct sutures

Males with eight pairs of normal legs in front of the 4-5-jointed copulatory legs, which are the posterior pair of the seventh segment and the anterior pair of the eighth; head and mouth-parts greatly reduced, the latter suctorial rather than manducatory: Order COLOBOGNATHA.

Males with seven more or less normal legs in front of the seventh segment, of which the anterior pair, and usually both pairs, are transformed into simple or 2-jointed copulatory organs; head large, the mouth-parts well developed and distinctly manducatory

Segments 1-5 with a single pair of legs each; plurae indicated by a longitudinal suture, which is met above by two transverse sutures crossing the dorsal part of the segment; labrum with a median sinus: Order ANOCHETA.

Segments 3 or 4 footless, segment 5 with two pairs of legs; plurae entirely obliterated; transverse suture single or wanting; labrum with a median tooth

Gnathochilarium with stipes broad at base, in contact in the median line between the mentum and promentum; external seminal ducts adnate: Order ZYGOCHETA.

Gnathochilarium with stipes narrower at base, widely separated by the mentum and promentum, which are in contact; external seminal ducts distinct or wanting.

Pedigerous laminae free throughout; external seminal ducts wanting, the apertures being located in the coxae of the second pair of legs: Order CÆLOCHETA.

Pedigerous laminae adnate (except the first two); external ducts distinct: Order DIPLOCHETA.

Order CÆLOCHETA Cook.

Cælocheta Cook, American Naturalist, December, 1895, p. 1115; Brandtia, 1896, p. 8.

Labrum tridentate, with a median tooth.

Mandibular stipe with a distinct cardo, not areate.

Gnathochilarium with stipes proximally separated by the mentum; cardo small.

Mentum large, entire, trapezoidal or semielliptic.

Promentum small, triangular, included between the bases of the lingual laminae (obsolete in some Chordeumatoida).

Lingual laminae distinct; lingual lobes provided with sense cones.

Median lobe well developed, with a styliform or tridentate chitinous process on each side.

Last segment at apex with a pair of articulated setiferous papillae known in some cases to function as spinning-organs.

Pedigerous laminae all free; pleurae completely coalesced with scuta.

Legs seven-jointed (except the first two pairs, which are six-jointed), second joint very short.

Genital openings of males in the posterior face of the coxae of the second pair of legs.

Legs of the seventh segment, and usually some others, modified for copulatory purposes.

The members of this order are distributed throughout the north temperate zone, with outliers known from the mountains of the Malay region and from New Zealand.

The affinities of this order are probably with the Merocheta, but it must be admitted that the characters on which this inference is based are mostly primitive rather than derivative, and are shared also by the Monocheta. The great external similarity of the orders of the Chilographa is explainable by the fact that they have not differentiated in response to habits changed by entering different fields in the economy of nature. Their wonderfully fixed structural differences can not on this

account be overlooked in taxonomy and classification, but should be ascribed to isolation since remote periods, as the geologic remains testify.

ANALYTICAL KEY TO THE SUBORDERS OF CŒLOCHETA.

Body composed of over 40 segments; repugnatorial pores present: Suborder LYSIOPETALOIDEA.

Body composed of 30 segments (rarely 26, 28, or 32); repugnatorial pores wanting.....

First segment subreniform, narrower and smaller than the large, exposed head; last segment entire at apex: Suborder CHORDEUMATOIDEA.

First segment broadly expanded in front and below, hoodlike, including and concealing the much smaller head; last segment three-lobed at apex: Suborder STRIARIOIDEA.

Suborder LYSIOPETALOIDEA Cook.

Callipodoidea Pocock, Journ. Linn. Soc. London, 1894, XXIV, p. 477.

Lysioptaloidea Cook, Ann. N. Y. Acad. Sci., 1895, IX, p. 3.

Body subcylindric, composed of more than 40 segments in the adult, capable of being coiled in a close spiral; exoskeleton moderately thick and firm.

Head large, exposed; antennæ remote; labrum not produced.

First segment small, narrower than the head.

Segments with very numerous longitudinal grooves whose prominent edges are called carinæ; setiferous tubercles wanting; repugnatorial pores present.

Anal segment entire; movements agile.

The name to be used for this suborder depends upon the distinctness of the genera *Callipus* Risso, and *Lysioptalum* Brandt. If held as synonymous, the former name is older and family and subordinal designations must be founded upon it, but until this identity is more clearly proven the priority of the family name Lysioptalidæ requires its use, with which the suborder should be made consistent.

Suborder CHORDEUMATOIDEA Cook and Collins.

Chordeumatoidea Cook and Collins, with Pocock, Max Weber's Reise, 1894, p. 341.

Craspedosomatoidea Cook, Ann. N. Y. Acad. Sci., 1895, IX, p. 3.

Body subsylindric or depressed, subfusiform, composed in the adult of 30 segments (rarely 26, 28, or 32); capable of being coiled into a rather open spiral; exoskeleton thin and fragile.

Head large, exposed; antennæ remote; labrum not produced.

First segment large, narrower than the head, and articulated in a broad emargination of its occiput.

Segments usually smooth, rarely somewhat roughened, but in all such cases with the dorsum flattened and the sides produced into lateral carinæ after the manner of the Polydesmidæ; setiferous tubercles present, six on each segment; repugnatorial pores wanting.

Last segment entire; movements agile.

This suborder may retain its earlier name if the Chordeumatidæ and Craspedosomatidæ are recognized as distinct families; otherwise the second name must be used, as that is the older for the family and the subordinal designation must be kept uniform with it.

Suborder STRIARIOIDEA Cook.

Striarioidea COOK, *Brandtia*, 1896, p. 8.

Body subcylindric, composed of 30 segments in the adult; capable of being coiled in a very close spiral: exoskeleton comparatively thick and firm.

Head small, included and concealed by the expanded first segment.

Antennæ inserted near together, below the middle of the head.

Labrum of male produced laterally into a large curved spine.

First segment very large, hood-like, concealing the head.

Segments with numerous abrupt and prominent carinæ; setiferous tubercles wanting; repugnatorial pores wanting.

Last segment trilobed.

Movements very slow.

Family STRIARIIDÆ (Bollman).

Striariine BOLLMAN, Bull. U. S. Nat. Mus., 1893, No. 46, p. 158.

Striariide COOK, Ann. N. Y. Acad. Sci., 1895, IX, p. 4.

Body subcylindric, capable of being coiled into a very close spiral.

Head small, mostly covered by the first segment; the face on each side broadly and deeply depressed.

Labrum in males produced at each end into a long decurved stylus.

Eyes poorly developed, of few ocelli, remote from the antennæ.

Antennæ inserted near together, below the middle of the head.

Mandibles with 10 pectinate lamellæ, a dentate lamella, a molar tooth, and a large masticatory plate; cardo very large; exposed surface of stipes small (compared with other families), nearly flat, not areate.

Mentum semielliptic.

Median lobe with a styliform process on each side.

First segment much larger than the others, expanded and produced anteriorly, hood-like, concealing the head.

Segments dorsally multicarinate longitudinally, and rough tuberculate; below unicarinate. Carinæ of equal size, the lateral carinæ not larger than the others. Median furrow present, including a fine ridge; setigerous tubercles wanting.

Supplementary margin regularly pectinate.

Pedigerous laminae anteriorly prominent.

First, second, fourth, and antepenultimate segments each with one pair of legs, the third and last two footless; the last two complete rings; whole number of legs 50.

Anal segment without carinæ, broadly trilobed. Under the apex with two papillæ.

Third pair of legs of males with the coxæ produced medianly into long, flask-like processes whose apices are accommodated by an excavation in the posterior face of the coxæ and second joint of the second pair of legs.

In males both pairs of legs of the eighth segment are modified into a complex copulatory apparatus, partially concealed and normally not projecting below the sides of the body.

Number of segments of adult, 30; younger stages unknown.

Distribution.—Temperate North America.

Genus STRIARIA Bollman.

Striaria BOLLMAN, ANN. N. Y. Acad. Sci., 1888, IV, p. 108.

Body small, about nine times as long as broad, cylindric subfusiform, narrowed posteriorly and behind the first segment. Head somewhat narrowed at the antennæ.

Vertex granular roughened, with evident longitudinal and transverse sulci.

Labrum in males produced at each end into a long decurved spine.

Eyes poorly developed, of few ocelli (5 to 9) differing in size and without regular arrangement.

Antennæ geniculate, of moderate length, joint longest, the others in order of length.

Mandibles with 10 pectinate lamellæ.

Cardo of gnathochilarium beset with spines.

Promentum small, triangular, slightly longer than broad.

First segment more than twice as long as the second, semielliptic, decurved at the sides, hood-like, concealing the head, strongly tuberculate, medianly and posteriorly with 10 longitudinal carinæ; median carinæ short, the others gradually longer; anterior and lateral margins raised.

Subsequent segments with 12 dorsal and lateral and 2 ventral carinæ, the latter separated from the others by a considerable ecarinate space. Surface not occupied by the carinæ rough with coarse, scattered, spinose tubercles.

Supplementary margin regularly pectinate with short, broad teeth.

Last segment projecting beyond the valves, ecarinate, very strongly tuberculate, posteriorly tridentate; the teeth broad and blunt, the incisions narrow, moderately deep; two long-conic, translucent papillæ at the base of the projecting apex.

Anal valves much flattened, strongly tuberculate, with 3 bristles.

Preanal scale semicircular, rough, with 2 bristles.

Pedigerous laminae broadly shield-shaped, inflated in front at apex and strongly tuberculate.

Stigmata large, elliptic, somewhat oblique, distant from the insertion of the legs.

First two pairs of legs small, 6-jointed.

Third pair of legs of males small, the coxæ very large, flask-like, produced ventrad into long processes.

Fourth, fifth, sixth, and seventh pairs of legs of males crassate, gradually larger from the fourth; third joint especially hypertrophied.

Male genitalia double, both laminae divided at apex into complex spinose and laciniate processes.

Ninth pair of legs of male two-jointed, the basal joint small, the apical capitate, shaped somewhat like a shoe.

Tenth legs of males with coxæ perforate.

Distribution.—Central Eastern States; also California.

The specimens on which this family is based differ from any known members of the *Chordeumatoidae* in the small head, poorly developed eyes, the antennæ inserted far from the eyes, low down and near each other, the moderate mandibular stipes, and the large first segment, characters in which they resemble the *Polyzonidae*. They differ further from the *Chordeumatidae* in the semicircular mentum, the carinae and rough granules of the segments, the trilobed anal segment, the flat anal valves and the peculiar second and third pairs of feet, all of which characters seem to be more or less unique. The carinae are not similar to those of the *Julidae* and *Lysiopetalidae*, being abrupt elevations of the surface, and not the edges of grooves. From the *Julidae* and *Lysiopetalidae* they differ in having no repugnatorial pores, and in this character are nearest the *Chordeumatidae*, with which they also agree in having 30 segments.

STRIARIA GRANULOSA Bollman.

(Plate LIII, figs. 1a-1j.)

Striaria granulosa BOLLMAN, Ann. N. Y. Acad. Sci., 1888, IV, p. 108; Bull. U. S. Nat. Mus., 1893, No. 46, p. 83.

Type.—No. 230, U.S.N.M.

Locality.—Beaver Creek, Jefferson County, Tennessee.

Length, 11 mm.; width, 1.2 mm.

Color in alcohol dull brownish, but probably stained from the rubber cork. In life probably much like the next species.

Body cylindrical, wider anteriorly, tapering very slightly caudad, and with twelve large carinae on each segment.

Head with sides flattened above and pubescent with fine, short hairs.

Vertex finely granular, roughened; below the anterior edge of the first segment with a medianly well-pronounced transverse furrow. In front of this the vertex is medianly prominent and laterally plane or depressed. The median sulcus is very shallow posteriorly, becoming gradually deeper and broader, and with a gradually more prominent ridge on each side. The ridges begin about halfway from the first

segment to a line connecting the bases of the antennæ, and diverge to the antennal sockets. The triangular space included is colored dark, with a median, longitudinally oval, light spot and a light spot between the antennæ.

Clypeus subquadrate, moderately convex, hirsute with rather short hairs, roughened medianly with fine, irregular, transverse wrinkles, laterally with very fine granules; lateral edges nearly straight, subparallel; lateral corners and lower median portion depressed and provided with a few hairs.

Eyes located on posterior of vertex, close to the edge of the first segment, of irregular shape, composed of five ocelli of moderate size. They are distant from the antennæ and are not close to the lateral margin of the head.

Antennæ located below the middle of the head and nearer to the median line than to the lateral margin. When the animal is coiled up the antennæ are held with the first three joints perpendicular, the fourth bent outward at a right angle to the third, the fifth is bent downward at a right angle to the fourth, the sixth, seventh, and eighth in a line with the fifth (fig. 1*i*) olfactory cones with high bases, to which they are articulated; that is, apparently two-jointed.

First segment very large, more than twice as long as the exposed portion of the second segment, very rough with rough granules, and on the posterior part of the dorsal portion with ten longitudinal carinæ, well pronounced, but not as large as those of the succeeding segments; median carinæ short, the lateral ones extending nearly across the segment; about one-fifth of the segment on each side is without carinæ. The posterior edge of the segment straight, and both the posterior and anterior lateral corners rounded; anterior portion of segment inflated and expanded so as to cover the head, the anterior lateral corners slightly produced; anterior edge with a raised margin and slightly curved, so that the lateral length is about two-thirds of the dorsal.

Third segment footless, one pair of legs on the fourth segment, with protuberances from the coxæ (fig. 1*d*). These legs are free; that is, not joined to the body except internally (the projections curve forward), so that this pair of feet could be protruded.

Segments subsequent to the first with a small median carina, and with six others, much larger, on each side, thicker and higher at their posterior ends. Below these the surface of the segment is smooth for a space about equal to three times the distance between two carinæ, or very finely roughened, but without the slightest trace of longitudinal carina or striation. Below this is another carina, distant from the ventral edge of the segment by somewhat more than the distance between two dorsal carinæ. This carina projects anteriorly from the subsegment, and does not reach its posterior margin. The exposed surface of the anterior subsegments and the posterior region of the posterior are very rough with granules, and one or two more or less

irregular rows of larger, rougher, granules are in the spaces between the dorsal carinæ. The whole surface of the segments and carinæ is finely granular-roughened, so as not to appear smooth and shining. The dorsal median carina decreases gradually caudad. The carinæ are very abrupt elevations, and differ very strikingly from those of *Lysio-petalum*, not having the appearance of the edges of grooves as in that genus. The anterior granule between the dorsal carinæ is slightly larger than the others, and is tipped with a larger, though small, seta, very small setæ being sometimes discernible on other granules. On the first segment and on the posterior segments the granules are larger, very rough and wart-like. On the posterior segments the carinæ are closer together and slightly larger.

Penultimate and antepenultimate segments yellow, without the ventral carinæ, like the first. Penultimate segment footless.

Last segment anteriorly somewhat constricted, very rough and granular, posteriorly broadly and bluntly, though deeply, tridentate; on the sides moderately sinuate, with no trace of carinæ.

Anal valves very flat, slightly convex in the middle, very rough with granules.

Preanal scale semicircular, convex, very rough, with two long hairs.

STRIARIA COLUMBIANA, new species.

(Plates LIII, fig. 3a; LIV, figs. 1a-1m.)

Type No. 775, U.S.N.M.

Locality.—Washington, D. C.

Length, 10 mm.; width, 1 mm.

Differs notably from the preceding in the much smaller carinæ, the more shallow incisions of the terminal segment, the larger processes of the coxæ of the third pair of legs, the longer ventral lobe of the fourth segment.

Color horn-brown, dark above, usually lighter between the three lateral carinæ, which gives the appearance of a yellow lateral line; below this line darker, then lighter. Ventral parts and three basal joints of legs dirty white, the apical darker. Last three segments yellowish or whitish, abruptly differing from the others; sometimes, however, the last segment is brownish. Antennæ usually colored like the legs. A fine pale median line is usually apparent, as well as a light transverse band near the suture between the subsegments. Near the posterior margin of each segment is a finer dark line sinuate at the carinæ, and running back upon each, thus giving the appearance of a series of arches.

The second and third of the dorsal carinæ, counting from side, are farther apart than the others, while the first and second are nearest together; the first is also more or less curved. Between each pair of carinæ, that is, in every second space, is a small setiferous tubercle

perhaps representing those of the Chordeumatoidea; this is opposite the anterior ends of the carinæ.

Preal scale very broadly rounded or subtruncate.

The setiferous papillæ (spinning organs) of the last segment have their bases much longer and more slender than in the Craspedosomatidæ.

This species is not uncommon in dry woods in the District of Columbia. It seems most abundant in the woods near the Catholic University, to the south of the Soldiers' Home grounds. The creatures frequent small hollows filled with decaying leaves in rather open dry woods consisting mostly of oak. Other myriapods were scarce, and the *Striaria* outnumbered all other species combined. It has been collected also in the Zoological Park and at Glen Sligo.

The distinctness of these animals from the Craspedosomatidæ is very evident in the living condition. The Craspedosomatidæ are the most active and fleet of foot of the Diplopoda, while *Striaria* is as slow as the slowest *Polyzonium*. When disturbed they at once coil up tightly and remain in that condition several minutes, sometimes for a considerable period, after which they slowly uncoil and as slowly move away. All their movements are sluggish and clumsy, their whole dependence being apparently placed on their strong armor.

STRIARIA CALIFORNICA, new species.

(Plate LIII, fig. 2a.)

Type.—No. 776, U.S.N.M.

Locality.—California.

Length, 13 mm.; width, 1.4 mm.

Color in alcohol pale horn-brown.

Distinguished from the preceding by the larger size, more cylindrical body, less constricted behind the head, proportionally somewhat smaller dorsal and larger ventral carinæ, fewer and smaller tubercles. First segment proportionally slightly smaller than in *S. granulosa*.

Eyes, seven, of different sizes and without regular arrangement.

Dorsal carinæ æqui-distant; the lateral not differing from the others in this respect.

Anal segment not so rough, dark colored, darker than those immediately preceding it; apical lobes broad, the notches narrow.

Length, 13 mm.; width, 1.4 mm.; habitat, California, probably near Sausalito.

Collected by Major Thomas L. Casey. A single female specimen.

EXPLANATION OF PLATES.

PLATE LIII.

Striaria granulosa, male.

- Fig. 1a. Gnathochilarium.
1b. First pair of legs.
1c. Second pair of legs.
1d. Third pair of legs.
1e. One side of the ventral part of segment 4.
1f, 1g. Views of apical portion of copulatory legs.
1h. Last segment, from above.
1i. Head and first three segments, from below.
1j. Same, from the side.

Striaria californica.

- 2a. Last segment, from above.

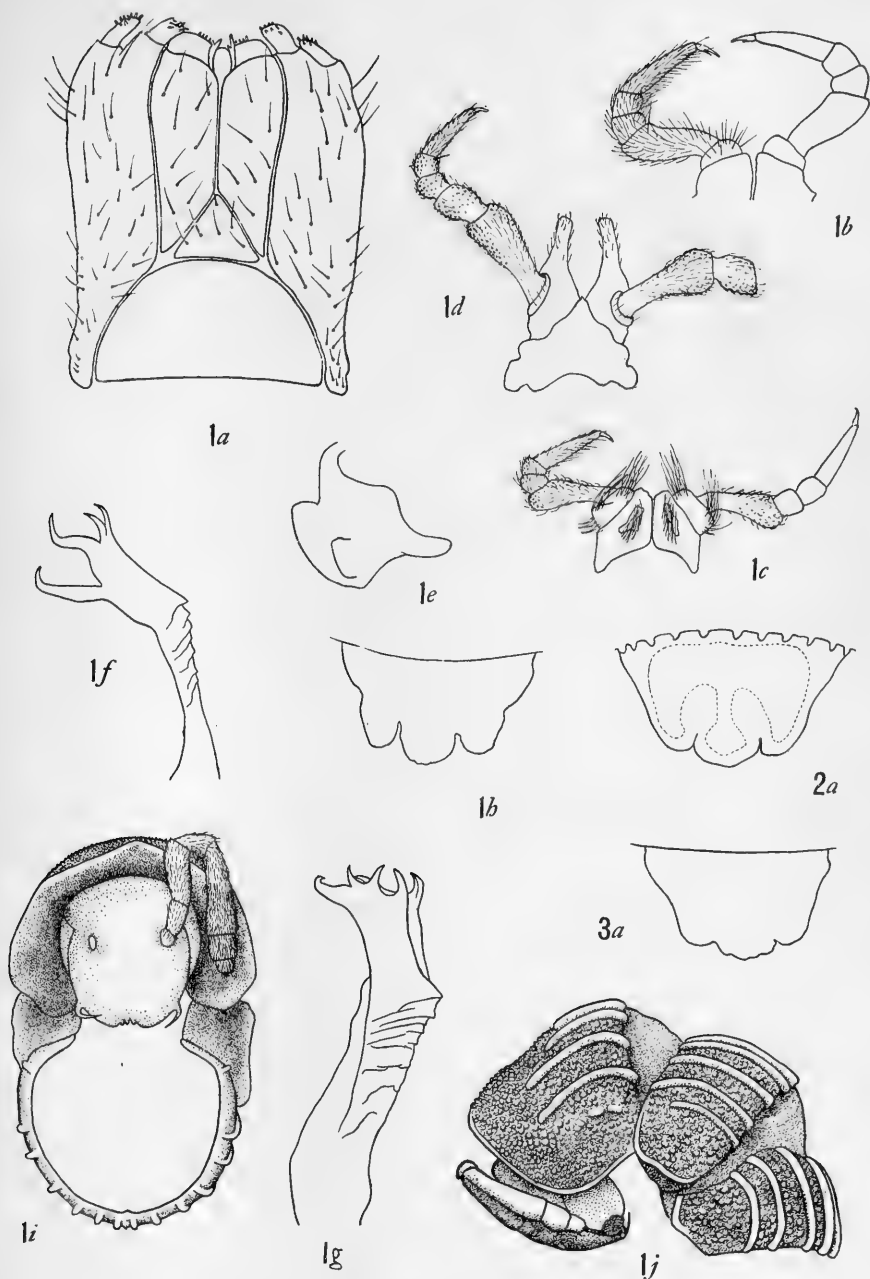
Striaria columbiana.

- 3a. Last segment, from above.

PLATE LIV.

Striaria columbiana—continued.

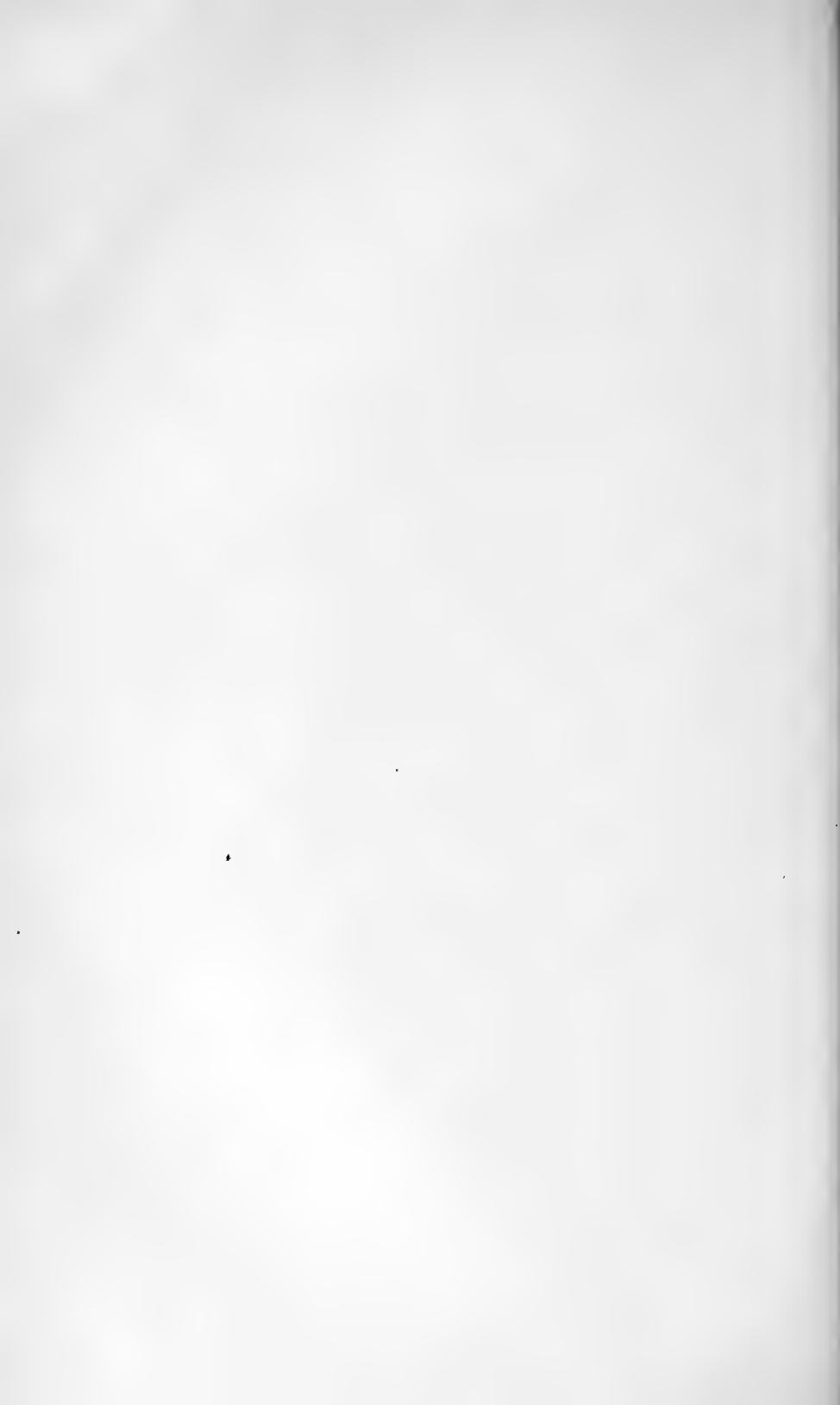
- Fig. 1a. Labrum of male.
1b. Median part of same, more highly magnified to show the arrangement of the setiferous punctations.
1c. Mandible.
1d. Last joint of same.
1e. Last two joints of antenna.
1f. Segments 3 to 7, ventral view, showing legs, pedigerous laminae, and spiracles.
1g. Third pair of legs of male.
1h, 1i. Different aspects of the apical portion of the copulatory legs.
1j. Ninth pair of legs of male, the second pair of the seventh segment.
1k. Copulatory legs, anterior face.
1l. Last eight segments, ventral view.
1m. Last six segments, lateral view.

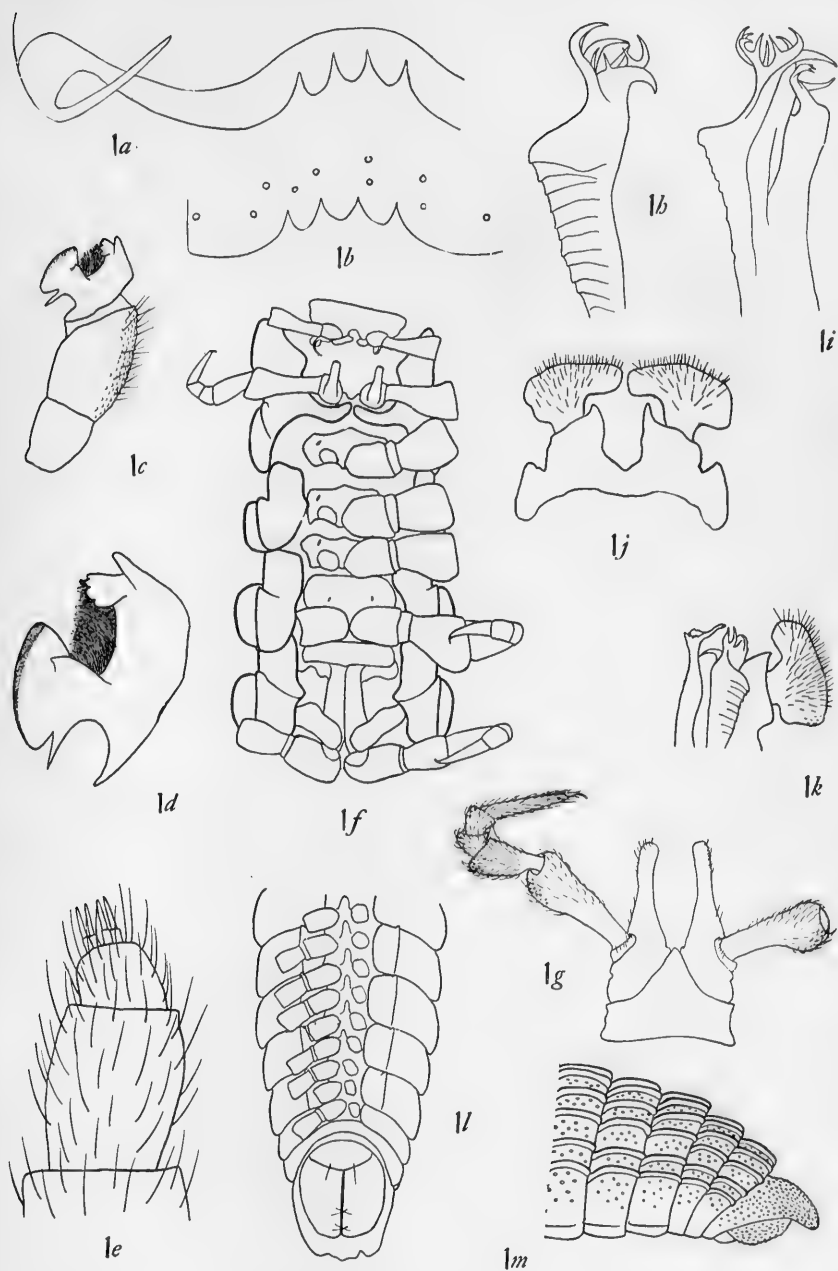


DIPLOPODA OF THE FAMILY STRIARIIDÆ.

FIG. 1. *Striaria granulosa*.
FIG. 2. *Striaria californica*.

FIG. 3. *Striaria columbiana*.





DIPLOPODA OF THE FAMILY STRIARIIDÆ.

FIG. 1. *Striaria columbiana*.

FOR EXPLANATION OF PLATE SEE PAGE 676.



AFRICAN DIPLOPODA OF THE FAMILY GOMPHODESMIDÆ.

By O. F. Cook,
Custodian of Myriapoda.

The Gomphodesmidæ constitute a clearly defined and homogeneous group. They are apparently the dominant Merocheta of tropical East Africa, with reference both to individuals and species, the Oxydesmidæ being their only rivals. The Gomphodesmidæ are clearly a more specialized group than the Oxydesmidæ and, indeed, present several characters unique in the order. The first six legs of males, for instance, are provided at the end of the last joint with a fleshy pad or sole, present in all known species. In several genera the number of olfactory cones of the last antennal joint is 10, while 4 is the normal and constant number for all other known Merocheta. In some forms segment 15 bears in males a subtriangular process from between the anterior pair of legs; such a modification of the sternum of a single segment of the posterior part of the body is elsewhere unknown in the Diplopoda. Several other equally peculiar but not entirely unparalleled secondary sexual characters are described under the various genera.

In habit the Gomphodesmidæ are also strikingly distinct from all African Merocheta, the salient features being a robust and compact body, a strongly convex, unsculptured dorsum, lateral carinæ with prominent, thickened, even, and entire lateral margins, the posterior segments greatly shortened, especially segment 18, with the last segment short, broadly triangular, narrowly truncate at apex and without prominent setiferous tubercles. The presence of pores on segments 11 and 14 will also serve as a means of family diagnosis, with the single exception of the genus *Marptodesmus*.

An agreement in pore-formula has led previous writers to refer the members of this family to the genus *Eurydesmus* Saussure,¹ a very imperfectly known genus supposed to come from South America. Probably related Brazilian forms belong to a series which has been

¹Essai Myr. Mex.—Mem. Soc. Phys. et Hist. Nat. Geneve, 1860, XV, p. 77. The type is *E. angulatus* Saussure, *idem*, p. 78, supposed to be from Brazil.

given the name *Chelodesmidæ*.¹ In *Chelodesmus* there is a laminate process from the distal corner of the ventral side of the penultimate joint of the legs, much after the manner of most *Spirostreptidæ*, and the other secondary characters are equally different from those of the *Gomphodesmidæ*, so that if affinity with the *Chelodesmidæ* may hardly be denied, yet the relationship, if any, is certainly not close, and no forms are known which could be looked upon as connecting links.

Family GOMPHODESMIDÆ Cook.

Gomphodesmidæ Cook, Ann. N. Y. Acad. Sci., 1895, IX, p. 4; Proc. U. S. Nat. Mus., 1895, XVIII, p. 82.

Body rather small to large, robust, oblong, abruptly narrowed at both ends, about five times as long as broad, the cavity somewhat depressed.

Vertex smooth, moderately and evenly convex, without hairs; sulcus distinct, meeting a subtransverse interantennal sulcus; postantennal depression deep, the supposed sense-organ large.

Labrum slightly emarginate, with three short, blunt teeth.

Antennæ filiform, joints in order of length 2, 4, 5, 6, 1, 7, joints 4-6 more or less subequal; olfactory cones 4 or 10.

Mandibular stipe with exposed surface divided by sutures into five areas, the basal larger than the others taken together.

Hypostoma strongly arcuate; rising from each side of the convex median portion is a flattened oblong process lying against depressions of the lower part of the mentum.

Cardo present, transversely oval.

Mentum broadly triangular, long pointed in front, very broadly emarginate behind, hirsute.

Stipes over twice as long as broad, hirsute; lingual lobes large; median lobe not evident.

First segment subelliptic or subreniform, usually about three times as broad as long.

Segments with dorsal surface nearly or quite smooth, neither granular nor areate. Along the posterior margin of each segment above is a row of very fine and short longitudinal wrinkles or striae, usually very distinct under a lens. They occur on the immediate edge of the tergite, at the base of the supplementary margin.

Lateral carinae moderately or strongly approximate, one-fourth as broad as the body cavity or narrower, inserted from one-half to three-fourths of the height of the body cylinder; lateral margins with a

¹Proc. N. Y. Acad. Sci., 1895, IX, p. 4. According to Saussure, his genus has the characters of *Fontaria* with the exception of the pore-formula. The South American forms known to me have not the spine of the second joint of the legs, the most characteristic feature of the *Xystodesmidæ*, though the habit is not strikingly different. Saussure's statement, however, led me to include *Eurydesmus* in the same family with *Fontaria*, but I now strongly suspect that it is in reality not widely different from *Chelodesmus*.

distinct, prominent callus, the edge blunt, entire; carinæ of anterior segments curved slightly forward; those of the posterior turned more strongly backward and their posterior corners increasingly produced caudad, usually sharp and dentiform on segments 17 to 19.

Repugnatorial pores small, dorsal or sublateral, located in a usually distinct cavity near the middle of the marginal calli of segments 5, 7, 9 to 19, with the single exception of the genus *Marptodesmus*, which lacks pores on segments 11 and 14.

Below the carinæ the segments are smooth or finely rugulose, with a small secondary carina above the insertion of the legs.

Anterior subsegments smooth or very minutely striolate longitudinally under a lens.

Supplementary margin long, membranous, finely striate longitudinally, not pectinate.

Penultimate segment very short, its small and dentiform carinæ included between and seldom exceeding those of segment 18, which are many times larger.

Last segment very short, triangular, the apex narrow, truncate or somewhat rounded, the entire sclerite bearing 16 setæ, as follows: Two pairs lateral, two pairs marginal, two pairs dorsal, all these rising from small or indistinct tubercles; one pair apical and one subapical, rising from punctations.

Anal valves with compressed, elevated margins and two setigerous tubercles, the upper pair placed on the outer slope of the raised margin, the lower somewhat removed from it.

Preanal scale subtriangular or rounded, usually apiculate, the two setiferous tubercles more or less developed, located rather close together.

Sternal space between the bases of the legs broad, except on anterior and posterior segments; the sterna are variously modified by the presence of secondary sexual characters noted below.

Legs, as compared with other families of the order, rather short and moderately robust.

Secondary sexual characters.

This family offers a considerable series of constant secondary sexual characters, several of which are, as far as known, entirely unique. In common with most other Merocheta, the females are somewhat more convex and robust than the males, and have shorter and more slender legs. The more peculiar features are as follows:

1. The sterna are in most of the larger genera provided in males with two transverse, medianly interrupted sharp ridges connecting the bases of the legs.

2. Sternum of fifth segment with a pair of small processes located between the bases of the fifth pair of legs: *Harmodesmus*.

3. Sternum of sixth segment with two distinctly separated processes

located between the bases of the sixth pair of legs: *Harmodesmus*, *Marptodesmus*.

4. Sternum of sixth segment with a similarly located very broad, thin and lamellar process divided nearly to base into two semicircular lobes: *Uloidesmus*.

5. The process broader than long, subquadrate, distinctly and broadly excised distally: *Mychodesmus*.

6. The process slender, quadrituberculate distad: *Tycodesmus*.

7. The process is semicircular, subquadrate, or triangular, about as broad as long, medianly more or less apiculate: *Astrodesmus* and all genera not mentioned under the four preceding numbers.

8. The posterior edge of the rim of the aperture in which the copulatory legs are inserted is deeply and broadly emarginate, leaving a pair of prominent laminate processes at the bases of the normal legs of the seventh segment: *Tycodesmus*, *Tymbodesmus*.

9. Transverse ridges between the posterior pair of legs of segment 8 short (narrow) and much more prominent than the others: *Tycodesmus*, *Tymbodesmus*, *Omodesmus*, and in a less degree, *Astrodesmus*.

10. Sternum of segment 15 with a median subtriangular, distally rounded, medianly canaliculate process directed cephalad and ventrad: *Astrodesmus* and all the larger genera except *Gomphodesmus* and *Tycodesmus*; the smallest genera, *Uloidesmus*, *Mychodesmus*, *Neodesmus*, and *Sphenodesmus*, are without such a process.

11. Segment 16 with a small papilliform process located similarly to the process of segment 15 previously described: *Tycodesmus*.

12. Second male legs with coxæ produced (ventrad), most in *Omodesmus*.

13. First 6 pairs of legs of male provided with a fleshy sole at the apex of the last joint; present in all known specimens.

14. The claw is more or less distinctly reduced, being most reduced in genera with crassate legs and large soles.

15. Anterior male legs with joints 4 to 6 more or less tuberculate on the ventral face: *Astrodesmus*, *Marptodesmus*, and probably most of the other genera.

16. Anterior male legs with second joint strongly inflated on the dorsal side; this feature appears in all the genera as far as known.

17. In the genus *Merodesmus* the coxæ of the second legs are greatly produced ventrad and beset with very long hairs.

18. In *Gomphodesmus* the coxæ of the second legs are somewhat produced and on the lateral side are expanded and bear two rounded, flattened processes.

19. In *Gomphodesmus* the ventral part of the third segment of the female is produced into a thin prominent rim, which is deeply and broadly emarginate in the middle to accommodate the second pair of legs.

The copulatory legs of the Gomphodesmidae are constructed on a

plan quite distinct from those of any other family. The second joint is compressed or triquetrous, hairy at base; it is soon narrowed into a strongly compressed chitinous band, which is strongly deflexed and provided with an irregular knot-like process in the sinus. Distad from this knot the copulatory legs are narrowed into a usually very long and variously curved flagellum. There are two genera, *Marptodesmus* and *Harmodesmus*, which depart strongly from this typical form and have other characters which separate them from the remainder of the group, without, however, connecting them with any other. The remarkable copulatory apparatus just described, together with the unusual number and unique character of the appliances whose function is in all probability to assist in copulation, are perhaps indications of some peculiar biologic condition existing in the present family, and perhaps correlated with the fact that fully seven-eighths of the known specimens are males. The inference would seem to be that in connection with the addition of the numerous accessories there has arisen a preponderance of males such as is not known to exist elsewhere among Diplopoda. As in other families, it has been found possible to separate the genera largely by the use of secondary sexual characters. That these are not meaningless and variable features, as supposed to be the case in some Coleoptera, for instance, appears from the above facts as well as from the constancy of the characters themselves.

It will perhaps appear that the genera have been unduly multiplied, which the future only can demonstrate. At present it seems to me that the species which remain as congeneric are not at all closely related, with one or two exceptions. It is also to be considered that a group obliged to adopt so many devices to make perpetuation possible would be likely to break into distinct subdivisions.

This family is distributed throughout tropical East Africa, and outlying species are known from Caffraria, the Upper Nile region, and from the German colonies of Kamerun and Togo. The Togo material consists of two or three young individuals which have not been described, but they belong without doubt to the present family. A single species, *Tymbodesmus figlinus*, from Kamerun, is known to me. Porath has reported *Aulodesmus mossambicus* from Kamerun, but its existence there is highly improbable, the nearest relative of the Kamerun species being that from the Nile basin, collected by Schweinfurth at Seriba Ghattas, Djur, in the Bahr el Ghazal region.

ANALYTICAL KEY TO THE SUBFAMILIES OF GOMPHODESMIDÆ.

Sternum of sixth segment of male with two slender processes located between the bases of the anterior pair of legs and separated from each other by a considerable space; fifth segment with a pair of similar though smaller processes between the posterior legs; copulatory legs with second joint nearly straight, short, divided at apex: Subfamily MARPTODESMINÆ, p. 682.

Sternum of sixth segment of male with a single median, slender, subquadrate, or very broad and medianly excised process; fifth segment without processes; copulatory legs with second joint very long, strongly compressed antero-postically

beyond the hairy base; the compressed portion is strongly decurved and bears in the sinus a usually large and nodiform process; beyond this is a usually long and slender, flexuous flagellum: Subfamily GOMPHODESMINÆ, p. 687.

Subfamily MARPTODESMINÆ.

The genera of this subdivision are two in number and agree closely in habit and small size. They are most conspicuously different from the remainder of the family in having the copulatory legs short and comparatively straight, not bent in the middle and produced into the long, flexuous flagellum which distinguishes other Gomphodesmidae among Merocheta.

ANALYTICAL KEY TO THE GENERA OF MARPTODESMINÆ.

Repugnatorial pores 11, segments 11 and 14 poreless; copulatory legs abruptly narrowed immediately above the broad base; distally with two subequal simple divisions: Genus *Marptodesmus*, p. 682.

Repugnatorial pores 13, segments 11 and 14 provided with pores; copulatory legs subconic, narrowed toward the apex and provided with a long, mesially directed, curved process and two somewhat unequal terminal divisions, the ventral (posterior) stouter and bifid at the apex; the other more slender, with several mesially directed teeth: Genus *Harmodesmus*, p. 685.

Genus MARPTODESMUS Cook.

Marptodesmus Cook, Proc. U. S. Nat. Mus., 1895, XVIII, p. 92.

Description.—Body of medium size, about four times as long as broad, oblong, very abruptly narrowed anteriorly, subtruncate posteriorly.

Labrum with shallow emargination and three small, rounded teeth of moderate length; supralabral bristles very numerous.

Antennæ filiform, second joint longest; joints 2, 3, 4, 5, 6 subequal; olfactory cones four, arranged in a square.

First segment three times as broad as long; anterior and posterior margins mediaily straight and subparallel; lateral end rounded, the posterior corner broadly truncate, the anterior slightly so; the segment is much broader than the head, twice as long, and somewhat narrower than the exposed portion of the second segment.

Segments smooth and shining, without markings.

Lateral carinæ approximate, about one-fourth as wide as the body cavity, inserted halfway up; a fine raised margin broadest laterad, especially on poriferous and caudal segments.

Repugnatorial pores opening subdorsally in a large, deep, rounded depression of the outer slope of an intramarginal ridge of segments 5, 7, 9, 10, 12, 13, 15, 16, 17, 18, 19.

Preanal segment very short; anal segment very short, the apical portion triangular, truncate at apex, and with four punctations there; twelve other punctations, ten located as in Plate LV, fig. 2j, and two others lower down on the sides, below the level of the carinæ (Plate LV, fig. 2h).

Anal valves with strongly elevated margins; two setigerous punctations, the superior marginal, the inferior submarginal.

Preanal scale semielliptic, a broad, rounded, setigerous prominence on each side of the middle, which is not produced, but rather truncate.

Sterna broad and densely hirsute, except the first and last.

Sternum of the fifth segment of male with two large papilliform hirsute processes between the second pair of legs.

Sternum of segment 6 with two similar processes between the anterior pair of legs.

Sterna of post genital segments of male with a stout, sharp, conical spine at the base of each leg, more pronounced on posterior segments and larger between the posterior pair of legs of each segment.

Sternum of segment 15 not different from its neighbors.

Legs of male crassate, hirsute, with long bristles, the joints in order of length 3, 2, 4, 5, 6, 1.

Second legs of male with the coxæ produced ventrad into a rounded-conic, somewhat recurved process; genital opening on the median face of the coxa, at the base of the process.

Seventh pair of legs with a broadly conic process on the apex of the inflated coxa, directed mesocephalad.

Pregenital legs of male with the distal joint supplemented at apex by a cushion-like process as long as the very slender claw.

Two distal joints of male legs roughened on the ventral face by papilliform tubercles, very large on post-genital legs.

Male genitalia with a broad basal joint; second joint incurved at base, ungual portion subequal in length with the other, slender, straight, bifid at apex.

In this genus the first segment is much more rounded laterally than in *Astrodesmus*, being without an apparent angle; the whole segment is more convex, making the ends more decurved; it is narrower in comparison with the second segment. It is, furthermore, not submarginate toward the ends, as in *Astrodesmus*.

The greater convexity is shared by the entire body, which has the dorsum more arched and the carinæ more depressed than in *Astrodesmus*.

MARPTODESMUS CHANLERI Cook.

(Plate LV, figs. 2a-2j.)

Marptodesmus chanleri COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 95, pl. IV, figs. 1-10.

•Vertex smooth and shining, sulcus transversely rugulose, not deeply; postantennal depression subvertically rugulose near the lateral margin.

Clypeus smooth and shining; a sharp, oblique depression parallel to the lateral margin, halfway between the margin and the antennal sockets; below, a few scattering bristles, gradually longer; supralabral bristles long and very numerous, a crowded row next the margin, otherwise without apparent arrangement.

Antennæ sparingly hirsute, the distal joints moderately so; basal joint bulbous, the others, except the last, obconic, with equal diameters; length, 4.5 mm.; diameter, 0.25 mm.; length of second joint, 0.8 mm.

Mentum, stipes, and lingual laminae densely hirsute with short hairs, except distally; stipes and laminae with long bristles along the margin.

First segment smooth and shining, a slight transverse depression in front of the middle; lateral ends with a fine raised margin. Medianly the segment is slightly and broadly emarginate.

Subsequent segments like the first, slightly broader and longer to the fifth; surface smooth and shining, very finely and regularly reticulate; areolate under sufficient magnifying power.

Lateral carinae irregularly rugulose inside the raised margin, more especially on posterior segments; on the first four segments the posterior margin is curved forward, while on subsequent segments it is turned more and more caudad and produced into a conical point until the projection of the eighteenth segment exceeds the nineteenth segment in length (see Plate LV, fig. 2j).

Posterior segments with scattering longitudinal wrinkles above, the submarginal wrinkles more pronounced.

Anal segment above irregularly rugulose transversely; setigerous punctations very inconspicuous. No setae were found, though their absence is probably accidental.

Anal valves not inflated, vertically rugose, the margins thick, raised, but not so strongly compressed as to be bounded by a definite furrow.

Preal anal scale very thick, somewhat rugulose on the edge, mostly smooth and shining.

Sterna, especially the posterior, densely hirsute with fine, long hairs.

Processes of the sternum of the fifth segment of males straight, erect subspatulate, flattened cephalo-caudad, armed at base with a few long, divergent bristles; naked and nearly smooth distad.

Processes of the sixth segment similar in shape, armed with long bristles on their inner faces, otherwise naked; in size they are slightly larger than those of the fifth segment.

Legs of male crassate, more or less densely hirsute with very long hairs.

Coxae of first pair of male legs approximate, moderately hirsute distad. Coxae of second male legs somewhat separated, conically produced ventrad, and with irregular prominences caudad; naked except a few long bristles. Coxae of third and subsequent legs widely separated, more or less hirsute. Coxae of seventh legs of males prominent mesad, especially the anterior corner; these prominences, with the processes from the sternum, give protection to the genitalia.

Pregenital legs of male with the claw much reduced, and a white membranous or fleshy sole projecting nearly as far as the claw. This is doubtless to assist in grasping the female; the same contrivance is found among the smooth Iulidae.

Postgenital legs of males with coarse, rounded, chitinous tubercles on the inner face of the apical joint; smaller tubercles also on the sub-apical joint.

Male genitalia simple, the basal joint very small, almost hidden under the expanded reniform base of the apical, which is densely hirsute on its median face, and has some especially long bristles at the base of the ungual portion. This last is bifid nearly half its length, the divisions subequal, one strongly falcate, the other oblique and less falcate.

Color in alcohol a faded light brown, the carinæ and ends of the anterior segments whitish. The posterior median part of each segment is lighter than the rest, except the carinæ, and the anterior part of the animal is lighter than the posterior. Legs and antennæ also light brown.

Length, 24 mm.; width, 6 mm.

Locality.—Tana River, East Africa.

Type.—One mature male in the U. S. National Museum collection.

Genus HARMODESMUS Cook.

Harmodesmus Cook, Proc. U. S. Nat. Mus., 1895, XVIII, p. 83.

Body small, about four times as long as broad, oblong; dorsum moderately convex, the carinæ somewhat horizontal.

Antennæ filiform, rather slender; joints 2 to 6 equal; olfactory cones 4.

First segment three times as broad as long, subelliptic, nearly symmetrical; the anterior and posterior margins converging laterad so that the carinæ are evenly rounded.

Segments dorsally smooth and shining, distinctly rugulose laterad.

Lateral carinæ inserted about halfway up, in width equal to about one-third the body cavity; the marginal callus distinct, moderately broad and prominent; on anterior carinæ the callus is narrowed; on the first it is short and passes very gradually into the raised margin; posterior corners of carinæ rather slightly produced, those of the posterior segments not narrowed and dentiform as in some of the larger genera.

Repugnatorial pores 13, facing dorso laterad and located in distinct excavations.

Preanal scale subsemicircular, scarcely apiculate; setiferous tubercles distinct, projecting slightly beyond the posterior margin but not exceeding the apex.

Sterna without transverse ridges.

Sternum of segment 5, with a distinct, narrowly conic process at the base of each leg of the fifth pair.

Sternum of segment 6 with larger similarly located subconic processes whose apices are turned obliquely laterad and cephalad.

Sternum of fifteenth segment unmodified.

Legs of males moderately crassate; dorsal surface of second joint scarcely inflated.

Anterior male legs to the sixth provided with a rather small fleshy sole.

Coxæ of second male legs with a slight rounded prominence in the mesial face of which is located a seminal opening.

Copulatory legs subcompressed at base, scarcely trigonal, and with a nodiform projection on the anterior side; the hairy portion is separated from the ungual by a distinct constriction or notch, as viewed from the side; the ungual portion is very short, less than half the other and bears three spiniform processes; the proximal is slender and turns mesad and distad, crossing its fellow; the other two are subequal in size and length; the posterior (ventral) turns mesad and then ventrad (cephalad); the other is directed cephalad and bears several slender spiniform teeth, which are directed mesad from its mesial margin.

HARMODESMUS NITENS Cook.

(Plate LV, figs. 1a, 1b.)

Harmodesmus nitens COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 83.

Vertex smooth and shining, evenly convex, without hairs; the sulcus slight, the suture distinct.

Clypeus without hairs; a pair of minute setiferous punctations between the antennal sockets and about as far from each other as from the sockets; somewhat below these is another pair of punctations wider apart; lateral edges of clypeus straight, the inferior corners rather square; labral emargination slight.

Antennæ rather sparsely hirsute with short hairs.

First segment with the carinae tilted somewhat horizontally, the anterior side somewhat downward; the raised anterior margin extends to the height of the antennæ; the posterior is somewhat shorter; the lateral part thus margined is distinctly rugulose.

Segments dorsally smooth and shining, the carinae distinctly rugulose; the posterior subsegments are somewhat more convex than is usual, so that, viewed from the side, the body appears slightly moniliform.

Lateral carinae with distinct raised margins in front and behind, the calli with their mesial edge distinct and longitudinal; lateral margins rounded, the corners obsolete on anterior segments, the posterior corner gradually more prominent, produced only on posterior segments.

Repugnatorial pores facing dorsolaterad, located in distinct excavations of the marginal callus, which is much broader on poriferous segments.

Anterior subsegments smooth on their anterior part, longitudinally rugulose on the posterior half; transverse sulcus very narrow and distinct, scarcely crenulate; supplementary margin very short.

Penultimate segment short, exposed portion equal to about one-third

of the preceding; the carinæ broad and rounded, not exceeding those of segment 18.

Last segment rather narrowly triangular, abruptly narrowed near the small, truncate apex.

Anal valves with very thin and narrow, compressed margins, especially below; the margins are, however, not prominent and are greatly exceeded by the projection of the last segment; surface of valves and preanal scale subrugulose.

Sterna rather densely hirsute between the bases of the legs, with a naked depression in the middle, between the anterior pair.

Sternum of segment 5 with somewhat longer hairs at the base of the processes, the apices of which are naked.

Sternum of segment 6 less hirsute, the processes with long hairs near the apex.

Coxæ of second legs of male slightly prominent ventrad.

Legs of male moderately hirsute, the second joints only slightly inflated on the superior face; joints 3 and 4 distinctly more crassate than the others; joints 5 and 6 finely tuberculate on the ventral face.

Copulatory legs (Plate LV, figs. 1a, 1b).

Color of alcoholic specimens rather bright brown, the carinæ yellowish.

Length, 17.5 mm.; width, 4.5 mm.; without carinæ, 2.5 mm.; length of antennæ, 4 mm.; leg from tenth segment, 4 mm.

Locality.—Ravirondo, German East Africa.

Three mature male specimens collected by Neumann in April, 1894, are in the Berlin Museum.

Subfamily GOMPHODESMINÆ.

The members of this group vary as much in size as any of the diplopod families, and include the most conspicuous of East African Merocheta. The peculiar copulatory legs distinguish them not alone among African forms, but separate them at once from all others.

ANALYTICAL KEY TO THE GENERA OF GOMPHODESMINÆ.

Series I. GOMPHODESMI. Olfactory Cones 4.

Process of sternum of sixth segment of male very broad, divided nearly to the base into two broadly rounded, thin, and lamellar lobes; copulatory legs with basal part of second joint long and slender, narrower than the unusually broad flagellum; the conspicuous nodiform process of the sinus of the copulatory legs of other genera appears here as a rather slender, flattened lateral tooth: Genus *Ulodesmus*, p. 689.

Process of sternum of sixth segment subquadrate or narrower, not extending to the bases of the legs between which it is located; copulatory legs with flagellum decidedly narrower than the basal portion, and with the process of the sinus conspicuous.....

Process of sternum of sixth segment distinctly broader than long, medianly with a broad, subrectangular excision; flagellum of copulatory legs short, very broad at base, the slender portion very short, ending in two subequal, strongly divaricate prongs: Genus *Mychodesmus*, p. 692.

Process of sternum of sixth segment semicircular, triangular, subquadrate, and medianly distinctly apiculate, or slender; flagellum slender from the base or at least with a long, slender, strongly curved or flexuous distal prolongation.....

Copulatory legs enormously elongate, much larger than the unmodified legs; the flagella strongly decurved, then turned laterad and expanded, slender and attenuate distad, the apex lying under the carina of segment 6: Genus *Neodesmus*, p. 694.

Copulatory legs mostly shorter than the others, turned mesad so that the flagella cross each other, or at least are not projected laterad; not expanded in the middle, the apices of the flagella lying near the median line.....

Sternum of segment 16 of male with a small, distinct, subconic process located at the middle of the anterior edge of the posterior subsegment; process of segment 6 twice as long as broad, somewhat narrowed in the middle, the distal corners prominent, the apical edge distinctly bidentate: Genus *Tycodesmus*, p. 697.

Sternum of segment 16 unmodified; process of segment 6 as broad as long, distally simply apiculate.....

Lateral carinae, especially the anterior, not sloping in the direction of the dorsal arch, but nearly horizontal; anterior segments with their posterior corners thickened, the very broad marginal calli there not clearly defined mesad: Genus *Omodesmus*, p. 700.

Lateral carinae sloping nearly in the direction of the dorsal arch; anterior carinae not thickened; their marginal calli not broader, clearly defined.....

Preanal scale with setiferous tubercles greatly enlarged, papilliform, much exceeding the apex; first segment with anterior and posterior margins converging to a somewhat symmetrical and produced, rounded lateral corner, the apex of which is occupied by the widened marginal callus; sterna of males without transverse ridges; sternum of segment 15 without a process: Genus *Gomphodesmus*, p. 704.

Preanal scale with setiferous tubercles scarcely exceeding the apex; first segment with lateral corner not produced, the callus not widened; segment 15 with a subtriangular process from the anterior edge of the sternum; sterna of other large forms with a distinct, transverse, medianly interrupted ridge between the bases of each pair of legs.....

Flagella of copulatory legs extended cephalad and downward in a simple and regular curve, so that their apices lie near their bases and are directed downward and backward; nodus with a large and broadly mammillate lateral prominence; first segment much narrowed laterad: Genus *Tymbodesmus*, p. 707.

Flagella with nearly two turns in a diffuse spiral, their apices lying between the bases of the copulatory legs, directed dorsad and cephalad; lateral prominence of nodus small and spiniform; first segment with a longer lateral side: Genus *Aulodesmus*, p. 713.

Series II. ASTRODESMI. Olfactory Cones 10.

Female with the coxae of the second pair of legs produced ventrad into cylindrical processes which exceed in length the second joints of the legs and are densely hirsute with very long hairs: Genus *Merodesmus*, p. 717.

Females of *Astrodesmus*, the only genus comparable in size and habit, with coxae not produced.....

Sternum of segment 15 of male without a process; sternum of segment 6 with a semicircular, minutely apiculate process; flagella of copulatory legs accommodated by a depression in the anterior part of the ventral surface of the seventh segment; first segment with lateral side evenly rounded, its raised margin scarcely thickened: Genus *Sphenodesmus*, p. 719.

Sternum of segment 15 of male with a subtriangular process; sternum of segment 6 with process triangular or subquadrate and apiculate; flagella of copulatory legs

not accommodated by an excavation; first segment with distinct, though rounded, lateral sides and posterior corner, the marginal callus thickened as in other segments

Copulatory legs with two large, slender spines rising from the median face of the nodus; one of these is bent laterad around the base of the flagellum; first segment proportionately long and narrow, its carinæ not equaling those of the second segment: Genus *Sigodesmus*, p. 722.

Copulatory legs without conspicuous spines from the mesial side of the nodus at the base of the flagellum; first segment with carinæ produced to equal or exceed those of the second segment: Genus *Astrodesmus*, p. 726.

The genus *Merodesmus*, being known only from the female, could not be satisfactorily treated in a synopsis in which the secondary sexual characters of the male play such an important part. Whether the females will also offer characters throughout the family can hardly be inferred as yet, for out of the fourteen genera thus far established females of only four are known, over three-quarters of the mature specimens extant in collections being males. As far as *Merodesmus* is concerned, however, it can not well be the female of any of the genera to which it might be supposed to be related, the long cylindrical hirsute processes of the coxæ of the second pair of legs separating it from *Astrodesmus*, the only other large genus with 10 olfactory cones.

ULODESMUS, new genus.

Body rather small, over five times as long as broad, oblong, tapering broadly at the ends; dorsum strongly convex, the narrow carinæ de-curved nearly in the direction of the dorsal arch.

Antennæ (?).

First segment nearly half as long as broad, subreniform; margins converging laterad; lateral edge short and broadly rounded.

Segments distinctly rugulose.

Lateral carinæ with lateral margins strongly developed, thick and prominent; margins of anterior segments distinct but much less developed, those of the first segment scarcely thickened laterad; posterior corners of carinæ scarcely produced on posterior segments.

Repugnatorial pores 13, located in large and deep depressions facing nearly laterad; the marginal callus is strongly thickened to accommodate the poriferous depression, that of the poreless segments being scarcely more than half as thick.

Preanal scale rounded triangular, bluntly apiculate, the setiferous tubercles small, not projecting beyond the anterior margin.

Sterna without transverse ridges.

Sternum of sixth segment of male with two broadly rounded laminate processes between the bases of the anterior pair of legs.

Sternum of fifteenth segment of male unmodified.

Legs of males moderately crassate, the anterior with a small fleshy sole and claws not much reduced, the second joint prominent dorsad, but not so prominent as in the larger forms.

Copulatory legs very slender above the short and bulbous base of the second joint; broader at the first flexure, beyond which they are turned slightly laterad and describe a curve of more than a circle; not attenuate distad, divided near the apex into two stout prongs, the slender apex of the larger being recurved to point toward the apex of the shorter; nodus rudimentary.

The form of the first segment, as well as that of the whole body, and the character of the dorsal sculpture, suggest an affinity of this genus with *Sphenodesmus*, but the armature of the sixth segment and the shape of the copulatory legs render diagnosis easy.

The lateral turn and spiral curve of the copulatory legs are somewhat as in *Neodesmus*, but the large nodus there present, as well as the attenuate and elongate flagellum, render the form in reality very dissimilar.

The form of the process of segment 6 will readily distinguish this genus from all others yet known. The next genus is the only one bearing even a remote similarity in this respect, and it is very distinct in the form of the copulatory legs. The form of the first segment, the rugulose dorsal surface, and the dark-brown color suggest *Sphenodesmus*, which is distinct in the undivided process of segment 6, the form of the copulatory legs, and in the 10 olfactory cones of the antennæ.

The long, spiral, copulatory legs indicate possible affinity with Porat's *Eurydesmus cafrarius* here placed provisionally in the genus *Neodesmus*, but as the process of segment 6 is described as simply triangular and the size is considerably greater than that of *U. micramma*, it seemed better not to refer it to *Ulodesmus*.

ULODESMUS MICRAMMA, new species.

(Plate LVI, figs. 1a-1c.)

Vertex without hairs, convex and prominent, the surface coriaceous or subrugulose; sulcus and suture distinct, meeting the suboblique interocular sulci at the lower end; the lower end of the vertical sulcus and the oblique sulci are more distinctly rugulose.

Clypeus with two pairs of setiferous punctations and a few others somewhat irregularly placed above the supra-labral groove, which is densely hirsute and punctate; lateral edges of clypeus slightly emarginate, the corners rounded.

Labrum with margin nearly transverse, the emargination narrow and shallow.

First segment subreniform, the anterior margin convex, carried around at the sides to an evenly rounded lateral carina about equal in lateral and ventral projection to that of the second segment; raised margin of anterior and posterior edges distinct, carried around the lateral corner without being widened into a distinct callus; surface coriaceous, especially on the carinæ; posterior margin slightly emarginate medianly.

Segments dorsally distinctly rugulose coriaceous, evenly convex and strongly arched.

Lateral carinæ narrow, less than one-fifth the body cavity, inserted about the middle line of side; dorsal surface decurved nearly in the direction of the dorsal arch, only the very large marginal calli projecting laterad; the calli about twice as thick on poriferous segments; anterior edge distinctly margined, the posterior very indistinctly; posterior corners scarcely produced except upon posterior segments; dorsal surface very distinctly rugulose.

Repugnatorial pores facing nearly laterad, surrounded by a fine raised rim and located in a large depression near the middle of the callus, which is distinctly widened opposite the pore.

Below the carinæ the segments are distinctly and finely rugulose; above the base of the leg a small carina.

Anterior subsegments distinctly, though finely, granular rugulose, the transverse constriction distinct and rather long, distinctly and irregularly crenulate; supplementary margin rather short.

Penultimate segment short, its carinæ short, broadly conic, included between the carinæ of segment 18, which are also unusually short and broad.

Last segment short, broadly triangular, narrowly and distinctly truncate.

Anal valves slightly rugulose vertically, the margins distinct, distinctly compressed and moderately prominent.

Preanal scale faintly rugulose, broadly triangular, slightly apiculate, the setiferous tubercles small, distinct, slightly projecting, not equaling the apex.

Sterna sparsely hirsute, the middle and anterior more densely so, and with longer hairs; no transverse ridges; the sterna are flat and plane in the middle and slightly raised at the bases of the legs; on middle and posterior segments the posterior edge of the sterna is broadly produced and rounded caudad, and the posterior part turned slightly ventrad, apparently so as not to interfere with coiling in a spiral.

Coxæ of second pair of legs of male prominent ventrad, the projection thick and rounded.

Process of segment 6 with a few very long hairs on the posterior face and ventral margin; the broad and rounded lobes are not entirely symmetrical, being a little more prominent laterad than in the middle of the distal margin.

Seventh segment with rim of copulatory aperture projecting on the sides, deeply cut away behind.

Legs of male moderately robust and hirsute, scarcely tuberculate; fleshy sole of anterior pairs moderately developed.

Copulatory legs (Plate LVI, figs. 1a-1c).

Color of alcoholic specimens uniform dark brown, possibly stained from large *Spirostrepti* in the same bottle.

Length, about 20 mm.; width, 3.7 mm.; without carinae, 2.8 mm.; length of leg from tenth segment, about 3 mm.

Locality.—Natal, Durban and Maritzburg; two male specimens collected by Schenck are in the Berlin Museum.

MYCHODESMUS, new genus.

Body small, less than five times as long as broad; dorsum moderately convex, the proportionally rather broad carinae tilted somewhat horizontally.

Antennae filiform, rather robust; second joint slightly longer than the four following, which are subequal; olfactory cones four.

First segment subreniform, less than three times as broad as long, the posterior margin much more nearly transverse than the anterior, which is laterally carried backward in a nearly even curve to the rounded posterior corner.

Segment dorsally evenly convex, smooth in the middle, rugulose in the margins.

Lateral carinae with marginal callus of moderate width and prominence, continuous with finely raised margin in front and behind; poreless carinae with callus much narrowed, those of the first segment very narrow and passing insensibly into the raised margins; posterior corners of carinae slightly produced, projecting only on a few posterior segments, where they are broad and not dentiform.

Repugnatorial pores 13, located in very distinct excavations and facing nearly laterad.

Preanal scale distinctly triangular and apiculate, the setiferous tubercles small, much exceeded by the apex.

Legs of male slightly crassate, the first six with fleshy sole of last joint very small, the claw scarcely reduced.

Coxae of second male legs with a suboblique, broadly rounded prominence.

Sternum of segment 6 with a broad, subquadrate process which has a deep, subrectangular notch in the middle.

Sternum of segment 7 with rim of copulatory aperture not produced.

Sternum of segment 15 without a process.

Copulatory legs subtrigonal at the somewhat bulbous base of the second joint, then strongly compressed and recurved in the usual manner; the nodus is very large and irregular; the flagellum is very thick and bulbous at base and is rapidly narrowed into a short, slender process which ends in two short, subequal, divergent prongs; thus the whole apical part of the structure from the top of the curve at the base of the nodus to the end of the flagellum is shorter than the remaining proximal portion. The swollen nodus and base of the flagellum are hollow, suggesting the possibility that the seminal fluid is stored there. The usual spine on the mesial side of the base of the flagellum is present, but very small.

Viewed from the mesial face, the broad base of the flagellum is seen to be merely a concave expansion, suggesting that of *Neodesmus*, notwithstanding the great difference in the form of the copulatory legs and the process of the sixth segment. The only other genus with which *Mychodesmus* will bear comparison is *Sphenodesmus*.

MYCHODESMUS MACRAMMA, new species.

(Plate LVI, figs. 2a, 2b.)

Vertex smooth and even, without hairs; suture and sulcus distinct.

Clypeus without hairs, rather flat; three pairs of setiferous punctations, the upper pair farther apart than in *Neodesmus*.

Antennæ rather robust, with the sixth joint slightly thicker than the others; moderately hirsute, with short hairs.

First segment subreniform, not symmetrical, the anterior margin being carried around to meet the posterior, which is nearly transverse, but has the usual broad emargination in the middle.

Segments dorsally smooth or faintly coriaceous in the middle, becoming rugulose laterad, distinctly so upon the carinæ.

Lateral carinæ with distinct raised margins in front and behind; marginal calli moderately distinct and prominent, distinctly broader on poriferous segment, the carinæ of which are also more distinctly rounded; posterior corners squared on anterior and middle segments, produced only on the posterior, and there only broadly.

Repugnatorial pores located in rather small but distinct cavities, those of the anterior and middle segments facing more nearly laterad than those of the posterior, but the cavities are not placed so far laterad as to cause the edges to appear emarginate, as in some species.

Penultimate segment of moderate length, the carinæ broader than long, rounded, not exceeding those of the eighteenth segment.

Last segment of moderate width, triangular, abruptly narrowed below the narrow, distinctly truncate apex.

Anal valves with margins rather distinct and narrow, though not strongly compressed nor prominent; surface of valves and preanal scale faintly rugulose.

Sterna nearly naked, a few long hairs near the posterior margin.

Sternum of segment 6 with lateral edges somewhat sloping; the two lobes are broadly rounded and more prominent laterad, sloping gradually mesad into the broad and shallow notch, the corner of which is greater than a right angle; the process is moderately hirsute, with long hairs, as are the prominent coxæ of the sixth pair of legs.

Legs moderately hirsute, with rather short hairs, a few long hairs on the basal joints more numerous cephalad; the second joint is only slightly inflated on the dorsal face.

Copulatory legs (Plate LVI, figs. 2a, 2b).

Color of alcoholic specimen distinctly brown, darkest on the dorsal

parts of the posterior subsegments; the head, legs, and antennae lighter; the carinae pale, perhaps white or yellow in life.

Length, 15 mm.; width, 3.4 mm.; without carinae, 2.3 mm.; length of antennae, 3.3 mm.; of leg, 3.8 mm.

Locality.—A single male specimen, collected by Neumann at Ravirondo, German East Africa, April, 1894, is in the Berlin Museum. It was taken from the same bottle with the types of *Harmodesmus nitens* and *Sphenodesmus rugulosus*, which indicates that a large Gomphodesmid fauna may be expected from that region.

NEODESMUS, new genus.

Body rather small, about five times as long as broad; dorsum rather strongly convex, the rather narrow carinae sloping nearly in the direction of the dorsal arch.

Antennae filiform, rather robust, second joint slightly longer than the four following, which are subequal with the sixth, scarcely exceeding the others; closely similar to those of *Sphenodesmus*, but the olfactory cones four.

First segment subreniform, somewhat more than twice as long as broad, not strongly narrowed (shortened) laterad, but evenly rounded; posteriorly broadly emarginate.

Segments dorsally evenly convex, distinctly rugulose.

Lateral carinae with marginal callus prominent, continuous in front, scarcely so behind; calli of anterior segments narrow, distinct; that of first segment passes gradually into the raised margins; posterior carinae rather slightly and broadly produced, as in *Sphenodesmus* and *Uloidesmus*.

Repugnatorial pores 13 (or 12?), located in distinct excavations somewhat behind the middle of posterior subsegments.

Preanal scale broadly triangular, the apex distinct and sharp; setiferous tubercles distinct, prominent ventrad, but not projecting caudad as far as the apex.

Sterna of male without transverse ridges.

Sternum of segment 6 of male, with a stout, subtriangular process.

Sternum of segment 16 without a process.

Legs of male slightly crassate; dorsal face of second joint moderately inflated.

Anterior male legs with the fleshy sole well developed; claw distinctly reduced.

Coxae of second male legs with a broad, subconic ventral prominence, a seminal opening in its flattened ventral posterior face.

Copulatory legs with second joint subbulbous and trigonal at base, then moderately compressed and flexed, as usual in this subfamily; the nodus is narrowed at base, and, viewed from the side, is deeply notched, the sinus rounded and the lobes connivent; in addition there is a strong spine directed mesad; a single large spine rises from the base

of the flagellum, as in many of the other genera; the base of the flagellum beyond the nodus is rather stout, and is then widened, flattened, and excavate, the flattened portion extending laterad; beyond this the leg terminates in an evenly curved and gradually narrowed spine, directed in general upward, with its apex lying under the carina of the sixth segment.

The copulatory legs of the type of this genus are very remarkable and readily distinguish it from all others; instead of being turned mesad beyond the nodus, the flagella nearly touch the bulbous base of the second joint and are then bent abruptly laterad, expanded and hollowed out into a somewhat spoon-shaped structure, which seems to be continuous with the seminal duct of the spiniform terminal portion. No such expansion or cavity occurs in the other genera. Its existence is probably indicative of some biologic peculiarity in the present genus. Perhaps the cavity in the expanded portion of the copulatory leg accommodates the seminal fluid, which it would not in that case be necessary to carry down to the reservoir of the basal joint.

The specimen which has served mainly for the above description presents a hitherto unknown abnormality in that the eleventh segment has a pore on one side and none on the other. The distribution of the pores in the present order is, as far as any recorded observations are concerned, absolutely constant in the same species, but the present instance shows that such variation is not impossible, and should accordingly be sought for the more carefully as furnishing evidence on the systematic value of the pore formula.

NEODESMUS JUVENIS, new species.

(Plate LVI, figs. 3a-3c.)

Eurydesmus mossambicus PETERS, Reise Nach Mossambique, Zoologie, 1862, V, p. 533, *pro parte*, i. e., the animals supposed by Peters to be young.

Vertex without hairs, not strongly convex, distinctly rugulose; sulcus distinct below, obsolete above; suture distinct.

Olypeus not hirsute, rather flat; a pair of setiferous (?) punctations near together near the lower end of the sulcus of the vertex; two pairs of similar punctations much wider apart between these and the labral edge; lateral edges of labrum slightly emarginate, the lower corners rather square.

First segment subreniform by reason of the broad posterior emargination; the lateral carinae are somewhat evenly rounded, the posterior corner being nearly obsolete; submarginal ridge somewhat more pronounced than in *Sphenodesmus rugulosus*, broadest at the posterior corner and gradually narrowed into the anterior raised margin; posterior raised margin very short.

Segments densely and finely rugulose over their entire surface.

Lateral carinae rather narrow, inserted about halfway up; marginal callus distinct and moderately prominent, not greatly broadened on

poriferous segments; the surface of the marginal callus is also somewhat rugulose.

Repugnatorial pores facing laterodorsad; on the specimen studied there is a pore on one side of the eleventh segment and none on the other, so that the normal number of pores is in doubt.

Penultimate segment moderately exposed, its carinæ broadly rounded, not dentiform, not exceeding those of the eighteenth segment.

Last segment broadly triangular, the apex rather broadly truncate and abruptly contracted, so that the sides appear somewhat notched.

Anal valves with distinct, though not very prominent, margins, the setiferous tubercles small, and the surface faintly rugulose.

Sterna rather densely hirsute with long hairs.

Process of segment 6 also hirsute with long hairs; as in some of the other genera, the coxæ of the sixth pair of legs are prominent toward the process, and hirsute with long hairs.

Seventh segment with the rim of the copulatory aperture not produced, even at the sides.

Legs of male moderately hirsute with rather long hairs, finely tuberculate on the ventral face of the distal joints.

Copulatory legs. (Plate LVI, figs. 3a-3c.)

Color of previously dried alcoholic specimen, bone yellow.

Length, about 22 mm.; width, 4 mm.; without carinæ, 2.9 mm.

Locality.—Dr. Peters reported his species from various places in the vicinity of Mozambique, island of Mossambique, Cabaceria, Rios de Sena, Querimba, and Tette. At which place these supposed young specimens were taken does not appear.

It may be well to note a suspicion that the rugulose surface described for this species is due to some accident in the history of the specimen. At the same time, the character appears with such regularity as to seem quite normal.

NEODESMUS CAFFRARIUS (Porat).

Eurydesmus cafrarius PORAT, Oefersigt f. K. Sv. Vet. Akad. Foerh., 1872, No. 5, p. 13.

Sphenodesmus cafrarius COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 93.

Body strongly convex, glabrous above, setose below between the coxæ, scarcely attenuate posteriorly.

Head with very few setigerous foveæ. Vertex medianly longitudinally sulcate, subglabrous. Clypeus subglabrous, margin setose.

Antennæ shorter than the breadth of the body, 6 mm. long.

First segment with anterior margin laterally thickened, oblique, nearly straight or very slightly sinuate; posterior straight, sides curved forward, processes rounded.

Segments glabrous, nearly smooth, or irregularly coriaceous under a lens; lateral carinæ thickened, somewhat ascending posteriorly, anterior angle rounded, posterior slightly acute, slightly prominent, more

acute on segments 16 to 19; ventral surface between segments 6 and 7 with a prominent triangular lamina.

Repugnatorial pores rather dorsal than lateral, placed a little behind the middle of the carina.

Last segment prolonged, apex truncate, transversely impressed near the apex; setæ few.

Anal valves margined, with two pairs of setæ. Preanal scale large, simple, or indistinctly trifid, the median lacinia far the longest; setigerous tubercles 2.

Legs of pairs 1 to 6 with a pulvillus on the last joint; a triangular prominent lamina between segments 6 and 7.

Legs shorter than the breadth of the body, 5 mm.

Copulatory legs much protruding, spiral, setose, the external margin bidentate, with a lacinia near the inflexed apex.

Color of alcoholic specimens testaceous.

Length, 34 mm.; breadth, 6.5 mm.

Locality.—Caffraria. Known only from Porat's description.

The generic position of this species is still in doubt. On the discovery of *Neodesmus* it appeared that *caffrarius* might be related by reason of the spiral copulatory legs, but Porat distinctly says that the process of the sixth segment is triangular. As the copulatory legs are large and protruding, and there seems to be greater similarity in size as well as distribution, it seems best now to place this species next to *N. juvenis*, rather than leave it under *Sphenodesmus*, where it would be less likely to be sought if determination were attempted by means of the synopsis of genera.

Genus TYCODESMUS Cook.

Tycodesmus Cook, Proc. U. S. Nat. Mus., 1895, XVIII, p. 83.

Body rather large, about five times as long as broad; dorsum moderately convex, the carinæ somewhat horizontal.

Antennæ filiform, second joint longest, four following subequal, successively slightly shorter distad; olfactory cones 4.

First segment about three times as broad as long; anterior margin subtransverse; the posterior turned forward laterally so that the carinæ are narrower than the median portion.

Segments dorsally smooth and shining, somewhat uneven laterad and with traces of transverse rows of granules on the posterior segments.

Lateral carinæ with thickened margins well developed and continued upon the anterior edge of the carinæ, scarcely upon the posterior, those of the anterior as broad as the others; posterior corners moderately produced.

Repugnatorial pores 13, located in distinct depressions.

Preanal scale triangular, pointed, setiferous tubercles distinct, small, close to the apex and not exceeding it.

Sterna without transverse ridges, somewhat excavate medianly as in *Gomphodesmus*.

Sternum of sixth segment of male with a process over twice as long as broad, slightly narrower in the middle and expanded distad where it bears two conical teeth; the distal corners are also somewhat produced into short, rounded processes.

Sternum of seventh segment medianly deeply and broadly emarginate behind the insertion of the copulatory legs, leaving a sharp laminate process at the base of each of the normal legs.

Sternum of the eighth segment with a distinct conic process at the base of each leg of the posterior pair.

Sternum of fifteenth segment unmodified.

Sternum of the sixteenth segment with an abrupt median subconic process immediately behind the transverse constriction; this process is directed ventrad.

Legs of males slender, the anterior scarcely more robust; dorsal surface of second joint moderately inflated; legs 1 to 6 with a distinct fleshy sole, but with claws less reduced than in the larger genera.

Coxae of second male legs produced into a short oblique cone.

The copulatory legs of this genus are so constructed as to suggest rather strongly those of *Gomphodesmus*, the more striking differences being that the node is much more strongly constricted at base, the lateral spine at the base of the flagellum is entirely wanting, and the flagella are not recurved or coiled, but merely flexuous; their apices lie between the bases of the copulatory legs.

The first segment is proportionally somewhat longer medianly, shorter laterally, and with the marginal callus much more strongly developed, than in *Astrodesmus*; the posterior corner is, however, less strongly developed and the marginal callus not so broad as in *Gomphodesmus*.

In general form and habit the type of this genus resembles most nearly *Astrodesmus*, the dorsal convexity being only slightly greater and the carinae only slightly more horizontal. Outside of the secondary sexual characters the generic differences are mostly quantitative. The interantennal suture is more distinct, the antennae are more slender, the marginal calli somewhat broader, the penultimate segment shorter, and the projecting portion of the last segment narrower at base. The secondary sexual differences are numerous and important, the sternal ridges and the process of the fifteenth segment are absent, the process of the sixth segment is slender, broader at apex, and bidentate or apparently quadridentate, on account of the sharp lateral shoulders; the seventh segment is deeply emarginate medianly behind the copulatory legs, and with a sharp, flattened tooth on each side at the base of the normal legs; there is a distinct subconical process at the base of each leg of the eleventh pair, the posterior pair of the eighth segment; the sternum of the sixteenth segment has an abrupt process in front.

In *Astrodesmus* the seventh segment has a median, rounded, flattened expansion behind the copulatory legs, between the normal pair; there are no conic processes on the eighth segment nor on the sixteenth segment.

The processes located at the bases of the posterior pair of legs of the eighth segment are narrower and longer than those of *Tymbodesmus*, the other genus to which the present might be most properly compared, and which has these processes much more developed than in any of the remaining genera.

TYCODESMUS MEDIUS Cook.

(Plate LVII, figs. 1a-1c.)

Tycodesmus medius Cook, Proc. U. S. Nat. Mus., 1895, XVIII, p. 83.

Vertex without hairs, polished and shining; the sulcus distinct, as well as the transverse sulcus connecting the antennal sockets.

Clypeus with lateral depressions moderate; a transverse row of minute punctations above the labrum.

Guathochilarium densely pilose.

First segment with posterior margins broadly emarginate in the middle and turned ahead laterad; marginal callus distinct, the anterior and posterior margins distinct on the carinæ.

Segments dorsally smooth and shining, uneven under a lens, rugulose on the carinæ and distinctly inflated at the base of the carinæ, as in *Aulodesmus*; on posterior segments there are faint traces of granules in transverse rows, and the surface of these segments is also more distinctly rugulose.

Lateral carinæ more than one-fourth as wide as the body cavity; marginal callus tapering gradually to the distinct anterior margin; posterior margin very fine or indistinct; posterior corners moderately produced, about as in *Astrodesmus stellifer*, slightly more on posterior segments; below the carinæ the segments are nearly smooth, the secondary carina very small, but distinct.

Anterior subsegments smooth and shining, very minutely striolate-rugulose under a high power; transverse constriction distinct, not crenulate.

Penultimate segment very short, the small dentiform carinæ exceeded by those of the eighteenth.

Last segment also very short, concealed from above by the preceding two; apical projecting portion long, narrow, the apex itself rounded.

Anal valves striolate-rugulose, the margins weak.

Preanal scale broadly triangular, apiculate, the setiferous tubercles small, projecting somewhat ventrad, not exceeding the apex; surface nearly smooth.

Sterna naked except a few hairs along the posterior edge.

Process of sixth segment hirsute laterad and distad.

Legs of male sparsely hirsute, except the anterior, of which the ventral faces of the basal joints are clothed with long hairs.

Male genitalia, see Plate LVII, figs. 1a-1c.

Color of alcoholic specimen grayish brown, the posterior margin of each segment, the carinae, antennae, and legs, yellowish brown.

Length, 50 mm.; width, 10.5 mm.; without the carinae, 6.5 mm.; length of antenna, 8.5 mm.; length of leg from tenth segment, 9.5 mm.

Locality.—A single male specimen collected by Röhmer at Mpapua, German East Africa, is in the Berlin Museum.

OMODESMUS, new genus.

Body rather large, about five times as long as broad, oblong, tapering slightly at both ends; dorsum slightly convex and the carinae more nearly horizontal than elsewhere in the present family.

Antennae (?).

First segment slightly less than three times as broad as long; posterior margin nearly straight, the lateral parts only slightly curved forward.

Segments show faint traces of three transverse rows of small granules.

Lateral carinae with lateral thickened margins well developed and distinctly continued upon the anterior and posterior edges of the carinae; on anterior segments the lateral margins are strongly thickened and very broad; the posterior corner of these segments is also strongly thickened, so that the broad margins are not distinct mesad. Corners of all carinae more prominent and produced caudad than in other known genera of the family.

Repugnatorial pores 13.

Preanal scale minutely apiculate; setiferous tubercles distinct, close together.

Sterna with a distinct, transverse, medianly interrupted ridge between the bases of each pair of legs.

Sternum of sixth segment of male with an oblong, strongly apiculate process between the bases of the anterior pair of legs.

Sternum of fifteenth segment of males with a broadly ensiform process projecting cephalad from between the anterior pair of legs into a socket in the posterior part of the fourteenth.

Legs of males rather slender, scarcely crassate; dorsal face of second joint inflated into a large, rounded prominence; anterior six male legs with a small fleshy sole at the apex of the last joint below.

Coxae of second male legs produced ventrad into an obliquely conic process with the seminal opening located in a slight depression of its ventroposterior face.

Male genitalia with second joint proximally hirsute and trigonal, the ungual portion proximally strongly compressed and strongly curved cephalad upon itself; it is then expanded into a large, irregu-

larly shaped node, which bears a long spine on its median face and a shorter one on its lateral, both directed distad; from the anterior (by flexure posterior) face of the node rises a simple flagellum, which describes a subelliptic curve and has its base and apex protected by the smaller and larger spine, respectively.

OMODESMUS OXYGONUS (Peters).

(Plate LVII, figs. 2a, 2e.)

Eurydesmus oxygonus PETERS, Reise nach Mossambique, Zoologie, 1862, V, p. 535.

Aulodesmus oxygonus COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 89, pl. III, figs. 10-14; pl. VI, figs. 4-7.

Vertex without hairs, smooth and even; sulcus distinct, not connected below with the antennal sulcus; about midway between the lower end of the sulcus and the antennal sockets is a distinct setiferous (?) punctation.

Clypeus not hirsute, even; lateral excavations shallow; punctations of the lower part obscure; above with a pair of small, distinct punctations somewhat wider apart than those mentioned in the preceding paragraph and half as far from them as from each other.

Antennæ lost.

Gnathochilarium densely hirsute, shaped, as far as can be seen, as in *Astrodesmus stellifer*.

First segment convex in front and behind, distinctly margined on the anterior corners and thickened on the posterior.

Segments dorsally finely coriaceous and somewhat rugulose, the wrinkles being most pronounced at the anterior shoulder of the carinæ, from which they extend obliquely caudad and mesad; three rows of very indistinct and small tubercles; these are scarcely prominent and are indicated mostly by small spots of darker color, finer and closer together on the posterior segments.

Lateral carinæ margined in front and behind, the lateral margin strongly thickened and convex; all the margins smooth and shining; on the second segment the posterior corner is nearly a right angle, while on all others it is produced caudad, increasingly so on the middle and posterior segments.

Repugnatorial pores facing dorsad and laterad, located slightly in front of the middle of the thickened margin, though on posterior segment, by reason of the posterior production of the carinæ, they are nearly on a line with the posterior margin of the segments.

Below the carinæ the segments are densely rugulose longitudinally, with occasional scattering prominences.

Anterior subsegments even and shining, marked with very short and fine impressed lines or striations; transverse constriction distinct though not deep, polished, faintly crenulate.

Penultimate segment very short, the exposed part equal to less than

half the preceding; the carinæ small and dentiform, not projecting as far as those of segment 18.

Last segment short, broadly triangular, rounded and subtruncate at apex, dorsally with several transverse furrows, the deepest of which separates the apically thickened and somewhat upturned part of the segment from the basal.

Anal valves scarcely convex, rugulose; margins distinct, prominent, shining, subcompressed.

Preanal scale rugulose, triangular; the apex pointed; setiferous tubercles located close to the apex, large and prominent ventrad, not projecting caudad beyond the apex.

Sterna sparsely hirsute with long hairs; the bases of the legs connected, except at the middle line, by distinct, sharp, transverse ridges.

Process of the sternum of the sixth segment hirsute distad with very long hairs; apically thickened and pointed; broader below, especially from slight shoulders about the middle.

Process of sternum of fifteenth segment, as in *Astrodesmus stellifer*, broadly subtriangular and rounded, medianly grooved below; the edges of this process continuous with the transverse ridges found on other sterna.

Legs of male hirsute with long bristles, especially on the distal joints of the anterior; tubercles wanting.

Anterior male legs with fleshy apical sole small, present on the first six pairs.

Copulatory legs with the basal part of the second joint much longer proportionally than in *Astrodesmus*; viewed from below, they show a long spine, which in *Astrodesmus* appears only as a small denticule; the slender flagella rise from the posterior side of the large knot-like thickening at the base of a posteriorly directed tubercle; the flagellum curves strongly dorsad, then cephalad, mesad, and finally again dorsad, and ends in a small mesially directed hook which lies on the base of the large spine referred to above; thus each flagellum is coiled upon its own leg and does not cross to the other side and become entangled with its fellow.

Color of dried specimen pale alutaceous, the legs showing a tinge of reddish, which, according to Peters's figure, was shared by the whole body.

Length, 55 mm.; width, 11.4 mm.

Locality.—Rios de Sena, near the Zambesi. Dr. Peters collected three male specimens, and at first considered them a variety of *mosambicus*. That from which the above description was drawn is No. 199 of the Berlin Museum.

This species is strikingly distinct from other Gomphodesmidæ in the more horizontally directed carinæ, which cause the dorsum to appear unusually flat, and by the greater posterior production of the carinæ. The form of the copulatory legs is also quite distinct from that of *mos-*

sambicus, the type of the genus *Aulodesmus*, to which it was previously referred, the present species being without doubt more similar to *Aulodesmus* than to *Astrodesmus* in this respect. It can hardly be said, on the other hand, that it is more similar to *Aulodesmus* than that genus is to *Astrodesmus*, and the different habit resulting from the more flattened dorsum and produced carinæ, together with the distinct and strongly elevated anterior and posterior margins of the carinæ, the very broad, thickened, and somewhat indistinctly defined lateral margins of the anterior carinæ, the much straighter posterior margin of the first segment, the more apiculate process from the sternum of the sixth segment of male, and the greater development of the curious prominence from the dorsal side of the second joint of the anterior male legs, furnish structural data leading to the inference of generic distinctness from both *Astrodesmus* and *Aulodesmus*, in both of which the anterior and posterior edges of the carinæ are narrowly and rather indistinctly margined, the lateral thickened margins of the anterior carinæ are narrow and well defined along the mesial side, and the posterior margin of the first segment is curved distinctly cephalad on each side, so that the lateral length is distinctly less than the mesial, which condition appears to a very much less degree in *oxygonus*. Here the posterior part of the raised margin is, as in the other anterior segments, very broad, strongly thickened, and poorly defined mesad; the whole carina is also, as on the other anterior segments, tilted more horizontally than the general slope of the mesial arch, which in the other two genera is scarcely varied, even on the anterior segments. From *Aulodesmus* the new genus is also distinct in the greater production of the coxæ of the second legs of male, the much less hirsute sterna and legs, the more distinct and abrupt transverse constriction of the segments, and in the proportionally greater robustness of at least the second joint of the antenna, the others having been lost. The rudiments, though slight, of dorsal sculpture in the form of three transverse rows of tubercles are interesting and of some phylogenetic importance in the present family, from which similar traces have so generally disappeared.

Recently Count Attems¹ has reported this species from Zanzibar, but I am inclined to doubt the determination on account of the fact that the other Mozambique Diplopoda described by Peters have not been found in the Zanzibar region, and for the further reason that the identification was made without an examination of the type, while the literature employed by Count Attems appears quite insufficient as the basis of a trustworthy reference.

¹ Beschreibung der von Dr. Stuhlmann in Ost-Afrika gesammelten Myriopoden. Mitth. Naturh. Mus. Hamburg, 1896, XIII, p. 26.

Genus GOMPHODESMUS Cook.

Gomphodesmus Cook, Proc. U. S. Nat. Mus., 1895, XVIII, p. 83.

Body large, nearly six times as long as broad, tapering slightly cephalad, scarcely so caudad near the end; dorsum strongly convex, the carinæ decurved in the direction of the dorsal arch.

Antennæ filiform, second joint longest, four following subequal.

First segment scarcely more than twice as broad as long; anterior margin subtransverse, the posterior laterally carried around to meet it at a small angle produced below the level of the other carinæ.

Segments dorsally polished and shining.

Lateral carinæ about one-fourth as wide as the body cavity, inserted at about the middle of the sides; lateral margins with a rather broad distinct callus extending along the anterior and posterior edges of the carinæ as a narrow distinct margin; on anterior segments the marginal callus is broad but distinct; on the first segment the callus occupies the entire lateral corner; posterior corners of carinæ produced increasingly caudad from about the seventh, though only segments 15 to 18 have the corners much exceeding the posterior margin of the segment.

Repugnatorial pores 13, located in large depressions, as in *Astrodesmus*.

Preal anal scale semicircular, apiculate, the setigerous tubercles more remote than in the other large genera, very large, papilliform and greatly exceeding the apex.

Sterna without distinct transverse ridges, somewhat excavate in the middle in front and with a small subconic prominence or very short ridge at the base of each leg.

Sternum of sixth segment of male with a nearly square, strongly apiculate process between the bases of the anterior pair of legs.

Sternum of fifteenth and sixteenth segments of male unmodified.

Legs of males distinctly crassate, dorsal face of second joint inflated, especially in the anterior; legs 1 to 5 of male with a small fleshy sole at apex, the claw distinctly reduced.

Coxæ of second male legs produced ventrad into a blunt protuberance.

Male genitalia constructed as in *Astrodesmus* and *Aulodesmus*, but with the node constricted at base, the flagellum broad and compressed at base, rather robust throughout and twice bidentate distad; it makes a single subcircular curve, crossing and lying against its fellow.

Females with coxæ of second legs produced ventrad into a small conic spine similarly situated to that of the male; laterally above the insertion of the second joint the coxæ are expanded and bear two rounded flattened processes; the second legs are deeply inserted, and on each side of their bases is a large, round, deep cavity; the sternum of the third segment is strongly produced ventrad into a thin plate, broadly and deeply emarginate medianly.

In this genus the copulatory legs are again constructed on the plan followed by *Astrodesmus* and *Aulodesmus*, but with some unique features. The basal part of the trigonal second joint is greatly reduced, while the node is curiously developed, being constricted at its base and borne as a projection from the anterior (by flexure posterior) face of the antico-postically compressed structure; the two spines described in *oxygonus* are still recognizable, being located at the base of the nodus and flagellum. The nodus bears in addition, however, two small conical spines on its lateral face, and two which project against and are covered by the upright part of the compressed portion at the beginning of the curve, and also another, large, strong, and curved, which is directed mesad at first, and curves around the base of the compressed portion. The flagellum is broad and compressed at the base, but is soon abruptly narrowed, although still compressed; it curves in nearly a circle, crossing its fellow, is bifid near the apex, the larger division taking a spiral turn and being again bifid. Thus, while the plan is evidently the same, the details are nearly all different.

Although the first segment is in reality proportionally longer than in the other genera, the relation between the length and breadth is somewhat affected by the fact that it is very strongly convex, so that the carinæ are decurved and do not project laterad. If the segment were flattened out it would be as broad as any on account of its produced lateral corners.

The segments are more convex, and more evenly so, with the surface more highly polished, and the posterior corners of the carinæ less produced than in the other large genera with which it is compared.

The marginal callus, though distinctly broad on anterior segments, does not taper abruptly cephalad as in *Omodesmus oxygonus*, the mesial edge being more nearly longitudinal.

GOMPHODESMUS CASTANEUS Cook.

(Plate LVIII, figs. 1a-11.)

Gomphodesmus castaneus COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 83.

The vertex is without hairs, highly polished and shining; sulcus distinct, ending below in a considerable depression which is connected with the antennal sockets by suboblique, finely rugulose, scarcely depressed lines.

Clypeus also polished and shining, evenly convex, the lateral depressions very slight, with a few oblique sulci, a pair of minute punctations somewhat below the level of the antennal sockets, and a somewhat irregular transverse row of about ten above the labrum.

Labrum inserted much below the level of the clypeus, the anterior edge transverse, the emargination very narrow and slight, the teeth very small.

Guathochilarium hirsute with fine, short hairs.

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First segment scarcely more than twice as broad as long; posterior margin distinctly and broadly emarginate in the middle, laterally directed obliquely cephalad; anterior margin transverse or very slightly emarginate medianly, more strongly so laterally opposite the antennal sockets, and converging toward the posterior margin by considerably less than a right angle; as a whole the anterior margin would be nearly transverse if the body were extended in a straight line, while the posterior curves forward to meet it at a small angle, as mentioned above. There is thus no lateral margin proper, and the lateral corner is produced ventrad considerably below the line of the other carinae, a condition not observed in the other genera of the family. Lateral callus not strongly thickened, but well defined, subtriangular in shape, occupying the extreme corner of the carina and continued along the anterior and posterior edges as a fine raised margin, more distinct on the anterior edge, but not reaching the middle.

Second segment with the carinae laterally produced beyond the level of the third; anterior edge distinctly margined; posterior less so; the marginal callus on this segment and the two following is as broad as that of the fifth segment.

Segments dorsally strongly polished and shining, minutely punctulate under a lens; posterior segments rugulose laterad inside the marginal callus.

Lateral carinae strongly margined in front, distinctly, though less strongly, behind; the marginal callus is not abruptly narrowed in front of the pore as on the anterior segments of *Aulodesmus*, but tapers gradually into the narrow margin.

Repugnatorial pores located in deep, circular excavations half as wide as the marginal callus.

Below the carinae the segments are finely rugulose; the secondary carinae slight, finely granulated.

Anterior subsegments minutely striolate and rugulose longitudinally, distinctly rougher under a lens than the posterior subsegments; transverse constriction distinct, polished, finely crenulate.

Penultimate segment not greatly shortened, the apices of its carinae slightly exceeding those of segment 18.

Last segment with triangular apical portion truncate, slightly tilted up; the setiferous punctations located in slightly prominent rings.

Anal valves rather strongly rugulose-striate below; setiferous tubercles small, distinct, the lower pair separated from the margin.

Preanal scale nearly smooth, nearly semicircular, minutely apiculate, the setiferous tubercles enormously enlarged, suggesting those of *Lacnodesmus flabellatus* of the family Oxydesmidae.

Sterna finely coriaceous, sparsely hirsute along the posterior slope, otherwise naked.

Process of sixth segment hirsute distad on its posterior face; the shape of the process would be nearly square but for the triangular apiculus.

Legs of males sparsely hirsute, the anterior and their sterna more strongly so, with longer hairs; the last two joints are distinctly though minutely tuberculate on their ventral face, and all the hairs appear to rise from the fine granules.

Copulatory legs (Plate LVIII, figs. 1*d*–1*i*).

Color of alcoholic specimens bright chestnut, the anterior subsegments, carinae, legs and antennae somewhat lighter; the basal part of the compressed portion of the copulatory legs is dark brown, as are also the apex of the last segment and the setiferous tubercles of the preanal scale.

Length, 70 mm.; width, including carinae, 12.5 mm.; width, without carinae, 8.5 mm.; length of antennae, 8 mm.; length of leg from tenth segment of male, 10 mm.; length of last leg of male, 7.5 mm.

Locality.—Tanga, Usambara, German East Africa, two mature males and one female, collected by Reimer. The female is more delicate in texture and had probably moulted shortly before being captured, but is evidently mature. A fourth specimen, a robust and deeply colored mature male, has recently come to the Berlin Museum from "Tanga Hinterland," collected by Heinsen.

A comparison of the measurements of the legs and antennae of this species with those of *Aulodesmus* and *Astrodesmus* will make apparent the much slighter development of secondary sexual characters, perhaps correlated with the absence of the process from the fifteenth segment and of ridges from the sterna.

TYMBODESMUS, new genus.

Body medium to rather large, somewhat more than five times as long as broad, oblong; dorsum rather strongly convex, the carinae somewhat horizontal.

Antennae filiform, moderately robust, second joint slightly longer than the four following, which are subequal; olfactory cones four.

First segment somewhat less than three times as broad as long, the anterior and posterior margins converging laterad, so that there is no lateral side but merely a rounded corner, much as in *Gomphodesmus*.

Segments dorsally smooth and shining, distinctly rugulose laterad.

Lateral carinae with thickened margins rather broad, prominent, and abrupt; on anterior segments the calli are somewhat reduced, but still prominent and distinct; posterior corners moderately produced.

Repugnatorial pores 13, located in large and deep excavations, opening subdorsally.

Preanal scale distinctly, though minutely, apiculate; setiferous tubercles rather small, though prominent, not exceeding the apex.

Sterna with a fine, though distinct, transverse ridge between the bases of each pair of legs; this is interrupted for a considerable distance in the middle and is more prominent between the posterior legs of each segment, especially segments 8 and 9, on the former of which it

is developed into a prominent, flattened process at the base of each leg as in *Astrodesmus luridus*.

Sternum of sixth segment of male with a subtrilobate process.

Sternum of fifteenth segment of male with a rounded triangular process from between the anterior pair of legs.

Legs of males moderately crassate; dorsal surface of second joint strongly inflated.

Anterior male legs with a distinct fleshy sole at the apex of the last joint.

Coxæ of second male legs with a subconic process distinctly notched on its ventral face.

Coxæ of second legs of female produced into subconic, divaricate processes as long as the second joint.

Sternum of third segment of female extended ventrally into a thin rim, which is broadly and deeply excavate in the middle to accomodate the coxæ of the second legs.

Copulatory legs scarcely trigonal, compressed nearly to base; node constricted at base, with a small spine on each side at the base of the flagellum, which is at base pressed against the basal part of the copulatory leg and is then curved cephalad and obliquely mesad, crossing its fellow.

The affinities of this genus are evidently with *Gomphodesmus* in the shape of the body and the form of the first segment; but it is distinct in the possession of the transverse ridges of the sterna and the process of the fifteenth segment. The copulatory legs are also strikingly different, not only from *Gomphodesmus* but from the other related genera, in that the flagella are not abruptly bent but make a simple curve obliquely cephalad, so that a lateral view gives a subelliptic outline.

From *Astrodesmus*, some species of which are strongly suggested by the processes of the sternum of the eighth segment as well as those of the sixth and fifteenth, it differs in the much more convex dorsum, narrower carinæ, and the narrowed and produced corners of the first segment, to say nothing of the differences displayed by the copulatory legs and the member of the olfactory cones.

TYMBODESMUS FIGLINUS, new species.

(Plate LVII, figs. 3a-3c.)

? *Eurydesmus mossambicus* PORAT, Bihang K. Sv. Vet., Akad. Handl., 1894, 20, IV, No. 5, p. 30; not PETERS, Reise nach Mossambique, 1862, V, p. 533.

Vertex without hairs, smooth and even; sulcus distinct, narrow, the suture deeply colored; obliquely transverse sulci indistinct.

Clypeus with a minute setiferous punctation on each side, somewhat below and slightly mesad from the antennal socket; a row of about 4 similar widely separated punctations, located nearer to the labral margin than to the antennal sockets.

Clypens slightly concave laterad, the oblique lateral margins nearly straight, meeting the labral margin at a distinct corner; above the labrum with two transverse rows of closely set setiferous punctations.

Labrum nearly transverse, broken only by the incisions which define the three teeth, the median of which is much the largest and projects beyond the transverse edge of the labrum.

Antennæ filiform, rather robust, the joints distinctly obconic, the distal densely hirsute with fine hairs; the sixth joint is slightly longer than the fifth and equal to the third.

Gnathochilarium densely hirsute with short hairs.

First segment subsymmetrical, except that the posterior margin is broadly emarginate medianly; laterad the margins converge evenly to a narrow, rounded corner; the marginal callus very short, about as broad as on other segments, and narrowed abruptly into the distinctly raised edges of the anterior and posterior margins.

Segments dorsally smooth, polished and shining, slightly rugulose on the carinæ.

Lateral carinæ with distinct raised margins in front and behind; marginal calli very prominent, narrow in front, very broad behind, on middle and posterior segments produced more and more; only on the first few segments are the posterior corners of the carinæ right angles.

Repugnatorial pores facing latero-dorsad, located in rather deep depressions in the middle of the calli, which are there distinctly broader than on poreless segments.

Below the carinæ the segments are rugulose; poriferous segments have a distinct prominence below the insertion of the carinæ, doubtless indicating the location of the repugnatorial gland.

Anterior subsegments smooth and shining, the transverse sulcus distinct, crenulate; supplementary margin rather short.

Penultimate segment very short; exposed portion equal to about one-quarter of the preceding; carinæ small, rather broad.

Last segment very short, triangular; apex rather broadly truncate, rather thick.

Anal valves with margins distinct, but not strongly compressed and not very prominent, somewhat exceeded by the apex of the last segment; surface of valves scarcely convex, rugulose.

Preanal scale rugulose, subsemicircular; setiferous tubercles distinct, abruptly projecting beyond the posterior margin, but not exceeding the acutely apiculate apex.

Sterna sparsely hirsute with long hairs on the posterior slope, otherwise naked; the posterior of the transverse ridges is more prominent except behind segment 15.

Coxæ of second legs of male with a rounded conic ventral prominence, the base of which is dark colored, the apex white and apparently fleshy; the seminal aperture lies in the posterior face of this and is surrounded by a raised rim.

Process of segment 6 densely hirsute distad; the apex prominent, rounded, nearly as large as the prominent shoulders, below which the process is distinctly narrowed.

Seventh segment with posterior rim of aperture very deeply, broadly, and abruptly excised, leaving two sharply angled, thin processes, one at the base of each of the normal legs.

Process of segment 15 constructed exactly as in the other large genera, such as *Astrodesmus*; rounded at apex and distinctly canaliculate medianly to near the apex.

Legs of male hirsute with long hairs, the anterior more hirsute than the posterior and somewhat more crassate, the ventral face of the four distal joints tuberculate; the fleshy soles of the first six pairs are well developed, with the claws much reduced.

Copulatory legs (Plate LVII, figs. 3a-3c.)

Color of alcoholic specimen pale grayish brown, the posterior margin of each segment with a very narrow transverse band of deep brown; legs and antennæ pale. The specimen may not have reached its full coloration after having molted.

Length, 50 mm.; width, with carinæ, 9.8 mm.; without carinæ, 6.2 mm.; length of antennæ, 7.6 mm.; of leg from segment 10, 9.3 mm.

Locality.—Mundame, Kamerun; a single male specimen collected by Conradt is in the Berlin Museum.

TYMBODESMUS VIDUA, new species.

Another Kamerun specimen, possibly a female of the preceding species, is much more convex than the last and has the terminal segments more exposed. The carinæ are proportionally much narrower and the calli are so tilted that the pores face nearly laterad. The coxæ of the second pair of legs are produced into long conic-cylindric, pointed, and divaricate processes; the ventral rim of the third segment is deeply and broadly emarginate, as in the genus *Gomphodesmus*.

Length, 53 mm.; width, with carinæ, 10.4 mm.; without carinæ, 7.5 mm.; length of antennæ, 7 mm.; of leg from segment 10, 7.5 mm.

Color distinctly darker than that of the male specimen.

Whether this is in reality the female of *figlinus* can not be determined until the Kamerun region has been more thoroughly explored. For the present I am inclined to treat it as distinct on the ground that the much greater convexity of the body and the lateral position of the pores are differences greater than known to exist between the sexes in the present family, and minor differences in the conformation of the first and last segments seem to support the supposition of specific distinctness. The anterior segments are even more strongly convex than the others, and the first, while narrowed at the lateral angle, as in *figlinus*, is broader farther laterad, so that the final convergence of the sides is more abrupt than in the other specimen. From above the marginal calli appear much narrower than in *figlinus* on account of being turned

laterad, there being in reality no appreciable differences when closely compared, except in the much narrower carinæ of the female specimen.

Locality.—Barombi Station, Kamerun Colony. Berlin Museum.

Which, if either, of the preceding two species is that referred to by Porat can not be determined with certainty from his brief remarks:

“Kamerun, Kitta: Sjöstedt; 4 specimens.”

“The specimens from Kamerun are of smaller size, 60 mm. long, 10–11 mm. broad; the males have, nevertheless, between the first pair of legs of segment 6 and on segment 15 the peculiar processes which Peters has indicated, and his description applies very well to the above individuals, so that the identity is established beyond doubt. Our specimens are, however, uniformly yellow, probably bleached in alcohol. Peters gives the color as dark reddish brown, with yellow carinæ, legs, and antennæ.”

After an examination of Peters's type of *mossambicus* it appears equally certain that the Kamerun specimens do not represent that species. As may be seen by a comparison of the descriptions of the larger forms, the processes of segments 6 and 15 may coexist with a considerable variety of other characters, while the greater part of the remainder of Peters's extended description will apply to any member of the Gomphodesmidae, it being, of course, impossible that differential characters could be selected in the description of the first member of what is probably a group of considerable extent.

A recent opportunity of examining fresh specimens of *mossambicus* in the Hamburg Museum shows that that species is in reality deep red in color, while all Kamerun specimens yet known are yellow.

TYMBODESMUS FALCATUS (Karsch).

(Plate LVII, figs. 4a–4c.)

Eurydesmus falcatus KARSCH, Troschel's Archiv. f. Naturgesch., 1881, p. 43.

Tyccdesmus falcatus (KARSCH) COOK, Proc. U. S. Nat. Mus., 1895, XVIII, pp. 92, 93, pl. III, figs. 15, 16.

Smaller and less convex than *T. figlinus*.

Vertex smooth and even, without hairs; the sulcus slight; the suture distinct, not colored; head otherwise as in *figlinus*, except that inferior corners are somewhat more rounded.

Antennæ filiform, rather slender, the joints not so strongly obconic nor so densely hirsute; the sixth joint not exceeding the fifth and slightly shorter than the third; the last joint is proportionally somewhat larger than in *T. figlinus*.

First segment subelliptic, with a distinct lateral side; less convex and proportionally somewhat longer than in *T. figlinus*; the lateral convergence of the sides is considerably less, and the lateral side is not produced and rounded, but has a distinctly longitudinal marginal callus and nearly straight lateral edge. The marginal callus is distinctly narrower than in *T. figlinus*, and the posterior edge is scarcely emarginate in the middle.

Segments 2 to 4 with lateral margins straight or slightly emarginate; in the other species they are slightly rounded.

Segments dorsally slightly uneven, rugulose laterad and upon the carinae.

Lateral carinae tilted somewhat horizontally out of the curve of the dorsal arch; anterior and posterior raised margins scarcely distinct; marginal calli moderately prominent, but distinctly less so than in *T. figlinus*, and less distinctly defined, especially upon anterior segments; lateral edge of carinae rather thin, distinctly thinner than in *T. figlinus*; posterior corner increasingly produced on all segments after the first, and prominent also there.

Repugnatorial pores facing more laterad than dorsad, located in distinct depressions which on account of their lateral position cause the edge of the carinae to appear slightly emarginate when viewed from above; poreless segments have the lateral edge considerably thinner, as the callus is distinctly narrower.

Anterior subsegments smooth and shining, the sulcus distinct, scarcely crenulate.

Penultimate segment very short, only a narrow edge exposed; carinae hidden under those of segment 18.

Last segment short, the apical projection broader, less distinctly triangular, by reason of the more curved sides, and somewhat more broadly truncate than in *T. figlinus*.

Anal valves rugulose, convex mesad, the margins not prominent, scarcely distinct, considerably exceeded by the thickened apex of the last segment; setiferous tubercles scarcely prominent.

Preal anal scale broader than a semicircle, evenly rounded, the apex rounded, only slightly projecting; setiferous tubercles submarginal, very small, scarcely projecting; surface even.

Sterna nearly naked except near the posterior margin, behind the posterior pair of ridges, which are much more pronounced than the anterior, except on segments 15 to 18.

Coxae of second legs with a rounded-conic prominence proportionally as large or larger than that of *T. figlinus* and similarly formed.

Process of segment 6 hirsute distad, the apex prominent, rounded, larger, and more projecting than the rounded shoulders; coxae of the sixth pair of legs with a large rounded hirsute prominence projecting apparently to fit against the anterior side of this process.

Seventh segment with posterior rim of aperture deeply excised as in *T. figlinus*, the excision rather deeper, with the lateral sides somewhat oblique, so that the mesial corners of the remaining laminate processes on each side are not so acute, but are nearly a right angle.

Process of segment 15 small, rather sharply triangular, somewhat flattened dorso-ventrad, but proportionally much thicker than in *T. figlinus*, especially in the middle where that of *T. figlinus* is canaliculate.

Legs of male slightly less crassate than in *T. figlinus* and somewhat

less densely hirsute; ventral face of four distal joints with minute tubercles; fleshy soles of last joint of pairs 1 to 6 moderately developed.

Copulatory legs (Plate LVII, figs. 4a-4c).

Color of alcoholic specimen pale grayish brown, the carinae, legs, and antennae sordid; the whole animal bleached in alcohol so that the darker contents of the alimentary canal show through. Karsch gave the color as uniform pale testaceous in 1881.

Length, about 40 mm.; width, 7.2 mm.; length of antenna, 7 mm.; of leg of tenth segment, 7.5 mm.

Locality.—Serbia Ghattas, Djur, in the upper valley of the White Nile (Bahr-el-Ghazal region); a single male specimen preserved in alcohol in the Berlin Museum was collected by Dr. Schweinfurth. The bottle (No. 629) contains also a fragment consisting of segments 12 to 20 of what was evidently another specimen of the same species.

This species was referred provisionally to the genus *Tycodesmus* on account of its size and habit, the characters from which the genus might be more accurately determined not being given in the original description.

Tymbodesmus falcatus differs from *T. figlinus* in the following important characters which may indicate generic distinctness, although the form of the copulatory legs is good evidence that the two are more nearly related to each other than to any known third. *T. falcatus* is less than half as large as *T. figlinus*, the segments, legs, and antennae are more slender and delicate, the dorsum is less convex, the lateral thickenings of the carinae are less prominent dorsally, but are turned sidewise more than in any other form here described, so that the poriferous depressions face nearly laterad and cause the carinae to appear emarginate when viewed from above; the processes of the sterna of the sixth and fifteenth segments are small, narrow, and not medianly sulcate. They are both rounded triangular in outline, that of the sixth segment having no lateral lobes or shoulders, which are strongly developed in *T. figlinus*. The sterna of segments 8-10 have the posterior pair of ridges increased into flattened knobs, while in *figlinus* even the produced pair of the eighth segment are thin and sharp at apex. The copulatory legs in *falcatus* have the node very prominent laterad and proportionally much larger than in *figlinus* and occupying the entire sinus of the curve; in *T. figlinus* the upper part of the sinus is open, the node is strongly constricted at base and bears sharp teeth on its median and lateral faces, the homologous prominences of *T. falcatus* being, as far as they can be distinguished at all, mere rudiments in comparison.

Genus AULODESMUS Cook.

Aulodesmus COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 83.

Body very large, five times as long as broad, tapering slightly caudad; dorsum strongly convex, the carinae decurved in the direction of the dorsal arch. Antennae filiform, second joint longest, the next four

subequal, the fourth slightly longer than the third or fifth, sixth only slightly shorter than fifth; olfactory cones four.

First segment three times as long as broad, posterior margin distinctly curved forward, so that the segment is laterally much shorter than in the middle. Segments dorsally even and smooth, neither granular nor areate.

Lateral carinae with thickened margins distinct, twice as broad on poriferous segments, distinctly narrower on posterior segments than on anterior; margins not expanded, not broader on segments 1 to 4 than on segment 6; posterior corners of carinae slightly produced, increasing caudad from the fifth segment; anterior and posterior edges of carinae very narrowly or faintly margined.

Repugnatorial pores 13, located in shallow cavities.

Preanal scale minutely apiculate, the setiferous tubercles distinct, close to the apex but not exceeding it.

Sterna with a distinct, transverse, medianly interrupted ridge between bases of each pair of legs.

Sternum of sixth segment of male with an oblong, minutely apiculate process between the bases of the anterior pair of legs.

Sternum of fifteenth segment of male with a broadly triangular ensiform process projecting cephalad between the anterior pair of legs.

Legs of male moderately crassate, dorsal face of second joint inflated, anterior six male legs with a small fleshy apical sole, the claw reduced.

Second male legs with coxae moderately produced into a blunt cone.

Copulatory legs as described for *Omodesmus*, but the two spines described in *Omodesmus* are subequal and there is another smaller spur located at the base of the mesial spine and directed mesad; the flagellum is bent laterad beyond the lateral spine, and makes nearly two turns in a diffuse spiral; its apex lies between the bases of the copulatory legs and not upon the nodus as in *Astrodesmus*.

The sixth antennal joint is distinctly longer in proportion to the fifth than in *Astrodesmus*, and the antennae as a whole, as well as the individual joints, are somewhat more slender than in that genus.

Repugnatorial pores appear much smaller in this genus than in *Astrodesmus*, where they are located in large cavities.

The process of the fifteenth segment is accommodated by a depression very slight in comparison with that of *Astrodesmus*.

As remarked under *Omodesmus*, there is great similarity between the copulatory legs of it and *Aulodesmus*, while those of *Astrodesmus*, though constructed on the same plan, offer several differences from both. The mesial and lateral spines are almost rudimentary in *Aulodesmus*, the flagellum, though it rises similarly from the anterior (by flexure posterior) face of the node, does not coil spirally, but is bent back upon itself and then turns mesad so that its bidentate apex lies against the node of its fellow. A small spine, perhaps homologous with the spur-like process described for *Omodesmus*, arises in *Aulodesmus* from the proximal

end of the mesial face of the node and is directed cephalad (by flexure ventrad or caudad) against the side of the compressed proximal part of the structure.

In *Aulodesmus*, moreover, the sternum of the sixth segment behind the process is hollowed out to accommodate the copulatory legs. This is not accomplished, as in some cases, by an excavation in the chitinous exoskeleton, but by the omission of that part of it which would interfere with the copulatory legs, so that the ventral part of the sixth segment is very short and broadly sinuate posteriorly to a much greater degree than in the two other genera under comparison.

The segments, including the carinæ, are evenly convex dorsally, the most conspicuous irregularity being a distinct, though gradual and not strongly pronounced, prominence or rather a general inflation of the surface at the base of the carinæ.

Notwithstanding the general similarity in habit between this genus and *Astrodesmus*, some differences may be pointed out. *Aulodesmus* is distinctly the larger and heavier of the two, and the dorsum is decidedly more convex when the same sexes are compared, the convexity not being due to a mere difference in the tilt of the carinæ, but resulting from a different curve of the dorsal arch. In *Aulodesmus*, too, the body is distinctly, though slightly and gradually, narrowed caudad from near the middle, while it is scarcely narrowed anteriorly to the second segment. In *Astrodesmus* the body is not appreciably narrowed to the ends, which are both very abrupt.

The small carina at the base of the posterior leg of each segment is much more pronounced than in *Astrodesmus*.

The legs of males are distinctly more crassate than in *Astrodesmus* and their two basal joints especially are densely hirsute, while in *Astrodesmus* the hairs are comparatively scattering. The copulatory legs of *Aulodesmus* are also much more densely hirsute and with longer hairs.

AULODESMUS MOSSAMBICUS (Peters).

(Plate LVIII, figs. 2a-2c.)

Polydesmus mossambicus PETERS, Monatsber. d. K. Preuss. Akad. d. Wiss., Berlin, 1855, p. 81.

Eurydesmus mossambicus PETERS, Reise nach Mossambique, Zoologie, 1862, V, p. 533.

Aulodesmus mossambicus COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 88, pl. III, figs. 17, 18; pl. VI, figs. 1-3.

Vertex without hairs, smooth and shining; sulcus distinct, ending between the sockets in a considerable depression.

Clypeus smooth and even, except two small and irregular (perhaps accidental) depressions near the middle, and the usual oblique, lateral excavations.

Antennæ sparsely hirsute.

Gnathochilarium densely hirsute with short hairs.

First segment with anterior margin straight, the posterior slightly and broadly emarginate in the middle, curved cephalad on each side; posterior corners somewhat greater than a right angle, rounded; a distinct lateral margin continuous in front nearly to the middle of the segment, posteriorly broader and becoming obsolete at the posterior corner; the segment is evenly convex in general contour, the carinae not being tilted as in *Omodesmus*.

Segments 2 to 4 with lateral margins distinct and continuous along the anterior edge, but not on the posterior; their carinae not tilted out of the general dorsal curve, though the anterior corner of the second segment, like that of the first, is strongly decurved.

Segments dorsally nearly even, the surface even and shining, faintly coriaceous or rugulose under a lens; on posterior segments very nearly obsolete granules in transverse rows can be traced under a lens.

Lateral carinae about one-fourth as wide as the body cavity; thickened margins distinct, continued in fine ridges on the anterior and posterior edges, twice as broad on poriferous as on the other segments; marginal callus of fifth segment broadest, the pore located nearer to the mesial edge than to the margin and somewhat behind the broadest part of the callus, which is distinctly narrowed caudad; on other segments except the seventh the callus is as broad opposite the pore as elsewhere and tapers almost equally to both ends.

Below the carinae the segments are more or less rugulose and with a distinct prominence at the middle of the base of the carinae; as this prominence does not appear on poreless segments, it is probably correlated with the presence of the repugnatorial gland.

Above the base of the posterior leg of each segment is a distinct longitudinal row of granules or secondary carina.

Anterior subsegments faintly rugulose-punctate under a lens.

Penultimate segment with the apices of the rather short carinae sometimes equaling or slightly exceeding the posterior corners of the eighteenth.

Last segment with the exposed basal portion rather long; the projecting triangular part broad, the apex rather broadly punctate, the setiferous punctations not located on tubercles.

Anal valves vertically rugulose, especially below; the setiferous tubercles small; the margins thin and prominent, not greatly exceeded by the apex of the last segment.

Preanal scale rugulose; the setiferous tubercles distinctly conic, projecting somewhat ventrad, scarcely equaling the minutely apiculate apex.

Sterna densely hirsute with long hairs, especially on the posterior slopes of the very prominent transverse ridges.

Process of the sternum of the sixth segment somewhat longer than broad, quadrate, with a small median apiculus; the process is rather densely hirsute with short hairs, except the apiculus; antically the

process is medianly carinate, while postically it has two median depressions, one above and the other below the middle.

Sternum of fifteenth segment with a broadly triangular, medianly excavate process consisting of an extension of the transverse ridge between the anterior pair of legs, directed cephalad and accommodated by a small concavity in the fourteenth segment. The ridge connecting the anterior pair of legs of the sixteenth segment is continuous, while all others are medianly interrupted. On the segments immediately following the copulatory legs the ridges are short, and those between the posterior pair of legs are much more prominent than those between the anterior.

Legs of males densely hirsute with long hairs on the ventral face of the two basal joints; especially is this the case in the anterior half of the body; distal joints of legs also densely hirsute with shorter hairs; the ventral faces of the distal joints of the legs are scarcely hirsute and slightly, if at all, tuberculate.

Copulatory legs (Plate LVIII, figs. 2a-2c).

Color: According to Peters the dorsum and antennæ were dark reddish brown, the carinæ, ventral surface, and legs brownish yellow.

Length, 83 mm.; width, including carinæ, 15 mm.; width of body cavity, 10 mm.; length of antenna, 11.5 mm.; length of leg of ninth segment, 15 mm.

Locality.—Dr. Peters says: "I found this species in rubbish heaps on the island of Mozambique and on the peninsula of Cabaceira in the month of December, at Querimba in May, and also at Tette." The specimen chiefly employed in the above description was collected by Peters at Mozambique and labeled as type in Peters's handwriting. It is No. 544 of the Berlin Museum. The specimens which Peters supposed were young males with well-developed copulatory legs are members of a distinct genus, here described under the name *Neodesmus juvenis*. Whether the specimens collected at other places belong in reality to the present species may perhaps be doubted.

MERODESMUS, new genus.

Body of medium size, about five times as long as broad, tapering gradually cephalad, very abruptly caudad; dorsum strongly convex, the carinæ strongly depressed in the direction of the dorsal arch.

Antennæ filiform, the second joint slightly longer than the four following, which are subequal; olfactory cones 10.

First segment about three times as broad as long; posterior margin nearly straight, the anterior strongly curved laterad so that there is no distinct lateral edge, the posterior corner of the segment being more pronounced than in the other genera.

Segments dorsally even and smooth.

Lateral carinæ rather narrow, their thickened margins of moderate width and prominence, the anterior and posterior edges very narrowly margined; the calli of poreless and anterior segments are narrow,

though distinct; they taper gradually from the posterior corner of the carina to its raised anterior edge; posterior corners moderately produced on posterior segments.

Repugnatorial pores 13, located in rather small depressions facing somewhat laterad.

Preanal scale scarcely apiculate, the apex considerably exceeded by the rather large setiferous tubercles, which are so close together that the slopes of their bases nearly meet.

Characters of mature males unknown.

Female with coxæ of second legs produced into two long cylindrical processes, which exceed the second joint of the legs in length and are densely hirsute with very long hairs.

The type of this genus is *M. compactilis* Gerstäcker. The processes are so remarkable and, as far as known, so unique a character that they may with safety be made the basis of a generic diagnosis. That we are not, however, dealing with an entirely anomalous condition may perhaps be inferred from the fact that the female of *Gomphodesmus* has the coxæ somewhat conically prominent. In that case, however, the posterior margin of the third segment is below much produced into a thin prominent rim, which is medianly broadly and deeply emarginate. In *Merodesmus* no such tendency appears, and the form and sculpture of the carinae of the first segment are different not only from *Gomphodesmus*, but from other Gomphodesmidae, to say nothing of the discrepancy of olfactory cones between the two genera compared. The general outline of the very short, strongly convex, and compacted body, which tapers distinctly cephalad, is also peculiar. The carinae are proportionally narrow, and are inserted below rather than above the middle line of height.

MERODESMUS COMPACTILIS Gerstäcker.

(Plate LXI, fig. 2a.)

Eurydesmus compactilis GERSTÄCKER, Deeken's Reise, 1873, III, 2, p. 519.

Aulodesmus compactilis COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 91.

Body short and stout, proportionally strongly arched, slightly shining.

Vertex with a fine, though sharp, median furrow; clypeus below more strongly contracted than in *A. latus*, the curved line above the middle of the margin distinct, the part below densely punctate.

Antennæ somewhat more slender than in *Astrodesmus latus*.

First segment with anterior margin even, moderately arcuate, passing with the same curve into the lateral margins; posterior edge emarginate in the middle and also on each side, so that the lateral corners are sharp and slightly produced caudad; marginal ridges smooth, linear, continued on the anterior margin and gradually narrowed.

Subsequent segments strongly arched dorsally. Second to fourth segments with an evident emargination on each side of the posterior edge.

Lateral carinae small, below the middle height of the segments; on

the anterior segments scarcely evident, but more pronounced from the fifth back, slightly arched, the posterior edge slightly more elevated. Marginal ridges of segments 2 to 4, also of 6 and 8, linear, more pronounced than on the first segment. Carinae gradually larger from segment 10; from 14 with evident tooth-like projections beyond the posterior margin. Projection of segment 18 smaller than that of 17, that of 19 small, blunt, papilliform.

Last segment with a distinct, fine, transverse furrow limiting the posterior caudal projection, which is short triangular, with a blunt, almost truncate, dorsally swollen apex, and has on each side a stout, wartlike knob. Both the knobs and the apex of the segment bear bristles.

Anal valves light gray, with smooth yellow margins. Preanal scale transversely subhexagonal, with a small median knob between the lateral wart-like prominences.

Second leg of the female with a long styliform process directed obliquely caudad and ventrad, and lying between the legs of the third pair.

Color in alcohol pale bone-yellow, with a light-brown posterior margin of the dorsal portion of the segments, and with more or less evidently brown posterior corners of the anterior and posterior carinae. Antennae and legs light ferruginous.

Length, 49 mm.; width, 10.5 mm.

Locality.—One mature female specimen and an immature male, collected at Mombassa.

The male specimen was 31 mm. long and 8 mm. broad, and had 19 segments. There was no trace of the button-like process of the coxa of the second leg, which bears the genital opening, nor of the processes of the pedigerous laminae of the sixth and fourth from the last pairs of legs. In place of the not yet developed genitalia, between the coxae of the legs of the seventh segment were two transversely quadrate cushion-like prominences.

Genus SPHENODESMUS Cook.

Sphenodesmus COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 83.

Body rather small, over five times as long as broad; dorsum moderately convex, the moderately broad carinae sloping nearly in the direction of the dorsal arch.

Antennae filiform, rather robust, second joint slightly longer than the four following, which are subequal; olfactory cones ten.

First segment scarcely three times as broad as long, subelliptic, the posterior margin laterally somewhat curved forward.

Segments evenly convex, distinctly coriaceous rugulose, especially laterad.

Lateral carinae with marginal callus very prominent, continuous in front, scarcely so behind; on anterior segments the callus is less prom-

inent and narrower, and does not appear on the first segment—that is, the raised margin is not specially thickened laterad; posterior corners of carinae thick, rounded, subrectangular to the middle segments, behind which they are slightly and gradually more produced.

Repugnatorial pores 13, located in distinct excavations behind the middle of the posterior subsegments.

Preanal scale subsemicircular, the setiferous tubercles smaller and not equaling the distinct apiculus.

Sterna without transverse ridges.

Sternum of sixth segment of male with a broad, rounded, apiculate process.

Sternum of fifteenth segment unmodified.

Legs of males scarcely crassate; dorsal face of second joint rather slightly inflated; legs 1 to 6 with a very small fleshy sole at apex, their claws not greatly reduced.

Coxae of second male legs produced into a long, stout papilla, of which the posterior face is flattened and contains the seminal aperture.

Copulatory legs strongly decurved and with large nodes, as in the large genera *Astrodesmus* and *Aulodesmus*; the mesial spine at the base of the flagellum is very long; the flagella are rather stout, strongly flexuous, cross each other, and are accommodated in a large cavity considerably in front of the aperture in which the copulatory legs are inserted. The anterior edge of this aperture is produced ventrad into a prominent rim, not noticed in other genera.

SPHENODESMUS RUGULOSUS Cook.

(Plate LIX, figs. 1a-1c.)

Sphenodesmus rugulosus COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 83.

Vertex without hairs, polished and shining; sulcus distinct, not deep; as also the interantennal suture.

Clypeus smooth and evenly convex, a curved transverse row of about six minute setiferous punctations below.

Antennae sparsely hirsute with short hairs, more numerous on the distal joints.

First segment subelliptic, more regular in outline than in the larger forms of the present family; dorsally smooth and even, the carinae distinctly and equally margined, the margin more distinct laterad, not abruptly, so that a marginal callus, as it appears on the other segments and on other genera, may be said to be wanting; dorsally the carinae are distinctly concave and rugulose; the margins do not extend more than halfway to the median line.

Second segment with a distinct lateral side, the anterior corner somewhat prominent.

Segments dorsally smooth, finely coriaceous, or sparsely punctulate in the middle; laterad and on the carinae distinctly rugulose; posterior segments are also rugulose along their posterior margin.

Lateral carinæ less than one-fourth as wide as the body cavity, inserted not much above the middle of the side; marginal callus prominent, continuous along the anterior edge as a distinct raised margin, the calli of poreless carinæ about half as wide as the others; anterior carinæ with the margins nearly straight, the middle rounded, the others with the posterior corner gradually, but not strongly, produced.

Repugnatorial pores 13, located in distinct excavations which open more nearly laterad than dorsad.

Anterior subsegments polished and shining; transverse constriction distinct, not crenulate; below the carinæ minutely rugulose; secondary carinæ obsolete.

Penultimate segment short, its minute carinæ not equaling those of the eighteenth segment.

Last segment subtriangular, distinctly truncate at apex.

Anal valves somewhat rugulose; margins distinct, moderately prominent, not strongly compressed; setiferous tubercles very small.

Preanal scale broadly rounded, triangular; setiferous tubercles minute, though distinct, exceeded considerably in size by the distinct, rather blunt, apiculus.

Sterna moderately hirsute with long hairs which are more numerous along the posterior margin and on anterior segments; no distinct sternal ridges; an indistinct transverse sulcus.

The sternal process of the sixth segment subsemicircular, faintly shouldered, and distinctly apiculate, hirsute along its edges with long hairs.

Legs of males probably slightly crassate, moderately hirsute with long hairs, especially on the inferior face of the basal joints.

Copulatory legs (Plates LIX, figs. 1a-1c).

Color of alcoholic specimen rather dark chestnut brown; marginal calli and under side somewhat lighter; antennæ and distal joints of the legs dark, like the dorsum.

Length, about 24 mm.; width, with carinæ, 4.2 mm.; without carinæ, 2.75 mm.; antennæ, 3.5 mm.; length of leg from middle segment, 3.5 mm.

Locality.—Ravirondo, East Africa. A single male specimen in a bottle with *Harmodesmus nitens* and *Mychodesmus macramma*.

The lateral angle of the first segment suggests that of *Gomphodesmus*, being evenly rounded, with no implication of a lateral side, but there is a distinct difference in the wide marginal callus of *Gomphodesmus* which occupies the whole apex of the lateral angle. In *Sphenodesmus* the angle is less pointed and the raised margin is scarcely more pronounced laterally than elsewhere.

This species presents the most pronounced dorsal sculpture yet known in the present family, the upper surface of the carinæ being densely rugulose, while in all other cases the sculpture is much fainter and more irregular in appearance, as though accidental.

SIGODESMUS, new genus.

Body rather small, nearly five times as long as broad; dorsum moderately convex, the carinae decurved nearly in the direction of the dorsal arch.

Antennae filiform, second joint longest, joints 3 to 5 subequal, distinctly longer than joint 6; olfactory cones ten.

First segment less than twice as broad as long, subsemicircular, the anterior margin being carried around in an even curve to the posterior corner, which is distinctly angled.

Segments dorsally smooth, rugulose laterad.

Lateral carinae distinctly margined in front, scarcely so behind; marginal callus distinct, narrowed in front, very narrow on poreless segments, very short and narrow on the first, and passing insensibly into the raised margin; posterior corners of all segments somewhat produced, those of the posterior segments increasingly so, but not as narrow and spiniform as on some of the larger genera.

Repugnatorial pores 13, located in distinct excavations facing nearly dorsad.

Preanal scale rounded triangular, distinctly angled but not apiculate; setiferous tubercles small, distinct, rather close together, not exceeding the apex.

Sterna with transverse ridges distinct, but not prominent, much as in the smaller species of *Astrodesmus*.

Sternum of segment 6 with a subtriangular process which has a distinct, rounded apiculus; it is slightly shouldered and has a broad base as in *Astrodesmus*.

Sternum of segment 7 with posterior rim of copulatory aperture expanded, entire.

Sternum of segment 15 with a very broadly triangular, small process which fits into a deep excavation in the posterior part of the sternum of segment 14.

Legs of male moderately crassate, proportionally about as long as in *Astrodesmus*; dorsal face of second joint much inflated; fleshy sole of first six pairs rather large, the claw much reduced.

Coxae of second legs of male broadly produced.

Copulatory legs constructed somewhat as in *Astrodesmus*, the basal hairy part compressed, not trigonal, narrower and longer than in *Astrodesmus*; from the mesial side of the base of the nodus arise two large spines not present in *Astrodesmus*; one of these is directed somewhat mesad and crosses its fellow while the other is turned laterad; the flagellum is moderately stout, crosses its fellow, and ends in two stout prongs.

From *Astrodesmus* the form of the first segment and copulatory legs render diagnosis easy. The difference in size is also very great, except in the case of *A. petilis*, from which it is distinct in the more compact

and robust body, the shorter legs and antennæ, the semicircular first segment, and the large spines of the copulatory legs.

The five species which are associated under the present name may not prove to be a natural group, but if they do not belong together it seems unlikely that they can be located under any of the preceding genera.

ANALYTICAL KEY TO THE SPECIES OF SIGODESMUS.

Length, 47 mm.; flagellum ending in a thickened node-like expansion from which projects a single curved prong: *Sigodæsmus monocerus*, p. 724.

Length, 40 mm., or under; flagellum ending in two distinct, slender, or at least pointed, prongs.....

Length, 40 mm.; flagellum ending in two strongly curved, connivent prongs, the longer of which is strongly recurved near the apex and has a sharp tooth near its base: *Sigodesmus ruspolii*, p. 725.

Length, less than 30 mm.; prongs not so strongly connivent, the longer not recurved at apex, and without a tooth at base.....

Flagellum without other processes than the terminal prongs, one of which is over twice as long as the other: *Sigodesmus indigus*, p. 723.

Flagellum with a small lateral process below the base of the more robust of two prongs, which are subequal in length.....

Lateral process mentioned above very small, acute, and spiniform: *Sigodesmus contortus*, p. 725.

Lateral process subrectangular, nearly as wide as the flagellum opposite the process: *Sigodesmus innotatus*, p. 726.

SIGODESMUS INDIGUS, new species.

(Plate LIX, figs. 2a-2c.)

Vertex without hairs, strongly convex, suture and sulcus distinct.

Clypeus with two minute setiferous punctations between the antennal sockets, somewhat closer to each other than to the sockets; another pair of similar punctations lower down and wider apart; supralabral punctations few and indistinct.

Antennæ rather sparsely hirsute with short hairs, the sixth joint distinctly shorter and slightly thicker than the fifth.

First segment without a trace of an anterior corner, the anterior margin being carried around to the posterior corner almost in a semicircle; the posterior corner is more distinctly angled than in any other member of the family here described, and the great length of the segment is also peculiar; the marginal callus is narrower than in any of the genera which have a lateral angle.

Segments dorsally finely coriaceous, somewhat rugulose on the carinæ.

Lateral carinæ of moderate width, distinctly narrower than in *Astrodesmus*; anterior margin much more distinct than the posterior; marginal callus narrowed in front and broadened opposite the pore, so that the poriferous carinæ are more rounded than the others; the carinæ of segments 17 to 19 are rather broad, much shorter and broader than in *Astrodesmus petilus*.

Segment 19 nearly concealed, its carinae small and rounded, exceeded by those of segment 18.

Last segment (abnormally?) very broad and rounded, the apex not produced nor truncate, somewhat exceeded by the margins of the anal valves.

Anal valves with margins scarcely distinct, not compressed nor prominent; setiferous tubercles distinct, the superior pair somewhat at the side of the margin instead of upon it; surface of anal valves and preanal scale faintly rugulose.

Sterna sparsely hirsute with long hairs on the posterior slope, otherwise nearly naked.

Sternum of segment 6 with process nearly naked, the mesial prominence of the basal joints of the sixth pair of legs with long hairs.

Sternum of segment 15 with process very broadly triangular, pointed, scarcely canaliculate.

Legs of male moderately hirsute, the anterior somewhat more densely than the others.

Copulatory legs (Plate LIX, figs. 1a-1c).

Color of alcoholic specimen pale bone yellow.

Length, 28 mm.; width, 6 mm.; without carinae, 4.3 mm.; length of antennae, 5 mm.; of leg from tenth segment, 6 mm.

Locality.—A single male specimen in the Berlin Museum was collected by Denhardt at Witu, British East Africa.

SIGODESMUS MONOCERUS, new species.

(Plate LIX, figs. 3a, 3b.)

Differs from the preceding in the much greater size and somewhat more robust habit.

The copulatory legs, while clearly more similar to those of *S. indigus* than to any other species, are strikingly distinct in the shorter and more robust flagellum, the longer prong of *S. indigus* being replaced by a thickened, rounded prominence. The other prong is here somewhat larger and more strongly curved than in the other species. Of the two large teeth opposite the node of *S. indigus*, the shorter is here rudimentary, while the other is much smaller than in that species.

Color of fresh alcoholic material light grayish brown on carinae and anterior subsegments, the posterior half of the posterior subsegment being also light dorsally; the anterior half, and especially a large but somewhat irregular and mottled patch at the base of the carina, dark brown; this darker marking is usually well defined and sometimes very conspicuous. The transverse sulcus, at least, is dorsally very dark brown, with a dark median line and a lateral patch on the anterior subsegment at the height of that of the posterior subsegment, but smaller, lighter, and poorly defined.

Length of male, about 47 mm.; diameter, 11.5 mm.; length of antenna, 9 mm.; of leg of tenth segment, 10 mm.

Locality.—One male and two female specimens are in the Berlin Museum from Taru, vicinity of Mombasa, collected by F. Thomas.

This species was compared with the type of *Astrodesmus luridus* (Karsch), also from Mombasa, but the two are, without doubt, distinct, and the basal remnants of the copulatory legs of *luridus*, which are robust and close together, render it certain that that species has nothing to do with those arranged under *Sigodesmus*, although in *S. monoceris* the process of the sixth segment has a distinct distal margin and a small, abruptly rounded apiculus, much as in *Astrodesmus luridus*.

SIGODESMUS CONTORTUS (Pocock).

Eurydesmus contortus POCKOCK, Ann. and Mag. Nat. Hist., 1896, 6th ser., XVII, p. 436, pl. XVIII, fig. 4.

Type.—British Museum.

Locality.—Mkonumbi, region of Mount Kenia, East Africa.

Length, 25 mm.; width, 5 mm.

This species agrees with *indigus* in size and habit and in the armature of the sterna of the male. The copulatory legs agree, moreover, in that the flagellum divides distad into two large prongs, but from the single drawing given by Mr. Pocock it appears that the two spines which arise near the node are more nearly equal in size and length than in *S. indigus*. Were the habitat the same, one would be inclined to look upon *S. innotatus* as a synonym of this species, on account of the close approximation in the shape of the distal part of the flagellum.

SIGODESMUS RUSPOLII (Silvestri).

Aulodesmus ruspolii SILVESTRI, Ann. Mus. Civ. Genoa, 1896, XXXVII, p. 59, fig. 1.

Color fusco-testaceus, antennæ and legs reddish.

First segment short, rounded in front, laterally margined and with the angles acute.

Preanal scale with the sides arcuate and the apex truncate, armed with three large tubercles, of which the lateral bear long hairs.

Sternum of segment 6 armed with a large, broad, upright process, somewhat rounded at apex and beset with long hairs.

Ninth pair of legs armed at base with a rather small, obtuse process.

Sternum of segment 15, with a rather long, triangular, acute process directed cephalad.

Copulatory legs at the base of the flagellum with three arcuate processes shorter and less attenuate [than in *S. innotatus*]; flagellum at apex with two connivent processes, of which the longer is not pointed and is provided near its base with a rather large tooth.

Length, 40 mm.; width, 10 mm.

Locality.—Ueb, Somaliland.

The above is a translation of Silvestri's description with the omission of characters common to all the representatives of this family. It was based on a male specimen collected by Prince Ruspoli and preserved in the Genoa Museum.

This and the following species were placed by Silvestri in the genus *Aulodesmus*, but the distribution, size, and especially the structure of the copulatory legs, seem to indicate much greater affinity with *Sigodesmus*, the only genus which has three spines at the base of a two-pronged flagellum.

SIGODESMUS INNOTATUS (Silvestri).

Aulodesmus innotatus SILVESTRI, Ann. Mus. Civ. Genoa, 1896, XXXVII, p. 59, fig. 2.

Color throughout testaceous and somewhat cinereous; antennæ and legs concolorous or reddish. Preanal scale with the sides slightly rounded and the apex truncate; armed with three large tubercles, of which the external bear each a long seta.

Sternum of segment 6 with a subrectangular upright process somewhat narrowed at apex and beset with setæ.

Ninth pair of legs at base with a very small obtuse process.

Sternum of segment 15, with a rather small, triangular, acute process.

Copulatory legs with three long, slender processes surrounding the base of the flagellum, which has at apex two prongs of subequal length, of which the longer is more robust and less pointed. The more slender process has a prominent acute angle at base, and below the terminal prongs is a small rectangular process.

Length, 28 mm.; width, 6 mm.

Locality.—Magala Re Umberto, Somaliland. Specimens collected by Prince Ruspoli are in the Genoa Museum.

The above description is translated and abridged from that of Silvestri.

It would seem, from a comparison of the figures, that the generic affinities of this species are not with *Aulodesmus*, but that it is very closely allied, if not identical, with *S. contortus*, which was published in June, 1896, while *innotatus* appeared in November of the same year. The shape of the distal part of the flagellum is at least closely alike, *S. contortus* being represented with the basal angle of the smaller tooth more rounded and the subapical process more pointed than in *S. indigus*.

Genus ASTRODESMUS Cook.

Astrodesmus COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 83.

Body very large, about five times as long as broad, cavity scarcely depressed; oblong, abruptly narrowed at both ends.

Labrum scarcely emarginate, with three short, blunt teeth.

Antennæ filiform, joints in order of length 2, 4, 5, 3, 6, 1, 7. Seventh joint broader than long, truncate, and with a conic depression in its apical face; ten olfactory cones arranged in a circle around the edge of the depression.

Mandibular stipe with exposed surface divided by sutures into five areas, the basal larger than all the others together.

Hypostoma strongly arcuate; rising from each side of the convex median portion is a flattened, oblong process lying against depressions of the lower part of the mentum.

Cardo present, transversely oval.

Mentum broadly triangular, long-pointed in front, very broadly emarginate behind, hirsute.

Stipes over twice as long as broad (2:5), hirsute.

Lingual laminae three times as long as broad, hirsute. Lingual lobes large. Median lobe not evident.

First segment three times as broad as long, with anterior and posterior margins medianly straight and parallel; posterior margin laterally curved forward; anterior corners broadly rounded, the posterior nearly a right angle. The segment is much broader than the head, very slightly narrower and noticeably longer than the second segment.

Segments with dorsal surface smooth, neither granular nor areate.

Lateral carinae subapproximate, about one-fourth as wide as the body cavity, inserted about three-fourths of the distance up; margin abruptly raised and thickened above, especially the lateral; edge blunt, entire; carinae of anterior segments curved slightly forward, the posterior with posterior corners more and more produced.

Repugnatorial pores small, dorsal, located in a slight depression of the middle of the thickened margins of the lateral carinae of segments 5, 7, 9 to 19, surrounded by a fine raised rim.

Penultimate segment very short, included between the projecting corners of the antepenultimate.

Last segment very short, triangular, the apex narrow, truncate or rounded, the whole segment bearing 16 setae, as follows: Two pairs lateral, two pairs marginal, two pairs dorsal; all these upon larger or smaller tubercles; one pair apical and one subapical, these last rising from punctations.

Anal valves with compressed, elevated margins and two setigerous tubercles, the upper placed on the outer slope of the raised margin, the lower somewhat removed from it.

Preanal scale semielliptic-triangular, tricuspidate, the three projections close together, the middle flat, the others conic, blunt, with piliferous punctations at apex.

Sterna with a sharp, transverse, medianly interrupted ridge between the bases of each pair of legs; between the ridges a transverse furrow.

Sternum of sixth segment of male with a three-cornered process projecting ventrad between the anterior pair of legs.

Sternum of the fifteenth segment of male with a broadly ensiform process projecting cephalad from between the anterior pair of legs into a socket in the posterior part of the fourteenth.

Eighteenth segment with the pedigerous laminae very narrow, especially the posterior, so that the legs project obliquely caudad over the preanal scale.

Legs of males long and crassate, the dorsal face of the second joint

strongly inflated; all the joints more or less tuberculate on the ventral face and beset with bristles on the apical joints.

First six pairs of male legs with a fleshy sole at apex of the last joint, the claw shortened.

First pair of legs of male six-jointed like the others; the coxæ long, approximate.

Second pair of male legs with the coxæ produced ventrad into a large process, in the depression of the flattened ventro-posterior face of which is the seminal opening.

Male genitalia with basal joint very small, flattened; distal joint very large, laterally compressed, tricarinate; ungual portion very long, complicate, thin and compressed at base to form a flexible pseudo-articulation, above which it is inflated, then extended into a long flexuous flagellum, very slender distally.

ANALYTICAL KEY TO THE SPECIES OF ASTRODESMUS.

Body large and robust (65 mm. by 13.5 mm.); dorsum strongly convex, distinctly rugulose to the naked eye, especially on the carinæ; marginal calli prominent and broad, that of the fifth segment strongly arcuate mesad, being greatly widened to accommodate the large poriferous cavity: *A. tanga*, p. 736.

Body much smaller or smooth and shining; marginal calli moderately developed, the poriferous merely oval, those of the fifth not so different from those of the seventh segment

Body rather small and slender (33 mm. by 6.5 mm.); antennæ and legs slender, equal in length to the width of the body; transverse ridges of sterna slightly developed; process of sternum of segment 15 very small, tuberculoid: *A. petilus*, p. 733.

Body larger and more robust; antennæ and legs more robust, not equaling in length the diameter of the body; transverse ridges of sterna distinct; process of segment 15 large and strongly chitinated

Process of sternum of segment 6 subquadrate, the sides being subparallel and the distal margin nearly transverse, except for a small median apiculus; two distinct, flattened processes between the bases of posterior pair of legs of segment 8: *A. luridus*, p. 734.

Process of sternum either subtriangular or narrower near the base than farther up, and with a large median projection, so that there is no transverse distal margin; segment 8 with the ridges of the sternum scarcely larger than the others

Body very robust (55 mm. by 14.5 mm.); the dorsum but slightly convex; the carinæ broad and fitting closely together: *A. robustus*, p. 731.

Body not more than 13 mm. in diameter by the above length; dorsum more convex, the carinæ distinctly separated

Copulatory legs slightly or not at all expanded, or at least entirely unarmed immediately below the slender terminal spine: *A. latus*, p. 731.

Copulatory legs distinctly and abruptly flattened and expanded below the terminal spine; proximal corner of expanded portion produced into a distinct, recurved spine

Size about 45 mm. by 11.5 mm.; dorsum distinctly rugulose striate longitudinally; expanded subterminal portion of copulatory legs short, the proximal spine short: *A. striatus*, p. 733.

Size at least 55 mm. by 12.5 mm.; dorsum not rugulose longitudinally, appearing smooth to the naked eye; expanded subterminal portion of copulatory legs longer and thinner, the proximal spine longer (see Plate LX, fig. 1c): *A. stellifer*, p. 729.

ASTRODESMUS STELLIFER Cook.

(Plate LX, figs. 1a-1k.)

Astrodesmus stellifer COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 86, pl. II, figs. 1-2; pl. III, figs. 1-9.

Vertex without hairs, polished and shining; sulcus distinct, meeting a transverse shallow sulcus (and suture) between the antennal sockets.

Clypeus smooth, even, excepting an oblique depression on each side and a few coarse punctations below.

Antennæ with basal joints very sparsely hairy, the distal gradually more hirsute.

Mentum hirsute over the posterior two-thirds of its surface.

Stipes densely hirsute, a broad depression along the lateral edge.

Lingual laminae very densely hirsute over their entire surface.

Segments dorsally apparently smooth, shining with a dull luster; uniformly covered with minute, irregular, indistinct, impressed lines and wrinkles, and very minutely and densely punctate. Posterior margins of all the segments more or less rough with fine longitudinal notches or very short wrinkles.

Anterior segments with the posterior subsegments slightly convex anteriorly in the middle; broadly emarginate on each side of the convexity.

Lateral carinae about one-fourth as wide as the body cavity; margin abruptly raised and thickened above, the edge entire, blunt; anterior and posterior edges of carinae with a distinct, though fine, raised margin, which does not extend across the segments. Anterior carinae laterally curved slightly forward, the posterior corners at first right angles, gradually more produced, until on posterior segments the rounded projection is more than half as long as the posterior subsegment. On posterior segments the raised margin is gradually broader, until on the penultimate it occupies the entire carina.

Below the carinae the segments are densely rugulose with fine, flexuous wrinkles; a small, subtuberculate, indistinct carina just above the insertion of the legs.

Anterior subsegments shining, very indistinctly marked with longitudinal impressed lines.

Last segment very short, triangular, the apex narrow, truncate, slightly rounded; superior lateral tubercle somewhat above the level of the carina of the nineteenth, the inferior somewhat below; the anterior tubercle near the sinuation, the posterior about halfway between the anterior and the apex. The dorsal bristles close to the margin; apical piliferous punctations rather close together, the subapical somewhat farther apart; apex of segment thick.

Anal valves moderately inflated, with compressed, elevated margins; rugulose, especially in the depressions.

Prenal scale with surface nearly smooth.

Sterna sparsely hirsute.

Process of the sternum of the sixth segment somewhat quadrate in posterior view, narrower at base, then broader, then narrowed again to a mucronate apex. The apical faces hirsute with very long hairs. Posteriorly the process, and the sternum below it, is medianly deeply canaliculate; antically the process is straight, with fine, raised lateral margins.

Sternum of the fifteenth segment with the process naked, broadly ensiform, medianly grooved below. The process consists of an extension of the transverse ridge between the anterior pair of legs, and is directed cephalad into a depression between the posterior legs of the fourteenth segment. Between the posterior legs of the fifteenth segment is also a similar depression, but smaller, although the sixteenth sternum is in no way modified.

Legs of males hirsute with long bristles, especially on the distal joints. Tubercles confined to the ventral face and best developed on the fifth joint; on the posterior legs the tubercles of the other joints are small or rudimentary. Posterior legs more slender than the others, but not much shorter.

First legs of males with the sole less developed and the claw larger than on the five following legs.

Male genitalia (Plate LX, figs. 1c-1i).

Color in alcohol varying from dirty yellowish-white (bone color) to dark purplish brown. The carinae are always light, and the posterior margin of the posterior subsegment usually so, also the anterior subsegments, excepting a dark median line and a line on each side along the level of the carinae. Posterior subsegments bordered all around with a fine margin of distinct brown. Legs and antennae reddish-brown, especially the distal joints. First segment usually with a broad margin of light color all around.

Length, 65 mm.; width, 13 mm.

Type.—U. S. National Museum collection. Four mature males.

Locality.—Tana River, East Africa, between the coast and Hamaye.

One aspect of the male genitalium of this species greatly resembles that of *Eurydesmus latus* Gerstäcker, as figured by Karsch, and the first inclination was to identify it with that species in spite of considerable discrepancies in Gerstäcker's description. These are, however, too grave to be reasonably ignored. Compared with most Polydesmoidea, the animal would be called very robust, instead of slender. Gerstäcker's measurements, however, justify his statement. Neither is it loosely articulated nor slightly convex. The apex of the process of the sixth segment of the male is not a distinct knob, and the shape of the process does not suggest a spherical triangle. The process of the fifteenth segment is not on the "fourth from the last" pair of legs, but the eighth from the last, though in this respect it would not be surprising if a mistake has been made in the description.

ASTRODESMUS ROBUSTUS, new species.

(Plate LX, fig. 2a.)

With general habit of *A. stellifer*, but distinctly more robust, and less convex than any of the other species. The carinae also fit very closely together, and assist in giving the animal a somewhat characteristic appearance.

The copulatory legs resemble those of *A. laxus*, and differ from those of *A. stellifer* in that the flagellum lacks the retrorse subapical spine and lamellar expansion.

Color like some of the browner specimens of *S. stellifer*.

Length of male, 55 mm.; width, 14.5 mm.

Locality.—East Africa, probably from the German colony; but more particular data are not at hand, and the type specimen of the Berlin Museum is not now accessible.

ASTRODESMUS LAXUS (Gerstäcker).

(Plate LXI, figs. 1a-1d.)

Eurydesmus laxus GERSTÄCKER, Deeken's Reise, 1873, III, 2, p. 518.

Aulodesmus laxus COOK, Proc. U. S. Nat. Mus., 1895, XVIII, pp. 90, 91.

Vertex hairless and smooth, the sulcus very shallow.

Clypeus smooth and even, excepting an oblique depression on each side, and a few coarse punctations below.

Antennae with basal joints very sparsely hairy, the distal gradually more hirsute.

Segments dorsally smooth and even, finely rugulose on the carinae.

Lateral carinae with the anterior and posterior margins moderately pronounced, the marginal calli distinctly and more abruptly broader on anterior segments, and the posterior corners moderately produced.

Repugnatorial pores in broad, shallow depressions, quite different from the smaller and distinctly deeper ones of *A. stellifer*.

Segment 18 much more exposed than in the other species of the genus. This character is shared by the other posterior segments, so that the body appears to taper more gradually caudad; carinae are of the usual size, but project considerably beyond those of segment 18.

Last segment with projecting portion distinctly narrow, rather broadly truncate, separated by a transverse sulcus.

Sterna densely hirsute on the posterior slopes of the not very strongly pronounced transverse ridges; process of sixth segment moderately hirsute laterally and upon its posterior face.

Legs of male moderately crassate and hirsute, both of these characters being more pronounced on the anterior.

Copulatory legs (Plate LXI, figs. 1a, 1b).

Length, about 62 mm.; width, 12.3 mm.; length of antenna, 9.5 mm.; of leg from middle segment, 12 mm.

Locality.—The type was a single male specimen from Mombassa. Subsequently this species has been reported from various other places in that region. It is without doubt congeneric with *A. stellifer*, the type of the genus, the habit, secondary sexual characters, and copulatory legs being closely the same.

The copulatory legs, compared with those of the specimen from Dar es Salaam (Stuhlmann), show several appreciable differences. The basal spurs of the node are much more pronounced. Those of the mesial face are situated close together at the apex of a long, subconic process. The distal spine of the node of *laxus* is smaller than that of Stuhlmann's specimen, while the lateral corner opposite is pointed in the type and rounded in the other.

The process of the sixth segment is broader and stronger than in the type and has the distal corners somewhat prominent, while that of the type is triangular, longer than broad, the lateral margins merely convex. The process of the fifteenth segment is somewhat longer and more pointed in the Dar es Salaam specimen, and the marginal calli are throughout somewhat broader and more prominent. The first segment is longer in the type and is more decidedly shortened laterad, the posterior margin being carried more obliquely forward. The depressions in which the pores are located are shallower in the type.

The preanal scale has a distinct, small and rounded, subconic apex, though the contrary might be inferred from Gerstäcker's description.

The wart-like prominences which Gerstäcker ascribes to the basal joints of the posterior legs seem to be merely the usual small granules which appear at the bases of the hairs of this and other families.

The terminal knob which Gerstäcker ascribes to the process of the sixth segment does not appear on his type. The apex of the process is as usual somewhat thickened and the point blunt, but in this specimen the apex distinctly tapers both in breadth and thickness.

The process of segment 15 is in its proper place, not on the fourth pair of legs from the last, as Gerstäcker states.

Gerstäcker gives the length as 78 mm., but this is certainly a mistake. The specimen is strongly curled at both ends, so that exact measurement is difficult, but his type is certainly less than 65 mm., 62 mm. being a careful estimate.

On the label of the type specimen in Gerstäcker's handwriting the locality is given as Sansibar, while in his published description it stands as Mombassa. Dr. Karsch informs me that this may not be a contradiction, as specimens were usually specially indicated which came from the island. The material, however, from any one locality is still so small that it is difficult to estimate the value of the minor differences noted, and some of the characters of the type specimen, such as the form of the last segment, may easily be the result of accident.

The species can be distinguished at once from *stellifer* by the somewhat more slender body and the more narrow and pointed process of

the sixth and fifteenth segments. The spine which stands at the base of the flagellum in front is much smaller than in *stellifer*, while the flagellum is provided with a sharp, proximally directed spine at the base of the small subapical expansion which appears in both species.

The Berlin Museum possesses a considerable number of specimens closely comparable with that collected by Stuhlmann at Dar es Salaam. These are labeled "*Zwischen der Küste und Kilimandscharo*" (Höhnelt); "*Madinula*;" "*Tana*" (Neumann).

ASTRODESMUS STRIATUS, new species.

(Plate LXI, fig. 3a.)

In habit and coloration resembling *A. stellifer*, but smaller, and differing from that and all other species in having the dorsal surface of the segments distinctly striate longitudinally in addition to being somewhat strongly rugulose.

Copulatory legs most closely similar to those of *A. stellifer*, but with the distal expansion and its attendant spines somewhat shorter than in that species. The stout spine at the base of the flagellum is larger than in *A. stellifer*, though scarcely equal to that of *luxus* and *robustus*.

Length of male, about 45 mm.; width, 11.5 mm.

Locality.—East Africa; type in the Berlin Museum.

ASTRODESMUS PETILUS, new species.

(Plate LXI, figs. 6a–6d.)

Vertex evenly convex, the sulcus rather shallow, the suture without hairs.

Clypeus with a pair of widely separated punctations somewhat below the antennal sockets, and several others above the labrum.

Antennæ filiform, slender, the distal joints moderately hirsute with short hairs.

First segment with marginal callus distinctly longitudinal, as on the following, there being a distinct lateral side.

Segments dorsally finely rugulose-coriaceous, more distinctly so upon the carinæ.

Lateral carinæ with distinct anterior and posterior margins; marginal callus with mesial edge nearly straight; on poriferous segments the callus is widened laterally, so that the carinæ appear more rounded than on the poreless segments.

Repugnatorial pores rather large, facing dorso-laterad, placed in a shallow depression and surrounded by a fine raised rim; the widening of the callus opposite the pore is sometimes rather abrupt, so that the edge behind it appears slightly emarginate.

Below the carinæ the segments are finely rugulose with distinctly tuberculate secondary carinæ.

Anterior subsegments very finely coriaceous; transverse constriction distinctly crenulate; supplementary margin of moderate length; the

spaces between the minute striae at the base of the supplementary margin are produced into small, broad, regular teeth.

Penultimate segment short, the carinae narrow and spiniform, not exceeding those of segment 18.

Last segment with projecting portion rather narrow, triangular, truncate; the seliferous tubercles are distinct, though small.

Anal valves with distinct, compressed, moderately prominent margins; surface of anal valves and preanal scale slightly rugulose.

Sterna rather sparsely hirsute; the ridges, which are prominent and distinct elsewhere in *Astrodesmus*, are here almost rudimentary, but the sterna are prominent between the bases of the legs, these broad ridges being separated by a transverse depression.

Sternum of segment 6 more hirsute than the others with long hairs, the process also hirsute, subtriangular in form, not so strongly apiculate and shouldered as in other species, and with a very broad sloping base which extends nearly to the sockets of the legs.

Sternum of segment 7 with rim of copulatory legs not produced at the base of the normal legs as in *A. stellifer*.

Sternum of segment 15 with process shaped much as in *A. stellifer*, but smaller.

Legs of male long and slender, the anterior slightly stronger than the posterior and more densely hirsute, the last two joints tuberculate on the ventral face.

Copulatory legs (Plate LXI, figs. 6b-6d).

Color of alcoholic specimen pale bone yellow with traces of a darker color dorsally.

Length, 33 mm.; width, 6.5 mm.; without carinae, 4.5 mm.; length of antenna, 6.5 mm.; of leg from sixth segment, 7 mm.; of leg from tenth segment, 6.5 mm.

Locality.—A single male specimen, collected by Fischer at Zanzibar, is in the Berlin Museum.

This similarity of the copulatory legs seems to indicate a close relationship with *stellifer*, from which there is, however, great distinctness in size, habit, and proportionally much longer and more slender legs.

The ridges or secondary carinae above the bases of the legs are very prominent in this species and are beset with papilliform tubercles much as in some *Oxydesmidae*. It seems probable that these prominences are of use in supporting the creature when it rests, and they are probably correlated with the dorsal prominence of the second joint of the legs, which probably lies against them.

ASTRODESMUS LURIDUS (Karsch).

(Plate LXI, figs. 4a, 4b.)

Eurydesmus luridus KARSCH, Troschel's Archiv f. Naturw., 1881, p. 43.

Astrodesmus luridus COOK, Proc. U. S. Nat. Mus., 1895, XVIII, p. 88.

Segments somewhat more convex than in *A. stellifer*, especially the anterior; their surface smooth, somewhat uneven and rugulose laterad,

and somewhat inflated at the base of the carinae, a character which is strongly developed in *Aulodesmus* and only slightly in *Astrodesmus stellifer*.

First segment less broadly emarginate in the middle of the posterior edge; the form, slope, and margins are closely similar to those of *A. stellifer*.

Lateral carinae slightly narrower than in *A. stellifer*, the posterior corners of posterior segments slightly less produced, the rounded anterior corners slightly more prominent.

Preanal scale less narrowed toward the apex, the setiferous tubercles not so close.

Sterna even more sparsely hirsute, the transverse ridges less prominent.

Process of sternum of sixth segment subquadrate, slightly broader at base and the distal angles more rounded; the process is minutely apiculate in the middle of the straight distal edge; the apiculus is small and weak compared with the thickened apex of the same structure in *A. stellifer*, where there is no transverse distal edge and the lateral corners project beyond the sides of the process below.

Sternum of fifteenth segment with process short and broad, the corresponding depression of the fourteenth segment very slight.

Sternum of eighth segment with the transverse ridges of the posterior pair of legs short (narrow) and produced to be nearly as high as broad; the corresponding ridges of *A. stellifer* are also prominent but not produced.

Legs of male moderately hirsute, about as in *A. stellifer*; they are slightly more slender proportionally than in that species, but the inflation of the dorsal face of the second joint is distinctly greater.

Copulatory legs broken at the base of the ungual portion; the remaining basal part of the second joint is shaped closely like that of *A. stellifer* and is slightly broader.

Color, according to Karsch, dirty testaceous; carinae testaceous yellow; also a large subdisciform spot on the posterior margin of cariniferous segments, strongly narrowed at the sides. From the specimen it would appear that the yellow spot is rather subcrescentic, occupying nearly half of the posterior subsegment in the middle and tapering off on each side to the base of the carina. The legs were evidently dark red, as in *A. stellifer*.

Length, 48 mm.; width, 10.5 mm.

Locality.—Mombassa. The typical and only specimen is a male collected by Hildebrandt and belonging to the Berlin Museum, No. 802.

The color pattern of this species is not essentially different from that of *A. stellifer*, which has the carinae yellowish and the posterior part of the segments sometimes with an oblique light band, and this, if developed, would have the shape of the spot described for *luridus*.

On account of the broken antennae and copulatory legs the generic reference of this species is not made with confidence. It possesses

characters in common with *Tycodesmus* in the emargination of the posterior rim of the aperture in which are inserted the copulatory legs and in the development of distinct processes at the bases of the last pair of legs of the eighth segment, but these processes are distinctly flattened, not conical as in *Tycodesmus*; the emargination of the rim of the copulatory aperture is much less than in *Tycodesmus medius*. With the partial exceptions just noted, the secondary sexual characters are those of *Astrodesmus*. The process of the sixth segment is even wider than in the other species of *Astrodesmus*, in striking contrast to the very slender process in *Tycodesmus*.

ASTRODESMUS TANGA, new species.

(Plate LXI, fig. 5a.)

Known only from the female; similar, but not closely related to *A. stellifer*, in that the body is larger and more robust, and the segments distinctly more convex dorsally; the carinae of the first segment, though not sharp, are distinctly more produced and pointed than in *A. stellifer* and have the marginal callus much shorter; the calli of poriferous segments are distinctly broader and shaped much as in *Aulodesmus mossambicus*; the carinae of posterior segments much more distinctly produced caudad, the corners sharp and spiniform; the dorsal surface is rather uneven, distinctly and rather densely rugulose laterad and on the carinae; the last segment is more robust and more broadly truncate. Legs longer and more robust, and the secondary carinae distinctly more prominent than in the other species of *Astrodesmus*.

Color of alcoholic specimens very dark olive brown; the carinae, legs, and antennae yellowish.

Length, about 65 mm.; width, including carinae, 13.5 mm.; without carinae, 9.5 mm.; length of antennae, 8 mm.; of leg of tenth segment, 9 mm.

Locality.—Tanga, Usambara, German East Africa, the type a female specimen collected by Reimer, in the Berlin Museum, where there is another entirely similar female from the same region.

As the body cavity of males of *Astrodesmus stellifer* measures only about 8 mm. it is evident that in the present species the body is heavier at the expense of the carinae, as the total measurement is more nearly the same. Such a difference might be expected in females, but not to so great an amount, and a female referred to *stellifer* differs from the males to a much less extent in dorsal convexity, so that, together with the other differences enumerated, it is not impossible that the discovery of males may reveal characters which will compel the removal of the present species from *Astrodesmus*.

EXPLANATION OF PLATES.

PLATE LV.

Harmodesmus nitens, p. 686.

- Fig. 1a. Copulatory leg, lateral view.
 1b. Copulatory legs, posterior view.

Marptodesmus chanleri, p. 683.

- 2a. Third leg of male, posterior view.
 2b. End of last joint of same, more magnified to show the fleshy apical pad and the somewhat rudimentary claw.
 2c. Fifteenth leg of male, anterior view.
 2d. Ventral aspect of segments 6 and 7, showing the copulatory legs *in situ*.
 2e. Copulatory leg, lateral view.
 2f. Copulatory legs, posterior view.
 2g. Antenna.
 2h. Last four segments, lateral view.
 2i. Head and first three segments, dorsal view.
 2j. Last five segments, dorsal view.

PLATE LVI.

Uloidesmus micramma, p. 690.

- Fig. 1a. Copulatory legs, anterior view.
 1b. Same, posterior view.
 1c. Same, lateral view.

Mychodesmus macramma, p. 693.

- 2a. Copulatory legs, anterior view.
 2b. Same, lateral view.

Neodesmus juvenis, p. 695.

- 3a. Copulatory legs, anterior view.
 3b. Same, posterior view.
 3c. Same, lateral view.

PLATE LVII.

Tycodesmus medius, p. 699.

- Fig. 1a. Copulatory leg, anterior view.
 1b. Same, lateral view.
 1c. Same, posterior view.

Omodesmus oxygonus, p. 701.

- 2a. Last three segments, dorsal view.
 2b. Copulatory legs, anterior view.
 2c. Copulatory leg, posterior view.
 2d. Same, posterior-lateral view.
 2e. Same, lateral view.

Tymbodesmus figlinus, p. 708.

- 3a. Copulatory legs, anterior view.
 3b. Same, posterior view.
 3c. Same, lateral view.

Tymbodesmus falcatus, p. 711.

- 4a. Copulatory legs, anterior view.
 4b. Same, lateral view.
 4c. Same, posterior view.

PLATE LVIII.

Gomphodesmus castaneus, p. 705.

- Fig. 1a. Head and first three segments, dorsal view.
1b. Segments 7 and 8, dorsal view.
1c. Segment and legs, posterior view.
1d. Copulatory legs, lateral view.
1e. Same, anterior view.
1f. Same, posterior view.
1g-1i. Same, different views of apex of flagellum, more magnified.
1j. Leg and process of sternum of segment 6, anterior view.
1k. Prenal scale.
1l. Antenna.

Aulodesmus mossambicus, p. 715.

- 2a. Copulatory legs, anterior view.
2b. Same, lateral view.
2c. Same, posterior view.

PLATE LIX.

Sphenodesmus rugulosus, p. 720.

- Fig. 1a. Copulatory legs, anterior view.
1b. Same, posterior view.
1c. Same, lateral view.

Sigodesmus indigus, p. 723.

- 2a. Copulatory legs, anterior view.
2b. Same, posterior view.
2c. Same, lateral view.

Sigodesmus monocerus, p. 724.

- 3a. Copulatory legs, anterior view.
3b. Same, lateral view.

PLATE LX.

Astrodesmus stellifer, p. 729.

- Fig. 1a. Diagrammatic view of the rudimentary eighth joint of the antenna, showing the ten olfactory cones.
1b. Third leg of male.
1c. Copulatory legs, anterior view.
1d. Same, posterior view, *in situ*.
1e-1i. Same, lateral and mesial views.
1j. Sternum of segment 6, anterior view, showing the median process and two basal joints of the legs.
1k. Posterior view of process of segment 6.

Astrodesmus robustus, p. 731.

- 2a. Copulatory legs, anterior view.

PLATE LXI.

Astrodesmus laxus, p. 731.

- Fig. 1a. Copulatory legs, anterior view.
1b. Same, lateral view.
1c. Carina, showing marginal callus and repugnatorial pore.
1d. Process of sternum of segment 6.

Merodesmus compactilis, p. 718.

Fig. 2a. Second pair of legs of female.

Astrodesmus striatus, p. 733.

3a. Copulatory leg, anterior view.

Astrodesmus luridus, p. 734.

4a. Process of sternum of segment 6.

4b. Two basal joints of second legs.

Astrodesmus tanga, p. 736.

5a. Carina, to compare with 1c.

Astrodesmus petilus, p. 733.

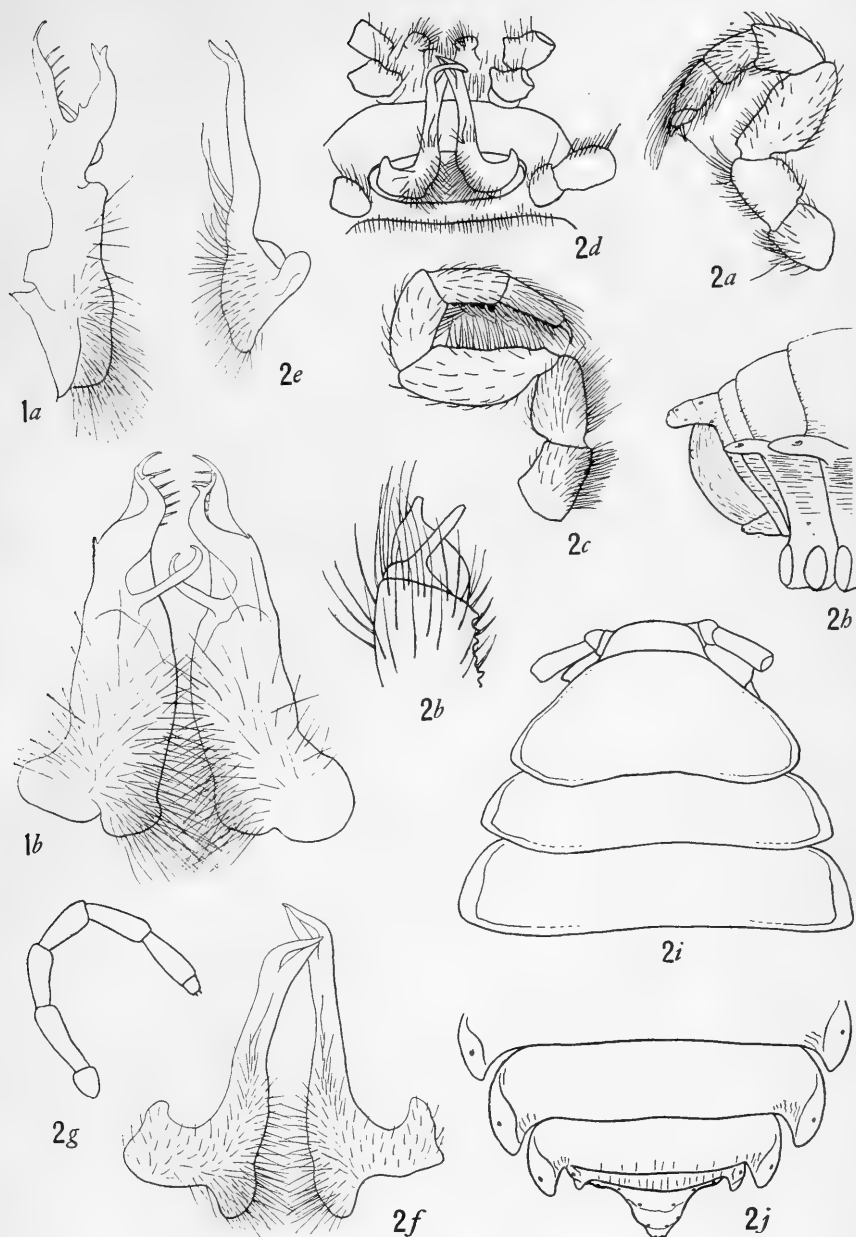
6a. Antenna.

6b. Copulatory legs, anterior view.

6c. Same, posterior view.

6d. Same, lateral view.

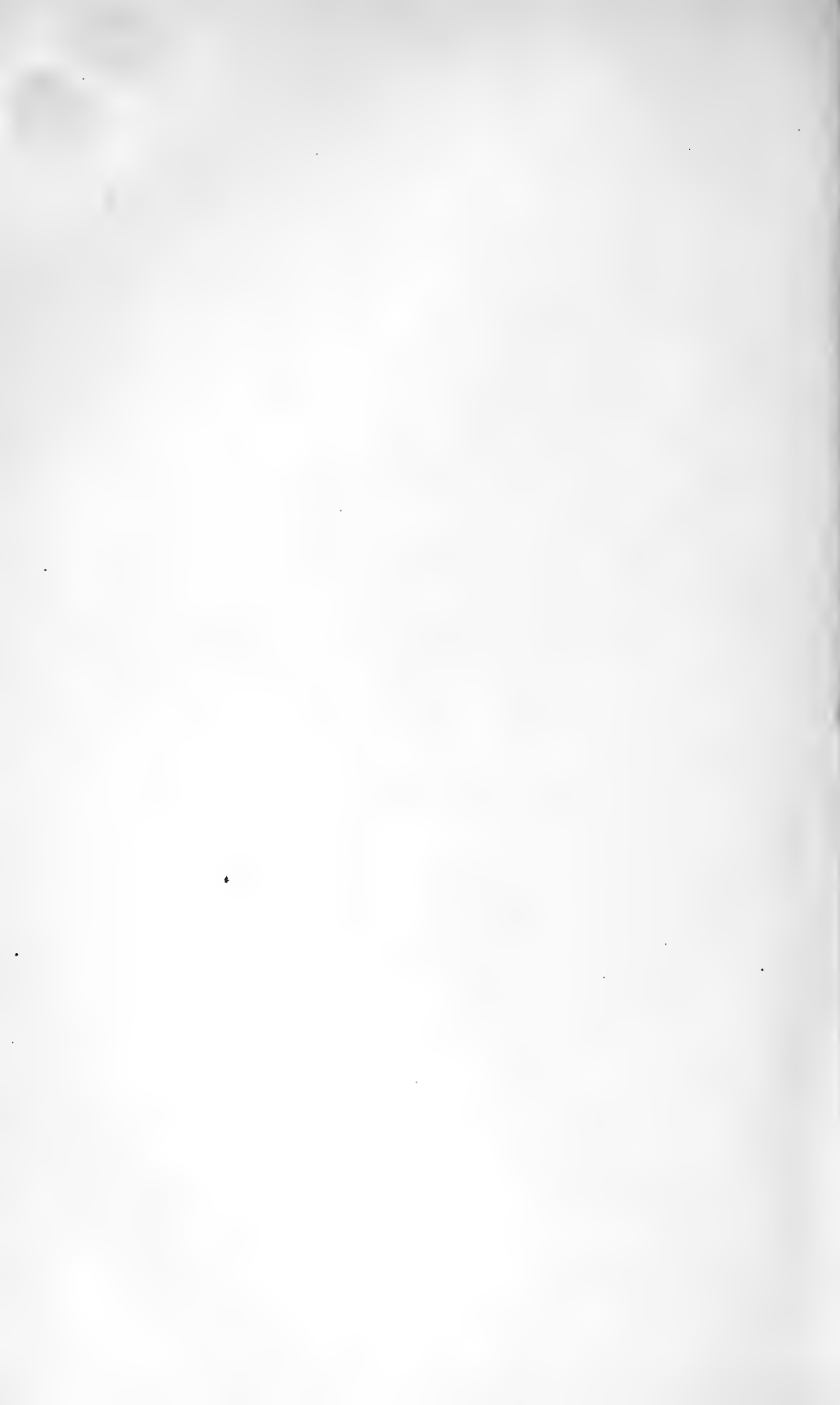




AFRICAN DIPLOPODA.

FIG. 1. *Harmodesmus nitens*.FIG. 2. *Marptodesmus chanleri*.

FOR EXPLANATION OF PLATE SEE PAGE 737.



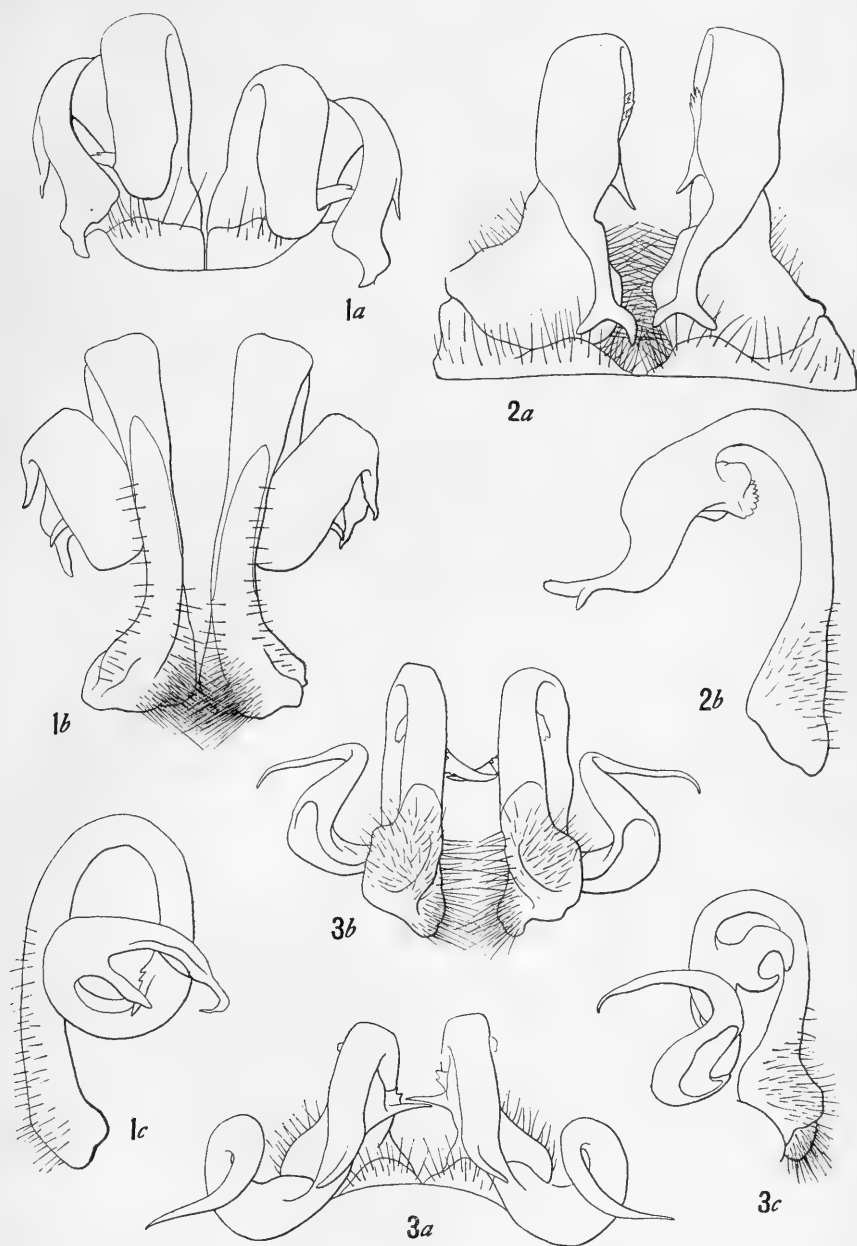
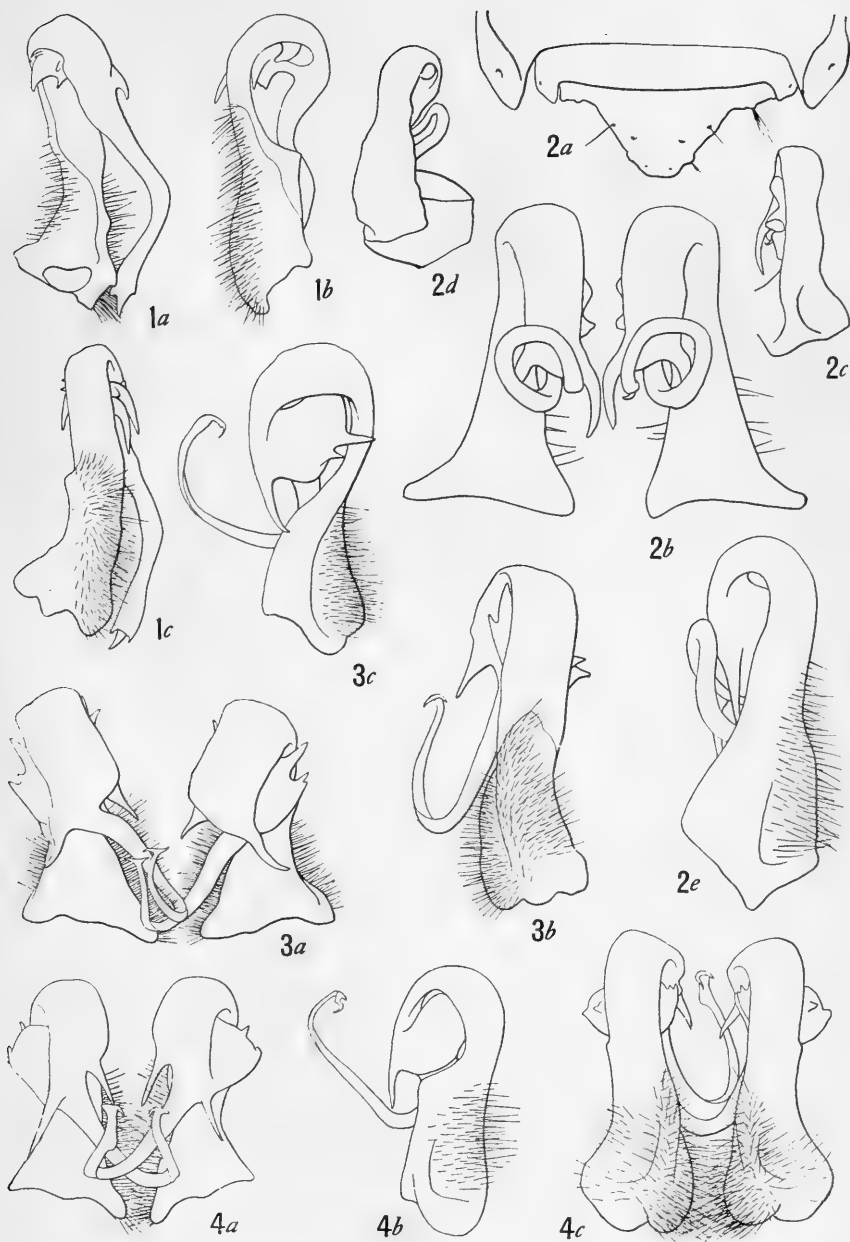


FIG. 1. *Ulodesmus micramma*.
FIG. 2. *Mychodesmus macramma*.

FIG. 3. *Neodesmus juvenis*.

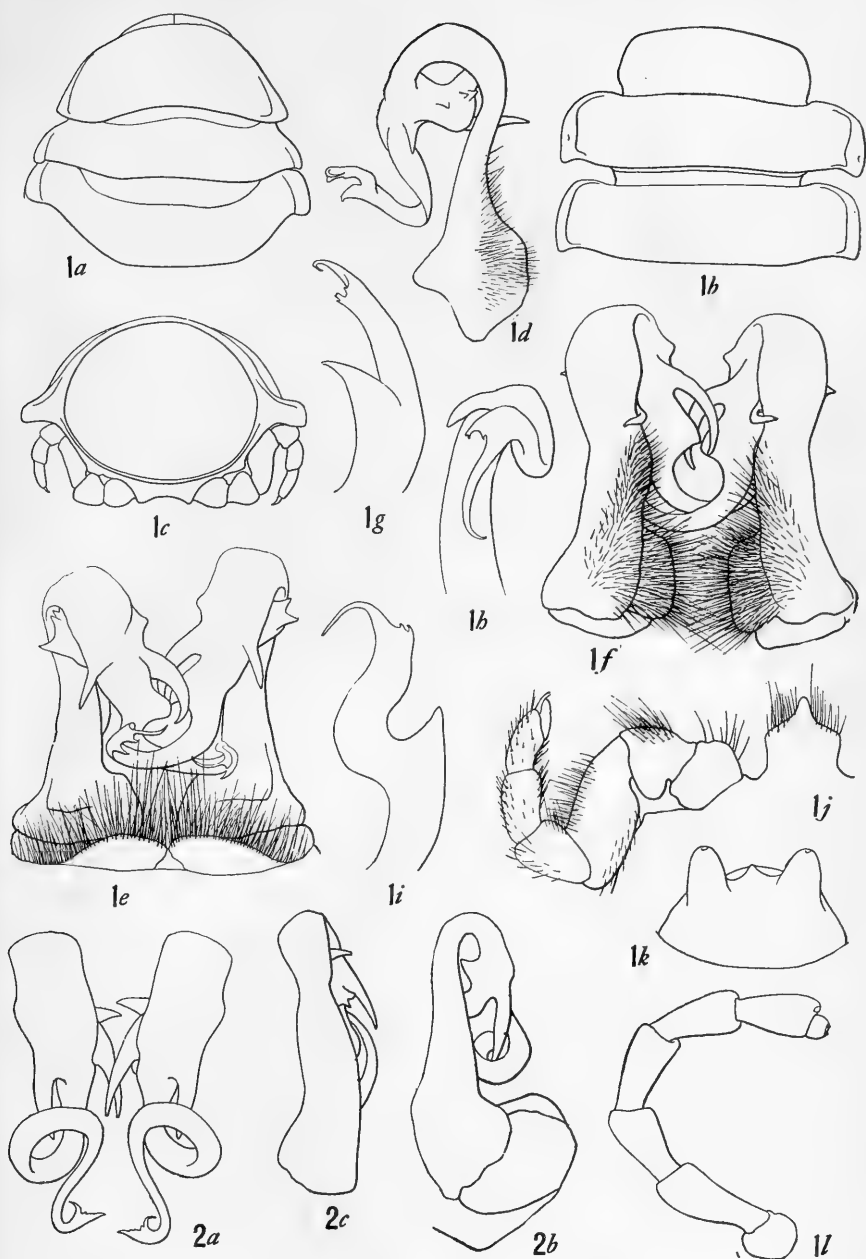


AFRICAN DIPLOPODA.

FIG. 1. *Tycodesmus medius*.
FIG. 2. *Omodesmus oxygonus*.

FIG. 3. *Tymbodesmus figlinus*.
FIG. 4. *Tymbodesmus falcatus*.



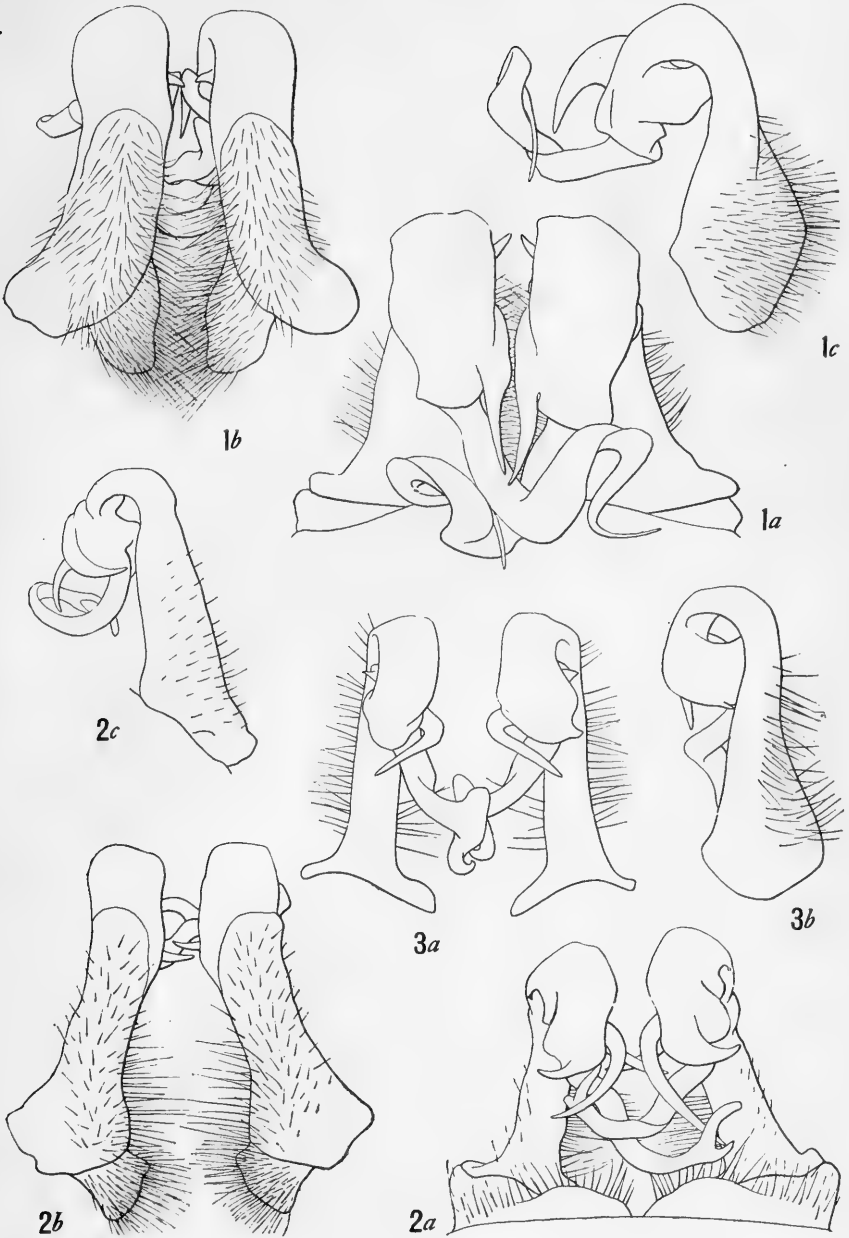


AFRICAN DIPLOPODA.

FIG. 1. *Gomphodesmus castaneus*.FIG. 2. *Aulodesmus mossambicus*.

FOR EXPLANATION OF PLATE SEE PAGE 738.

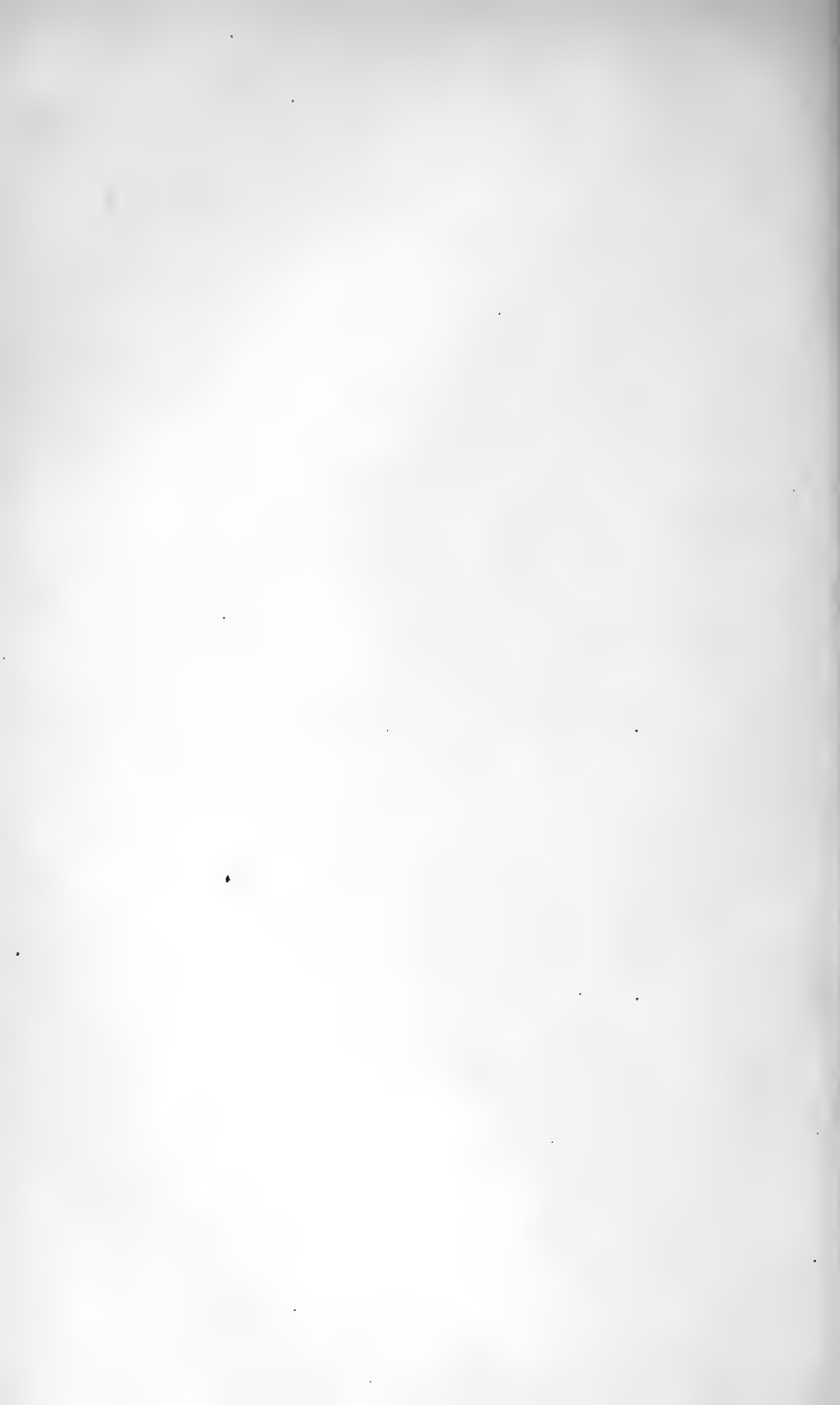


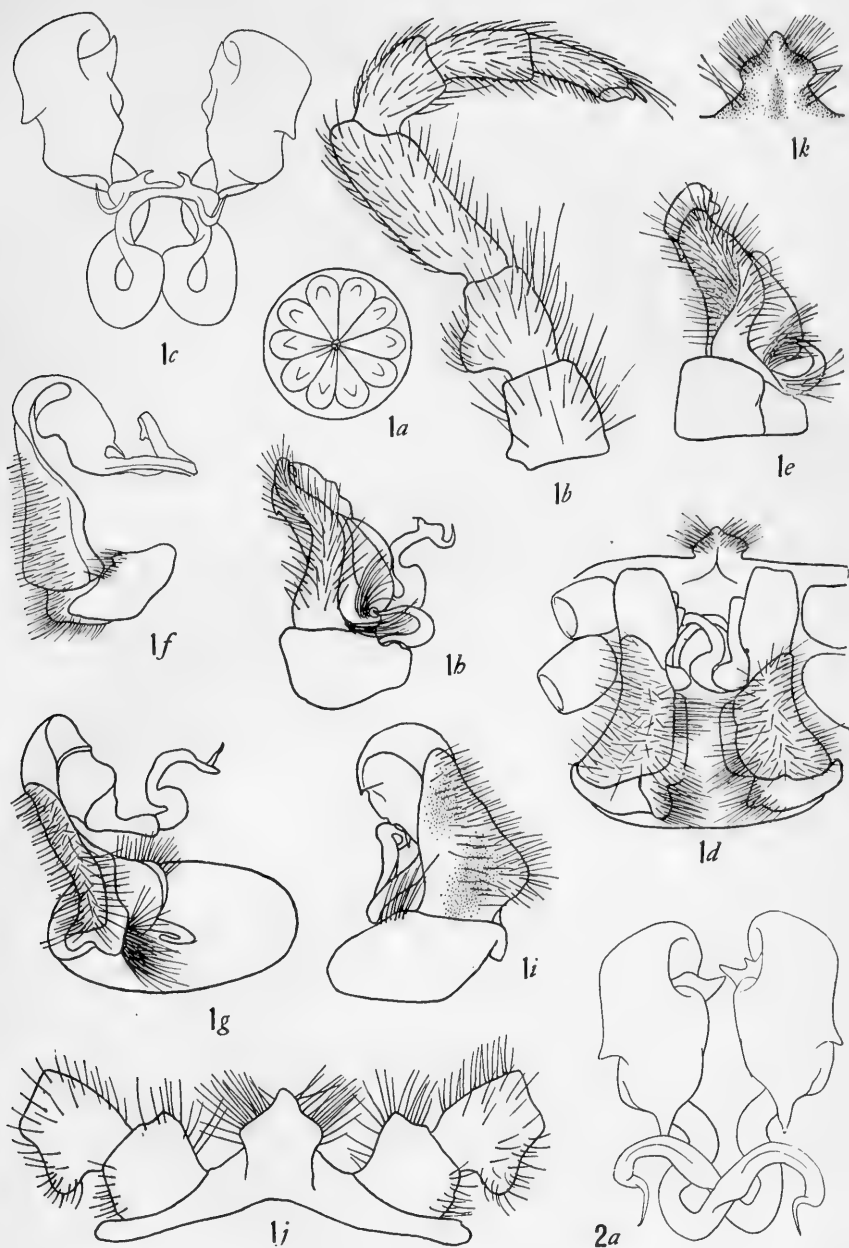


AFRICAN DIPLOPODA.

FIG. 1. *Sphenodesmus rugulosus*.
FIG. 2. *Sigodesmus indigus*.

FIG. 3. *Sigodesmus monocerus*.



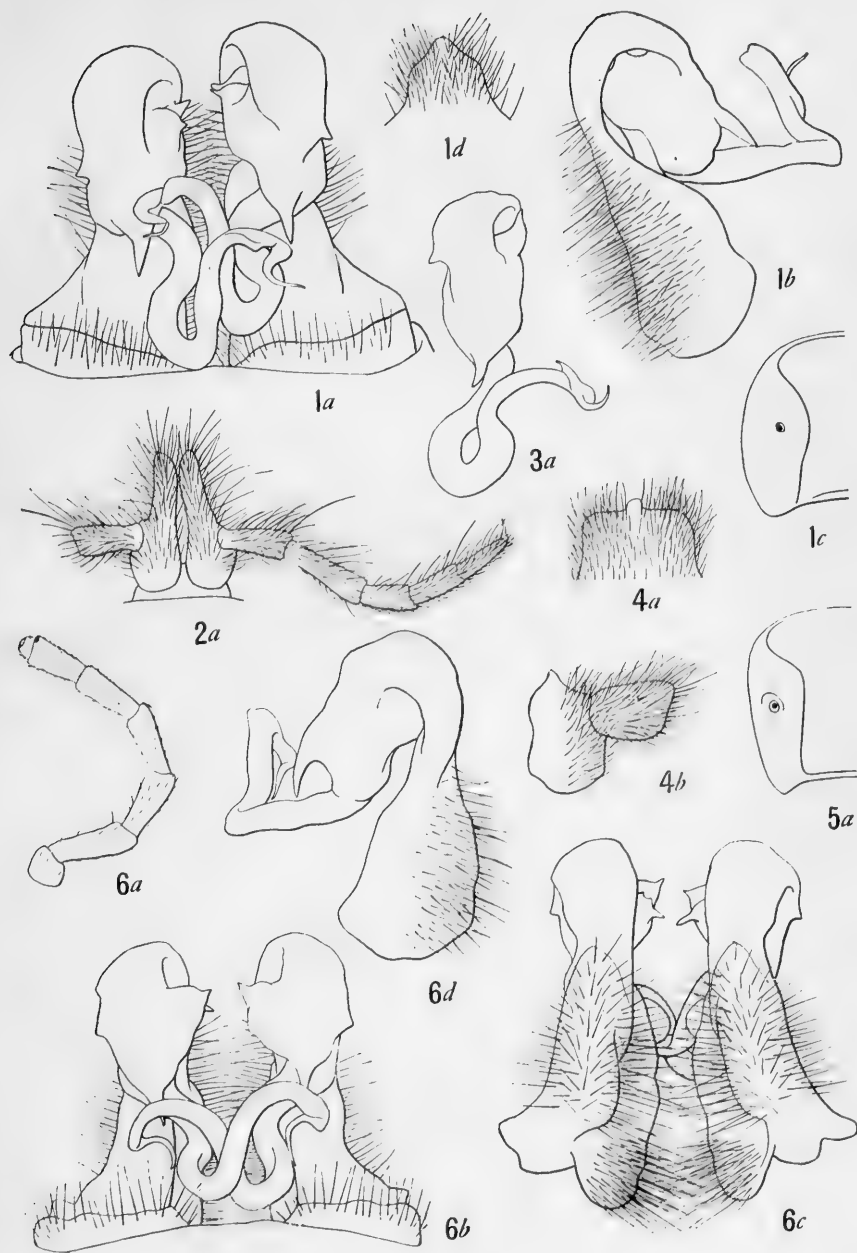


AFRICAN DIPLOPODA.

FIG. 1. *Astrodesmus stellifer*.FIG. 2. *Astrodesmus robustus*.

FOR EXPLANATION OF PLATE SEE PAGE 738.





AFRICAN DIPLOPODA.

FIG. 1. *Astrodesmus latus*.
 FIG. 2. *Merodesmus compactilis*.
 FIG. 3. *Astrodesmus striatus*.

FIG. 4. *Astrodesmus luridus*.
 FIG. 5. *Astrodesmus tanga*.
 FIG. 6. *Astrodesmus petilus*.



HYDROIDA FROM ALASKA AND PUGET SOUND.

BY CHARLES CLEVELAND NUTTING,

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The following notes are based on a small collection of hydroids from the Pacific coast and St. Pauls Island, Alaska, sent to the writer by Mr. Trevor Kincaid, of the University of Washington.

A considerable proportion of the material was collected by the Young Naturalist's Society, in connection with the University of Washington, which organized a dredging expedition in Puget Sound in the summer of 1895. So far as the writer is informed, this is the first dredging that has been done in those waters, and it has resulted in a very interesting series of new forms, as well as the extension of the known range of a number of species. As might have been anticipated, the fauna of Puget Sound, beyond the littoral zone, is most closely allied to that of more northern waters, a number of forms collected in Alaska by Mr. W. H. Dall¹ appearing in the material secured by dredging in Puget Sound.

The following table of distribution of the previously described species contained in this collection will at once show the subarctic nature of the hydroid fauna of Puget Sound:

Geographical distribution of Hydroids.

Names of species.	Puget Sound (21) and the present paper.	Great Britain (16) (3).	Norway (16) (25) and Sweden (27).	Denmark (18) (19) (31) and Heligoland (14).	Spitzbergen (20) and Iceland (19).	Greenland (19).	Alaska (10) (22).	New England (1) (2) (28) (30).	Labrador (16).	California (11) (21).
<i>Syncoryne mirabilis</i> (Agassiz) (2).....	+	+	+	+
<i>Campanularia circula</i> Clark (10).....	+	+	+	+
<i>Obelia plicata</i> Hincks (16).....	+	+
<i>Calyceella syringæ</i> (Linnæus).....	+	+	+	+	+	+	+	+
<i>Lafoëa dumosa</i> Fleming.....	+	+	+	+	+	+	+	+
<i>Lafoëa fruticosa</i> Sars.....	+	+	+	+	+	+	+	+	+
<i>Lafoëa gracillima</i> (Alder) (3).....	+	+	+	+	+	+
<i>Halecium halecinum</i> Linnæus.....	+	+	+	+	+	+	+
<i>Sertularia variabilis</i> Clark ² (10).....	+	+
<i>Sertularia argentea</i> Ellis and Solander (13).....	+	+	+	+	+
<i>Sertularia tenera</i> Sars (25).....	+	+	+	+	+
<i>Sertularella ticuspidata</i> (Alder) (3).....	+	+	+	+	+	+
<i>Sertularella rugosa</i> (Linnæus).....	+	+	+	+	+
<i>Thuiaria gigantea</i> Clark (10).....
<i>Thuiaria turgida</i> Clark (10).....
<i>Sertaginopsis mirabilis</i> (Verrill) (28).....
<i>Plumularia californica</i> Marktanner (21).....	+

NOTE.—The numbers in parentheses have reference to the bibliography at the end of the paper.

¹ Report on the Hydroids collected on the coast of Alaska and the Aleutian Islands, Proc. Acad. Nat. Sci., Philadelphia, 1876.

² This name is also used by S. F. Clarke in connection with an entirely different species. See Bull. Mus. Comp. Zool., XXV, No. 6, p. 75, pls. IV, V.

ANALYSIS OF TABLE.

Species common to Puget Sound and Great Britain	8
Species common to Puget Sound and Scandinavia	5
Species common to Puget Sound and Denmark and Heligoland	4
Species common to Puget Sound and Spitzbergen	6
Species common to Puget Sound and Greenland	4
Species common to Puget Sound and Alaska	8
Species common to Puget Sound and New England	8
Species common to Puget Sound and Labrador	4
Species common to Puget Sound and Pacific coast south of Vancouver	3

Taking Spitzbergen, Iceland, and Greenland together, as representing the Arctic area thus far explored, and regarding the species found there as strictly Arctic species, what may be called the meridional distribution southward is significant:

Arctic species in Puget Sound	7, or 70 per cent
Arctic species in Great Britain	9, or 90 per cent
Arctic species in Norway and Sweden	7, or 70 per cent
Arctic species in Denmark and Heligoland	6, or 60 per cent
Arctic species in Alaska	8, or 80 per cent
Arctic species in New England	10, or 100 per cent
Arctic species in Labrador	15
Arctic species in California	2

The fact that the hydroid fauna of New England is more thoroughly Arctic than that of Great Britain is surprising at first sight, but may be accounted for by the fact that the Arctic current sweeps southward along a great part of the New England coast.

The fact that the Puget Sound fauna is equally related to that of Great Britain, Alaska, and New England would seem to be a strong indication that the distribution has been southward from the Arctic regions along meridional lines.

The sharp differentiation between the fauna of Puget Sound and the region between Vancouver Island and southern California shows, apparently, that the limit of the Arctic fauna is not far south of Puget Sound, a point much more northerly than on the Atlantic side. This is doubtless due to the Japan current on the Pacific coast and the Arctic current on the Atlantic coast.

Among the species collected by Mr. Kincaid and the Young Naturalists' Society, were two which, although previously known, had not before been reported from American coasts, namely, *Obelia plicata* Hincks² and *Sertularia tenera* Sars.³ The latter species not having been previously described in any English publication, so far as I can discover, the accompanying figure (see Plate LXII) and description may be of service.

¹ All the species from Labrador in the list.

² British Hydroid Zoophytes, 1868, p. 159.

³ Bidrag til Kundskaben om Norges Hydroider, p. 20

SERTULARIA TENERA Sars.(Plate LXII, figs. 1 *A*, *B*.)

Trophosome.—Colony attaining a height of one-half inch. Hydrocaulus growing from a creeping root stalk. Stem flexuous, there being a bend opposite the origin of each branch, divided into regular internodes, each of which bears a branch near its proximal end, and three hydrothecæ, one in the axil of the branch and a subopposite pair on the distal end of the internode. Branches alternate, divided into regular internodes, each of which usually bears four, sometimes two, pairs of subopposite hydrothecæ.

Hydrothecæ flask-shaped, free for half their length, the distal end becoming gradually more slender and terminating in a bilabiate orifice.

Gonosome.¹—Gonangia ovate with a round aperture, growing from the branches below the bases of the hydrothecæ.

Locality.—St. Paul Island, Alaska. Collected by Mr. Trevor Kincaid.

The collection contained five apparently new species, as described below.

CAMPANULARIA KINCAIDI, new species.(Plate LXII, figs. 2 *A-C*.)

Trophosome.—Hydrocaulus springing from a creeping root stalk, unbranched, peduncles long, rather slender, with three to ten annulations immediately below the hydrotheca, two to five at the proximal end, and sometimes a few on the middle part.

Hydrothecæ small, sometimes minute, about three times as long as broad, tubular, with parallel sides; aperture armed with seven to ten long, sharply pointed teeth; hydrothecæ fluted lengthwise, the number of flutings corresponding to the number of teeth.

Gonosome.—Unknown.

The amount of variation among individual hydrothecæ is very great, both as to size and the number of teeth and flutings, the smaller and presumably younger ones having but few teeth. The general shape and ornamentation seem quite constant, however. The flutings are very deep and distinct, as indicated in fig. 2 *C*, which represents the outline of the orifice. The hydrothecæ of this species greatly resemble those of *Obelia bicuspidata* Clark² in shape, but the teeth of the latter are quite different, and the manner of growth of the two species precludes any likelihood of their being identical. The present form bears some resemblance to *C. hincksii*,³ but is very much smaller, while the

¹ Not found by the original describer, Sars. It is figured, however, in *Hydroiden von Ost-Spitzbergen*, Marktanner-Turneretscher, pl. 11, fig. 14; pl. 12, fig. 5. The latter figure shows that the gonangium is provided with an acrocyt.

² Report on the Hydroids collected on the coast of Alaska and the Aleutian Islands by W. H. Dall, Proc. Acad. Nat. Sci., Philadelphia, 1876, p. 50, pl. ix.

³ A Catalogue of the Zoophytes of Northumberland and Durham, Trans. Tyneside Nat. Field Club, 1857, p. 37, pl. II, fig. 9.

teeth are acuminate instead of square. Found growing on specimens of *Hydrallmania distans* collected by the Young Naturalists' Society in Puget Sound, 1895. Named in honor of Mr. Trevor Kincaid, of Washington University, who is doing much to advance our knowledge of the marine fauna of the far Northwest.

CAMPANULARIA LINEATA, new species.

(Plate LXII, fig. 3 A, B.)

Trophosome.—Hydrocaulus springing from a creeping root stalk and consisting of unbranched pedicels which are more or less annulated throughout and two or three times as long as the hydrothecæ.

Hydrothecæ exceedingly thin and delicate in texture, large, larger than *Clytea johnstoni*, about one and one-half times as deep as wide, sides parallel, bottom rounded in the form of a half sphere, aperture armed with twelve to fourteen evenly rounded teeth. At each interdental space the margin is sharply crimped, the edge of the crimping forming a distinct straight line down the side of the hydrotheca nearly to the bottom.

Gonosome.—Unknown.

Locality.—Puget Sound, found growing on *Halecium geniculatum*. Collected by the Young Naturalists' Society, 1895.

This very large and strikingly ornamented species is probably most nearly allied to *C. hincksii* Alder,¹ from which it differs in its extensively corrugated stem, and the proportions, shape of teeth, and delicate texture of the hydrothecæ.

It will be noticed that the longitudinal lines on the hydrothecæ are very different from the flutings of the preceding species. In the latter the sharp ridges formed by the flutings are continuous with the points of the teeth, while in *C. lineata* the ridges are continuous with the interdental spaces.

The comparative sizes of the two species are correctly illustrated by the figures, which are camera lucida sketches with the same magnification.

This species is also closely related to *C. grænlandica* Levinsen,² from which it differs in the almost exactly parallel sides of the hydrothecæ and more extensively annulated peduncles.

HALECIUM GENICULATUM, new species

(Plate LXIII, figs. 1 A-D.)

Trophosome.—Hydrocaulus but slightly fascicled proximally, simple for the most part, branching very irregularly with a tendency to an

¹A Catalogue of the Zoophytes of Northumberland and Durham, Trans. Tyneside Nat. Field Club, 1857, p. 37.

²Medusea, Ctenophorer, og Hydroider fra Grönlands Vestkyst, Copenhagen, 1893, p. 26, pl. v, figs. 10-12.

alternate arrangement; branches and branchlets composed of unusually long internodes, each of which gives off a hydrophore at its distal end and shows two or three decided annulations at its proximal end, the annulations on the distal part of the branches being decidedly oblique. The internodes on the ultimate branchlets are arranged so as to give a decidedly zigzag appearance, although this largely disappears as we approach the larger branches and main stem.

Hydrothecæ occur either singly or in pairs at the distal end of each internode; their pedicels are sometimes annulated proximally, but free from annulations on the distal parts of the branches; margins usually moderately everted, but sometimes greatly so, as in *H. beani*; the characteristic circle of bright dots is very strongly marked. Hydranths large, bodies thick, ovate; tentacles sixteen to twenty.

Gonosome.—Gonangia borne singly in the axils of the branches and branchlets, regularly ovoid in one view, barnacle-shaped in the other; aperture large, terminal. The appearance of the contents of some of them would indicate the possible presence of an acrocyt at a later stage of development.

Locality.—Puget Sound. Collected by the Young Naturalists' Society in the summer of 1895.

This species is most closely allied to *H. labrosum* Alder, from which it differs in the limited amount of fasciculation of the hydrocaulus, in the much longer internodes of the stem, in the comparatively slight amount of annulations throughout, and in the position of the gonangia, which are axillary in *H. geniculatum*, while they are borne in rows on the branches of *H. labrosum*.

The stems in the specimens secured are so invested with parasitic growths that they appear much more compound than they really are. In fact, the fasciculation is very limited and in some specimens not apparent. The specimen also resembles *H. gracile*¹ Bale,² which is, however, monosiphonic, and, judging from the figure, not distinctly geniculate.

HALECIUM CORRUGATUM, new species.

(Plate LXIII, figs. 2 A, B.)

Trophosome.—Hydrocaulus springing from a creeping root stalk, stem simple, not fascicled, and seldom branched, the branching when present having no regularity whatever. Ordinarily the hydrocaulus consists of single pedicels supporting hydrothecæ and resembling in manner of growth the simple unbranched campanularians. Pedicels closely and very distinctly annulated or corrugated throughout. Hydrothecæ small, with everted margins and the characteristic necklace

¹The name *Halecium gracile* is preoccupied, having been used by Verrill in 1874. Invertebrate Animals of Vineyard Sound, 1874, p. 328.

²On Some New and Rare Hydroida in the Australian Museum Collection, Proc. Linn. Soc., New South Wales, 1888, p. 759.

of dots; the reduplication of margins is not so extensive as in many Halecidae, there being seldom more than two to each hydranth.

Hydranth large, nonretractile, with a somewhat slender, slightly gibbous body and about twenty tentacles.

Gonosome.—Not known.

This species is the only one known to me among the Halecidae in which the parasitic habit has so profoundly modified the manner of growth that all regularity in branching has been lost. It resembles somewhat the *Haloikema lankasterii*¹ Bourne² in this respect, but the latter species is not stated to be parasitic and appears to be rather a very simple, sparingly branched form. The complete annulations of the pedicels is also a novel feature.

Locality.—Puget Sound. Collected by the Young Naturalists' Society in 1895. The specimens were found growing on *Sertularella tricuspidata*.

HYDRALLMANIA DISTANS, new species.

(Plate LXIII, figs. 3 A-D.)

Trophosome.—Stem long, slender, flexuous; cauline internodes long, nonhydrothecate, each giving forth a branch just above its proximal end; branches alternate, hydrothecate, divided into internodes considerably shorter than those of the main stem, each internode giving origin to an ultimate branchlet or hydrocladium. Hydrocladia alternate, laterally compressed, composed of unequal internodes, each bearing a group of three to five (usually four) hydrothecae on its anterior aspect.

Hydrothecae tubular, flattened, curved forward and outward, arranged so as to project alternately to the right and left. Aperture triangular or flattened oval, opening outward and forward, furnished with opercula, only slightly gibbous proximally, the sides being nearly parallel, the top of one reaching not more than about one-third the height of the next above.

Gonosome.—Unknown.

Locality.—Puget Sound. Dredged by the Young Naturalists' Society in the summer of 1895.

This species seems to me to be fairly distinct from *H. falcata*, with which I have directly compared it, being more slender throughout, with hydrothecae much less crowded, more slender, and having their distal ends more distinctly curved outward and forward. The internodes in *H. falcata* bear groups composed of a considerably greater number of

¹ The genus *Haloikema* appears to me to be founded on insufficient characters, embodying no really new features, according to the author's description and the type specimen which I have examined. The hydranths are more or less nonretractile in many species of the old genus *Halecium*. The simple stem is found in *H. tenellum* Hincks, and the manner of growth strongly resembles that of a young specimen of the last-mentioned species, from which, however, it is very well separated by other characters.

² Notes on the Hydroids of Plymouth, Journ. Marine Biol. Assoc., I, pp. 395-398.

hydrothecæ than do those of *H. distans*. In *H. falcata* each hydrotheca attains a level above the middle of the next one above it, while in *H. distans* it only attains the level of one-third the height of its successor.

Through the courtesy of Mr. Charles Fuchs, of San Francisco, I have obtained a copy of the original description and figure of *Hydrallmania* (*Plumularia*) *franciscana* Trask.¹

It appears from both the original descriptions and the figure that *H. franciscana* differs from *H. falcata* and *H. distans* in having the hydrothecæ distinctly flask-shaped and much narrowed at their distal ends, being, according to the figure, more than twice as wide near the proximal end as near the aperture. *H. franciscana* approaches *H. falcata* and differs from *H. distans* in having the hydrothecæ closely crowded together on the front of the stem.

LAFOËA DUMOSA Fleming.

Specimens of this species collected in Puget Sound are provided with well-developed gonosomes. The history of the discovery of the identity of this structure and the genus *Coppinia* of Authors is an exceedingly interesting one. The Lافœiæ have been known and studied by several generations of naturalists, who over and over again have scanned abundant material for the long-sought reproductive bodies, and all in vain until Levinsen announced the final clearing of the mystery and the discovery of the gonosome of one species at least, *L. fruticosa*.²

The story in brief is this: Dalyell in 1847-48 published a work entitled "Rare and Remarkable Animals of Scotland," in which he described under the name *Sertularia arctica* a remarkable form of hydroid which appeared as a parasitic growth forming an encrusting mass on the other hydroids. Hincks³ makes this species the type of the family Coppiniæ and genus *Coppinia*, characterized as follows:

Zoophyte consisting of a number of long tubular hydrothecæ crowded closely together and united by an adherent cellular mass, which involves the lower portion of them, the upper portion remaining free; ova developed in the cavities of the cellular mass, and escaping as planule; polypites cylindrical and very extensile. The ova are produced in the cavities or compartments which pervade the common connecting substance, and give a tessellated appearance to its upper surface.²

Coppinia is described as follows by Allman:⁴

In this singular hydroid the hydrothecæ and gonangia spring directly from a creeping retiform hydrorhiza, while the gonangia, which are very numerous, become closely adherent to one another by their sides, so as to form with the proximal portion of the hydrothecæ and with the hydrorhiza a continuous encrusting basis spreading over the surface to which the hydroid had attached itself. Each Gonan-

¹ Proc. Cal. Acad. Nat. Sci., I, p. 113, pl. iv, fig. 3.

² Meduser, Ctenophorer, og Hydroider fra Grönlands Vestkyst., Copenhagen, 1893, p. 20, pl. vii, figs. 2, 3.

³ British Hydroid Zoophytes, p. 218.

⁴ Monograph of the Gymnoblatic or Tubularian Hydroids, Ray Society, 1870, 1871, 1872, pp. 54, 55.

gium in the female contains a single sporosac with a single ovum; and this ovum, after a time, becomes extra-capsular in order to undergo within an acrocyt some of the earlier stages of its development.

This author also says *Coppinia* is found on *Sertularia abietina* and *Hydrallmania falcata* from deep water.

The Hydranths are furnished with a verticil of filiform tentacles disposed around the base of a short conical hypostome. They are, however, often imperfect and apparently destitute of mouth and tentacles.

In 1865, under the name *Lafoëa calcarata*, Alexander Agassiz¹ describes a species which produced medusæ. It is almost certain, however, that this species would not be included in the family Lafoëidæ as at present understood.

In 1875 Canon Norman² described a new genus, *Scapus*, as follows:

Zoophyte in the form of a spongy mass rolled in cylindrical form around the stems of branching Hydrozoa (*Acryptolaria*) and consisting of a series of somewhat closely packed subquadrate hydrothecæ, closed in above, except at the center, where the hydrotheca projected in the form of a short, simple cylindrical horny tube.

In describing the species *Scapus tubulifer*, the author says that these "hydrothecæ" are packed closely together, and that they are "bottle-shaped, expanded below and forming the mass, and contracted above into narrow projecting tubes." If Canon Norman's interpretation is correct, we have here the only "bottle-shaped" hydrothecæ known to me. The figure given would indicate that the specimen upon which it was based was dried. If this is so, it might be hard to determine whether the bottle-shaped structures were hydrothecæ or gonangia. In view of later discoveries, it seems not unlikely that the latter is the case. Indeed, Marktanner-Turneretscher does not hesitate to call them gonangia.

Norman hat unter dem Namen *Scapus tubulifer* ein anderes Aggregat von Gonotheken beschrieben, welch er auf *Acryptolaria exserta* angetroffen hat; es besteht aus lauter Gonotheken, zwischen denen keine Hydrotheken stehen.³

Allman, writing in 1877, in discussing *Cryptolaria conferta*⁴ says:

On the branches of the specimen here described there occurred here and there certain very remarkable bodies the real nature of which I have not succeeded in placing beyond doubt. They are of an irregular fusiform shape, and at the spots where they occur surround the branch like minute sponges. A closer examination shows them to consist of a multitude of flask-shaped, apparently chitinous receptacles, adnate to one another by their sides, and springing by a narrow base from an irregular network of tubes which encircle the branch. The distal extremity of each is prolonged into a free neck-like extension, which terminates in an even circular orifice.

¹ North American Aculephæ, Illustrated Catalogue, Mus. Comp. Zool., 1865, No. II, p. 124.

² Submarine Cable Fauna, Ann. and Mag. Nat. Hist., 4th ser., XV, p. 173, pl. XII, fig. 3.

³ Hydroiden von Ost-Spitzbergen, Zool. Jahrb., VIII, Abth. f. Syst., p. 403.

⁴ Report of the Hydroida collected during the Exploration of the Gulf Stream, Mem. Mus. Comp. Zool., 1877, No. 2, V, p. 18.

Each receptacle gives exit after a time to a single spherical body, which is retained for a period in an external membranous sac connected by a narrow neck to the orifice of the flask-shaped receptacle.

It is scarcely possible not to recognize in these bodies an assemblage of true hydroid gonangia.

The author goes on to say that these bodies closely resemble a colony of *Coppinia* with the hydrothecæ wanting, and adds:

Another view, however, suggests itself. May they not represent the gonosome of the hydroid with which they are associated? In favor of this interpretation it may be urged that nothing that can be regarded as a gonosome occurs in the specimen, and that if we look upon them as merely a parasitic hydroid we should have in these bodies a gonosome without its correlative trophosome. Further, the tubular base from which the gonangia spring forms a close irregular plexus which embraces the fascicled stem of the supporting hydroid, and I believe I have traced a communication between this plexus and the cavities of the outermost tubes of the stem.

Allman, however, does not feel sure of this interpretation, and leaves the question to be settled by further research.

Two years later S. F. Clarke¹ in discussing *Cryptolaria longitheca* says:

Centered about the upper portions of the stem of one of the finest specimens were a number of peculiar bodies, very like in character to the similiar bodies described by Professor Allman as occurring on the stems of *C. conferta*. They are polygonal in form, largest at the distal end, tapering to the base, crowded so closely together that the walls of the adjoining bodies are in contact throughout their length, and are provided with a small tubular orifice arising from the center of the distal end; at the base they are connected by branching stolons, but I was unable to make out any connection between these remarkable bodies and the stems of *Cryptolaria* upon which they were growing.

The fact of these two slightly different forms of these peculiar colonies having been found upon these two closely allied forms of *Cryptolaria* is an argument in favor of the suggestion of Professor Allman, that these bodies are the gonangia of the species of *Cryptolaria* to which they are attached, and that there may exist some communication between them as yet undiscovered. I worked with great care on sections, transverse, longitudinal, and oblique, of cleared and stained specimens, but was unable to detect any connection between them.

In 1888 Allman again refers to the matter in his *Challenger* report, and concludes that he was mistaken in his previous surmise. He says:

It is now evident that the structure in question is an independent growth, having nothing to do with the gonosome of the hydroid on which it had taken up its abode.²

In 1893, in an excellent systematic discussion of the family Campanularidæ, Levinsen reopens the question with some very positive testimony.³ Speaking of *Coppinia arcta* the author claims that Allman is mistaken in describing the hydranths as often rudimentary and without tentacles, Allman's figure showing that undeveloped instead

¹ Report of the Hydroida collected during the Exploration of the Gulf Stream, Bull. Mus. Comp. Zool., No. 10, V, p. 244.

² Report on the Hydroida dredged by H. M. S. *Challenger*, 1888, Pt. 2, p. 38 (note).

³ Meduser, Ctenophorer, og Hydroider fra Grönlands Vestkyst., Copenhagen, 1893, pp. 20-23, pl. VII, figs. 2, 3.

of rudimentary hydranths were described. Hincks also is mistaken in describing the hydrothecæ as operculate. Continuing, Levinsen says:

I, as well as Allman and Hincks, have found these bodies on *Hydrallmania falcata* and *Diphasia abietena*, but only on such specimens as are overgrown with *Lafoëa dumosa*, or *Filellum serpens*. I have also found them on *Lafoëa fruticosa* and *Grammaria abietina*. Just such species with which no one has heretofore found gonophores.

On the other hand, the author regards it a suspicious circumstance that in *Coppinia* the gonangia largely predominate. The importance of this discussion of Levinsen's lies, however, largely in the following announcement:

A closer investigation shows, however, that the network from which *Coppinia* springs is connected with the stem or tube of that of *Lafoëa*, *Filellum*, or *Grammaria*, together with which it (*Coppinia*) appears.¹

In *Lafoëa fruticosa* the gonangia, as well as the curiously modified hydrothecæ, arise from the superficial peripheral tubes which form a richly branched network. It follows, therefore, that *Coppinia arcta* is simply the gonosome of species of *Lafoëa*, *Filellum*, and *Grammaria*." [The emphasis is Levinsen's.]

The figure given by this author shows a distinct connection between the modified hydrothecæ of *Coppinia* and the stem tubes of *Lafoëa fruticosa*, but does not indicate very plainly a similar connection between the gonangia of *Coppinia* and the stem tubes of *Lafoëa*.

Here, then, we have a remarkable disagreement between competent authorities. Allman, after proposing the theory that *Coppinia* is simply the gonosome of the species on which it grows, is forced upon further research to distinctly abandon it. Clarke, with the same theory in mind, makes a very careful study of material sectioned and stained, and is unable to find any real connection between *Coppinia* and the stem tubes of the species on which it grows. Levinsen announces confidently that he has demonstrated such a connection and the theory originally proposed by Allman as well.

Among some material collected in Puget Sound by the Young Naturalists' Society of Seattle were a number of specimens of *Lafoëa dumosa* with the so-called *Coppinia* growing in dense masses on the stems. The present writer gladly embraced the opportunity to carefully investigate the question so long in dispute regarding the identity of *Coppinia* with the gonosome of the species upon which it grows. This investigation was completed and the drawings made before I had seen any account of Levinsen's researches, and therefore has the merit of an independent discovery of the real nature of *Coppinia*, together with interesting details not mentioned by Levinsen or other previous writers.

A number of transverse sections were made of the compound stem of the *Lafoëa dumosa* and the encrusting growth of so-called *Coppinia*. These sections were double stained, and upon examination were found to reveal the following facts:

First. There are well-defined lateral connections between the axial

¹ En nærmere Undersøgelse viser nu, at det Netværk, hvorfra *Coppinia* udgaar, hænger sammen med Stammen eller Rørene af den *Lafoëa*, *Filellum*, eller *Grammaria*, sammen med hvilken den optræder.

and peripheral tubes of *Lafoëa*. (Shown between *a. t.* and *p. t.*, Plate LXIV, fig. 1.)

Second. There are direct connections between the sarcodal contents of the peripheral tubes of *Lafoëa* and the modified hydrothecæ of *Coppinia*. (Shown between *p. t'*. and *m. h'*., Plate LXIV; fig. 1.)

Third. There are indirect connections between the peripheral tubes of *Lafoëa* and the modified hydrothecæ of *Coppinia* through the mediation of the mass of tubes of *Coppinia* which surround the tubes of *Lafoëa*. (*P. t''*. to *m. h''*., through *t. b.*, Plate LXIV, fig. 1.)

Fourth. There is a direct cross connection of sarcode between the axial tubes of *Lafoëa* and the gonangia of *Coppinia* directly through (in a horizontal plane) the axial tube of *Lafoëa*. (Plate LXIV, fig. 2.)

Fifth. There is an indirect connection of sarcode between the peripheral tubes of *Lafoëa* and the gonangia of *Coppinia* through the mediation of the network of tubes of *Coppinia* surrounding the fascicled stem of *Lafoëa*. (Shown in Plate LXIV, fig. 1, between *g'*, *tb'*, and *p. t''*.)

My sections therefore completely demonstrate that the gonangia of *Coppinia* are nothing more nor less than the gonangia of *Lafoëa dumosa*, and that the hydrothecæ of *Coppinia* are simply modified hydrothecæ of *Lafoëa dumosa*. Further than this, normal hydrothecæ containing normal hydranths of *Lafoëa* are sometimes interspersed among the gonangia. (Plate LXIV, fig. 1*h*.)

A still further discovery, however, was made through the study of these sections. A careful examination showed that interspersed among the female gonangia containing ova were male gonangia containing spermaries in which were mature spermatozoa. (Plate LXIV, figs. 1*s*, 4.)

The male gonangia were much more slender than the female and very much less numerous, the proportion of male to female being about one to twenty. The only contents that could be made out in each male gonangium was a long saclike sperosac or spermary containing mature spermatozoa.

Bisexual colonies are rare among the hydroida,¹ and, so far as the present writer knows, have not hitherto been found in campanularian forms.

The large, strongly modified hydrothecæ do not show the characteristic hydranths of *Coppinia* in the part of the specimen included by the sections examined, but are closed at the end and show no indication of tentacles. Further up on the stem these structures intergrade with other hydrothecæ, which are open at the end and contain hydranths with tentacles, such as those usually described as pertaining to *Coppinia*.

¹ Allman says (Monograph of the Gymnoblatic or Tubularian Hydroids, Ray Society, 1870, 1871, 1872, p. 148), "As an almost universal rule, then, the Hydroida are dioecious; in other words, every colony is unisexual." The only exceptions mentioned by this author are *Hydra*, *Plumularia pinnata*, and *Dicoryne conferta*.

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¹ It appears that Dr. Clarke originally spelled his name "Clark" and added the final *e* in his later papers. The present author has always written the name as spelled on the title page of the paper in question.

EXPLANATION OF PLATES.

PLATE LXII.

Fig. 1. *Sertularia tenera* Sars.

A. Portion of colony with gonangium.

B. A pair of hydrothecæ, enlarged.

2. *Campanularia kincaidi* Nutting.

A. Portion of colony showing characteristic hydrothecæ.

B. A single unusually large hydrotheca.

C. Outline of aperture.

3. *Campanularia lineata* Nutting.

A. Hydrotheca with pedicel.

B. Side view of another hydrotheca.

PLATE LXIII.

Fig. 1. *Halecium geniculatum* Nutting.

A. Portion of colony showing hydranths and gonangium.

B, C, D. Single gonangia.

2. *Halecium corrugatum* Nutting.A. Portion of a colony growing on *Sertularella tricuspidata*.

B. A single hydrophore, enlarged.

3. *Hydrallmania distans* Nutting.

A. Side view of branch showing arrangement of hydrothecæ.

B. Anterior view of branch.

C. Anterior view of a pair of hydrothecæ, enlarged.

D. Single hydrotheca, side view, showing aperture.

PLATE LXIV.

Fig. 1. Cross section of stem and gonosome of *Lafoëa dumosa*.

a. t. Axial tube of colony.

g., g.' Female gonangia.

h. Hydrotheca containing a normal hydranth.

m. h., m. h.,' m. h.'" Greatly elongated modified hydrothecæ.

o. Ovum.

p. t., p. t.,' p. t.'" Peripheral tubes of main stem.

tb., tb.' Tubules or secondary tubes forming a network around the peripheral tubes, and connecting the latter with the gonangia and modified hydrothecæ.

s. Male gonangium containing the spermary.

2. Part of a section similar to the above, showing the sarcodal connection between the axial tube and the gonangium.

ax. Axial tube.

bs. Blastostyle of the female gonangium.

c. t. Connecting tubule between the gonangium and the peripheral tube,

g. The female gonangium.

ov. Ovum.

p. Peripheral tube traversed by sarcodal connection between the blastostyle and axial tube.

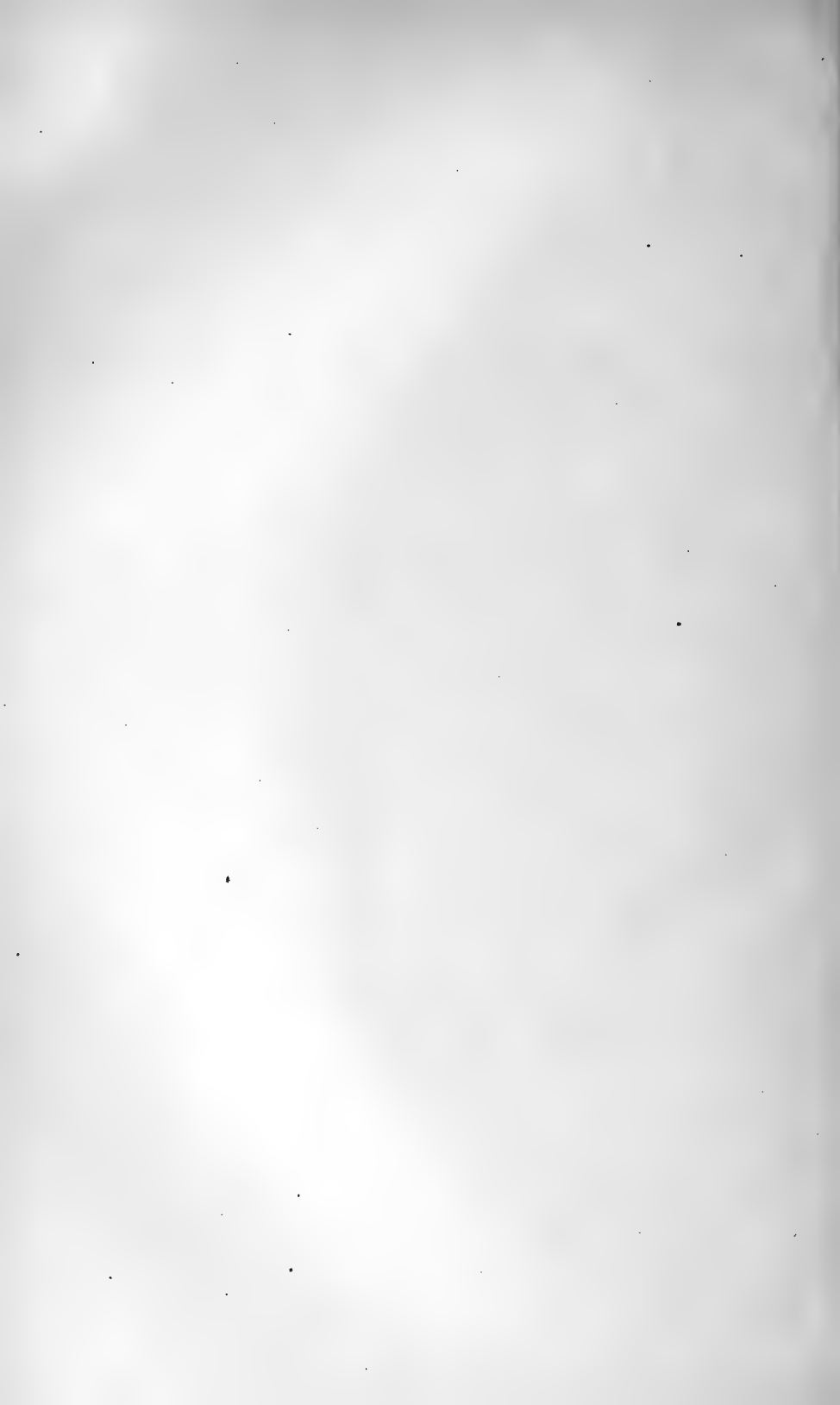
3. A single female gonangium, enlarged.

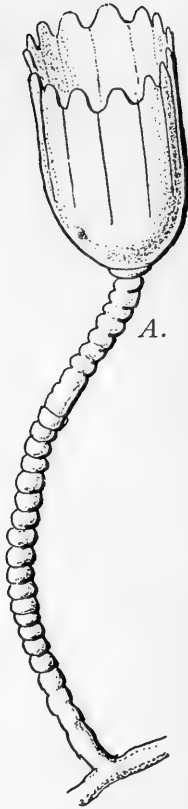
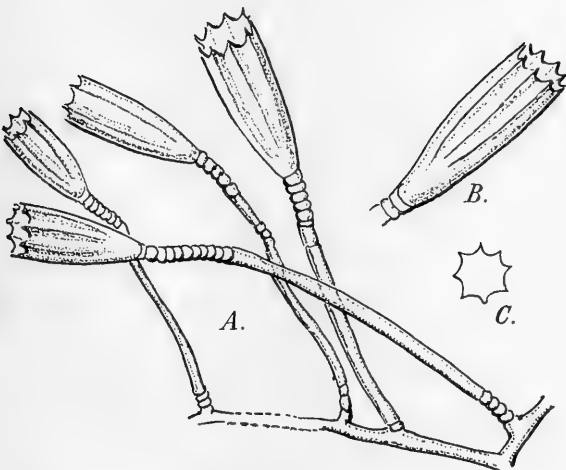
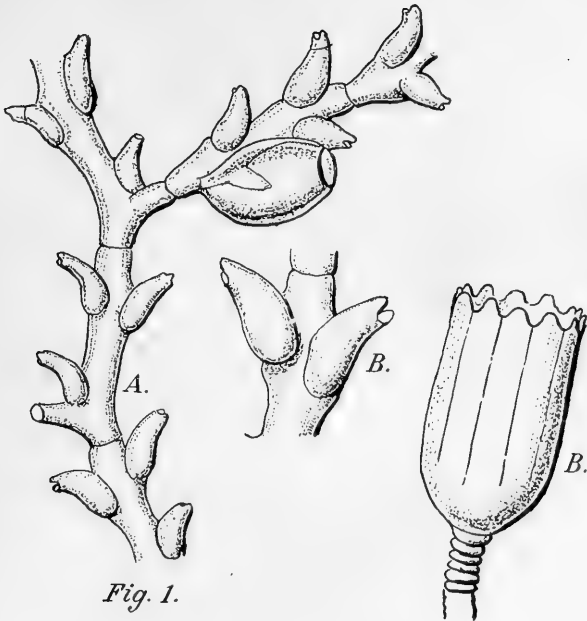
bs. Blastostyle.

ov. The single developing ovum.

4. A single male gonangium, enlarged.

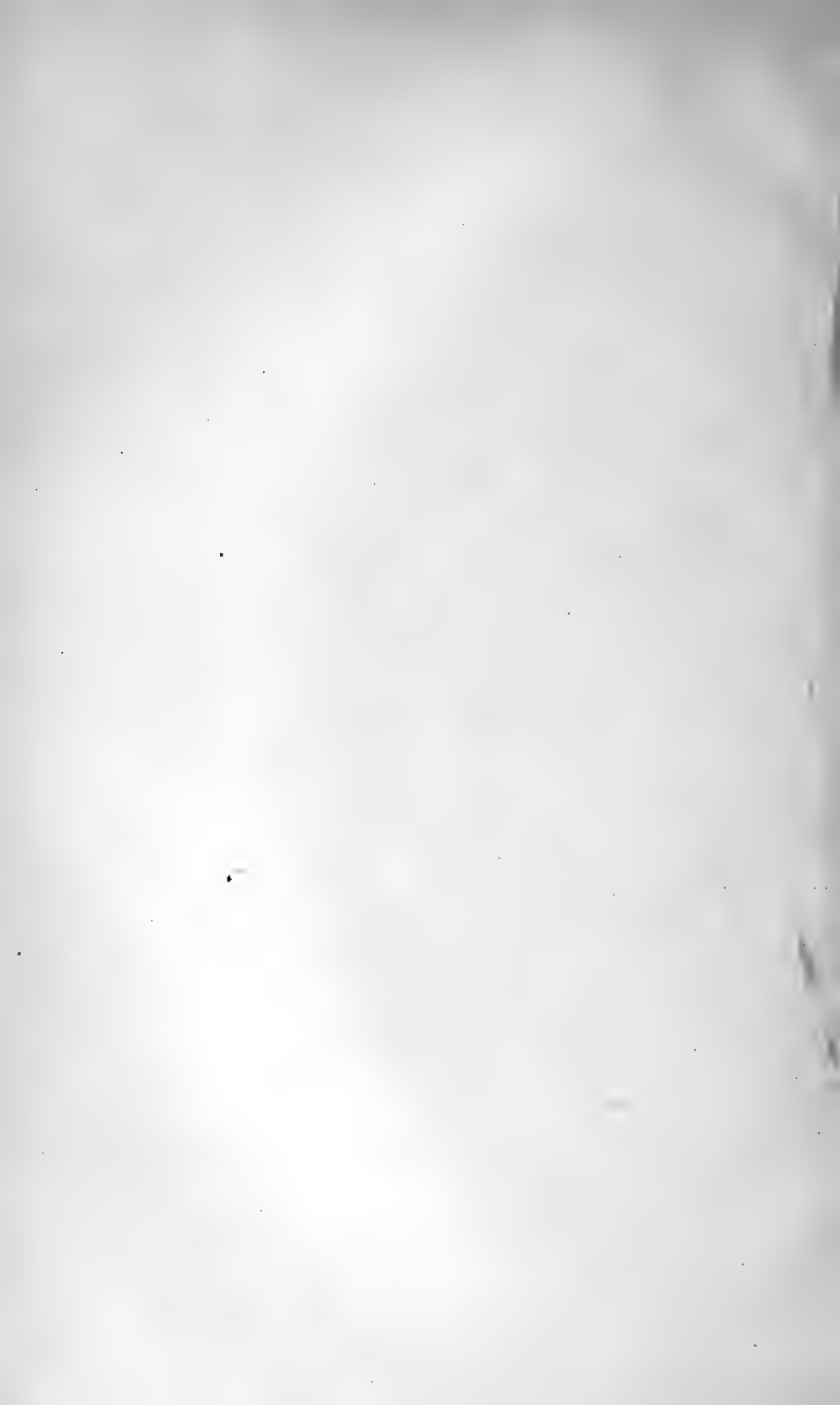
s. Spermary.

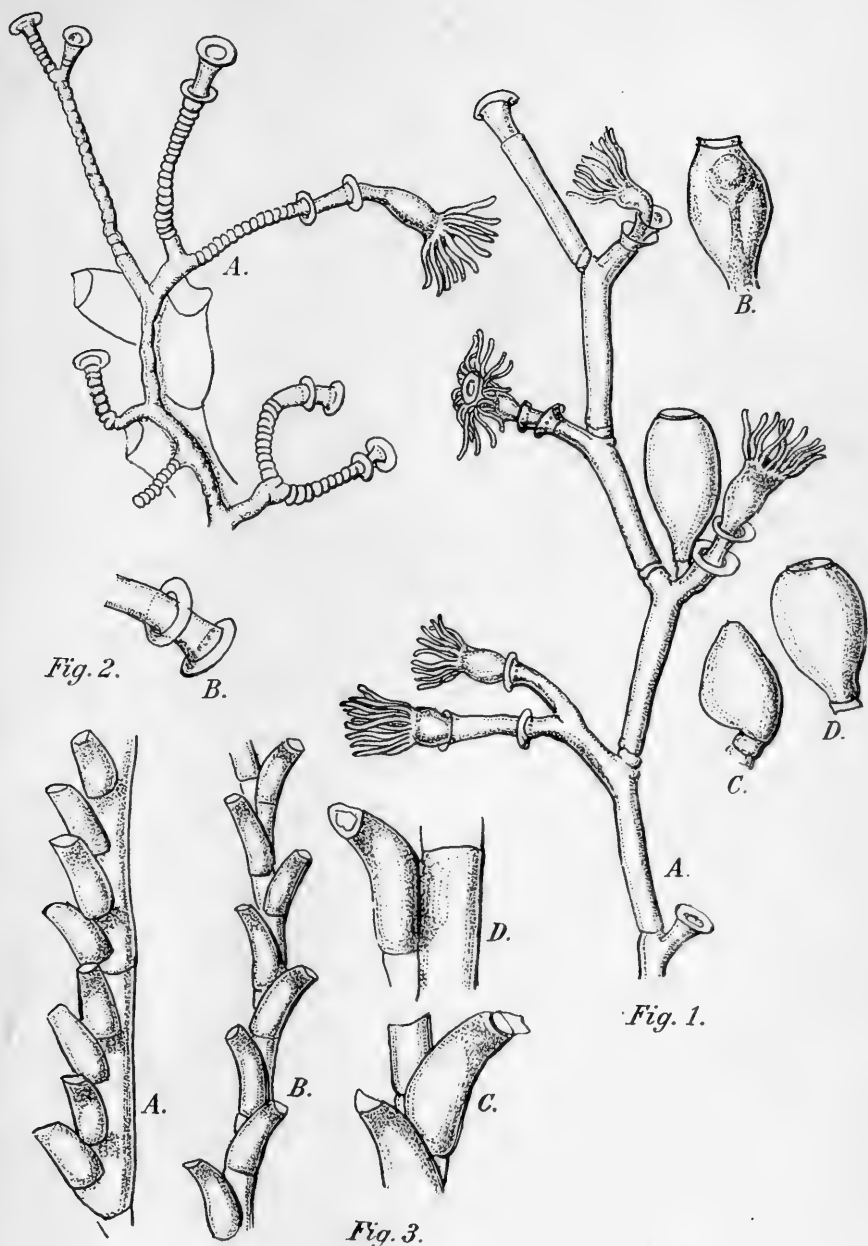




NEW HYDROIDA FROM THE PACIFIC COAST AND ALASKA.

FOR EXPLANATION OF PLATE SEE PAGE 753.

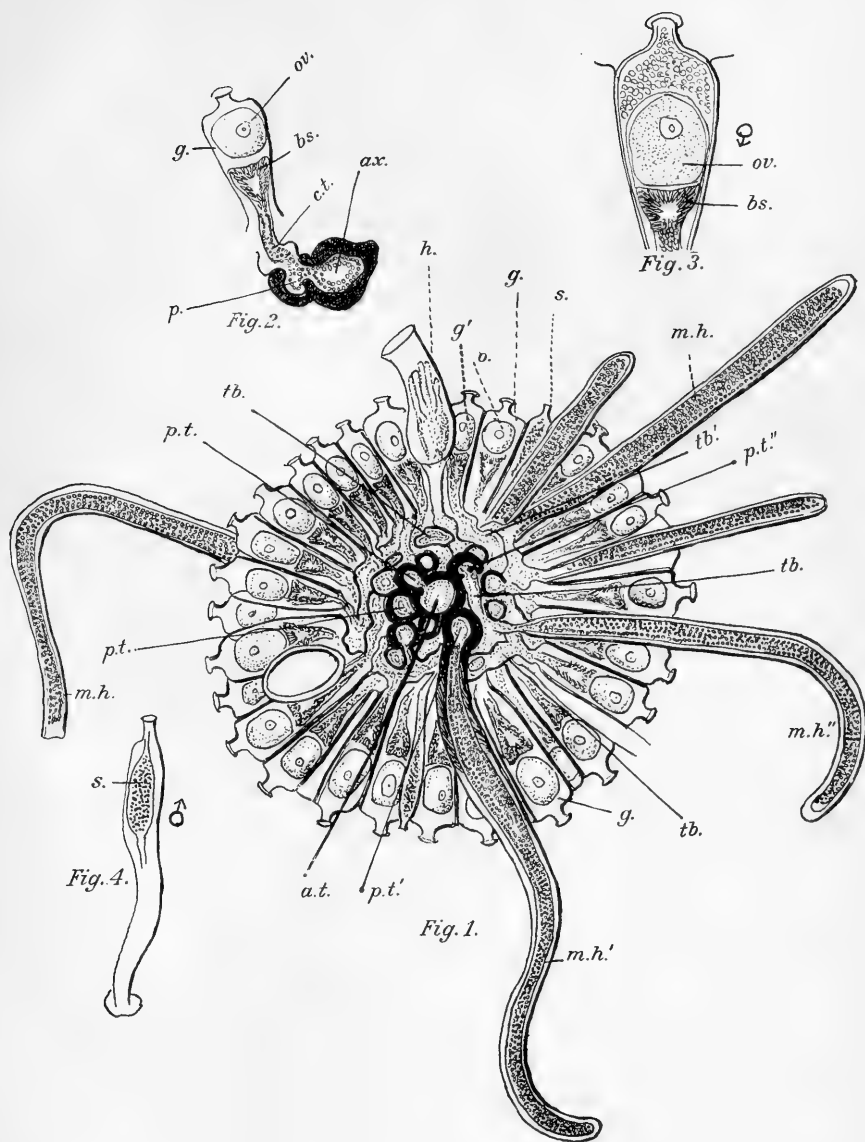




NEW HYDROIDA FROM PUGET SOUND.

FOR EXPLANATION OF PLATE SEE PAGE 753.





THE GONOSOME OF LAFOËA.

FOR EXPLANATION OF PLATE SEE PAGE 753.

THE FOSSIL BISON OF NORTH AMERICA.

By FREDERIC A. LUCAS,

Curator, Division of Comparative Anatomy.

The aim of this paper is to assign definite characters to the various species of bison occurring in a fossil condition in North America and to disentangle the complicated synonymy in which they have been involved. With the exception of *Bison crassicornis* and *Bos arizonica* the types of the various alleged species have all been examined, and to aid in defining the species and to unravel the synonymic snarl either the types or characteristic examples of all species are herein figured.

I wish to express my thanks to Profs. J. C. Branner and C. W. Greene, Dr. Josua Lindahl, Mr. S. N. Rhoads, and Prof. S. W. Williston for photographs and information concerning various specimens, and to Prof. O. C. Marsh, the Academy of Natural Sciences, Philadelphia, and to the University of Pennsylvania for the loan of specimens.

While remains of fossil bison are not uncommon in North America, they occur as a rule in such a scattered and fragmentary condition and the various parts so disassociated that at present it is impossible to correlate the teeth with the other portions of the skeleton and to diagnose the species in a thoroughly satisfactory manner. The best that can be done is to use such material as we have and endeavor to distinguish the species by their horn cores, and after going over the subject carefully I am convinced that in spite of an admitted amount of individual variation the horn cores afford very good specific characters. They do not differ among themselves any more than do other portions of the skeleton, and in the present case they are infinitely preferable to scattered teeth. Moreover the differences between the skulls of such species as *B. bison* and *B. occidentalis* indicate that the various species could be well differentiated did we possess sufficient material.

Little or no attempt has been made in this paper to name or describe individual teeth, since, so far as known, these so closely resemble the corresponding teeth of the existing bison that really the best that can be done is to make a guess at the species from the locality in which they were found.

So far as can be judged by the appearance of the specimens or the

conditions under which they have been found all species might have been coeval, although this is naturally highly improbable. *Bison bison* has been found in a mineralized condition beneath 25 feet of gravel, *B. crassicornis* has been found in a fairly fresh state on the tundra of Alaska, while *B. latifrons* has been found semifossilized at Big Bone Lick, Kentucky, and well mineralized at Peace Creek, Florida.

In regard to geographical distribution, it may be said that *Bison crassicornis* has not been found outside of Alaska; *B. antiquus* is not definitely known to occur farther east than Big Bone Lick, Kentucky; and that no species save *B. latifrons* is certainly known from Florida and other Southern localities, while it has not been found on the Pacific coast, horn cores ascribed to this species being really those of *B. antiquus*. *B. occidentalis* is so far known from Kansas and Alaska.

The changes of nomenclature proposed in this article are as follows:

Bison occidentalis is proposed for a species occurring in Alaska and Kansas.

Bison alaskensis Rhoads, is considered a synonym of *B. crassicornis* Richardson.

Bison californicus Rhoads, is considered a synonym of *B. antiquus* Leidy.

Bos scaphoceras Cope, is considered to be an *Ovis*.

Bos crampianus Cope, is considered a synonym of *B. alleni* Marsh.

Bos arizonica Blake, is considered as a synonym of *B. latifrons* (Harlan).

Bison appalachicolus Rhoads, needs no consideration, being confessedly based on a horn core of *Ovibos*,¹ nor does *Bison alticornis* Marsh, it having been founded on the horn cores of a dinosaur, *Triceratops*.²

As for *Bos scaphoceras* Cope,³ the conviction has been forced upon me after careful consideration that this is not a *Bison*, but an *Ovis*, a conclusion concurred in by Dr. F. W. True, Dr. J. A. Allen, and Mr. G. S. Miller, jr. The type of this from northern Nicaragua and now in the Museum of the University of Pennsylvania may be described as follows:

Horn cores short and robust, circumference at base greatly exceeding length on concave face; subtriangular in section, flattened on concave face, transverse diameter greater than vertical; strongly recurved with tips directed slightly backwards.

The texture, structure, curvature, and subtriangular shape are like one of the big-horned sheep, such as *Ovis ammon*, the horn core being more triangular in section than that of our *Ovis montana*. The species will stand, but the genus must be changed. This extension of the range of the genus *Ovis* southwards is in accordance with the range of existing species.

¹Proc. Acad. Nat. Sci., Phila., 1897, p. 492.

²Am. Journ. Sci., XXXVIII, 1889, p. 174.

³Two species Leidy, Proc. Acad. Nat. Sci., Phila., 1886, p. 275. *Bos scaphoceras* Cope, Journ. Acad. Nat. Sci., Phila., IX, 1894, p. 457, pl. xxii, figs. 5-9.

The horn core, considered to be that of the female, differs considerably from that of the male, being straighter and not flattened above. It is keeled on convex face, the edge near the tip being quite sharp, and there is a bare possibility that it may belong to a young female of some species of *Bison*, although this is doubtful.

Measurements of horn cores given in this paper do not include the frontal pedicel, but are taken from the raised edge of the portion covered by horn. Transverse diameter means greatest diameter in a line parallel with the longitudinal axis of the skull; vertical diameter is the greatest diameter at right angles to this.

The dorsal views of the crania are taken perpendicularly to the plane of the forehead, the posterior views at right angles to the back of the skull. It is highly important that all views of crania for comparative purposes should be taken in the same manner, since a slight change in the angle of sight, looking down upon the skull, makes a considerable apparent change in the direction of the horn cores.

Seven species of *Bison* are herein recognized: *Bison alleni*, *antiquus*, *bison*, *crassicornis*, *ferox*, *latifrons*, and *occidentalis*. Descriptions of these are given below together with the location of the type, the principal synonymy and measurements of the more important specimens.

BISON BISON (Linnæus).

Bos bison LINNÆUS, Syst. Nat., 1758, I, p. 72.

Bos bison var. β , LINNÆUS, Syst. Nat., 1766, I, p. 99.

Bos americanus GMELIN, Syst. Nat., 1788, I, p. 204.

Bison americanus SMITH, Griffith's Cuv., V, 1827, p. 374.

Horn cores short, circumference at base usually much greater than length along upper curve; subcircular in section, vertical diameter slightly exceeding transverse, generally abruptly recurved; directed backwards at the tip.

Remains of this species occur abundantly in a semifossil condition at Big Bone Lick, Kentucky, and completely mineralized specimens have been obtained in Kansas. The upper portion of the skull, with perfect horn cores, No. 1718, U.S.N.M., was obtained by Dr. A. G. Chase, at Millwood, Kansas, 25 feet below the surface. Another good specimen, the fairly complete skull of a large bull, No. 4158, U.S.N.M., was collected by Dr. T. T. Minor, in the loess of Missouri, at a locality in the Winnebago Reservation. It is remarkable for the spread of the horns (655 mm.) and for the size of the teeth, which equal any yet discovered.

Measurements of horn cores of *Bison bison*.

	Vertical diameter.	Trans- verse diameter.	Circum- ference at base.	Length along upper curve.	Length along lower curve.	Distance between tips.
	mm.	mm.	mm.	mm.	mm.	mm.
No. 4158, U.S.N.M., from loess of Mis- souri	81	77	247	220	270	655
No. 2050, Museum Comparative Zoology			300	260		650
No. 12456, U.S.N.M.	88	84	280	226	280	615

BISON OCCIDENTALIS Lucas.

(Plates LXV, LXVI.)

Bison antiquus STEWART, Kan. Univ. Quar., VI, July, 1897, p. 127, pl. xvii.*Bison occidentalis* LUCAS, Science, November 11, 1898, p. 678.*Bison occidentalis* LUCAS, Kansas Univ. Quar., VIII, January, 1899, pp. 17, 18.

Type.—No. 4157, U.S.N.M., from Fort Yukon, Alaska; collected by Sir John Richardson. Quaternary of Kansas and Alaska.

Horn cores moderate; circumference at base equal to or slightly greater than length along upper curve; subcircular in section, regularly curved upward and backward.

This species is readily distinguished from *B. antiquus* by its more slender and proportionally longer horn cores and the fact that they are directed upward and backward, as is well shown in the plates and the diagram.

An excellent figure of this species is given by Dr. J. A. Allen in his Monograph of North American Bison, on Plate IV, where it is called *B. antiquus*.

A practically complete skeleton of *Bison occidentalis* was discovered in the valley of the Smoky Hill River, in Gove County, Kansas, in the same deposit as remains of *Elephas* and *Platygonus* and in connection with small flint arrowheads. A detailed description of this specimen, which is preserved in the Museum of the State University in Lawrence, Kansas, has recently been published by Mr. Alban Stewart,¹ but, like other writers, he unfortunately confuses the species with *B. crassicornis* and *B. latifrons*, which are very distinct and from which it may readily be distinguished by the form and curvature of the horn cores. (See diagram on p. 762.) As shown by the Kansas specimen, the skull is larger than in *B. bison* and anteriorly more tapering, while the nasals and premaxillaries are much longer. The orbits look more directly forward than in *B. bison*, and the distance between orbits and horn cores is greater, the result being that the jugals are long and slender.

Specimens have been obtained from St. Michael, Fort Yukon, and the Tatlo River, Alaska, and Gove County, Kansas.

It is the species most nearly resembling the existing bison, with which it was probably for a time contemporaneous.

Measurements of horn cores of Bison occidentalis.

	Vertical diameter.	Trans- verse diameter.	Circum- ference at base.	Length along upper curve.	Length along lower curve.	Distance between tips.
	mm.	mm.	mm.	mm.	mm.	mm.
Type No. 4157, U.S.N.M.	96	98	298	298	365	710
University of Kansas	108	108	343	318	372	875
Specimen from St. Michael, figured by Dr. J. A. Allen			300	260		680

¹ Kansas University Quarterly, July, 1897, Ser. A, pp. 127-135.

BISON ANTIQUUS Leidy.

(Plates LXVII-LXX.)

- Bison antiquus* LEIDY, Proc. Acad. Nat. Sci., Phila., 1852, p. 117; Mem. Ext. Spec. Amer. Ox., 1852, p. 11, pl. II, fig. 1 (Smithsonian Contributions, III).
Bison latifrons LEIDY, Extinct Mam. of N. A., 1869, p. 371 (in part); Extinct Vert. Fauna, 1873, p. 253, pl. XXVIII, figs. 4-7 (Report U. S. Geol. Surv., I).
Bison antiquus ALLEN, Am. Bisons, Living and Extinct, 1876, p. 21 (in part).
Bison californicus RHOADS, Proc. Acad. Nat. Sci., Phila., 1897, p. 501.
Bos prisca LYDEKKER, Wild Oxen, Sheep and Goats of All Lands, London, 1898, p. 61.

Type.—In the Academy of Natural Sciences, Philadelphia; from Big Bone Lick, Kentucky. Horn cores comparatively short, stout, and abruptly tapering; circumference at base much exceeding length along upper curve; subcircular or slightly triangular in section, transverse diameter very little greater than vertical; slightly recurved at tips, which barely rise above the plane of the forehead.¹ Axis of horn cores nearly at right angles to longitudinal axis of skull. This last character distinguishes *Bison antiquus* from all other American species.

A large specimen from Ilford, Sussex (Plate LXXII), labeled *B. bonasus*, has the horn cores at right angles to the axis of the skull, but they are much larger and very much more up-curved than in *B. antiquus*.

The horn cores of *B. antiquus* have a rather sharp ridge along the inferior face toward the tip, and they are deeply grooved on the posterior face.

The horn cores of *Bison antiquus* are so different in size, proportions, and curvatures from those of *B. crassicornis* and *B. latifrons* that it is difficult to see why the species should have been confused. Putting aside all differences in appearance due to mere size, the horns of *B. antiquus*, it may be well to repeat, differ from all other American species in standing at right angles to the skull. Imperfect specimens of *B. antiquus* may be distinguished from similar specimens of *B. latifrons*, even should they be of approximately the same size, by the very different shape of the transverse section of the horn cores, this being broadly elliptical in *latifrons* and roundly subtriangular in *antiquus*.

Mr. Rhoads, who has named the Californian bison *B. californicus*, correctly says² that I concurred in his opinion that the California bison was distinct from *B. antiquus*, but at the time I had not seen the type of *B. antiquus* and labored under the impression that it was similar to the specimens from Alaska and Kansas which are herein described as *B. occidentalis*. From these the California specimen certainly is distinct, although it is the one specimen that has been correctly referred to *B. antiquus*. I regret that I should have thus inadvertently added

¹ The difference between *B. antiquus* and *B. occidentalis* in this respect is well shown in the plate (XVII) accompanying Mr. Stewart's paper in the Kansas University Quarterly for July, 1897, the upper figure being *antiquus*, the lower *occidentalis*, although described as *antiquus*.

² Proc. Acad. Nat. Sci., Phila., 1897, p. 501.

to the confusion existing in the nomenclature of our fossil bison, and I also regret that I find myself compelled to differ from Mr. Rhoads, to whom I am under many obligations. The fact remains, however, that the type of *B. antiquus*, imperfect as it is, agrees in every particular with the horn cores of the California specimen, and there can be no question as to their specific identity.

Remains of *Bison antiquus* have been found at the following localities: Big Bone Lick, Kentucky; Alameda County, California, in post-pliocene gravel, associated with bones of *Elephas*, *Mastodon*, *Equus*, and *Procamelus*; Pilarcitos Valley, California, in blue clay, 21 feet below the surface.

The teeth found at Darien, Georgia, are not definitely ascribable to *B. antiquus*, and are considerably smaller than the specimens noted from California. It is probable that they appertain to *B. latifrons*.

An imperfect ramus, probably of this species, from Alameda County, California, is characterized by its size, being very much larger in every way than any example of *B. bison*, although perhaps best shown by the length of the tooth series, which is 0.197 mm. in *B. antiquus* and but 0.164 mm. in *B. bison*.

The type of *antiquus* is unfortunately very imperfect and much water-worn, the upper and lower surfaces having lost much the most. The restoration of this is largely guesswork, but as well as may be estimated the vertical diameter is 120 mm., the transverse 128 mm., the circumference 390 mm., the length along upper curve 340 mm.

Measurements of horn cores of *Bison antiquus*.

	Vertical diameter.	Transverse diameter.	Circumference at base.	Length along upper curve.	Length along lower curve.	Distance between tips.
	mm.	mm.	mm.	mm.	mm.	mm.
Type Acad. Nat. Sci., Phila.	102	122	364	213	252	.....
The same approximately restored	120	128	390	270	340	.....
California specimen <i>B. californicus</i>						
Rhoads	120	125	360	285	370	912

BISON CRASSICORNIS Richardson.

(Plates LXXIII-LXXVI.)

Bos urus BUCKLAND, Beechey's Voy. to the Pacific, 1831, II, p. 539, pl. III, figs. 1-7.

Bison priscus ? RICHARDSON, Zool. Voy. of *Herald*, 1852-54, pp. 33, 139, pls. VI, figs. 5, 6; VII; X, figs. 1-6; XIII, fig. 3.

Bison crassicornis RICHARDSON, Zool. Voy. of *Herald*, 1852-54, pp. 40, 139, pls. IX, XI, fig. 6; XII, figs. 1-4; XIII, figs. 1, 2; XV, figs. 1-4.

Bison crassicornis LEIDY, Proc. Acad. Nat. Sci., Phila., 1854, p. 210.

Bison priscus LEIDY, Proc. Acad. Nat. Sci., Phila., 1854, p. 210; Ext. Mam. N. A., 1869, p. 371. (Journ. Acad. Nat. Sci., Phila., new ser., VII.)

Bison latifrons LEIDY, Ext. Mam. N. A., 1869, p. 371 (Journ. Acad. Nat. Sci., Phila., new ser., VII), in part.

Bison antiquus ALLEN, The Am. Bisons, Living and Extinct, Cambridge, 1876 (Memoirs Geol. Surv., Kentucky, I, Pt. 2), in part, pp. 21-26.

- Bison bonasus* var. *priscus* LYDEKKER, Cat. Foss. Mam. Brit. Mus., Pt. II, Contng. the Order Ungulata, Suborder Artiodactyla, 1885, pp. 25, 26, London, in part.
Bison alaskensis RHOADS, Proc. Acad. Nat. Sci., Phila., 1897, p. 490.
Bos priscus LYDEKKER, Wild Oxen, Sheep, and Goats of All Lands, London, 1898, p. 61.

Type.—In the British Museum, from Eschscholtz Bay, Alaska. Horns long; length of horn core along upper curve very much greater than circumference at base; horn cores slightly flattened on superior face; transverse diameter much greater than vertical; curve of horn regular, the tip not abruptly reflected nor pointing decidedly backward; horn cores raking decidedly backward.

This species, which has fared so well in the matter of synonyms, is, so far as American species go, perfectly distinct, and its affinities with Europeo-Asiatic forms remain to be decided, though from the relations between the existing faunas of northeastern Asia and northwestern America it would be quite natural to find fossil bison in eastern Siberia that were indistinguishable from *B. crassicornis*.

Dr. J. A. Allen, in his Monograph of American Bisons, treats *B. crassicornis* as a synonym of *B. antiquus* Leidy, while still more recently Mr. Rhoads¹ has divided Richardson's specimens into two species, one of which, including the type, he considers as *B. antiquus*, while the other he calls *B. alaskensis*. The validity of Richardson's *Bison crassicornis* hinges on the question of the identity of his type I, A, with Leidy's *B. antiquus*. Both species are founded on more or less imperfect specimens, but after going over descriptions, figures, and specimens the conclusions reached are as follows: Richardson's I, A, Plate IX, fig. 1, is specifically identical with his No. 24589, Plate VII, fig. 1, and this in turn with the specimens in the U. S. National Museum and University of Pennsylvania, which do not in any way resemble *B. antiquus* and do resemble one another.

The disparity in size between the specimens under discussion amounts to nearly 30 per cent, but the form and proportions of the crania and horn cores are similar, while the specimen shown on Plate VII, fig. 1, is shown by the cast to be young, being what would be termed a spike horn. Owing to this youthfulness the horn cores do not have the proximal downward curve found in adults, but the slender nature of the horn cores and their backward inclination distinguish this from *B. antiquus* at a glance.

The type of *B. crassicornis* is Richardson's I, A, figured on Plate IX and described on pages 40–43 of the Voyage of the *Herald*,² and while the horn cores are broken off a short distance from the base, enough

¹Proc. Acad. Nat. Sci., Phila., 1897, p. 490.

²A very good idea of the type may be obtained from Plate LXXV, taken from No. 13753 of the Museum of Archæology and Palæontology, University of Pennsylvania. This specimen Mr. Rhoads considers to be identical with *B. antiquus*, but from the backward rake of its horn cores this is out of the question.

remains to show that they had a very decided backward inclination, as noted by Richardson, who states that the horn cores—

Are more depressed at the base or flattened on the concave side than those referred above to *Bison priscus*?¹ and they are directed horizontally with a slight basilar inclination and more iniaad, much in the way that the horns of the mushtush (*Bison bison*) would curve were that animal horned on a much larger scale. Their backward position is such that a spot on their posterior edge 2 inches from their base is even with the sides of the occipital arch when the skull is seen in profile. Though the cores are much wasted by decay, they are still considerably larger than those of an adult mushtush or aurochs bull.

This backward flare is very characteristic of *crassicornis*, as may be seen by reference to Plates LXXIII, LXXVI and the figures below, where the great differences between the horn cores of *B. antiquus*, *crassicornis*, and *occidentalis* are well shown.

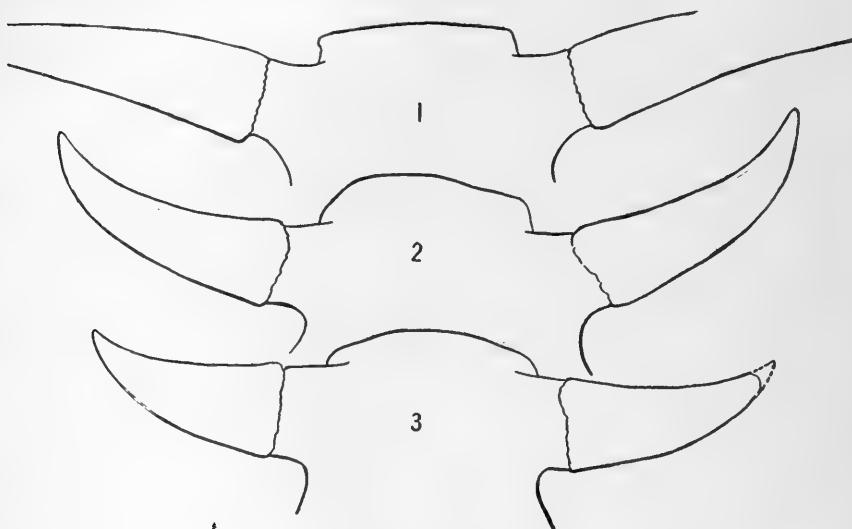


FIG. 1.—DIFFERENCES IN CURVATURE OF HORN CORES OF (1) *BISON CRASSICORNIS*, (2) *B. OCCIDENTALIS*, (3) *B. ANTIQUUS*.

No. 1 of these figures is from the small, complete specimen shown by Richardson,² No. 2 is *Bison occidentalis* in the University of Kansas, and No. 3 is *Bison antiquus* from the specimen in the Academy of Natural Sciences, Philadelphia, named by Rhoads *B. californicus*. The identity of this species is discussed under *Bison antiquus*.

The type of *Bison antiquus* is an imperfect, waterworn, right-horn core, which, however, shows the horn cores to be but moderately long, with the transverse diameter but little greater than the vertical, although this character is much exaggerated owing to the wearing away of the upper surface as shown in the plate. The horn cores of *B. antiquus*, as noted in the diagnosis of that species, stand out almost at

¹ This is the "spikehorn" figured on Plate LXXVI of this paper.

² Zoology of the Voyage of the *Herald*, pl. VII, fig. 1.

right angles to the longitudinal axis of the skull, so that a line drawn across the back of the cranium misses them completely, their tips being 3 inches within (anterior to) the line.

In this respect all specimens of *B. antiquus* differ very decidedly from any that have been referred to *B. crassicornis*, even such imperfect specimens as Richardson's type or the similar specimen figured herein on



FIG. 2.—DIFFERENCES IN CURVATURE BETWEEN THE HORN CORES OF BISON CRASSICORNIS AND BISON ALLENI.

The light line distinguishes *Bison alleni*, the heavy line *Bison crassicornis*

Plate LXXV. This being the case, none of the Alaskan specimens can by any possibility be referred to *Bison antiquus*, and, as previously stated, the type stands.

Bison crassicornis may be distinguished from *B. alleni*, the species which it most nearly resembles, by the lesser curvature of the horn cores, which are also stouter, more flattened on the superior face, and more elliptical in section than are those of *B. alleni*. These differences are evident enough in the specimens, but not in small figures.

Dr. Lydekker¹ considers *B. crassicornis* as identical with *B. priscus*, "since the fossil crania agree precisely with European specimens, and those from Kotzebue Sound were obtained in company with remains of *Elephas primigenius* and *Oribos moschatus*." *Bison priscus* and *B. bonasus* are united² on the ground that while in the typical forms of *priscus* "the horns are larger and less curved than in the living aurochs, the specimens in the British Museum seem to indicate a complete transition in this respect, and some of them can not be distinguished from the living race."

That there is a great variety in the horns of fossil European bison is true, but it seems not at all improbable that two or more species have been confounded, that *Bison priscus* is a valid species, and that others remain to be described.

The cast of a bison cranium received from the Brussels Museum and labeled *Bison europæus* bears some resemblance to *B. crassicornis*, but differs in the curvature of its horns, the tips being more reflexed.

In another bison cranium from Ilford, Sussex, the horn cores stand nearly at right angles to the long axis of the skull and curve very regularly upward. (See Plate LXXI.) There can be little doubt but what these represent two distinct species.

Some bison bones were obtained by Capt. C. L. Hooper at Elephant Point, Kotzebue Sound, at the mouth of the Buckland River. They were associated with remains of the mammoth, *Elephas primigenius*, and a horse, probably *Equus fraternus*. These bones are of two sizes and may either indicate two sexes or two species, probably the latter. The smaller bones are the size of a large male *Bison bison*. The large bones are larger than the measurements given by Mr. Stewart³ of bones of *B. antiquus* (= *B. occidentalis*), although, from the imperfect condition of the ends, the exact measurements can not be given.

A metacarpal from Alaska in the U.S. National Museum has been ascribed to, and very likely belongs to, *B. crassicornis*, although it is of course possible that it pertains to *B. occidentalis*, since the two overlap in Alaska.

It is a trifle larger and more robust than any example of *B. bison* examined, either by Dr. Allen or myself, although we have each had opportunities for examining large series. Otherwise there is no difference between the metacarpals of the two species.

¹ Catalogue of the Fossil Mammalia in the British Museum, II, p. 24.

² Idem., p. 24.

³ Kansas University Quarterly, VI, July, 1897, pp. 134, 135

Appended are the measurements of these compared with good examples of *B. bison* and *B. bonasus*:

Measurements of metacarpals.

Species.	Locality.	Length.	Proximal breadth.	Distal breadth.	Least diameter.	Circumference.
		<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
<i>Bison latifrons?</i>	Florida.....	254	91	92	55	150
<i>Bison crassicornis?</i>	Alaska.....	220	81	83	55	148
<i>Bison occidentalis</i>	Kansas.....	221	85	88		
<i>Bison bonasus</i>		218	88	76	52	134
<i>Bison bison</i>		207	83	84	52	145

The term Ice Cliffs of Eschscholtz Bay, often given as the locality for the fossil remains from Kotzebue Sound, is a little misleading, since the bones either occur in the stratum of more or less frozen soil above the ice or in the talus at the foot of the bluffs. Capt. C. L. Hooper, who obtained numerous specimens for the U. S. National Museum, blasted off considerable portions of the ice without finding any bones therein.¹

Measurements of horn cores of Bison crassicornis.

	Vertical diameter.	Transverse diameter.	Circumference at base.	Length along upper curve.	Length along lower curve.	Distance between tips.
	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
Type I, A. of Richardson.....	92	106	318			
No. 91, of Richardson.....	106	132	383			
No. 24589, <i>B. priscus?</i> , of Richardson.....	176	93	280	300	330	830
No. 105, <i>B. priscus</i> , of Richardson.....	64	69	215	268	313	
No. 1584, U.S.N.M.....	103	133	390	460	500	1, 110
Acad. Nat. Sci., San Francisco.....	90	114	343	358	442	1, 030

¹ Part of lower side of horn core lacking.

BISON ALLENI Marsh.

(Plates LXXVII-LXXX.)

Bison alleni MARSH, Am. Journ. Sci., XIV, 1877, p. 252.

Bos crampianus COPE, Journ. Acad. Nat. Sci., Phila., IX, p. 456, pl. xxii, figs. 1-4.

Type.—No. 911, Museum of Yale College. Pleistocene of Idaho and Kansas.²

Horn cores long, slender, much curved, slightly flattened above at base; transverse diameter considerably greater than vertical; length along upper curve much greater than circumference at base. *Bison alleni* is distinguished from *B. crassicornis* by the much greater curvature of the horn cores, these being also more flattened and more elliptical in section in *crassicornis*. Like *crassicornis* this species is distin-

¹ For a description of these cliffs and a discussion of their origin see Richardson, Voyage of the *Herald*, pp. 1-8; Dall, Bulletin U. S. Geol. Surv., 84; Correlation Papers, Neocene, pp. 260-268.

² This species was assigned to the Lower Pliocene by Professor Marsh, but the specimen found in the gravel by Professor Greene shows it to have been beyond doubt Pleistocene.

guished from most specimens of equal size ascribed to *B. bonasus*¹ by the more regular taper and curve of the horn cores and by the fact that they are directed much more backward.

So far as is known, however, this species is separated geographically from any Asiatic species by the interposition of *B. crassicornis* and *B. occidentalis*. The horn cores are much longer and less conical than in *B. occidentalis*, while they are shorter and more curved than in the great *Bison latifrons*.

This species was founded by Professor Marsh² on a horn core found in the Blue River near Manhattan, Kansas. A much more complete specimen, deposited in Stanford University, California, was obtained by Prof. C. W. Greene from the banks of the Snake River, Idaho, about 9 miles above American Falls, in the gravel overlying the lava beds, which are considered by Dr. Lindgren to be late Miocene or early Pleistocene.

Two molars found by Mr. W. H. Hackney in the auriferous gravel on the south bank of the Snake River, 10 miles from Glens Ferry, Idaho, are very possibly from this species. They are the largest teeth of bison in the collection of the U. S. National Museum.

Professor Cope's *Bos crampianus* from the Pleistocene sands of southern Kansas is assigned to *B. alleni*, because on examination, I find that the horn core of *B. crampianus* is less triangular in section than one would be led to suppose from the figure, and because this triangular section seems to a certain extent to be the result of crushing to which the specimens had been subjected. In size and curvature the two agree.

Measurements of horn cores of Bison alleni.

	Vertical diameter.	Trans- verse diameter.	Circum- ference at base.	Length along upper curve.	Length along lower curve.	Distance between tips of horns.
	mm.	mm.	mm.	mm.	mm.	mm.
Type, No. 911, Museum of Yale College.	115	140	415	628	760	.....
Specimen in Stanford University	145	160	480	635	710	1,338
<i>Bos crampianus</i> Cope	130	150	322	.....	² 623	.....

¹ Imperfect at base.

² Actual length, estimated length of complete horn core 720.

BISON FEROX Marsh.

(Plate LXXXI.)

Bison ferox MARSH, Am. Journ. Sci., XIV, 1877, p. 252.

Type.—No. 910, Museum of Yale College. Pleistocene (?) of Nebraska.³
Horn cores long, length along upper curve much greater than circum-

¹ These very likely should be known as *Bison prisus* or *B. europæus*.

² Am. Journ. Sci., XIV, 1877, p. 252.

³ I have ventured to call the horizon Pleistocene instead of Pliocene, as given by Professor Marsh, since the specimen was not associated with other species that would aid in determining its age, while, on the other hand, no other species of *Bison* is known from so low a horizon.

ference at base, slightly flattened above; transverse diameter slightly exceeding vertical; curve of horn core regular, but slight.

This species is based on an imperfect horn core, which indicates a species more nearly like *B. latifrons* in the shape of the horn cores than any other species, although little can be said save that the fragment indicates a robust horn core with comparatively little curve. The specimen is but little furrowed; less so than any other specimen examined.

It differs from *B. crassicornis* in having rounder and more massive horn cores, besides, as was said in the introduction, *B. crassicornis* has not as yet been found outside of Alaska.

Measurements of horn core of Bison ferox.

	Vertical diameter.	Trans- verse diameter.	Circum- ference at base.	Length along upper curve.	Length along lower curve.
Type No. 911, Museum of Yale College.....	mm. 118	mm. 123	mm. 1360	mm. 1560	mm. 1650

¹ Estimated, the specimen being imperfect.

BISON LATIFRONS (Harlan).

(Plate LXXXII.)

Aurochs CUVIER, Ann. du Mus., 1808, p. 382, pl. xxxiv, fig. 2.

Aurochs CUVIER, Oss. Foss., IV, 1812, p. 50, pl. iii, fig. 2.

Bos latifrons HARLAN, Fauna Americana, 1825, p. 273.

Bison latifrons LEIDY, Proc. Acad. Nat. Sci., Phila., 1852, p. 117.

Bison latifrons LEIDY, Mem. Ext. Sp. Am. Ox., 1852, p. 8, pls. i. ii (Smithsonian Contributions).

Bos arizonica BLAKE, Am. Geologist, August, 1898, p. 65.

Bos latifrons LYDEKKER, Wild Oxen, Sheep and Goats of all Lands, London, 1898, p. 92.

Type.—In the Academy of Natural Sciences, Philadelphia, from Big Bone Lick, Kentucky. Horn cores very long, the distance along the upper curve very greatly exceeding the circumference at the base, regularly and slightly curved, subcircular in section, the transverse but slightly exceeding the vertical diameter; tips not abruptly recurved nor directed backward.

This is the largest species of American bison, the horn cores attaining a spread of 6 feet from tip to tip and the height at the shoulder, as indicated by a metacarpal, being upward of 6 feet, or from 6 to 9 inches greater than in the largest examples of *B. bison*.

The horn cores are directed somewhat backward, as in *B. crassicornis*, but they do not have the very decided downward dip which characterizes adults of that species.

The U. S. National Museum possesses an imperfect skull of this species from the Withlacoochee River, Florida, and a metacarpal and three teeth from the Peace Creek phosphate deposits are also ascribable to *B. latifrons*. The metacarpal is distinguished by its size, and particu-

larly by its length, which is 0.340 mm., or about one-seventh longer than that of the metacarpal ascribed to *B. crassicornis*. Posteriorly it is more convex and rugose near the proximal extremity than the metacarpal of any other bison examined, but this may be an individual peculiarity.

Two of the teeth are third upper molars, one from the left and one from the right side, and one is a second upper premolar from the right side. The premolar and one molar are large and massive, corresponding in character with teeth previously assigned to *B. latifrons*, though not exceeding in these respects the largest teeth of *B. bison*. The other molar is smaller and probably came from a female.

Four teeth contained in fragments of the lower jaw, obtained by Mr. R. T. Hill on Onion Creek, Travis County, Texas, are provisionally referred to *B. latifrons*. The jaw when entire was longer than that of *B. bison* and much more massive, the portion containing the last molar being very thick and heavy. On the other hand, the jaw is lighter and the teeth smaller than in *B. antiquus* from California.

Any statements, however, regarding teeth of fossil bison must be made and accepted with caution, as so far teeth and horn cores have not been found associated except in the case of *B. bison*. The longitudinal diameters of the teeth slightly exceed those of the corresponding teeth of *B. bison*, but the transverse diameters are much greater, the general appearance of the teeth being stout and massive, a character brought out much better by a direct comparison of specimens than by a comparison of their respective measurements.

In regard to the jaw from Texas, Mr. R. T. Hill writes:

It was found in the banks of a little lateral flowing northward into Onion Creek, about 2 miles west of Pilot Knob, Travis County, Texas. It comes from an extensive formation which I am calling the Onion Creek formation, having wide development over the State of Texas. As an ancient marly alluvium of the older drainage, and for other reasons than this bone, I consider it to be the equivalent of the Equus beds, or early Pleistocene.

Mr. W. P. Blake's *Bos arizonica*¹ is referable to this species, as may be seen by his description and measurements. That the horns curved downward and forward is an inference probably due to the condition of the specimen on which *Bos arizonica* is based. The measurements of the horn cores are given in the table, and it will be seen that they harmonize perfectly with the measurements of other specimens of the species. That it should be found in Arizona agrees perfectly with the little that is known of its geographical distribution. The specimen was found at Greaterville, in the Pima Mountains, and is now in the Museum of the University of Arizona.

Remains ascribed to *Bison latifrons* have been found as follows:

Peace Creek, Florida. Teeth.

¹ Remains of a species of *Bos* in the Quaternary of Arizona, Am. Geologist, XXII, August, 1898, pp. 65-71.

Withlacoochee River, Florida. Part of cranium.

Brunswick, Darien County, Georgia. Teeth.

Natchez, Mississippi. Teeth.

Ashley River, South Carolina. Teeth.

Big Bone Lick, Kentucky. Cranium.

Brush Creek, Brown County, Ohio. Horn cores.

San Felipe, Texas. Cranium.

By far the finest example of this species is that preserved in the collection of the Cincinnati Society of Natural History and noted above as having been found at Brush Creek. I am indebted to Dr. Lindahl for the photographs from which Plate LXXXII was made.

B. latifrons G. Fischer¹ is based on a fairly complete cranium from la Daourie, Siberia, but it is impossible to gather much idea of the specimen, either from the description or plate, the more that the latter shows only the proximal portion of the horns. From the description one infers that they stand out at right angles to the skull, as Fischer says (p. 82):

Les cornes commencent par une ligne droite, qui, sensiblement allongée dans cette espèce, se dirige un peu en arrière. La courbure n'est sensible qu'à la pointe.

The following measurements are given in French feet and inches:

	Feet. Inches.
From occipital crest to base of nasals	1 $\frac{9}{12}$
Width between roots of horns	11 $\frac{0}{12}$
Width between outer part of orbits	1 $\frac{6}{12}$

Of a specimen from Volgda, Fischer says, "l'envergure a, en y conservant le peu de courbure, 3' 2" de France."

From this description, as well as from the measurements given, this Siberian species would seem to resemble *Bison antiquus* more nearly than any other.

Measurements of horn cores of Bison latifrons.

	Vertical diameter.	Transverse diameter.	Circumference at base.	Length along upper curve.	Length along lower curve.	Distance between tips.
	mm.	mm.	mm.	mm.	mm.	mm.
Type, Acad. Nat. Sci., Phila. ¹	160	175	532			
Cincinnati Soc. Nat. Hist.	146	166	520	784	810	1,775
<i>Bos arizonica</i> Blake	140	152	442	2050		2,1500
No. 1171, U.S.N.M. ¹	121	136	415			
No. 20706, British Museum			432			

¹ Incomplete; basal portion of horn core alone present.

² Estimated.

It may be said, in conclusion, that owing to various circumstances the writing of this paper has extended over two years, and that it was not published until six months after completion, so that it can not be claimed to have been prepared with undue haste. The question of individual

¹ Bulletin de la Société Impériale des Naturalistes de Moscou, Seconde Année, 1830, pp. 81-84, pl. II.

variation has been carefully considered in the light of extensive series of crania of *Bison bison*, and while the material on which the paper is based is confessedly scanty, yet the species herein enumerated are believed to be valid.

EXPLANATION OF PLATES.

NOTE.—The smaller divisions on the scale shown in some of the plates are centimeters, the larger are decimeters.

PLATE LXV.

Bison occidentalis Lucas.

Posterior view of the type, No. 4157, U.S.N.M., from Fort Yukon, Alaska.

PLATE LXVI.

Bison occidentalis Lucas.

Superior view of cranium from Gove County, Kansas, in the museum of the University of Kansas.

PLATE LXVII.

Bison antiquus Leidy.

Superior view of the type, a right-horn core, in the collection of the Academy of Natural Sciences, Philadelphia.

PLATE LXVIII.

Bison antiquus Leidy.

Posterior view of the type, a right-horn core, in the collection of the Academy of Natural Sciences, Philadelphia.

PLATE LXIX.

Bison antiquus Leidy.

Posterior view of a cranium from California, in the Academy of Natural Sciences, Philadelphia. Described by Rhoads as *Bison californicus*.

PLATE LXX.

Bison antiquus Leidy.

Superior view of the specimen shown on Plate LXIX.

PLATE LXXI.

Bison species.

Posterior view of a specimen of bison from Ilford, Sussex, England. Recorded in the catalogue of the British Museum as *Bison bonasus*, No. 45392.

PLATE LXXII.

Bison.

Superior view of specimen shown on Plate LXXI.

PLATE LXXIII.

Bison crassicornis Richardson.

Superior view of a specimen from Alaska; No. 1584, U.S.N.M.

PLATE LXXIV.

Bison crassicornis Richardson.

Posterior view of specimen shown on Plate LXXIII.

PLATE LXXV.

Bison crassicornis Richardson.

Superior view of a specimen from the tundra back of Point Barrow, Alaska; No. 13753, Museum of Archæology and Paleontology, University of Pennsylvania. This specimen is figured because it so nearly resembles the type of Richardson's *Bison crassicornis*.

PLATE LXXVI.

Bison crassicornis Richardson.

Superior view of cranium from Eschscholtz Bay, Alaska, figured by Richardson on Plate VII, fig. 3, Zoology of the Voyage of the *Herald*. No. 24589, Catalogue of the British Museum.

PLATE LXXVII.

Bison alleni Marsh.

Anterior view of left-horn core from the type No. 911, museum of Yale University.

PLATE LXXVIII.

Bison alleni Marsh.

Superior view of specimen shown on Plate LXXVII.

PLATE LXXIX.

Bison alleni Marsh.

Posterior view of specimen deposited by C. W. Greene in the museum of Stanford University.

PLATE LXXX.

Bison alleni Marsh.

Superior view of specimen shown on Plate LXXIX.

PLATE LXXXI.

Bison ferox Marsh.

Superior and posterior (?) views of the type specimen No. 910, museum of Yale University.

PLATE LXXXII.

Bison latifrons (Harlan).

Anterior and superior view of the horn cores in the collection of the Cincinnati Society of Natural History.

These have been carefully adjusted by Dr. Lindahl, as shown in this picture, with the result that they have more of an upward curve than in other published views. This has naturally slightly lessened the distance between the tips.

PLATE LXXXIII.

Left hand, smaller figure, a right metacarpal from Alaska, ascribed to *Bison crassicornis*, although possibly belonging to *B. occidentalis*; No. 1719, U.S.N.M. Right hand, larger figure, a right metacarpal from Peace Creek, Florida, ascribed to *Bison latifrons*; No. 1989, U.S.N.M.

PLATE LXXXIV.

Ovis scaphoceras (Cope).

Horn core from Nicaragua named *Bos scaphoceras* by Cope. From the specimen belonging to the School of Biology, University of Pennsylvania.





BISON OCCIDENTALIS LUCAS. Type.

FOR EXPLANATION OF PLATE SEE PAGE 770.





BISON OCCIDENTALIS LUCAS.

FOR EXPLANATION OF PLATE SEE PAGE 770.





BISON ANTIQUUS LEIDY. Type.

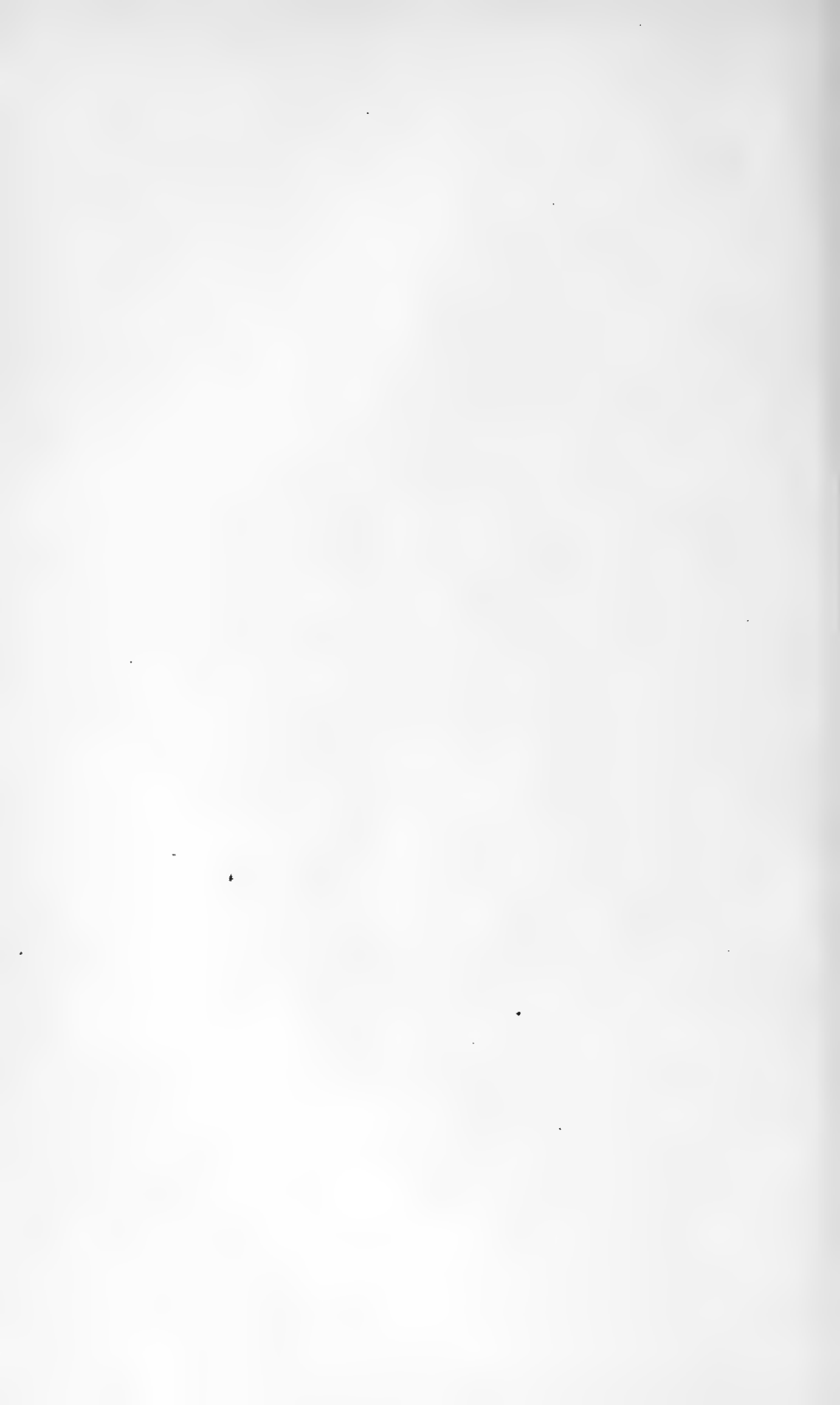
FOR EXPLANATION OF PLATE SEE PAGE 770.





BISON ANTIQUUS LEIDY. Type.

FOR EXPLANATION OF PLATE SEE PAGE 770.





BISON ANTIQUUS LEIDY.

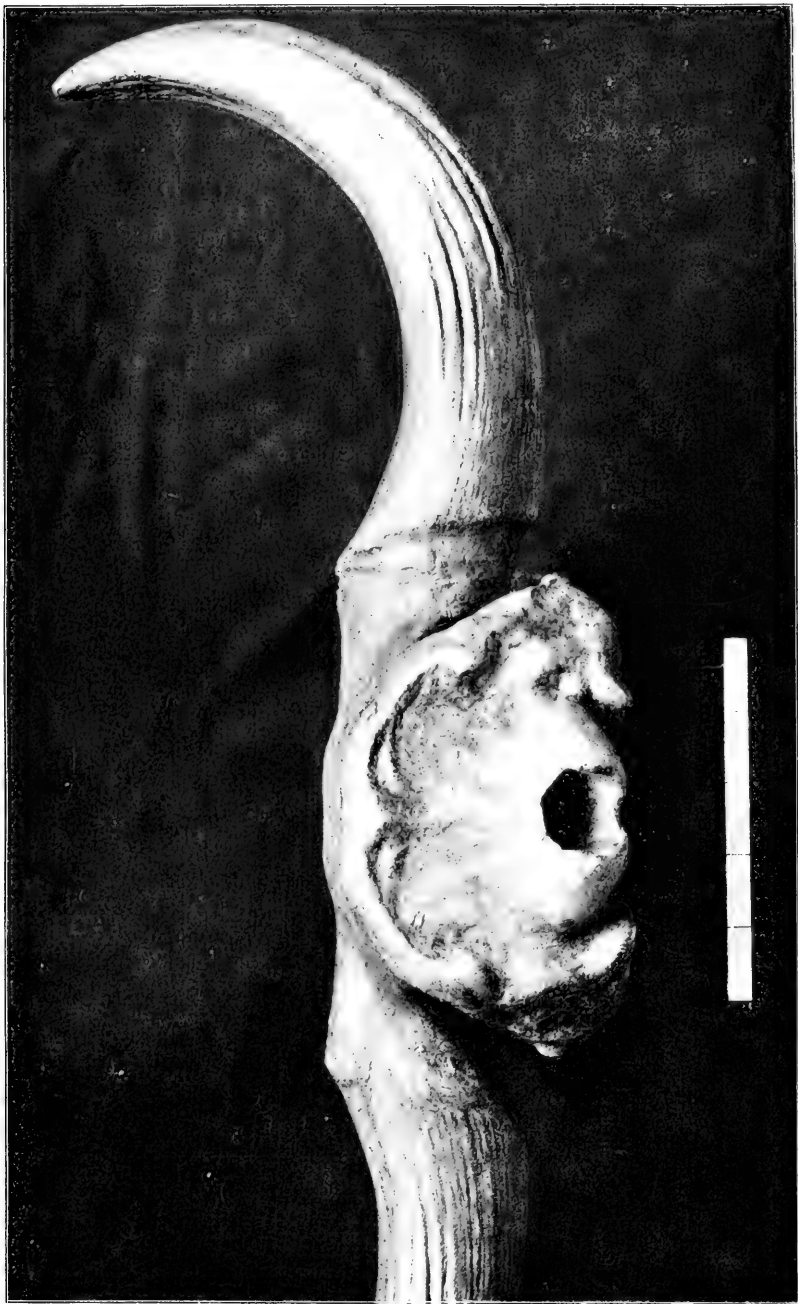
FOR EXPLANATION OF PLATE SEE PAGE 770.





BISON ANTIQUUS LEIDY.

FOR EXPLANATION OF PLATE SEE PAGE 770.



BISON.

Ilford, Sussex, England.

FOR EXPLANATION OF PLATE SEE PAGE 770.



BISON.

Ilford, Sussex, England.

FOR EXPLANATION OF PLATE SEE PAGE 770.





BISON CRASSICORNIS RICHARDSON.

FOR EXPLANATION OF PLATE SEE PAGE 770.





BISON CRASSICORNIS RICHARDSON.

FOR EXPLANATION OF PLATE SEE PAGE 770.

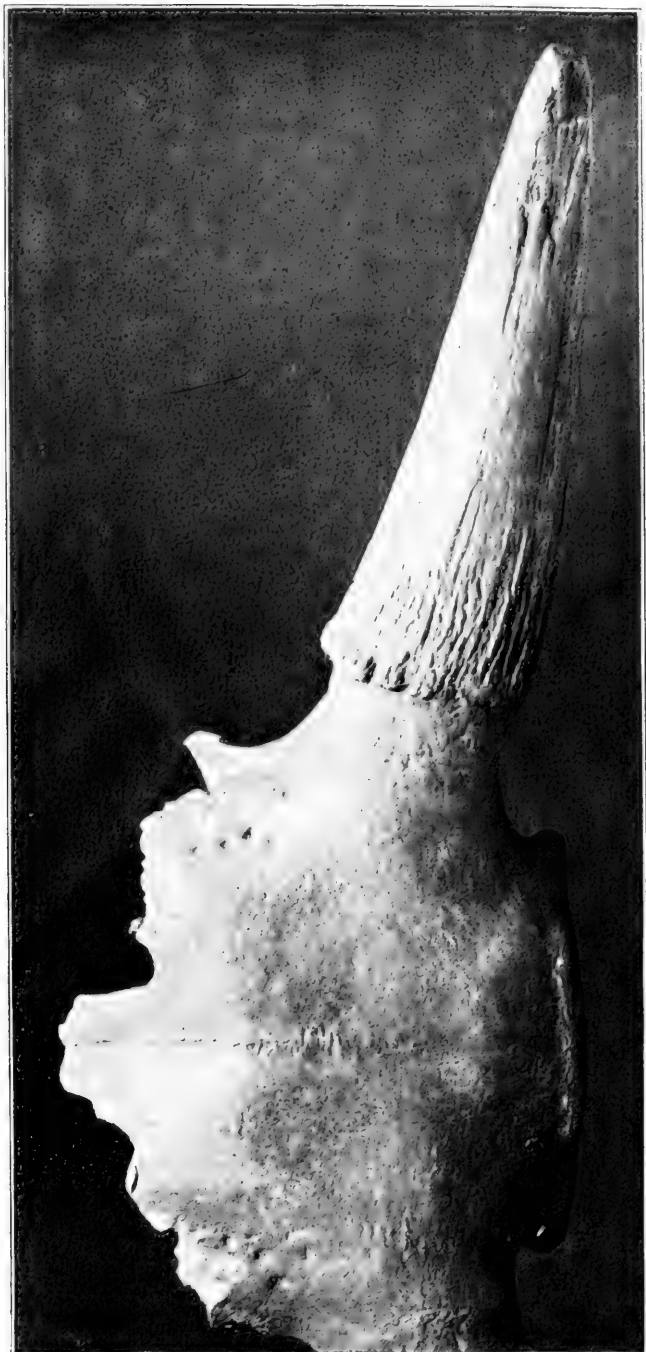




BISON CRASSICORNIS RICHARDSON.

FOR EXPLANATION OF PLATE SEE PAGE 771.





BISON CRASSICORNIS RICHARDSON.

FOR EXPLANATION OF PLATE SEE PAGE 771.





BISON ALLENI MARSH. Type.

FOR EXPLANATION OF PLATE SEE PAGE 771.



BISON ALLENI MARSH. Type.

FOR EXPLANATION OF PLATE SEE PAGE 771.





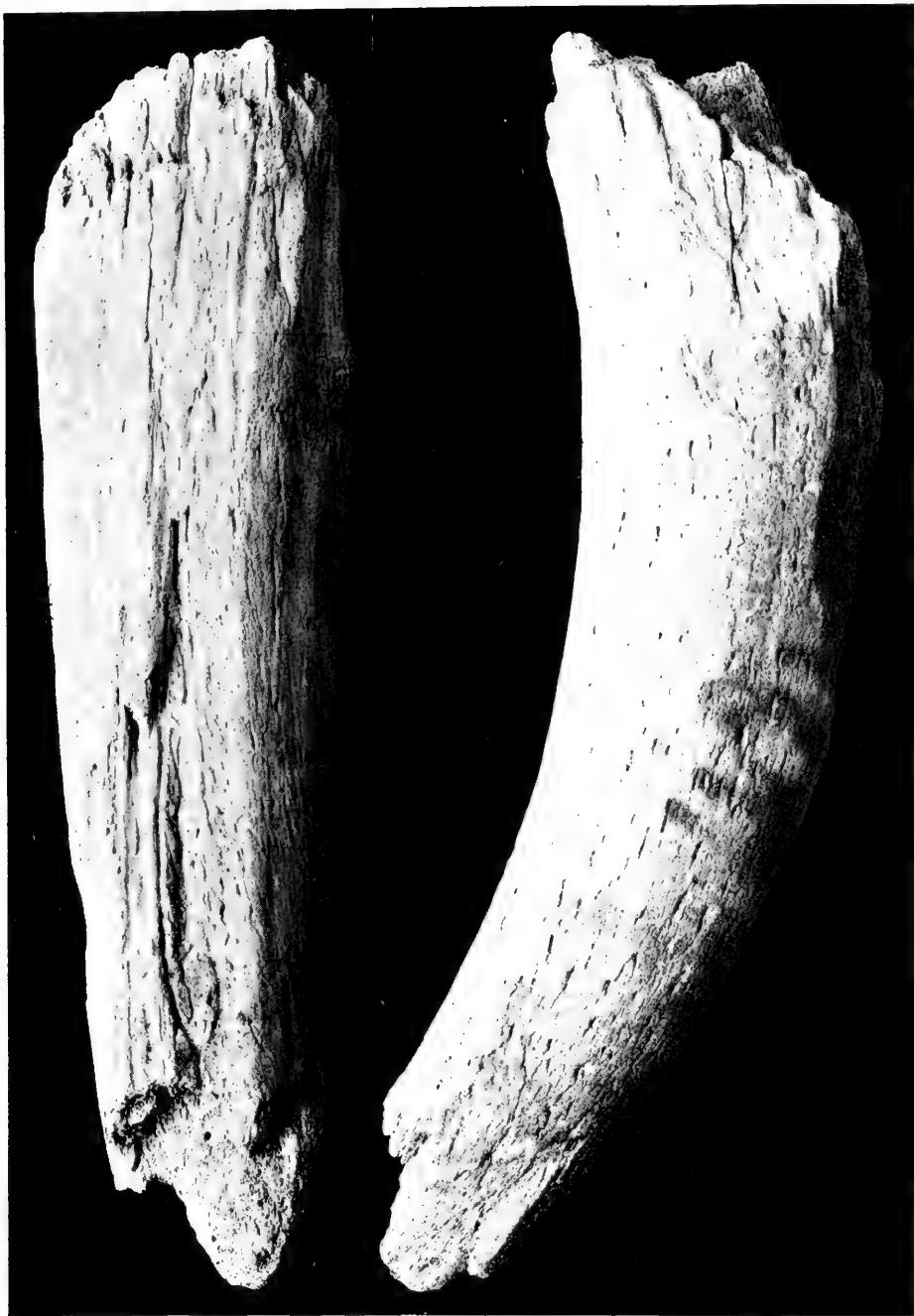
BISON ALLENI MARSH.

FOR EXPLANATION OF PLATE SEE PAGE 771.



BISON ALLENI MARSH.

FOR EXPLANATION OF PLATE SEE PAGE 771.



BISON FEROX MARSH. Type.

FOR EXPLANATION OF PLATE SEE PAGE 771.





BISON LATIFRONS (HARLAN).

FOR EXPLANATION OF PLATE SEE PAGE 771.





BISON CRASSICORNIS RICHARDSON.
BISON LATIFRONS (HARLAN).

FOR EXPLANATION OF PLATE SEE PAGE 771.





OVIS SCAPHOCERAS (COPE).

FOR EXPLANATION OF PLATE SEE PAGE 771.



PETROGRAPHIC REPORT ON ROCKS FROM THE UNITED STATES-MEXICO BOUNDARY.

By EDWIN C. E. LORD, Ph. D.

The material upon which this report is based was collected by Dr. E. A. Mearns, of the International Boundary Commission, and deposited by him in the U. S. National Museum.¹

The method used in collecting the rock specimens may be briefly described as follows:

Beginning at a point on the Rio Grande about 3 miles above El Paso, Texas, the line of survey extended across the continent, a distance of more than 725 miles, through a geologically unexplored country. At certain monument stations along the route special halts were made for the purpose of collecting and shipping specimens of scientific value. Only those monument stations, however, in the immediate vicinity of which petrographic material was obtained, have been given on the map.²

Owing to the rapid progress of the survey these halting places were frequently far apart and the geologic data obtained of a very fragmentary nature. In view of these facts it has been found necessary to treat the subject exclusively from a petrographical standpoint and describe the rock in petrographic groups without regard to their geological relationship.

The geographical order of occurrence, however, has been strictly maintained in each group, and the monument numbers (Mon. Nos.) attached to each locality can be readily found on the map. The specimen numbers appear in parentheses.

¹The specimens were accompanied by many field notes. These and a small scale map of the boundary line, prepared especially by Dr. Mearns, have been of great value to the author, who also wishes to express his indebtedness to Prof. G. P. Merrill, head curator department of geology, for the many privileges accorded him in the Museum.

²For more exact data concerning the topography of the country the reader is referred to the large scale (600000) topographic map of the boundary line soon to appear with the report of the commissioners under the auspices of the State Department.

CLASSIFICATION OF THE ROCK TYPES.

On preliminary examination many of the specimens were found too much decomposed to warrant the preparation of thin sections.

The comparatively fresh rock from which slides were made may be arranged under the following headings:

I. Intrusive rock.

- a. Granite.
- b. Gabbro-diorite.
- c. Uralite-diabase (proterobase).
- d. Diorite-porphyry.

II. Effusive rock.

- e. Rhyolite.
- f. Hornblende-mica-andesite.
- g. Augite-andesite and andesite-breccia.
- h. Basalt.

Under Group I are classified rock-types with a granitic-granular and holocrystalline-porphyritic structure.

Granite is composed chiefly of quartz, orthoclase, and biotite.

Gabbro-diorite consists principally of augite (diplage), green hornblende (uralite), biotite, and plagioclase.

Uralite-diabase has uralite and plagioclase as chief mineral constituents.

Diorite-porphyry contains plagioclase, hornblende, and quartz as chief ingredients.

Under Group II are united rock-types of porphyritic structure. They represent the effusive forms of granitic, dioritic, and gabbro magmas.

Rhyolite is made up of phenocrysts of sanidine, quartz, and biotite, in a holocrystalline or vitreous groundmass, and shows in some instances structural phenomena of special interest. (See pp. 777, 778.)

A peculiar development of this magma is seen in the spherulitic nodules from an obsidian flow near Aqua Dulce. (See pp. 778, 779.)

Hornblende-mica-andesite has essentially the same mineral constituents as diorite-porphyry without quartz.

Augite-andesite contains augite (diopside), plagioclase, and magnetite as chief ingredients.

Basalt is composed principally of olivine, augite, plagioclase, and magnetite. A rare instance of olivine occurring in two generations is observed in the basalt from Tule Mountains, Gila County, Arizona. (See p. 782.)

DESCRIPTION OF THE ROCK IN GROUPS.

I. INTRUSIVE ROCK.

a. *Granite*.—Nogales, Mon. No. 122 (No. 53266). La Osa, Pima County, Arizona, Mon. No. 140 (No. 53267). Pozo Verde, Sonora, Mexico, Mon. No. 141 (No. 53268). Quitobaquita, Sonoyta Valley, Arizona, Mon. No. 172 (No. 53269). Tenajas Altas, Gila Mountains, Yuma County, Arizona,

Mon. No. 191 (No. 53272). Colorado River, right bank, Yuma, Arizona, Mon. No. 206 (No. 53270). Gila Mountains at Gila City, Yuma County, Arizona, near Mon. No. 206 (No. 53271). Eastern base Coast Range, California, Mon. No. 224 (No. 53273).

The specimens of granite vary but slightly in structure and mineral composition.

These are, with one exception (No. 53273, original No. 513), coarse grained, and show in some instances evidence of excessive mechanical deformation (Nos. 53267, 53269, 53270, original Nos. 392, 433, 458) which is revealed by foliated structure (No. 53270) or by a system of rifting and the accompanying formation of a secondary quartz-mosaic (Nos. 53267, 53269, original Nos. 392, 433). They are characterized mineralogically by an extensive development of plagioclase, which occasionally equals in amount the orthoclase. Microcline is quite common in those specimens that have undergone mechanical crushing. Biotite is especially plentiful in specimen No. 53268 (original Nos. 404, 405) from Pozo Verde and No. 53273 (original No. 514) from the eastern base of the Coast Range. The latter rock contains also an occasional green hornblende. Quartz, orthoclase, and the accessory constituents muscovite, magnetite, apatite, zircon, and titanite (Nos. 53269, 53273, original Nos. 433, 514) are of normal development.

The plagioclase may be regarded as oligoclase with an average extinction angle of about 5° on pinacoidal cleavage plates. The crystals show the usual polysynthetic structure. In two sections (Nos. 53269, 53272, original Nos. 433, 482) feldspar individuals were observed, composed of an inner andesine core much decomposed, and extinguishing at an angle of 9° , and a perfectly fresh outer zone with the extinction angle of oligoclase (5°).

In many of the specimens of granite—notably Nos. 53267, 53268 (original Nos. 390, 398, 405)—decomposition by atmospheric agencies has reached an advanced stage. The feldspar is altered to kaolin and muscovite; the biotite to chlorite, epidote (No. 53268, original No. 395), and calcite, and the magnetite to leucoxene (No. 53271).

b. Gabbro-diorite.—Coast Range, California, Mon. No. 224 (No. 53274).

This is a peculiar coarse-grained rock composed of quartz and plagioclase, together with considerable biotite and diallage in about equal proportion. Accessory minerals are magnetite and apatite.

The most interesting feature disclosed by the microscope is the paramorphic alteration of diallage to green hornblende (uralite). This process of molecular readjustment has taken place without change in bulk or appreciably altering the contour of the original augite crystal. The secondary amphibole has a distinctly massive structure in contrast to the commonly fibrous character of uralite, but shows the usual crystallographic orientation in regard to the parent mineral. On sections approximately parallel the plane of symmetry (the angle $\epsilon:c$) measures about 40° for the augite and 18° for the inclosing hornblende.

This process of uralitization has progressed to such an extent that in many instances the original pyroxene has entirely disappeared.

The plagioclase of the gabbro-diorite is tabular formed after M (010), but usually of irregular crystal outline and striated by polysynthetic twinning lamellæ. Sections parallel (010) show a maximum extinction of 16° , which corresponds with that of basic andesine.

c. *Uralite-diabase* (proterobase).—Pozo Verde, "El Banorie," Sonora, Mexico, Mon. No. 141 (No. 53276).

The specimens vary in color from grayish green (No. 53276, original Nos. 401, 415) to a dark green (No. 414). They are characterized macroscopically by an outspoken even granular structure. Under the microscope a panidiomorphic development of the rock constituents is apparent, although the original structure is considerably obscured by excessive chloritization and uralitization. Mineralogically the rock consists of green hornblende, lath-shaped labradorite, magnetite, quartz (No. 415), and apatite, besides the secondary products chlorite, epidote, muscovite, and calcite. In slide (No. 415) the ferro magnesian constituents are completely altered to chlorite and epidote.

The hornblende of the proterobase has the physical properties of uralite, and appears to be an alteration product from a preexisting monoclinic pyroxene, retaining generally the crystal form of the parent mineral (No. 414).

The plagioclase crystals of this rock are extended in the direction of \hat{a} , and are usually twinned after the albite law. On M section α forms an angle of about 20° with the principal sections of the nicols. Decomposition products are muscovite, kaolin, and a colorless low double-refracting mineral surrounding the altered labradorite crystals, and resembling an outer zone of secondary enlargement. This mineral, however, is uniaxial, optically positive, and extinguishes parallel with the sides of the feldspar crystal (No. 414). It is insoluble in dilute hydrochloric acid, and can be nothing else than quartz.

d. *Diorite-porphry*.—La Osa, Pima County, Arizona, Mon. No. 140 (No. 53275).

The specimen represents a coarse grained porphyritic rock, containing abundant phenocrysts of plagioclase, green amphibole, biotite, quartz, and magnetite. The groundmass reveals upon microscopic investigation a similar mineral aggregation with a preponderance of quartz and feldspar.

The hornblende crystals are of prismatic development and frequently twinned after (100). They show strong pleochroism—dark green parallel β and γ , yellowish green parallel α —and an average extinction angle on (100) of 17° .

The plagioclase is tabular formed after M (010), and, apart from a well-defined zonal structure and a more perfect crystal outline, resembles the feldspar of the gabbro-diorite very closely. The crystals are, however, far from fresh; being extensively altered to muscovite and kaolin.

The biotite of the diorite-porphry is in a highly altered condition, in contrast to the remarkably fresh hornblende; the crystals are in many cases completely replaced by chlorite and epidote.

e. Rhyolite.—Fifty-eight miles west of the Rio Grande on parallel 31° 47' at Mon. No. 19 (No. 53277). Six miles west of Lake Palomas, Mexico, Mon. No. 20 (No. 53278). Carrizallilo Mountains, south of Carrizallilo Springs, New Mexico, Mon. No. 33 (No. 53279). South of Dog Spring, Dog Mountains, Mon. No. 55 (No. 53280). West side of San Luis Mountains, Mon. No. 73 (No. 53281). San Bernardino River, Mon. No. 77 (No. 53282). Nogales, Mon. No. 122 (No. 53283). Warsaw Mills, Pima County, Arizona, Mon. No. 132 (No. 53284). Pozo Verde, "El Banorie," Sonora, Mexico, Mon. No. 141 (No. 53285). Sierra Moreno, Pima County, Arizona, Mon. No. 146 (No. 53286). Aqua Dulce Creek, Mon. No. 172 (No. 53287.)

The specimens of rhyolite vary in character from a pitchy black obsidian (Nos. 53281, 53287, original Nos. 338, 483) to a light gray porphyritic rock with holocrystalline groundmass (Nos. 53278, 53279, 53280, 53283, 53284, 53285, 53286, original Nos. 150, 168, 314, 370, 389, 396, 412, 419, 432). Intermediate types showing microscopically a felsitic (No. 53277, original No. 133), spherulitic (Nos. 53279, 53282, original Nos. 170, 343), or glassy groundmass (Nos. 53277, 53280, original Nos. 129, 136, 137, 312) are not uncommon.

The holocrystalline variety is the more common and consists mineralogically of orthoclase, quartz, plagioclase, biotite, and magnetite of intratelluric origin, and a groundmass of cryptocrystalline quartz and feldspar, through which are scattered minute particles of biotite and magnetite. Many specimens bear evidence of a preexisting residual glass-base, now completely devitrified. The products of devitrification are either quartz (Nos. 150, 314, 412, 419, 432), or quartz accompanied by chalcedony (Nos. 53277, 53279, 53280, original Nos. 136, 167, 168, 170, 312, 315). Opal occurs in specimens Nos. 129 and 137. In many instances the mica constituent of the rhyolite is completely decomposed (Nos. 396, 412, 419, 432).

Amygdaloidal types are highly colored by infiltrated limonite (Nos. 136, 168, 170, 315).

A mineralogical peculiarity of the rock from the region about Mon. No. 19 (Nos. 129, 133, 136, 137), Lake Palomas (No. 150), and from the Dog Mountains, Mon. No. 55 (Nos. 312, 314, 315) is the abundance of triclinic feldspar (andesine) among the porphyritic constituents. In some instances it occurs in sufficient quantity to render the determination of the rock as dacite permissible.

A holocrystalline rhyolite from Nogales, Mon. No. 122 (No. 370), contains among the phenocrysts large grains of brown tourmaline with strong absorption —O > E.

The successive stages of crystal development from a vitreous obsidian (No. 183) to a spherulitic rhyolite (No. 343) are beautifully illustrated in specimens Nos. 483, 338, 133, 343. No. 483 represents a homogene-

ous, pitchy-black rock glass with conchoidal fracture and without crystal development of any kind. No. 338 is dark steel-gray pitchstone with greasy luster, even fracture, and microperlitic-soudering. In this rock the first evidences of crystallization are seen in parallel, yellowish-brown bands of microfelsite and in other minute crystallitic forms, including some small spherulites. No. 133 is a light-gray banded pitchstone porphyry, consisting of a groundmass of glass and microfelsite in about equal proportion, and a few small phenocrysts of quartz, feldspar, and mica.

No. 343 is a light gray, beautifully banded rhyolite, differing from No. 133 in the holocrystalline, spherulitic condition of the groundmass.

The spherulites of this rock are about one-tenth of a millimeter in diameter, very symmetrical in form, and arranged in approximately parallel lines. They are separated by micropoikilitic areas of quartz and feldspar, containing minute crystals of magnetite and biotite, and by bands of microfelsite, which give the rock its characteristic banded structure.

The spherulites are very dense and are made up of radiating fibers of an optically-negative feldspar elongated parallel \bar{a} ; thus differing from those found in the compound spherulites from Aqua Dulce (No. 53285, original No. 483) (see p. 779), which are uniformly positive in longest dimension. This fibrous feldspar is not always confined to the spherulitic bodies, but extends frequently into the adjoining poikilitic areas, and there assumes the form of well-developed radiating crystals with extinction angles of 10° to 12° .

This relatively large angle is characteristic of soda orthoclase.

Quartz could not be directly determined in the spherulites, but on examination between crossed nicols, however, an anomalous divergence in the arms of the dark cross would suggest its presence. Streams of dark crystallitic grains, presumably magnetite, follow the general parallel structure of the rock only deviating from their course to avoid phenocrysts and some spherulitic forms containing feldspar nuclei.

Peculiar spherulitic nodules are found in the obsidian flows (No. 53285) which, alternating with sheets of rhyolite, form a high bluff on the right bank of Aqua Dulce Creek close to the United States border.

These nodular masses are thick-lenticular in shape, and with their irregular botryoidal surfaces bear some resemblance to full-blown roses. Some forms are more spherical with less uneven surfaces and are not unlike tulip bulbs.

The spherulites are of a brown terra-cotta color and vary from 1 to $2\frac{1}{2}$ inches in greater diameter. They occur singly or in groups and always with ribbed or net-veined surfaces. These veins consist of secondary quartz which has filled shrinkage cracks in the nodules and now stands out in considerable relief. In thin sections it is evident that these nodules, although apparently homogeneous in mineral composition are structurally extremely complex. They are made up of an intricate intergrowth of brown, finely fibrous spherulites composing the botry-

oidal surface forms and a bluish gray, more coarsely crystalline rock mass confined chiefly to the interior portion of the nodule, and consisting of fine prismatic crystals of orthoclase, allotriomorphic quartz, and minute particles of magnetite and biotite. These feldspar needles are optically positive and elongated parallel \hat{c} , with symmetrical position of the plane of optical axes. They show weak double refraction and extinguish at an angle of not more than 5° , and have either a divergent fibrous structure, with at times a slight tendency to fluidal arrangement, or are intergrown poikilitically with quartz, as was the case in the coarser grained areas of the rhyolite from the San Bernardino River (No. 343) (p. 778).

The denser spherulitic aggregates forming the surface of the nodules consist principally of optically positive feldspar fibers with a few films of biotite; quartz, if present, is too finely distributed to be recognized by optical tests.

Owing to unequal development in different directions these denser portions of the nodules assume all manner of irregular discoidal and plume-like forms, frequently overlapping and interpenetrating in such a manner as to render it difficult to determine where one ceases and the one adjoining begins.

The brown color of the nodules is due to the oxidation of trichites and minute ferritic particles that intersect them in parallel lines regardless of their complex inner structure.

The chemical composition of these peculiar types of compound spherulites is given under Analysis No. I, and differs not essentially from that of the dark blue spherulites from Obsidian Cliff as given by Iddings¹ (No. II). They contain somewhat less SiO_2 and more Fe_2O_3 .

Analysis of spherulites.

Constituents.	No. I.	No. II.
SiO_2	74.75	76.70
Al_2O_3	12.01	12.30
Fe_2O_3	3.72	1.43
CaO} .....	.54	.39
Na_2O	4.02	3.89
K_2O	4.73	4.73
Ign .....	.52	.66
Total	100.29	100.10

f. Hornblende-mica-andesite.—Fifty-eight miles west of the Rio Grande River, Mon. No. 19 (No. 53288). Corner Mon. Apache Mountains, Mon. No. 40 (No. 53289). Dog Spring, Dog Mountains, Mon. No. 55 (No. 53290). Tule Mountains, Mon. No. 186 (No. 53291). San Isidro Ranch, north of Signal Mountain, Mon. No. 224 (No. 53292). Coast Range, Mon. No. 224 (No. 53293).

These are fine-grained porphyritic rock types, varying in color from steel gray to reddish brown according to the state of preservation.

¹ J. P. Iddings, Obsidian Cliff, Yellowstone National Park, Seventh Ann. Rept. U. S. Geol. Surv., III, 1885-86, p. 282.

Macroscopically phenocrysts of plagioclase, hornblende, and biotite are, in most cases, easily recognizable in a dense aphanitic groundmass.

Under the microscope this groundmass resolves itself into a finely felted mass of delicate hornblende needles, plagioclase laths, and minute grains of magnetite (No. 53288, original No. 127).

The porphyritic plagioclase crystals are tabular formed after M (010) and are almost rectangular in cross sections. They show characteristic albite twinning and many individuals are frequently united in accordance with the carlsbad law. Judging by an extinction angle on M (010) sections of 15° , they are acid labradorites. Zonal structure is not uncommon. The crystals consist of a corroded inner core of more basic feldspar and an outer shell of acid labradorite. The inner portion is heavily charged with rock glass and extinguishes at a considerably larger angle than the homogeneous outer zone (No. 127).

The hornblende phenocrysts of the andesite are distinctly prismatic in habit, showing the prism faces (110) combined with the clinopinacoid (010). Twinning parallel (100) is quite frequent. The crystals have a brownish-green color and are strongly pleochroitic: α greenish yellow, β yellowish brown, γ greenish brown. The angle of extinction, measured on prismatic sections, is small: the angle ϵ : γ = about 12° .

This mineral is one of the first to undergo decomposition. It is replaced in most sections by limonite and chlorite, or by epidote (No. 53293, original No. 506).

Biotite occurs in the form of yellowish-brown, hexagonal plates with strong pleochroism in the rock from the vicinity of Mon. No. 19 (Nos. 127, 142). It is, however, usually altered to magnetite (Nos. 53289, 53291, original Nos. 157, 467) or chlorite (No. 53291, original No. 464).

Small, purplish brown, prismatic crystals of apatite with strong absorption ($E > O$) are very plentiful in slide No. 127 from Mon. No. 19.

Magnetite is of normal development.

The delicate network of the andesite groundmass is in many cases greatly obscured by the infiltration of secondary quartz and limonite (Nos. 53288, 53292, 53293, original Nos. 126, 492, 506), and calcite (Nos. 53289, 53291, 53293, original Nos. 157, 464, 465, 508).

Chalcedony occurs abundantly in rifts formed in the rock from Dog Springs (No. 53290).

g. Augite-andesite.—Six miles west of Lake Palomas, Mexico, Mon. No. 20 (No. 53294). San Clemente Island, Pacific Ocean, Mon. No. 258 (No. 53295).

The specimens of augite-andesite are dark brown in color, being considerably weathered. They differ from the rock just described in the vitreous condition of the groundmass and by the presence of augite in place of hornblende and mica.

Augite occurs both in the groundmass and among the porphyritic constituents. It is pale yellowish green in color and has the large extinction angle common to this mineral: the angle ϵ : γ = 47° . The

products of atmospheric weathering are similar to those of the hornblende. In an extremely vesicular specimen (No. 53294, individual No. 153) the amygdaloid cavities were partially filled by chalcedony and cryptocrystalline quartz.

The glassy andesite from San Clemente Island (No. 53295, original No. 515) is peculiar in that it contains abundant phenocrysts of enstatite. The groundmass of this rock consists of a brown andesitic glass filled with microlitic grains of augite and magnetite and minute lath-shaped plagioclase crystals.

The enstatite is of prismatic form and perfectly colorless and shows the effect of extensive magmatic corrosion. The crystals are surrounded by a resorption rim of light-green augite grains similar to those of the groundmass. These grains are frequently somewhat elongated and have a tendency to radial arrangement around the core of the parental mineral.

Inclusions of glass are very frequent in the phenocrysts of this rock.

Two types of andesitic breccia (No. 53296, original Nos. 495, 520) may be mentioned here. One from San Diego, Mon. No. 258 (No. 495), a highly altered volcanic arkose, is extremely rich in chlorite, epidote, chalcedony, and secondary biotite; the other, from San Clemente Island, Mon. No. 258 (No. 520), consists of fresh fragments of andesite, scoriaceous basalt, and vitreous rhyolite cemented together by coarse granular calcite.

h. Basalt.—Fifty miles west of the Rio Grande River, Mon. No. 15 (No. 53297). San Bernardino River, Mon. No. 77 (No. 53298). Nogales, Mon. No. 122 (No. 53302). Pozo Verde, "El Banorie," Sonora, Mexico, Mon. No. 140 (No. 53299). Quitobaquita, Sonoyta Valley, Arizona, Mon. No. 172 (No. 53300). Tule Mountains, Arizona, Mon. No. 186 (No. 53303). Tucson, Arizona, 60 miles north of Mon. No. 122 (Nos. 53301, 53304).

Two distinct types of basalt are represented. One a scoriaceous, andesitic variety, rich in feldspar and poor in olivine; the other a normal holocrystalline rock, with a preponderance of olivine and augite.

The specimens vary in color from dark steel gray (Nos. 53297, 53298, 53299, 53300, 53301, original Nos. 56, 346, 426, 449, 533); to a brownish red (No. 439); intermediate shades being brown (Nos. 53299, 53303, 53301, 53304, original Nos. 406, 473, 529, 531) or yellowish brown (No. 53302, original No. 364) according to the state of preservation.

The andesitic type is by far the more common (Nos. 56, 346, 406, 426, 439, 449, 529, 533). It is identical mineralogically and structurally with the young Tertiary basalts from the Snake River Valley and Great Basin of the West and requires but a brief description. The dark-gray, sometimes almost black, color of the rock is due to the vitreous groundmass, consisting of an opaque, finely granulated glass-base, rich in skeleton crystals of magnetite, lath-shaped labradorite, and granular augite. The porphyritic constituents are tabular-formed labradorite, prismatic augite, olivine, and magnetite.

The labradorite phenocrysts have on M (010) faces an extinction angle of from 20° to 22° , and are consequently somewhat more basic than those of the andesite.

The amount of feldspar varies considerably in the different specimens of this rock. It decreases, apparently, in proportion to an increase in the ferro-magnesian constituents.

Olivine occurs in beautiful idiomorphic crystals showing very distinctly the combination of prism (110) with an acute brachydome (021) and the brachypinacoid (010). Inclusions of magnetite, augite, and rock glass are frequent.

The olivine is often colored yellowish brown by limonite, which, with serpentine, form its chief decomposition product.

Augite, magnetite, and apatite are analogous to those of the andesite.

Normal olivine-basalt is represented by Nos. 53302, 53303, and 53304.

The difference between this and the foregoing type lies principally in the holocrystalline development of the groundmass, which contains besides labradorite, augite, and magnetite, a large amount of small, idiomorphic olivine crystals (No. 53303).

The porphyritic constituents consist chiefly of olivine with a few scattering crystals of augite, labradorite, and magnetite (No. 53302).

The olivine of both generations, especially those of the groundmass, are yellowish brown, being strongly impregnated with limonite; from which it would appear that they belong to a ferruginous variety.

Exogeneous inclusions of slightly fused sandstone are of rather frequent occurrence in the scoriaceous andesitic basalt from Mon. No. 15 (No. 53297).

From what has been said it is seen that the rock types encountered by the survey vary from an old, in part highly metamorphosed, granite to the most recent form of basaltic lava. A detailed mapping of the geology of the boundary line on the scale of the topographic map already referred to is much to be desired and would lead undoubtedly to many interesting results concerning the geological relationship of the igneous rock of the southwestern border of the United States.

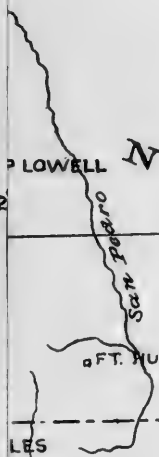
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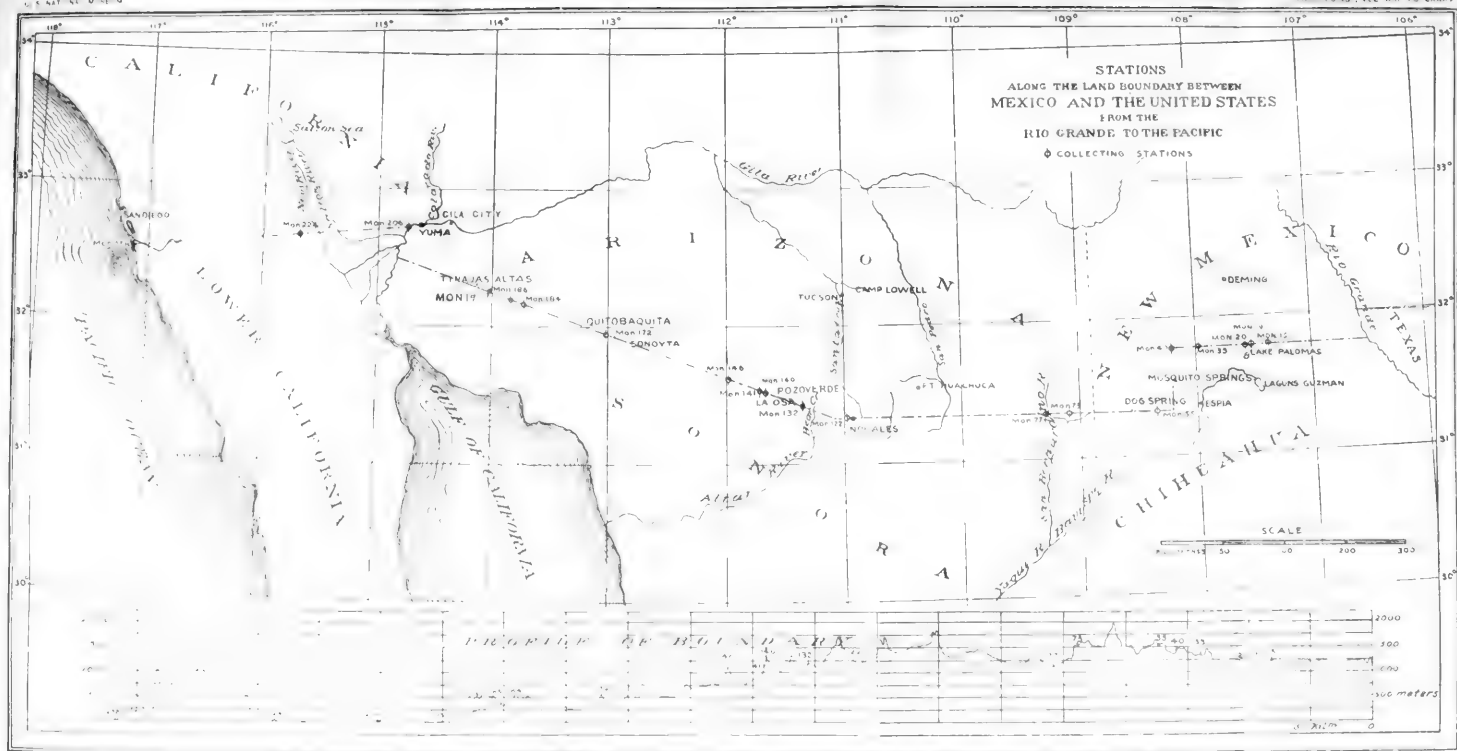
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THE LAND REPTILES OF THE HAWAIIAN ISLANDS.

By LEONHARD STEJNEGER,
Curator, Division of Reptiles and Batrachians.

Specimens of all the species of land reptiles known to inhabit the Hawaiian Islands have recently been added to the collection of the U. S. National Museum chiefly through the efforts of the late Mr. V. Knudsen, of Kauai, Mr. R. Meyer, of Molokai, and Mr. H. W. Henshaw, of Hawaii, who have kindly furnished me with a large amount of material. As no collected account of this branch of the Hawaiian fauna has ever been published, I have thought it proper to treat the subject somewhat fully and to add descriptions and figures so that residents, as well as visitors, may be able to identify reptiles they may meet without being obliged to refer to the widely scattered literature. For the sake of completeness I have added the synonyms of each species with citations of the principal herpetological works, as well as other bibliographical references, so far as they relate to specimens from the Hawaiian Islands. These citations have been personally verified by me in all cases in which the page reference is not included in parenthesis or omitted.

List of species occurring in the Hawaiian Islands.

Family Gekkonidæ:	Page.
<i>Lepidodactylus lugubris</i>	788
<i>Hemidactylus garnotii</i>	792
<i>Peropus utilatus</i>	796
<i>Hemiphyllodactylus leucostictus</i>	800
Family Scinidæ:	
<i>Leiopisma noctua</i>	805
<i>Emoia cyanura</i>	807
<i>Ablepharus boutonii pacilopleurus</i>	811

It is quite significant that there are no true land reptiles in the Hawaiian Archipelago other than a few species of lizards, and particularly that all the species known to occur there belong to the cosmopolitan families, the geckos and the skinks. It is further to be observed that all three skinks and three of the four species of geckos belong to species widely distributed over the Indo-Polynesian island world, and,

finally, that the remaining gecko has close relatives in New Caledonia, Java, Sumatra, and Ceylon.

This distribution does not sustain the theory of a once continuous land connection between the various island groups. On the contrary, the limited number and wide range of this fauna go to show that at the time of immigration the Hawaiian Islands, at least, were separated, and probably widely so, from whatever land masses may have connected other islands at that time or earlier.

If the meteorologic and hydrographic conditions at that time were anything like what they are at present, it is not likely that these frail land vertebrates were distributed over thousands of miles of ocean by ordinary means. Currents and wind would have prevented their distribution, and such obstacles which have appeared to some authors so formidable as to make them dubious concerning the western origin of the Polynesian navigators themselves seem insurmountable for small land vertebrates incapable of flight.

It is a well-known fact, however, that these small lizards are easily transported in vessels and among household goods over great distances, and when looking for the means by which these animals may have reached the Hawaiian Islands it is not possible to escape the conclusion that they have been introduced by man's agency. From the circumstances that the true home of these lizards is to the south and west of Hawaii; that nearly all the species were collected there as early as the visit of the United States Exploring Expedition under Wilkes; and that the species are more or less common on the principal islands of the Hawaiian group;¹ from these circumstances it is permissible to conclude that the lizards immigrated to the islands with the ancestors of the Hawaiians.

A greater antiquity in the islands can hardly be assigned to them, for if their immigration was anywhere near concomitant with the first appearance, for instance, of the ancestors of the Drepanidine birds now living there, it is scarcely credible that they would not have become more differentiated. The fact that specimens identical with *Hemiphyllodactylus leucostictus* have thus far not been found outside the Hawaiian Islands does not prove anything to the contrary, partly because it is possible that they may be found in some of the as yet but little explored archipelagoes to the west and south, and partly because the differences which distinguish this gecko from its nearest allies are so slight that it is conceivable that they may have been evolved since the advent of man in the islands.

At the present stage of our knowledge the distribution of these animals throws very little light upon the question by which route they and man—if it be true that they accompanied him—reached the archipelago.

¹ Thus far, specimens have only been collected in Hawaii, Molokai, Oahu, and Kauai; but there is no reason to believe that they are not also to be found on the intervening islands.

It should be added, however, that a better and more detailed knowledge of all the forms inhabiting Polynesia might give better results. Not until specimens from all the groups have been brought together in sufficient numbers will it be possible to affirm with certainty that these widely distributed species have not differentiated into local forms by which, however slight the characters, it might become possible to trace their evolution and incidentally their migrations.

The only point which can be claimed with certainty is that they came from the west. One or two of the species, it is true, have also been found in a few localities in America, but their distribution here is purely local and, no doubt, is due to introduction by man, much in the same way as they reached the Hawaiian Islands, though probably much later. If, then, it be true that these lizards have accompanied the Polynesians in their migrations, the conclusions to be drawn add to the mass of evidence available against any theory of their having originated in America, though this addition may perhaps be superfluous at the present day.

I am not aware of records of any of the marine snakes having been taken at the Hawaiian Islands. Some are known to occur as far east as the Society Islands; but the only surprising feature is that *Hydruis platurus*, which is recorded from Japan, Tahiti, and the west coast of Mexico, has not been found in Hawaiian waters, at least occasionally.

The marine turtles living in the seas surrounding the Hawaiian Archipelago and breeding on some of its outlying islets are, as yet, too imperfectly known to make it profitable to discuss them on the present occasion, hence the limitation of this paper to the terrestrial reptiles of the islands.

There are no indigenous batrachians in the Hawaiian Islands notwithstanding the oft-repeated assertion that a toad, the so-called *Bufo dialophus* Cope, occurs there.¹ Cope himself has acknowledged his double error, both in regard to the specific distinctness of the specimen upon which the description was based and the habitat alleged.² It was in fact a specimen of *Bufo quercicus* Holbrook, from eastern North America.

Batrachians have been introduced intentionally, however, during recent years. Frogs and toads are said to have been brought from China and Japan, as well as from America, in order to assist in the fight against the mosquitoes.

¹ The latest author to repeat this statement is Beddard in his Text-book of Zoogeography (1895), p. 147, footnote. On page 77 of the same work he attributes this same species to the Fiji Islands.

² "The redescription of the species by myself was due to the omission of its characteristic peculiarities from extant writings. The erroneous locality (Sandwich Islands) is one of several such errors, based on the incorrect labelling" . . . Cope, Man. N. Am. Batr., 1889, p. 292.

Order SQUAMATA.

Suborder SAURL.

The lizards occurring in the Hawaiian Islands belong to two different families, and may be distinguished as follows:

- a*¹ No large symmetrical shields on top of head; body covered with small granules or minute scales; digits dilated; pupil vertical (fig. 7) GEKKONIDÆ, p. 786
*a*² Top of head with large symmetrical shields; body scales large, cycloid; digits not dilated; pupil round (fig. 11) SCINCIDÆ, p. 803

Family GEKKONIDÆ.

THE GECKOS.

Four species, belonging to four genera, are known from the Hawaiian Islands. All are rather closely related and are very much alike in general appearance. In identifying them strict attention must be paid to the structural characters as given below. The four species may be distinguished as follows:

- a*¹ Compressed distal phalanx of digits adhering to the dilated portion and extending somewhat beyond it, but not rising angularly from within the edge (fig. 1).....*Lepidodactylus lugubris*, p. 788
- a*² Compressed distal phalanx of digits free, rising angularly from within the edge of the dilated portion (fig. 2).
- b*¹ Inner digits with distal phalanx compressed and clawed (fig. 3).
Hemidactylus garnotii, p. 792
- b*² Inner digits without a distal compressed and clawed phalanx.
- c*¹ Chin-shields large (fig. 5); a series of transverse plates under the tail.
Peropus mutilatus, p. 796
- c*² Chin-shields not differentiated (fig. 6); no transverse plates under the tail.
Hemiphyllodactylus leucostictus, p. 800

Each of the four species has its own peculiar characteristic, which makes their exact identification comparatively easy, namely:

Hemidactylus garnotii, a well-developed raised terminal joint on the inner digit;

Lepidodactylus lugubris, the terminal joint of the digits adhering to the disk, not raised up from it;

Peropus mutilatus, the peculiar pattern of the chin-shields, shown in fig. 5 (p. 797);

Hemiphyllodactylus leucostictus, the elongated body and short cylindrical tail.

Comparative table of dimensions.

Species.	Total length.	Snout to vent.	Vent to tip of tail.	Snout to ear.	Width of head.	Fore limb.	Hind limb.	Axilla to groin
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
<i>L. lugubris</i>	85	38	47	9.5	8	11	14	18
<i>H. garnotii</i>	114	50	64	13	8	14	21	21
<i>P. mutilatus</i>	95	46	49	12	9	12	16	21
<i>H. leucostictus</i>	67	38	29	8	5.5	8	13	20

The most striking difference in the proportions is shown by *H. leucostictus*, in which the (nonreproduced) tail is considerably shorter than head and body, while in the other species it is longer.

One of the peculiarities of most geckos is the facility with which their tail breaks off and is again reproduced. It is not uncommon for them, if caught by the tail, to wriggle themselves away from that organ, which is thus left in the hands of the captor. A new tail soon grows out again, but of a different shape and more or less different scale covering than in the original, being usually shorter, broader at base, and often devoid of such specialized structures as spines, plates, and denticulations along the edges. In comparing specimens and descriptions it is therefore essential to observe whether the tail is an original or a reproduced one. Duplication of species has often resulted from this rule not having been observed.

The geckos to a great extent are crepuscular and nocturnal in their habits, coming out at night from their hiding places to hunt for insects. They are found not only on trees and among the vegetation generally, but commonly take up their abode in and near human habitations being particularly frequent about verandas and outhouses. All four species occurring in the Hawaiian Islands are thus found in houses though possibly in different proportion. Mr. Knudsen, when collecting them for me, kept those obtained in the same place together in the same bottle, and in the one containing the lizards caught in the house there were 6 *Hemidactylus garnotii*, 3 *Peropus mutilatus*, 2 *Lepidodactylus lugubris*, and 1 *Hemiphyllodactylus leucostictus*. He adds that they are "never found inside good houses," but only in "thatched and open houses." However that may be in *Kauai*, Mr. E. P. Church, in a letter to Prof. A. A. Wright, of Oberlin College, about the geckos in Honolulu writes expressly as follows:

The lizards live in the best of houses, and are not seriously objected to by the most excellent housekeepers. They remain behind the mirrors, pictures, etc., in the daytime in the best of parlors. At nightfall they come out from their concealment and call to their fellows with a little chirping noise that can be heard across good-sized rooms. They run about on the walls and ceiling catching flies and mosquitos. This renders them somewhat welcome inmates of human dwellings. It is easy to catch them as their powers of locomotion are not great.

It would be very interesting to know, however, whether the geckos in the Hawaiian houses during the time of their concealment keep apart in different localities like those of India observed by Colonel Tytler, who says:

As a general rule they keep separate and aloof from each other; for instance, in a house the dark cellars may be the resort of one species, the roof of another, and crevices of the walls may be exclusively occupied by a third species. However, at night they issue forth in quest of insects, and may be found mixed up together in the same spot; but on the slightest disturbance, or when they have done feeding, they return hurriedly to their particular hiding places.

On each side of the neck behind the ear-opening there may be seen

in many geckos a more or less enlarged oblong swelling which, in large specimens, often assumes great dimensions—equalling one-half the size of the skull. This is a sac filled with calcareous matter, which is connected with the ear by ducts or canals. Professor Wiedersheimer, who was the first to describe this organ in detail, considers it an auxiliary to the auditory apparatus, having as its object the perfecting of the sense of hearing in the animals. These calcareous masses are popularly, but erroneously, believed to be the undeveloped eggs which the females are supposed to carry about in a sort of pouch until they are deposited in some safe place for hatching.

The geckos, with very few exceptions, seem to be oviparous, the eggs being spherical and covered with a white, hard shell.

LEPIDODACTYLUS¹ Fitzinger.

1843.—*Lepidodactylus* FITZINGER, Syst. Rept., p. 98 (type, *L. lugubris*).

1845.—*Amydosaurus* GRAY, Cat. Lizards Brit. Mus., p. 162 (same type).

Compressed distal phalanx of digits adhering to the dilated basal portion and extending somewhat beyond it, but not rising angularly from within the edge; subdigital lamellæ divided by a median groove; thumb without claw; no enlarged plates on under side of tail.

The geographical range of the genus does not exceed that of the typical species. A few imperfectly known species, with habitats outside that range, have been assigned to it, but it is doubtful whether they really belong there.

LEPIDODACTYLUS LUGUBRIS (Duméril and Bibron).

MOURNING GECKO.

(Figs. 1, 6.)

- 1836.—*Platydictylus lugubris* DUMÉRIL and BIBRON, Erpét. Gén., III, p. 304 (type locality, Tahiti).—*Lepidodactylus lugubris* FITZINGER, Syst. Rept. (1843), p. 98.—BOULENGER, Proc. Zool. Soc., London, 1883, p. 120, pl. XXII, fig. 3; Cat., Liz. Brit. Mus., I (1885), p. 165; III (1887), p. 487; Ann. Mag. Nat. Hist., (6) XX, September, 1897, p. 306.—*Peripia lugubris* PETERS and DORIA, Ann. Mus. Civ. St. Nat., Genova, XIII (1878), p. 371.
- 1857.—*Peropus neglectus* GIRARD, Proc. Phila. Acad., p. 197; extr. p. 5 (type locality, unknown); U. S. Expl. Exp. Herpet. (1858), p. 278.—*Gehyra? neglecta* BOULENGER, Cat. Liz. Brit. Mus. (1885), I, p. 150.
- 1858.—*Hemidactylus meyeri* BLEEKER, Natuurk. Tijds. Nederl. Ind., XVI, p. 47 (type locality, Bintang).
- 1864.—*Peripia cantoris* GÜNTHER, Rept. Brit. Ind., p. 110 (type locality, Pinang).
- 1869.—*Gymnodactylus caudeloti* BAVAY, Mém. Soc. Linn. Normandie, XV, No. 5, p. 13 (type locality, New Caledonia).
- 1872.—*Peripia meyeri* GÜNTHER, Proc. Zool. Soc. Lond., 1872, p. 594.
- 1874.—*Peripia mysorensis* MEYER, Sitz. Ber. Berlin Akad., 1874, p. 129 (type locality, Mysore).

¹ From λεπίς, -δος, scale; and δάκτυλος, finger.

The type of Girard's *Peropus neglectus* was lost long ago, but there can be no doubt that it belongs here.

As to the identity of the Hawaiian specimens with the present widely distributed species I have only to say that they fit the descriptions exactly, and that I have compared them with specimens believed to have been collected in Samoa, without being able to discover any tangible differences. The Hawaiian specimens seem to be of somewhat stouter build; their eyes are possibly a trifle larger, and there is a slightly greater uniformity of the upper and lower caudal scales, but the differences, if indeed they are real, are too slight to be expressed in a diagnosis. Possibly the anterior chin-shields may average a little smaller, but the individual variation in this respect is too great to offer any basis for a separation. The specimens from the Hawaiian Islands have the subdigital pads colored blackish, but it is doubtful if this character is of any value.

L. lugubris has a wide distribution ranging from the Malay peninsula and archipelago in the west through New Guinea, Solomon Islands, New Hebrides, New Caledonia, Fiji, Rotuma, Samoa, Tonga, Tahiti, Gilbert, and Marshall Islands¹ to the Hawaiian Islands.

From the latter it has first been noted by Peters and Doria, who recorded specimens in the Genoa Museum, collected by D'Albertis in Honolulu. The specimens in the U. S. National Museum show that the mourning gecko besides occurring in Oahu is also found in Kauai and Hawaii. Records from the other islands are lacking.

This species ought not to be easily confounded with any of the other Hawaiian geckos, except *Hemiphyllodactylus leucostictus*. Both are lacking large and well-defined chin-shields and transverse plates under the tail, but apart from the radical differences in the structure of the digits explained elsewhere, the coloration of the fresh specimens seems to be sufficient to distinguish them. In *L. lugubris* the ground color is a more or less light drab with scattered dusky markings, while in *L. leucostictus* it is of a more brownish cast with white markings behind the eyes, on the upper surface of the toes, and at the base of the tail above.

Description.—No. 23456, U.S.N.M. Male adult; Hawaii, Hawaiian Islands; collector, H. W. Henshaw. Rostral rectangular, broader than high in contact with two supranasals and three small scales between the latter; first supralabial in contact with the lower post-nasal and reaching nostril; nostril between upper posterior corner of rostral, first supralabial, and three scales behind and above, the upper one, or supranasal, being small and not in contact with the corresponding one of the other side; fourteen supralabials, the last four being small, the tenth located under center of eye; scales on top of head finely granular, somewhat larger on snout; eye equidistant from nostril

¹ In the St. Petersburg Museum, according to Strauch, Mém. Ac. St. Petersb. (7), XXXV, No. 2, 1887, p. 27, there are specimens from Tarowa and Yaluit by Dr. E. Riebeck, 1885.

and ear-opening, the diameter about one-half its distance from ear-opening, which is roundish and smaller than the larger supralabials; mental pentagonal narrow, scarcely as wide as the nearest infralabials; nine larger infralabials; the scale rows adjoining the infralabials considerably larger than the granules covering the throat, and more or less hexagonal, especially the pair behind the mental, but not clearly differentiated as chin-shields, merging by degrees into the granules; body and legs above covered with small uniform granules barely larger than those on head; throat with granules of the same size, but the rest of the underside with imbricate scales two to three times larger than dorsal granules; scales on preanal region somewhat larger, nonimbricate, more or less hexagonal; an angular series of eight of these, the angle pointing backwards, with obscurely developed pores, join a similarly modified series of eight scales on the proximal half of each thigh, together twenty-four obscure pores; fingers and toes free, all except inner ones (which are otherwise well developed) with a compressed clawed joint adhering to the dilated basal portion; the distal part of the latter underneath provided with seven to eight pairs of lamellæ; tail flattened underneath, with a sharpish edge, and covered with small scales, somewhat larger inferiorly (proportion as 10 to 7), which show a slight though perceptible verticillate arrangement every tenth or eleventh scale row above and every sixth or seventh below, being a trifle larger than the others and emphasized on the lateral edge by a slightly enlarged spine-like scale imparting a light denticulation to the edge.

Color above pale drab with a few scattered blackish dots of which a pair at the base of the tail is most conspicuous; head with obscure brownish marblings, the labial sutures being also marked with brown; a band of similar color and white-edged above from snout through eye to above the ear; underside white; the terminal portion of the dilated part of the digit's dusky; tail like body, with alternating pale-brownish irregular cross bars above.

Dimensions.—Total length, 85 mm.; snout to vent, 38 mm.; vent to tip of tail, 47 mm.; snout to ear-opening, 9.5 mm.; greatest width of head, 8 mm.; fore leg from axilla, 11 mm.; hind leg from groin, 14 mm.; from axilla to groin, 18 mm.

Variation.—All the specimens examined by me agree very closely in structure with the specimen described above. One specimen (No. 23504, U.S.N.M.) has the tail reproduced. It is much shorter, flatter, and broader at base, the scales rougher and not arranged in regular transverse series. As a curiosity, it may be mentioned that the tip of this tail is bifurcate for a distance of about 3 mm.

The chief variation is in the coloration. In some specimens black spots are nearly absent above, while in others they are more numerous. Thus in a specimen which I collected in Honolulu (No. 23508, U.S.N.M.) there is from the shoulders to the base of the tail a double series of

black spots which form the posterior angles of obscure transverse chevron bands; the band at the base of the tail is entirely black, bordered behind with whitish and continues down the posterior edge of the thigh; the trans-ocular line passes posteriorly to above the arm and there is a distinct dusky interocular band. In some of the specimens the throat is densely speckled with minute brownish dots.

The dusky color of the lamellated digital pads is constant in all the specimens, a character which is not present in the two specimens before me said to have been collected in Samoa (Nos. 15571, 15572, U.S.N.M.).

*List of specimens of Lepidodactylus lugubris.**

Number.	Collection.	Age.	Locality.	When collected.	From whom received.	Remarks.
23483	U. S. N. M.	Adult.	Kauai, Waiawa	May —, 1895	V. Knudsen	
23484	do	do	do	do	do	
23503	do	do	do	do	do	
23504	do	do	do	do	do	Tail reproduced, forked. See p. 790.
23505	do	do	do	do	do	
23506	do	do	do	do	do	
23508	do	do	Oahu, Honolulu	Nov. 17, 1896	L. Stejneger	See p. 790.
23453	do	do	Hawaii		H. W. Henshaw	
23454	do	do	do		do	
23455	do	do	do		do	
23456	do	do	do		do	Specimen described, p. 789.
23457	do	do	do		do	
23458	do	do	do		do	
902	Oberlin	do	Oahu, Honolulu		E. P. Church	
902	do	do	do		do	

HEMIDACTYLUS¹ Gray.

1825.—*Hemidactylus* GRAY, Ann. Philos., (2) X, 1825 (p. 199) (type, *H. verruculatus* Cuvier = *turcicus* Linnaeus).

1843.—*Onychopus* FITZINGER, Syst. Rept., p. 104 (type, *H. garnotii*).

1843.—*Hoplopodion* FITZINGER, Syst. Rept., p. 104 (type, *H. coctei*).

1845.—*Doryura* GRAY, Cat. Liz. Brit. Mus., p. 156 (type, *D. bowringii*).

1845.—*Boltalia* GRAY, Cat. Liz. Brit. Mus., p. 158 (type, *B. sublaevis* = *H. coctei*).

2



FIG. 2.—TERMINAL JOINTS OF TOE OF *HEMIDACTYLUS* GARNOTII. (ENLARGED.)

Compressed distal phalanx of digits free, rising angularly from within the edge of the dilated portion; subdigital lamellæ in two series; inner digit with compressed clawed phalanx; underside of tail with a median series of large transversely dilated plates.

The genus *Hemidactylus* comprises numerous species distributed over nearly all the warmer portions of the globe.

3



FIG. 3.—UNDERSIDE OF FOOT OF *HEMIDACTYLUS* GARNOTII. (ENLARGED.)

¹ From 'ημι, half; and δάκτυλος, finger.

HEMIDACTYLUS GARNOTII¹ Duméril and Bibron.

THE FOX GECKO.

(Figs. 2-4.)

1836.—*Hemidactylus garnotii* DUMÉRIL and BIBRON, *Erpét. Gén.*, III, p. 368 (type locality, Tahiti).—BOULENGER, *Cat. Liz. Brit. Mus.*, I (1885), p. 141; III (1887), p. 485.—*H. garnotii* BOULENGER, *Proc. Zool. Soc. London*, 1883, p. 118, pl. XXII, figs. 1, 1a.

1857.—*Doryura vulpecula* GIRARD, *Proc. Phila. Acad.*, 1857, p. 197; extr., p. 5 (type locality, "Sandwich Islands"); U. S. Expl. Exp., *Herpet.* (1858), p. 286, *Atlas*, pl. XXIV, figs. 17-24.

I have left out of the synonymy of this species all references to specimens from India, Burma, and Sumatra,² since Theobald describes his *Doryura guadama* as possessing nineteen femoral pores, while the true *H. garnotii* appears to be entirely destitute of femoral pores. Boulenger, when writing his account of the species, in the *Catalogue of Lizards*, does not seem to have examined male specimens, and the types in the British Museum are also stated to be females. The negative result from them is consequently not convincing.

There can scarcely be a doubt that Girard's *Doryura vulpecula* is correctly referred to this species. It is true, Girard says that "from *D. garnoti* it differs by a more pointed snout or muzzle, and by the sides of the tail not being denticulated," and in the description of the tail he expressly states that "the sides of that organ are sharp, though not otherwise serrated or denticulated," while in all the specimens before me with unreproduced tail the edge of the latter is most distinctly and obviously denticulated, strongly differentiated spines being placed at equal intervals along the sharp margin. Girard's specimens are lost,³ but it is almost safe to say that those he examined and described had the tail reproduced, for in such specimens before me I find the new portion destitute of the spinous denticulation. No. 23470, U.S.N.M., is particularly instructive in this respect, as only the terminal two-thirds of the tail are reproduced, with the result that the edge of the basal third of the tail of this individual is strongly denticulated, while the distal two-thirds are "nearly even laterally," as expressed by Girard. An inspection of the figure presented by him⁴ bears out this theory, as it certainly has the appearance of a specimen with a reproduced tail.

¹ Named for Prosper Garnot, French traveler and naturalist.

² *Hemidactylus ludekingii* BLEEKER, *Natuurk. Tijdschr. Nederl. Ind.*, XVI, 1858, p. 27 (Agam, W. Sumatra). *Hemidactylus* [*Doryura*] *mandellianus* STOLICZKA, *Journ. As. Soc. Bengal*, XLI, 1872, Pt. 2, p. 101, pl. III, figs. 1, 2 (Sikkim). *Doryura guadama* THEOBALD, *Journ. Linn. Soc. London, Zool.*, X, 1870, p. 30 (Burma). *Hemidactylus blanfordii* BOULENGER, *Cat. Liz. Brit. Mus.*, I (1885), p. 141 (Darjeeling).

³ Unless No. 11288, U.S.N.M., a small specimen without locality, but recorded as collected by the Exploring Expedition, be one of the cotypes.

⁴ U. S. Expl. Exped., *Herpet.*, *Atlas*, pl. XXIV, fig. 17.

The range of the present species can not be stated with any degree of certainty on account of the doubt attached to the western specimens which may belong to a separate species distinguished by a long series of femoral pores in the male. The distribution in Polynesia and Melanesia is also known but fragmentarily, New Caledonia, Tahiti, and the Hawaiian Islands being the principal localities in which the species has been found hitherto.

The fox gecko, which derives its name from the long fox-like snout, according to Mr. Knudsen's notes is found in thatched and open houses as well as in cocoanut palms and large mango trees. A number of those sent were picked up from under large flat stones and planks. Judging from the numbers sent, this is the most common of the geckos.

It is apparently the largest of the Hawaiian geckos and is easily distinguished from the other species not only by the fifth digit being perfectly formed as the others, but also by its chin-shields and color. In the latter respect it may often resemble some specimens of *Hemiphyllodactylus leucostictus*, but the latter has a cylindric tail with no enlarged plates underneath.

Description.—No. 23510, U.S.N.M. Adult; Kalae, Molokai; November, 1896; collector, R. Meyer. Rostral broader than high, squarish, with a nick in the posterior margin for the anterior angle of the internasal and a median suture, or cleft, extending forward for about one-half the height of the shield; in contact with two supranasals and one hexagonal scale of about equal size between the latter; first supralabial in contact with lower postnasal and reaching nostril; nostril between rostral, first supralabial and three scales behind and above, the upper one, or supranasal, being of about same size as the others and separated from the supranasal of the other side by a hexagonal internasal; fourteen supralabials, including the small posterior ones, the eleventh being under the center of the eye; top of head covered with minute granules considerably larger on snout; eye much nearer the ear-opening than the nostril, the diameter about two-thirds its distance from ear-opening and much less than one-half its distance from tip of snout; ear-opening roundish, small, smaller than largest supralabials; mental triangular large, its free margin twice as wide as nearest infralabials; nine larger infralabials; one pair of large, elongated, irregularly hexagonal chin-shields, their anterior angle fitting into the corner between mental and first infralabials, broadly in contact with each other on the median line and followed behind by another pair of shorter and broader chin-shields, which are separated from each other by granules and from the infralabials by somewhat larger scales; body and legs above covered with small uniform granules about the size of those on snout; those on throat of about same size, but flat and smooth; scales on rest of underside about four times larger, imbricate,



FIG. 4.—CHIN-SHIELDS AND LOWER LABIALS OF *HEMIDACTYLUS GARNOTII*. (ENLARGED.)

those on preanal region and underside of tibia still larger; on the underside of the thigh the three posterior rows of scales are overlapping considerably sideways so as to appear very much narrowed, there being about eighteen such scales in the last row corresponding to the pore-bearing scales in other species, but apparently without pores; fingers and toes nearly free, all with a long compressed free terminal joint rising angularly from within the dilated basal portion; the underside of the latter with two series of oval lamellæ placed angularly and meeting on the median line, about thirteen pairs under the fourth toe; a distinct but narrow fold between axilla and groin and a similar one along the posterior margin of the thighs; tail flattened, somewhat constricted at base with a sharp denticulated lateral edge; it is covered above with small squarish scales somewhat larger than the dorsal ones and arranged in distinct transverse rows, about every tenth one being slightly larger and marking the end of a distinctly perceptible section or verticil which on the lateral edge of the tail is emphasized by a raised claw-like scale or spine, while the minor denticulation of the edge is caused by four smaller but similar scales between every two spines; underneath the tail has a median series of broad, hexagonal, transverse plates, about two to each verticil, a few series of small imbricate scales filling the space between the plates and the edge, the scale row nearest the plates being considerably larger than the others.

Color above dark grayish drab with numerous irregular whitish spots, no special pattern being observable, except that there is a whitish transocular stripe, and that on the back the spots seem to be arranged in longitudinal series. The tail has ill-defined light crossbars which become gradually more pronounced toward the tip, and the large spines on the edge at the end of each verticil are conspicuously white; whole underside white except the small lateral subcaudals, which are colored like the upper side.

Dimensions.—Total length, 114 mm.; snout to vent, 50 mm.; vent to tip of tail, 64 mm.; snout to ear-opening, 13 mm.; greatest width of head, 8 mm.; fore leg from axilla, 14 mm.; hind leg from groin, 21 mm.; axilla to groin, 21 mm.

Variation.—The chief individual variation noticed in a long series of individuals consists in minor deviations in the size and shape of the chin-shields and the internasals. Occasionally there are two smaller internasals in place of one large, or a minute granule is interposed in the cleft of the rostral.

The reproduced tail does not seem to be different in shape or to be much shorter than the original one (No. 23491, U.S.N.M.; snout to vent, 55 mm.; vent to tip of tail, 55 mm.), but the scutellation is different. The scales on the upper surface are irregular and not arranged in rows, much less are there any indications of regular verticils, and there are no spines or serrations along the lateral edge; there are well-developed

transverse plates underneath, but the scales bordering these plates are reduced to one row.

The ground color seems to be subject to some slight variation and in the paler specimens there are indications of irregular darker mottlings, a dark stripe through the eye underneath the white one and darkish edges to the white spots.

A very young specimen from Kauai (No. 23495, U.S.N.M.; length from snout to vent, 22 mm.) shows all the characters of the adult. except that the color above seems to be uniform drab. The anterior chin-shields are also separated by two small scales.

List of specimens of Hemidactylus garnotii.

Number.	Collection.	Age.	Locality.	When collected.	From whom received.	Remarks.
23466	U.S.N.M.	Adult	Kauai, Waiawa....	May, 1895	V. Knudsen...	See p. 792.
23467	...do.....	...do.....	...do.....	...do.....	...do.....	
23468	...do.....	...do.....	...do.....	...do.....	...do.....	
23469	...do.....	...do.....	...do.....	...do.....	...do.....	
23470	...do.....	...do.....	...do.....	...do.....	...do.....	
23471	...do.....	...do.....	...do.....	...do.....	...do.....	
23472	...do.....	...do.....	...do.....	...do.....	...do.....	
23473	...do.....	...do.....	...do.....	...do.....	...do.....	
23474	...do.....	...do.....	...do.....	...do.....	...do.....	
23475	...do.....	...do.....	...do.....	...do.....	...do.....	
23476	...do.....	...do.....	...do.....	...do.....	...do.....	
23477	...do.....	...do.....	...do.....	...do.....	...do.....	
23478	...do.....	...do.....	...do.....	...do.....	...do.....	
23479	...do.....	...do.....	...do.....	...do.....	...do.....	
23486	...do.....	...do.....	...do.....	...do.....	...do.....	
23487	...do.....	...do.....	...do.....	...do.....	...do.....	See p. 794.
23488	...do.....	...do.....	...do.....	...do.....	...do.....	
23489	...do.....	...do.....	...do.....	...do.....	...do.....	
23490	...do.....	...do.....	...do.....	...do.....	...do.....	
23491	...do.....	...do.....	...do.....	...do.....	...do.....	
23492	...do.....	...do.....	...do.....	...do.....	...do.....	
23493	...do.....	...do.....	...do.....	...do.....	...do.....	
23494	...do.....	...do.....	...do.....	...do.....	...do.....	
23495	...do.....	Young.....	...do.....	...do.....	...do.....	
23510	...do.....	Adult.....	Molokai, Kalae....	Nov., 1896	R. Meyer.....	See p. 795.
23511	...do.....	...do.....	...do.....	...do.....	...do.....	See p. 793.
23512	...do.....	...do.....	...do.....	...do.....	...do.....	
23513	...do.....	...do.....	...do.....	...do.....	...do.....	
23514	...do.....	...do.....	...do.....	...do.....	...do.....	
23515	...do.....	...do.....	...do.....	...do.....	...do.....	
23461	...do.....	...do.....	Hawaii.....	...	H. W. Henshaw	
23462	...do.....	...do.....	...do.....do.....	
23463	...do.....	...do.....	...do.....do.....	
23464	...do.....	...do.....	...do.....do.....	
23465	...do.....	...do.....	...do.....do.....	
902	Oberlin.....	...do.....	Oahu, Honolulu....	...	E. P. Church..	

PEROPUS¹ Wiegmann.

1835.—*Peropus* WIEGMANN, Nova Acta Acad. Cæs. Leop.-Carol., XVII, i, p. 238 (type, *H. mutilatus*).

1843.—*Dactyloperus* FITZINGER, Syst. Rept., p. 103 (type, *H. variegatus*).

1845.—*Peripia* GRAY, Cat. Lizards Brit. Mus., p. 158 (type, *H. peronii* = *mutilatus*).

1883.—*Chalinocnemis* DUGÈS, La Naturelleza (Mex.), VI, p. 312 (type, *H. navarri* = *mutilatus*).

1883.—*Spasmocnemis* DUGÈS, La Naturelleza (Mex.), VI, p. 312 (same type).

Compressed distal phalanx of digits free rising angularly from within the edge of the dilated portion; subdigital lamellæ confined to the distal end of the dilatation and divided by a median groove; inner digits

¹ From *πηρος*, mutilated, and *πούς*, foot.

without a free distal phalanx, clawless; underside of tail with a median series of large transversely dilated plates.

Only the typical species has a very wide distribution, the others being much more local, except one which occurs in Australia.

Peropus has lately been put aside for *Dactyloperus* (and *Gehyra* by those who regard the two as identical) on the ground that it was pre-occupied by a genus of fishes, the *Peropus* of Lay and Bennett,¹ the date being given as 1831, while Wiegmann's *Peropus* only dates from 1835. But there is ample proof² that the Zoology of the *Blossom* was not published until 1839 or 1840, although printed many years before.

PEROPUS MUTILATUS³ (Wiegmann).

STUMP-TOED GECKO.

(Fig. 5.)

- 1834.—*Hemidactylus mutilatus* WIEGMANN, Herpet. Mex., I, p. 54 (corrected for *H. pristiurus*, p. 20; type locality, Manila).—*Hemidactylus* (*Peropus*) *mutilatus* WIEGMANN, Nova Acta Acad. Cæs. Leop.-Carol., XVII, i (1835), p. 238.—*Peripia mutilata* PETERS and DORIA, Ann. Mus. Civ. St. Nat. Geneva, XIII, 1878, p. 370.—*Gehyra mutilata* BOULENGER, Cat. Liz. Brit. Mus., I (1885), p. 148.
- 1857.—*Dactyloperus insulensis* GIRARD, Proc. Phila. Acad., 1857, p. 197; extr. p. 5 (type locality, "Sandwich Islands"); U. S. Expl. Exp., Herpet. (1858), p. 280.—*Gehyra insulensis* BOULENGER, Cat. Liz. Brit. Mus., I (1885), p. 150.
- 1836.—*Hemidactylus peronii* DUMÉRIL and BIBRON, Erpét. Gén., III, p. 352, pl. XXX, fig. 1 (type locality, Mauritius).
- 1858.—*Hemidactylus platurus* BLEEKER, Natuurk. Tijdschr. Nederl. Ind., XVI, p. 31 (type localities, Java, Sumatra, Nias, Banka).
- 1864.—*Gecko pardus* TYTLER, Journ. As. Soc. Bengal, XXXIII, ii (p. 47).
- 1868.—*Peropus packardii* COPE, Proc. Phila. Acad., 1868, p. 319 (type locality, Penang, Malacca).
- 1883.—*Hemidactylus nararri* DUGÈS, La Naturaleza, VI, p. 311, pl. VII a (type locality, Tangancicuara, Michoacan, Mexico).

In Boulenger's Catalogue of Lizards Girard's *D. insulensis* is separated as possessing no post-femoral fold, a proceeding warranted by the fact that Girard in the description fails to mention the fold. In the only one of Girard's specimens preserved (No. 21219, U.S.N.M.) the fold is well developed, and the distinction falls to the ground. This specimen agrees closely with ten others from Kauai and Oahu before me, which in turn prove themselves indistinguishable from the well-known and widely distributed *P. mutilatus*.

I have compared the Hawaiian specimens with a topotype of *H. peronii* from Mauritius (No. 16308, U.S.N.M.) and find no tangible differences. Manila specimens are not at hand, but I have no doubt that the result would be the same if they were. I may add that Professor

¹ Zoology of the *Voyage* of the *Blossom*, p. 59.

² "The long looked-for and long despaired-of Zoology of Beechey's *Voyage* is at last before us." Mag. Nat. Hist., March, 1840.

³ Mutilated.

Peters has likewise identified Honolulu specimens as belonging to this species.¹

Peropus mutilatus has a distribution nearly as extensive as *Ablepharus pœcilopleurus*, occurring, as it does, from Mauritius and the Seychelles to the west coast of Mexico. It has been found in Ceylon, the Malay archipelago and peninsula, Philippines, and New Guinea, but, curiously enough, not as yet in any part of Polynesia, New Caledonia, or Solomon Islands.

It was first collected in the Hawaiian Islands by the Wilkes Exploring Expedition, specimens being obtained in Hawaii, Oahu, and Kauai (Nos. 5676, 5677, U.S.N.M. record book, division of reptiles). It has since been collected by D'Albertis, at Honolulu, as recorded by Peters and Doria, and also by Mr. E. P. Church. Knudsen sent a number of specimens from Kauai, but it was not in the collections made by Meyer in Molokai or by Henshaw in Hawaii.

Description.—No. 23498, U.S.N.M. Female adult; Waiawa, Kauai; May, 1895; collector, V. Knudsen. Rostral broader than high, with a median cleft above, in contact with two supranasals; first supralabial in contact with the lower postnasal and reaching nostril; nostril between rostral, first supralabial, and three scales behind and above, the upper one of which is large, squarish, and broadly in contact behind the rostral with the corresponding scale of the other side; nine supralabials, seventh under center of eye, last two very small; scales on top of head finely granular, slightly larger on snout; eye equidistant from nostril and ear-opening, large, its diameter more than two-thirds the distance from ear-opening, which is moderate, being about the size of the large supralabials; mental shield moderate, triangular, its labial border about twice the width of nearest infralabials; it is followed by six chin-shields in one transverse series, their posterior outline forming together a slightly curved line, the median pair large, elongate, pentagonal, the others gradually smaller toward the sides; outer pair separated from labials by smaller scales, the others in contact with first and second infralabials anteriorly; nine infralabials, gradually decreasing in size backward; body and legs above covered with small uniform granules like those on head and gradually increasing in size on the sides to those of the scales of the lower surface, which are considerably larger and imbricate, except those on the throat, which are like the dorsal ones, but flat; a distinct dermal fold along the posterior edge of thigh and tibia; toes slightly webbed at base; eight pairs of oblique lamellæ under longest toe, the lamellæ on all the digits being restricted to the distal half of the digital dilatation; tail flattened, with sharp, finely serrated edge, with a very distinct lateral constriction at base; it is covered with small scales above



FIG. 5.—CHIN-SHIELDS AND LOWER LABIALS OF *PEROPUS MUTILATUS*. (ENLARGED.)

¹ Peters and Doria, Ann. Mus. Civ. Genova, XIII, 1878, p. 370.

arranged in regular transverse series and with a median series of wide plates below, the space between them and the lateral edge being occupied by several series of imbricate rounded scales near the base, forming as many as five rows. No femoral pores (female).

Color above nearly uniform drab with faint indications of darker brownish markings on the head, as well as of a white transocular stripe bordered above and below with dusky; underside whitish, but dusted over with minute specks of blackish; these minute specks are also present all over the upper surface, only much denser.

Dimensions.—Total length, 95 mm.; snout to vent, 46 mm.; vent to tip of tail, 49 mm.; snout to ear-opening, 12 mm.; greatest width of head, 9 mm.; fore limb, 12 mm.; hind limb, 16 mm.; from axilla to groin, 21 mm.

Variation.—A not uncommon deviation from the above description consists in the presence of a small granule at the juncture of the rostral cleft with the sutures of the supernasals, to which is sometimes added one or more granules in the suture between these two shields, which may then become entirely separated, as in one of Knudsen's specimens from Kauai (No. 23482, U.S.N.M.). The size of the exterior pair of chin-shields is also somewhat variable, the extreme being No. 23481, U.S.N.M., in which it has entirely been broken up into small scales like those adjoining the infralabials.

The regenerated tail resembles the original one very much and has well-developed subcaudal plates, but it seems to be broader at the base, and shorter, while the scales are more irregular and more pointed.

The color markings vary also to some extent, being more pronounced and definite in some examples than in others. Thus in No. 23501, U.S.N.M., there are three distinct series of brownish spots, one median and two lateral, with pale markings between, the median series extending to the neck and occiput where it forms a distinct line. In this specimen the white, dusky-edged line from nostril through eye to above ear is very strongly marked.

An immature male (No. 902, Oberlin College collection) has about seventeen obscure femoral pores on each side meeting at an angle, directed forward, on the preanal region, the scales behind the angle being larger and more differentiated than in the female.

List of specimens of Peropus mutilatus.

Number.	Collection.	Age.	Locality.	When collected.	From whom received.	Remarks.
21219	U.S.N.M.	Adult	"Sandwich Islands"	.....	U. S. Exploring Expedition.	Type (?) of <i>D. insulensis</i> Girard.
23480	.....do.....	.....do.....	Kauai, Waiawa.....	May, 1895	V. Knudsen...	
23481	.....do.....	.....do.....	.....do.....	.....do.....	.....do.....	See p. 798.
23482	.....do.....	.....do.....	.....do.....	.....do.....	.....do.....	See p. 798.
23496	.....do.....	.....do.....	.....do.....	.....do.....	.....do.....	
23497	.....do.....	.....do.....	.....do.....	.....do.....	.....do.....	
23498	.....do.....	.....do.....	.....do.....	.....do.....	.....do.....	See p. 797.
23501	.....do.....	.....do.....	.....do.....	.....do.....	.....do.....	See p. 798.
23502	.....do.....	.....do.....	.....do.....	.....do.....	.....do.....	
902	Oberlin	.....do.....	Oahu, Honolulu.....	.....do.....	E. P. Church..	
902	.....do.....	Immature.	.....do.....	.....do.....	.....do.....	See p. 798.

HEMIPHYLLODACTYLUS¹ Bleeker.

(Fig. 9.)

1860.—*Hemiphyllodactylus* BLEEKER, Natuurk. Tijds. Nederl. Ind., XX, p. — (type, *H. typus*).

1872.—*Spathodactylus* GÜNTHER, Proc. Zool. Soc. Lond., p. 594 (type, *S. multilatus* = *H. typus*) (not of Pictet, 1858).

1885.—*Spathoscalabotes* BOULENGER, Cat. Liz. Brit. Mus., I, p. 156 (substitute name).

Compressed distal phalanx of digits free, rising angularly from within the edge of the dilated portion; subdigital lamellæ confined to the distal end of the dilatation and divided by a median groove; inner digits rudimentary, without distal free phalanges, clawless; tail narrow, cylindric, without median transverse plates underneath; no enlarged chin-shields.

Not having any specimen of Bleeker's type of this species I have had to rely on Günther's and Boulenger's descriptions and figures. The only differences which I can make out from these seem to be the greater slenderness of the digits at the base and the greater length of the raised distal phalanx, differences of degree which would hardly justify a generic separation. Günther's figures of the underside of the digits² seem to have a few granules separating the posterior lamellæ from each other and also to be lacking lamellæ under the inner digits, but the differences, if they really exist, are immaterial.

Boulenger's *Lepidodactylus crepuscularis* and *L. ceylonensis* belong apparently to this genus, and possibly also his *L. aurantiacus*. The structure of their toes differs very materially, however, from that of *Lepidodactylus*, as typified by *L. lugubris*, being in fact more nearly related to *Peropus* and *Gehyra* in this respect. In *Lepidodactylus* the compressed distal phalanx adheres to the dilatation underneath it, only its extreme end extending beyond the edge of the pad without being raised or bent angularly to its plane. In the species included by me in *Hemiphyllodactylus*, on the other hand, although the terminal phalanges are rather short in all, except the typical species, the compressed joint rises angularly out of the surface of the dilatation, not from the edge, but from within it, exactly as in *Hemidactylus*, *Gehyra*, and *Peropus*. In the absence of chin-shields and enlarged transverse subcaudal plates they show some resemblance to *Lepidodactylus*, but that is offset by the different shape of the tail and the greater reduction of the inner digits. The true relations, however, lie with *Peropus*, I have no doubt.

The species here included under Bleeker's generic name seem to form



FIG. 6.—UNDERSIDE OF CHIN OF *LEPIDODACTYLUS LUGUBRIS*. (ENLARGED.)

¹ From ἡμι, half; φύλλον, leaf; δάκτυλος, finger.

² Proc. Zool. Soc., 1872, p. 594.

a very natural and compact little group with a somewhat disconnected distribution, though it is probable that future explorations may bridge the gaps. One species, *H. ceylonensis*, is said to occur in Ceylon and Java; another, *H. typus*, is from Sumatra; a third, *H. crepuscularis*, occurs in the New Caledonian Islands, and the fourth, the one here described, has thus far only been found in the Hawaiian archipelago.

HEMIPHYLLODACTYLUS LEUCOSTICTUS,¹ new species.

HAWAIIAN GECKO.

(Figs. 7-9.)

Diagnosis.—Five divided lamellæ under the fourth toe, which is longer than the third; distal free phalanx short; snout slightly shorter than distance of eye from ear-opening; male with eleven preanal and seven to eight femoral pores.

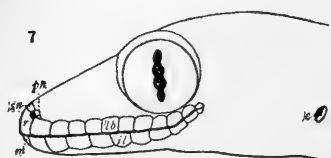


FIG. 7.—SIDE OF HEAD OF HEMIPHYLLODACTYLUS LEUCOSTICTUS, TO SHOW NOSTRIL, LABIALS, EYE, AND EAR-OPENING. (ENLARGED.) *a*, EAR-OPENING; *il*, LOWER LABIALS; *lb*, UPPER LABIALS; *m*, MENTAL; *pn*, UPPER AND LOWER POSTNASAL; *r*, ROSTRAL; *sn*, SUPRNASAL.

Type.—No. 23500, U.S.N.M. Kauai, Hawaiian Islands; collector, V. Knudsen.

Habitat.—Hawaiian Islands.

Description of type specimen.—Male adult; Waiawa, Kauai. Rostral broader than high, nicked behind, in contact with two supranasals and a small scale between them; first supralabial in contact

with the lower postnasal and reaching nostril; nostril between rostral, first supralabial, two postnasals, and a larger supranasal which is separated from the one of the other side by a small scale; ten supralabials, last small, eighth under center of eye; scales on top of head finely granular, considerably larger on snout; eye slightly nearer the tip of snout than the ear-opening, large, its diameter being more than two-thirds the distance from ear-opening which is quite small being smaller than the larger supralabials; mental small, polygonal, narrowed behind with almost parallel sides; ten infralabials gradually decreasing in size posteriorly; no distinctly differentiated chin-shields, but the granules or scales nearest the infralabials and mental being larger than the others, especially the three immediately behind the mental; body and legs above, as well as throat, covered with uniform minute granules

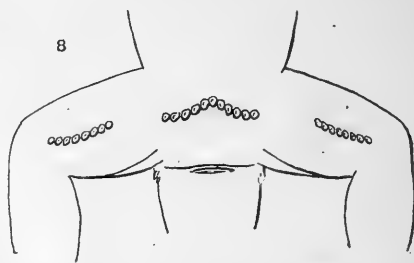


FIG. 8.—THIGHS AND ANAL REGION OF MALE HEMIPHYLLODACTYLUS LEUCOSTICTUS SHOWING PRE-ANAL AND FEMORAL PORES. (ENLARGED.)

¹ Λευκοστίκτης, flecked with white.

like those on top of head; rest of under surface with somewhat larger imbricate scales; digits free, with short but perfectly formed and free distal joints rising angularly from within the basal dilatation, except on the inner digits, which are quite rudimentary; fourth toe longer than third; subdigital lamellæ few and confined to the terminal portion of the dilatation, three and four pairs under the fingers, four and five under the toes, arranged nearly fan like; borders of digital dilatation not unusually denticulated; tail narrow, rather short, subcylindric, without lateral edge, covered by small imbricate scales slightly larger than those on the snout, the lateral ones somewhat more pointed and raised, those on the underside somewhat larger but otherwise similar; an angular series of eleven preanal pores, the angle turned forward, and about eight femoral pores under the distal half of the thigh, all rather obscure (male).

Color above dull chestnut brown, with obscure, irregular darker marblings and several series of small whitish spots on each side of back and similar ones irregularly scattered all over; a pale dark-edged band from snout through eye to shoulder, in which, behind eye, three well-defined roundish white spots with dusky margins; a well-defined white dark-edged spot on the basal half of each digit above; a well-defined transverse spot of white across the base of tail above; throat white, unspotted; rest of underside of body pale, with indefinite marblings of same brown color as back; tail above of color of body, with ill-defined pale cross bands, white spots on sides, below whitish, with a median continuous marbling of brown.

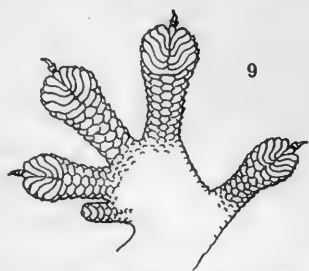


FIG. 9.—UNDERSIDE OF FOOT OF HEMI-PHYLLODACTYLUS LEUCOSTICTUS. (ENLARGED.)

Dimensions.—Total length, 67 mm.; snout to vent, 38 mm.; vent to tip of tail, 29 mm.; snout to ear-opening, 8 mm.; greatest width of head, 5.5 mm.; fore limb, 8 mm.; hind limb, 13 mm.; from axilla to groin, 20 mm.

Variation.—Preanal and femoral pores are of course wanting in the female.

There is not much structural difference in the various specimens, it being mostly confined to the usual slight deviations in the number of internasal scales, postmental scales, labials, pores, and subdigital lamellæ. The reproduced tail is exceedingly short, the scales are rougher and more irregularly placed, those on the sides being neither more pointed nor raised, but does not differ otherwise.

The color is also fairly uniform in all the specimens examined by me, except that in Nos. 23509, 23460, U.S.N.M., the throat is nearly as much marbled with brown as the rest of the under surface.

Remarks.—This addition to the Hawaiian fauna is very closely allied

to *Hemiphyllodactylus crepuscularis*,¹ hitherto only found in New Caledonia, and *H. ceylonensis*,² of which we only have records from Ceylon and Java, resembling both in structure, proportions, and coloration. Not having specimens of either of these species, I have to rely upon Boulenger's descriptions and figures. The differences from *H. crepuscularis* seem to consist in the slightly shorter snout, the distance of the tip of snout from the eye being shorter than the distance of the ear-opening from the eye; in a slightly greater number of lamellæ under the digits; in a less strong denticulation along the borders of the digits, none being visible outside the lamellæ; in the greater angular obliquity of the latter; in the absence of any marked denticulation along the side of the tail. It differs, furthermore, by the males having a short series of femoral pores on the distal half of the thigh, in addition to the angular preanal series, the femoral pores probably lacking in *H. crepuscularis*, as they are not mentioned by Boulenger. Our present species seems to agree with *H. ceylonensis* in the lesser asperity of the digital border; but the toes do not appear to be slenderer or less dilated at the base. If the figure given by Boulenger (fig. 6a) is correct, the inner toe is also more rudimentary in *H. leucostictus* than in *H. crepuscularis*.

Slight as these distinctions are, they seem to indicate real differences between the forms inhabiting the Hawaiian Islands and New Caledonia, and are apparently more marked than those which distinguish the latter from the Ceylonese and Javanese form.

The typical species of the genus, the *H. typus*,³ seems to differ chiefly in having the toes slenderer at the base, less uniform in length, possibly more abrupt dilatation anteriorly, and the distal free, raised joint longer. In slenderness of body, shortness of limb, cylindric and slender tail, absence of chin-shields, and subcaudal plates, it agrees with the other members of the genus.

List of specimens of Hemiphyllodactylus leucostictus.

Number.	Collection.	Age.	Locality.	When collected.	From whom received.	Remarks.
23485	U. S. N. M.	Adult	Kauai, Waiawa....	May —, 1895	V. Knudsen	Type.
23499	.....do.....	.....do.....	.....do.....	.....do.....	.....do.....
23500	.....do.....	.....do.....	.....do.....	.....do.....	.....do.....
23509	.....do.....	.....do.....	Oahu, Honolulu	Nov. 17, 1896	L. Stejneger
23459	.....do.....	.....do.....	Hawaii .....	.....do.....	H. W. Henshaw
23460	.....do.....	.....do.....	.....do.....	.....do.....	.....do.....
21220do.....do.....	No recorddo.....	No record	

¹ *Platydictylus crepuscularis* BAVAY, Mém. Soc. Linn. Normand., XV, No. 5, 1869, p. 8 (type locality, New Caledonia). *Lepidodactylus crepuscularis* BOULENGER, Proc. Zool. Soc., London, 1883, p. 122, pl. XXII, fig. 6; Cat. Liz. Brit. Mus., I (1885), p. 163; III (1887), p. 486.

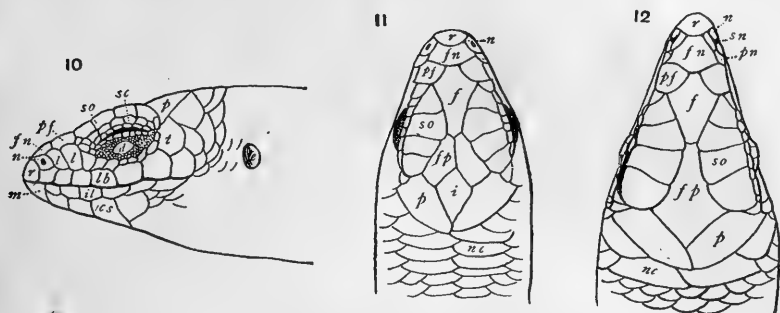
² *Lepidodactylus ceylonensis* BOULENGER, Cat. Liz. Brit. Mus., I (1885), p. 164, pl. XIII, fig. 3; III (1887), p. 487 (type locality, Ceylon).

³ *Hemiphyllodactylus typus* BLEEKER, Natuurk. Tijds. Nederl. Ind., XX, 1860, p. — (type locality, Agam, West Sumatra).

Family SCINCIDÆ.

THE SKINKS.

Only three widely distributed species, each belonging to a distinct genus, have been found in the Hawaiian Islands. The chief characters by which they may be distinguished from each other are as follows:

FIG. 10.—SIDE VIEW OF HEAD OF *LEIOLOPISMA*.FIG. 11.—UPPER VIEW OF HEAD OF *LEIOLOPISMA*.FIG. 12.—UPPER VIEW OF HEAD OF *EMOIA*.

cs, CHIN-SHIELDS; d, DISK ON LOWER EYELID; e, EAR-OPENING; f, FRONTAL; fn, FRONTALNASAL; fp, FRONTOPIRIETAL; i, INTERPIRIETAL; il, LOWER LABIALS; l, LOREALS; lb, UPPER LABIALS; m, MENTAL; n, NASAL; nc, NUCHALS; p, PARIETALS; pf, PREFRONTAL; pn, POSTNASAL; r, ROSTRAL; sc, SUPRACILIARIES; sn, SUPRANASAL; so, SUPRAOCULAR; t, TEMPORAL. (ALL FIGURES ENLARGED.)

*a*¹ Eyelids well developed, movable (fig. 10).

*b*¹ Nostril pierced in the nasal; no supranasal (fig. 10); frontoparietals and interparietal distinct (fig. 11); two or three pairs of nuchals (fig. 11).

Leiopisma noctua, p. 805

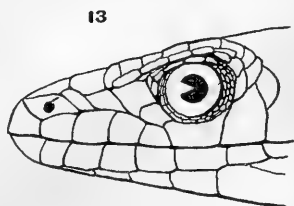
*b*² Nostril pierced between three small shields, a nasal, a postnasal, and a supranasal (fig. 12); frontoparietals and interparietal fused into a single large shield (fig. 12); a pair of nuchals (fig. 12)..... *Emoia cyanura*, p. 807

*a*² Eyelids rudimentary, not movable (fig. 13).

Ablepharus boutonii pacilopleurus, p. 811

The Hawaiian skinks are small, smooth, and shiny lizards of a more or less bronzy or brownish-olive color, and with more or less conspicuous longitudinal lighter stripes. They are consequently very much alike in general appearance, but a close attention to the structural characters tabulated above will insure their correct identification.

The difference between the rudimentary, nonmovable eyelids in *Ablepharus pacilopleurus* and the well-developed conniving lids in the two other species is well shown in the two figures, Nos. 13 and 10, respectively, the eyelids being represented nearly closed in fig. 10. In the former the eye is large, staring, and uncovered, like that of a snake, only surrounded by several narrow rings of granules,

FIG. 13.—SIDE VIEW OF SNOUT AND EYE OF *ABLEPHARUS PACILOPLEURUS*. (ENLARGED.)

while in the latter there is a movable covering, which shuts over the eye and protects it.

The three species can not well be confounded if it be remembered that the *Ablepharus* has no eyelid; that the *Leiopisma* has the plate between the frontal and the parietal split up into three separate plates, namely, two frontoparietals and one interparietal (compare figs. 8 and 9); and that the *Emoia* has the nasal shield split up into a small nasal proper, an elongated horizontal supranasal above it, and a small post-nasal behind it. This character is not always exclusive, however, as it may be seen occasionally in specimens of *Ablepharus*, in which case the character of the eyelid must decide.

Comparative table of dimensions.

Species.	Total length.	Snout to vent.	Vent to tip of tail.	Snout to ear.	Width of head.	Fore limb.	Hind limb.	Axilla to groin.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
<i>L. noctua</i>	80	38	42	9	5.5	12	15	19
<i>E. cyanura</i>	126	43	83	11	7	15	21	22
<i>A. pœcilopleurus</i>	106	47	59	10	6	15	19	22

This table demonstrates the greater proportionate length of the tail in *E. cyanura* and the more forward position of the ear-opening in *A. pœcilopleurus*.

The tail of a skink is liable to be broken off, though not quite so fragile as that of our geckos, and is reproduced with equal ease. The new tail is not quite so long or so perfect as the old one, the scales are not arranged with the same symmetry, but otherwise there is less difference than usual in the geckos, though the often abrupt change in coloration will in most cases reveal the reproduced part. Two-pronged caudal appendages of the second growth are also sometimes met with.

LEIOLOPISMA¹ Duméril and Bibron.

(Figs. 10, 11.)

1839.—*Leiopisma* DUMÉRIL and BIBRON, *Erpét. Gén.*, V, p. 742 (type, *L. telfairii*).

1843.—*Leiopisma* FITZINGER, *Syst. Rept.*, p. 22 (emend.).

1843.—*Lampropholis* FITZINGER, *Syst. Rept.*, p. 22 (type, *M. guichenoti*).

1845.—*Mococa* GRAY, *Cat. Liz. Brit. Mus.*, p. 80, (type, *M. guichenoti*).

1857.—*Oligosoma* GIRARD, *Proc. Phila. Acad.*, 1857, p. 196 extr., p. 4 (type, *M. zelandica* = *O. mococa*).

1864.—*Leiopisma* PETERS, *Mon. Ber. Berlin Akad. Wiss.*, 1864, p. 387 (emend.).

Eyelids well developed, movable, the lower with an undivided transparent disk; no supranasals; interparietal distinct.

The genus which is here regarded as more restricted than Boulenger's section of the genus *Lygosoma* of the same name, contains a large num-

¹ From λείος, smooth; λόπισμα, envelope.

ber of species mostly confined to the Indian and Australian regions, but with a few species of wider range, as, for instance, *Leiopisma laterale*, which occurs in southern North America.

LEIOLOPISMA NOCTUA¹ (Lesson).

MOTH SKINK.

- 1830.—*Scincus noctua* LESSON, Zool. Voy. *Coquille*, II, i, p. 48, pl. III, fig. 4 (type locality, Ualan, Caroline Islands).—*Oligosoma noctuum* GIRARD, U. S. Expl. Exp., Herpet. (1858), p. 249.—*Lygosoma noctua* BOULENGER, Cat. Liz. Brit. Mus., III (1887), p. 256.
- 1860.—*Lygosoma vertebrale* HALLOWELL, Proc. Phila. Acad., 1860, p. 487 (type locality, "Sandwich Islands").
- 1861.—*Lampropholis novara* FITZINGER, Sitz. Ber. Akad. Wiss. Wien, XLII, p. 403 (nomen nudum).—*Euprepes novara* STEINDACHNER, Reise Freg. *Novara*, Zool. I, Rept., 1869, p. 47, pl. II, fig. 4 (type localities, Tahiti and Samoa).
- 1874.—*Lygosoma (Lipinia) aurea* MEYER, Mon. Ber. Akad. Wiss. Berlin, 1874, p. 132 (type locality, Jobi Island, New Guinea).

This skink, to which Lesson gave the name *noctua* on account of its displaying "the soft and harmonious tints of certain moths," has a distribution only less extensive than that of the azure-tailed skink. Originally described from a specimen captured near a hut in a sugar-cane field in Ualan, the largest eastern island of the Carolines, it was found by the U. S. Exploring Expedition in Tahiti, Eimeo, Samoa, Raraka, and the "Sandwich Islands." Specimens from the latter were entered in the record book in the U. S. National Museum as from Oahu and Kauai (No. 5648, U. S. N. M.) and from Hawaii (No. 5885, U. S. N. M.) but none of these have been preserved. The Rogers North Pacific Exploring Expedition also obtained it in the Sandwich Islands, and Hallowell redescribed it as *L. vertebrale*, but his type seems to have had the same fate as the Hawaiian specimens of the Wilkes Expedition. The British Museum, according to Boulenger, has specimens from Solomon Islands, Fiji, Tongatabu, and Samoa, while Dr. Finch sent specimens to Dr. Peters in Berlin from Tarova (Gilbert Islands). Boulenger, who examined Meyer's type in the Dresden Museum, also regards *L. aurea* as being this species, which extends its range to the western end of New Guinea, while, according to the same author, it occurs even as far west as Celebes.

This species is only represented among Mr. Henshaw's specimens, three of which he secured on the porch of his house in Hilo, where, according to him, they are scarce. The records of the exploring expedition specimens show, however, that it occurs both in Oahu and Kauai, and the probability is that it is not lacking on the other islands either, though its unobtrusive habits render it difficult to observe and collect.

Description.—No. 23446, U. S. N. M. Adult, Hawaii; collector, H. W. Henshaw. Rostral wide, low, broadly in contact with nasals and

¹ A moth.

frontonasal; nasal large, lozenge shaped, undivided, and pierced about the middle by the nostril; frontonasal rather large, pentagonal, in contact with rostral, nasals, first loreals prefrontals and frontal; prefrontals not in contact; frontal long, very narrow behind, in contact with frontonasal and with first and second supraoculars; four supraoculars, second, third, and fourth in contact with frontoparietal; eight supraciliaries; frontoparietals separate, and also separated (on one side only in this individual) from interparietal, the length of the latter and frontoparietals together being slightly less than that of the frontal; parietals large, broadly in contact behind interparietal; three pairs of transversely enlarged nuchals; two loreals, one behind the other, second slightly larger than first, and followed by two preoculars one above the other; seven supralabials, fifth under center of eye and entering orbit, fifth and sixth largest; lower eyelid with a large transparent disk; ear-opening nearly as large as eye, the borders without projecting knobs or lobules; mental followed by a single unpaired postmental; six narrow infralabials; twenty-six smooth scale-rows around middle of body, those on back gradually increasing in size toward the median line; the two scales bordering anal opening anteriorly greatly enlarged; toes underneath with regular scales like those on top; a few of the scales under the tail transversely enlarged but no regular series of such scales.

Color above glossy clay-colored, paler on tail, and with a paler band on the two median scale rows extending down the back; this pale median band is bordered on either side by an almost continuous line of dark brown spots; sides of head dark brown, which color is continued over the ear and forelegs down the sides of the body and tail as a dark band irregularly dotted with pale spots; similar pale spots on each of the labials; on the occiput a very conspicuous white spot covering the posterior angle of the interparietal, the parietal and first nuchal sutures, posteriorly continuous with the pale median dorsal band and, like the latter, broadly bordered with dark brown; legs above brown densely dotted with whitish spots; lower surface whitish with irregular dull brownish marblings mostly confined to the edges of the scales, and hence with a tendency to form longitudinal lines.

Dimensions.—Total length, 80 mm.; snout to vent, 38 mm.; vent to tip of tail, 42 mm.; snout to ear-opening, 9 mm.; greatest width of head, 5.5 mm.; axilla to groin, 19 mm.; fore limb, 12 mm.; hind limb, 15 mm.

Variation.—The other specimens from Hawaii show but little deviation from the above description. In No. 23447, U.S.N.M., the interparietal is entirely separated from both frontoparietals; ear-opening is somewhat larger; and there is a decided tendency toward a regular median series of transversely enlarged scales under the tail; the coloration is more decided and better contrasted but otherwise identical.

List of specimens of Leiopismā noctua.

Number.	Collection.	Age.	Locality.	When collected.	From whom received.	Remarks.
23446	U. S. N. M.	Adult	Hawaii		H. W. Henshaw	See p. 805.
23447	do	do	do		do	See p. 806.
25442	do	do	Hawaii, Hilo	Jan., 1899	do	
25443	do	do	do	do	do	
25444	do	do	do	do	do	

EMOIA¹ Gray.

(Fig. 12.)

1845.—*Emoia* GRAY, Cat. Liz. Brit. Mus., p. 95 (type, *Mabouya atrocostatus*).1857.—*Emoa* GIRARD, Proc. Phila. Acad., 1857, p. 197; extr., p. 5 (type, *E. nigrita*).1862.—*Emœa* COPE, Proc. Phila. Acad., 1862, p. 185 (emend.).

Eyelids well developed, movable, the lower one with an undivided transparent disk; supranasals present; interparietal fused with frontoparietals into a large shield.

The geographical range of this genus which corresponds nearly to Boulenger's section *Emoa* of his *Lygosoma* is covered by that of its most widely distributed species, namely, *E. cyanura*.

EMOIA CYANURA² (Lesson).

AZURE-TAILED SKINK.

1830.—*Scincus cyanurus* LESSON, Zool. Voy. *Coquille*, II, i, p. 49, pl. iv, fig. 2 (type locality, Tahiti).—*Emoa cyanura* GIRARD, U. S. Expl. Exp., Herpet. (1858), p. 270.—*Lygosoma cyanurum* BOULENGER, Cat. Liz. Brit. Mus., III (1887), p. 290.

1839.—*Eumeces lessonii* DUMÉRIL and BIBRON, Erpét. Gén., V, p. 654 (substitute name).—DUMÉRIL, Cat. Méth. Rept. Mus. Paris (1851), p. 157.

The azure-tailed skink has a very extensive range. It was first discovered in many of the Oceanian islands during the circumnavigation of the world by the French corvette *La Coquille*, and described by Lesson from Tahitian specimens. The U. S. Exploring Expedition added numerous other islands to the habitat of this species. Girard mentions it from Kings Island, Peacock's Island, Tahiti, Navigator and Fiji groups, Tongatabu, and the Philippine Archipelago; also from the "Sandwich Islands." According to the record book of the U. S. National Museum the exploring expedition obtained specimens on Mangsi Island, in the Balabac Passage, and in the Hawaiian Islands at Hilo (No. 5635, U.S.N.M.) and Mauna Kea, Hawaii (No. 5629, U.S.N.M.), but these have long since been lost. It seems that it was also obtained by Quoy and Gaimard in the Hawaiian Archipelago,³ specimens from these being

¹ From *Emo*, the alleged native name of one of the species in Tahiti.² From *κυάνεος*, glossy-blue; *οὐρά*, tail.³ Lesson, Voy. *Coquille*, Zool., II, i (1830), p. 21.

in the Paris Museum, according to Duméril. Dr. Otto Finsch collected it on Yaluit Island and on Ebon Island (Marshall Islands), Kushai (Carolines), and in Tarova (Gilbert Archipelago), according to Peters.¹ Boulenger records it from Celebes, the Moluccas, New Guinea, Admiralty Islands, Solomon Islands, New Hebrides, and many others. Curiously enough it seems to be absent in New Caledonia.

The name *E. lessonii* was afterwards bestowed upon the species, as *cyanurus* was believed to lead to confusion, there being a number of species which all have a blue tail.

Lesson says that the natives on Tahiti, where it lives in the habitations, call the species *Emo*, a name which he also attributes to a gecko, *Gehyra oceanica*.

The coloration of the Hawaiian specimens, whether from Oahu, Molokai, or Hawaii, is fairly uniform, with such variations as are mainly due to age, differing, however, to some extent from that of typical *E. cyanura* as described by Duméril and Bibron. According to them, and in conformity with the original figure,² in the latter a golden-yellow stripe follows the median line of the head, neck, and body to the tail; two lateral stripes united on the snout with the median line soon separate from it, passing over the superior border of the orbit and the sides of the body to the origin of the tail. All the Hawaiian specimens before me differ from this description. In only one of them does the median light stripe start from the snout, namely, in the youngest, the specimen from Molokai (No. 23517, U.S.N.M.). In the largest specimen (No. 23448, U.S.N.M.) from Hawaii there are no light stripes. The stripes start in all the others on the frontoparietal, leaving a dark-brown spot in the middle of this plate, and then separating on the parietals into the median and the two lateral light stripes. Moreover, the stripes do not extend to the base of the tail, but disappear gradually about the middle of the body, except in the very young specimen mentioned above, in which the median stripe only is clearly defined to the tail. Whether we have to do in this case with a distinct color variety, or whether age may account for the difference, can only be decided by comparison with large series of individuals from the other Polynesian islands.

Description.—No. 23448, U.S.N.M. Adult; Hawaii; collector, H. W. Henshaw. Rostral extending some little distance on the snout above in contact with nasals, supranasals, and the frontonasal; nasal small, consisting chiefly of a somewhat raised semilunar rim bordering the anterior half of the comparatively large nostril; behind nostril a triangular postnasal in contact with first supralabial, first loreal, and above with a very narrow supranasal, which borders the frontonasal and entirely shuts it out from contact with nasal and postnasal; frontonasal rather large, broadly in contact with rostral, supranasals, prefrontals, and also, but more narrowly, with first loreals and frontal;

¹ Sitz. Ber. Berlin Naturf. Fr., 1881, p. 72.

² Zool. Voy. Coquille, Rept., pl. IV, fig. 2.

frontal long, in contact with two anterior supraoculars; four large supraoculars; eight supraciliaries; frontoparietals and interparietal fused into a large shield in contact with frontal, second, third, and fourth supraoculars, though only very narrowly with the second, somewhat longer than frontal; parietal broadly contiguous behind frontoparietal (abnormally fused together in the present specimen), followed by a single large pair of nuchals in contact; first loreal in contact with postnasal, supranasal, frontonasal, prefrontal, second loreal, and second supralabial, higher than wide; second loreal larger, wider than high, in contact with second and third supralabials, and behind with two preoculars, of which the lower is the larger; eight supralabials, sixth and seventh much higher than the others, fifth very wide, twice the width of the anterior ones, bordering the whole lower edge of the orbit (abnormally divided in two on the right side of the present specimen); lower eyelid with a large transparent disk; ear-opening oval, small, about the size of the anterior supralabials; mental nearly straight behind, followed by a single unpaired postmental; eight narrow intralabials, of which the first is very small, triangular, and barely touching the postmental; thirty rows of smooth scales around the middle of the body, those on back and underside of uniform size and larger than those on the sides; scales in front of anal opening somewhat enlarged; toes underneath not covered with regular scales like those on top except under the more compressed portion near the tip, but with a regular series of very numerous transverse corrugations; tail underneath, with a regular median series of transversely enlarged scales.

Color.—Scales on upper parts narrowly edged with dark brown forming a regular network, the six median dorsal rows of a bronzed tawny olive, those on the sides more dark brown forming a broad dark band from behind the eyes to the root of the tail; top of head like back, interparietal and parietals each with a large ill-defined brown spot occupying most of the shield except the margins; underside of body paler than the back and more greenish, the throat with dusky margins to the scales; tail like upper surface becoming dull dark bluish on the posterior half.

Dimensions.—Total length, 126 mm.; snout to vent, 43 mm.; vent to tip of tail, 83 mm.; snout to ear-opening, 11 mm.; greatest width of head, 7 mm.; axilla to groin, 22 mm.; fore limb, 15 mm.; hind limb, 21 mm.

Variation.—The arrangement of the head shields offers but few variations in the specimens before me; the number of scale rows around the body is somewhat varying, however, as in Nos. 23449, 23452, U.S.N.M., for instance, I count twenty-eight rows. In most of the specimens there are a couple of minute knobs or lobes in the anterior border of the ear opening, but these are indistinguishable in the specimen described.

As to coloration there seems to be three distinct stages according to

age. First, the fully adult animal as described above. Next, the intermediate age which is somewhat similar, but in which the contrasts of the colors are stronger, the light tints of the back being lighter, more brassy, and the browns darker, nearly blackish; in this stage the dark spot on the parietals is very dark, each continued backward down the back in a dark longitudinal line which occupies the margins of the first and second scale rows on each side of the median line; with increasing age these two lines disappear in the direction from the tail toward the head; in this stage the supraoculars are also marked with dark irregular blotches, the underside, except throat, and the tail is decidedly bluish.

The third stage is that of the young represented in our series by No. 23517, U.S.N.M., from Molokai; in this the dorsal dark stripes are much wider and better defined, occupying more than one-half of the two scale rows; the spot on the parietal has a pale center; the lateral, blackish stripe extends less down on the sides but encroaches more on the dorsal space, the bronze color of the latter being reduced to a narrow lateral light stripe which extends anteriorly to the supraoculars; the entire median line from the tip of the snout to the root of the tail is occupied by a sharply defined whitish (in alcohol) stripe bordered on each side by the black lateral stripe; underside whitish; tail lighter blue, especially underneath.

List of specimens of Emoia cyanura.

Number.	Collection.	Age.	Locality.	When collected.	From whom received.	Remarks.
23448	U.S.N.M.	Adult	Hawaii		H. W. Henshaw	See p. 808.
23449	do	do	do		do	See p. 809.
23450	do	do	do		do	
23451	do	do	do		do	
23452	do	do	do		do	
23517	do	Juvenile.	Molokai, Kalae	Nov. 28, 1896	R. Meyer	See p. 809.
22604	do	Adult	Oahu, Honolulu.		Fish Commission steamer <i>Albatross</i> .	See p. 808.
22605	do	do	do		do	
22606	do	do	do		do	
22607	do	do	do		do	

ABLEPHARUS¹ Fitzinger.

(Fig. 13.)

1824.—*Ablepharus* FITZINGER, Verhandl. Ges. Naturf. Fr. Berlin, I (p. 297) (type, *A. pannonicus* Fitzinger).

1834.—*Cryptoblepharus* WIEGMANN, Herpet. Mex., p. 12 (type, *A. pacilopleurus*).

Eyelids rudimentary, not movable.

The genus as here understood is represented all over the warmer portions of the globe by the type of the subgenus *Cryptoblepharus*, which it would possibly have been better to accord generic rank. Not having access at present to the type species of *Ablepharus*, I have left the matter as presented by Boulenger.

¹From α, without; and βλέφαρον, eyelid.

ABLEPHARUS BOUTONII¹ PŒCILOPLEURUS² (Wiegmann).

SNAKE-EYED SKINK.

- 1835.—*Ablepharus pœciopleurus* WIEGMANN, Nova Acta Acad. Cæs. Leop.-Carol., XVII, i, p. 202, pl. XVIII, figs. 1-1a (type locality, islands at Pisacoma, Peru).
- 1851.—*Scincus plagiocephalus* PERON, in Duméril's Cat. Méth. Rept. Mus. Paris, p. 191 (type locality, Van Diemen Land).—*Cryptoblepharus plagiocephalus* GIRARD, U. S. Expl. Exp., Herpet. (1858), p. 220, pl. XXVI, figs. 17-24 ("Otaheite and Sandwich Islands").
- 1860.—*Ablepharus nigropunctatus* HALLOWELL, Proc. Phila. Acad., 1860, p. 487 (type locality, Bonin Islands).
- 1887.—*Ablepharus boutonii* var. *pœciopleurus* BOULENGER, Cat. Liz. Brit. Mus., III, p. 347.

Various closely related forms, the status and geographical distribution of which have not as yet been definitely ascertained, have been relegated as varieties, or subspecies, under *Ablepharus boutonii*, and there I am willing to leave them for the present. The Hawaiian specimens seem to agree best with the form described by Wiegmann, and are named accordingly.

De Freycinet collected this species in the Hawaiian Islands, his specimens being in the Museum at Paris,³ and the U. S. Exploration Expedition brought specimens from Oahu, Kauai (No. 5706, U.S.N.M.), and Hawaii (No. 5674, U.S.N.M.).

The frontal is separated from the frontonasal in all the Hawaiian specimens before me, the prefrontals in most cases forming a long suture between the shields mentioned, except in one of No. 5706, U.S.N.M., in which a small azygos shield is interposed between the others, being in fact the detached anterior angle of the frontal.

A much more interesting aberration is shown by No. 23507, U.S.N.M., from Kauai, in which there are very distinct and regular supranasals and postnasals, while in all the other specimens the nostril is pierced in an undivided nasal. There is, however, in many of them a distinct tendency to a suture back of the nostril, the first beginning of a separation of a postnasal, or the last trace of it. It is hardly to be expected that the individuals inhabiting Kauai will show a similar condition, which is probably only an individual (atavistic ?) variation. The specimen agrees in all other respects with those from the other islands.

In sending a single specimen of this species from Waiawa, Kauai the late Mr. V. Knudsen wrote me as follows:

The skinks are as common here as leaves on a tree; go along a cliff and you can see them all over it. But catch one! That is a difficult thing, for they are as quick as a flash of light and do not go far away from a hole or crack in the rocks, out of which nobody can get them. I have had six smart men with me for three days promising them a dollar apiece, and all I can send is one glossy, smooth, greenish thing with tiny spots.

¹ Named for Louis Bouton, a French botanist.

² From *ποικίλος*, mottled, and *πλευρά*, side.

³ Duméril, Cat. Méth. Rept. Mus. Paris, 1851, p. 191.

Description.—No. 5706a, U.S.N.M. Adult; Oahu or Kauai; collection U. S. Exploring Expedition. Rostral broadly in contact with nasals and frontonasal; nasal long, lozenge-shaped, pierced in the middle by the round nostril and with a groove, or suture, near the upper posterior corner from nostril to loreal suture; frontonasal large in contact with nasals, first loreals and prefrontals, not in contact with frontal; frontal small, considerably smaller than frontoparietal, in contact with two supraoculars; four supraoculars, second, third, and fourth in contact with frontoparietal; four supraciliaries (or five on the right side of the present specimen); frontoparietal large, nearly rectangular, narrowly in touch with frontal, and composed of the fusion of the two frontoparietals and interparietal; parietals large, broadly in contact behind frontoparietal; one pair of large nuchals scarcely in touch behind parietals, and followed by a double series of short very wide plates or scales which gradually decrease in width backward, emerging into the two median dorsal scale rows; first loreal high and narrow separating nasal from prefrontal; second loreal which is considerably lower and wider in contact behind, with only the upper preocular which is considerably larger than the lower one; the upper suture of the supralabials from the rostral to the anterior side of the subocular supralabial deeply depressed, forming a slightly arched groove which even indents the anterior portion of the subocular supralabial; seven supralabials, sixth largest, fifth forming a long low subocular (eight on left side, sixth entering orbit, in present specimen); ear-opening round, nearly the size of the anterior supralabials, with smooth margins without anterior knobs or lobules; mental rather short, followed by a single unpaired postmental; six narrow infralabials, fourth and fifth very elongate; twenty-eight rows of scales, more or less longitudinally rugose, those on back larger, nearly twice the size of those on sides and belly, their rugosities forming about five very blunt keels; those bordering anal opening in front scarcely enlarged; a median series of moderately widened scales under tail; covering under toes consisting of smooth scales like those on top.

Ground color above a light brownish bronze with numerous irregular dark brownish dots all over and a distinct pale band on each side from superciliaries to base of tail, and even fairly indicated on basal half of the latter; this pale band has very ragged edges, being intruded upon by blackish spots which form an irregular dark border on each side; sutures on the head with dark edges; sides and upper side of legs darker brownish with numerous whitish dots scattered all over; underside whitish; terminal third of tail becoming gradually pale brownish flesh color.

Dimensions.—Total length, 106 mm.; from snout to vent, 47 mm.; from vent to tip of tail, 59 mm.; from snout to ear-opening, 10 mm.; greatest width of head, 6 mm.; from axilla to groin, 22 mm.; fore legs, 15 mm.; hind legs, 19 mm.

Variation.—There is considerable variation in the shape and disposition of the head shields of this species. Allusion has already been made (p. 811) to the distinct separation of a supranasal and postnasal in the specimen received from Mr. Knudsen, from Kauai (No. 23507, U.S.N.M.). This specimen shows another marked anomaly, inasmuch as the second loreal is in contact behind with two preoculars, the upper one being divided horizontally. The relations between the frontonasal, prefrontals, and frontal are also subject to some variation, though all the Hawaiian specimens before me agree in having the prefrontals broadly in contact behind the frontonasal, thus separating this shield widely from the frontal, except in the specimen above described, in which they are separated by a small median unpaired shield which barely touches the frontonasal with its anterior angle, being in fact only the detached anterior portion of the frontal.

The ground color varies greatly, it being quite pale bronze green in some specimens. The specimens from Molokai are considerably darker above and decidedly bluish below, but this difference is probably due to the different preserving fluid.

The reproduced tail is dull flesh color freckled with brown.

List of specimens of Ablepharus boutonii pacilopleurus.

Number.	Collection.	Age.	Locality.	When collected.	From whom received.	Remarks.
5706 <i>a</i>	U. S. N. M.	Adult.	Oahu and Kauai	.....	U. S. Exploring Expedition.	Described, p. 812.
5706 <i>b</i>	do	do	do	.....	do	Tail reproduced.
5706 <i>c</i>	do	do	do	.....	do	
12260	do	do	do	.....	do	
23507	do	do	Kauai, Waiawa.	May —, 1895	V. Knudsen.	See p. 813.
23516	do	do	Molokai, Kalea	Nov. 26-28, 1896	R. Meyer	
23518	do	do	do	do	do	
23519	do	do	do	do	do	
23520	do	do	do	do	do	Tail reproduced.



KEY TO THE ISOPODS OF THE PACIFIC COAST OF NORTH AMERICA, WITH DESCRIPTIONS OF TWENTY-TWO NEW SPECIES.

By HARRIET RICHARDSON.

The isopods of the Pacific coast of North America have claimed the attention of a number of naturalists during the last half of the nineteenth century. Among the first to contribute to the knowledge of the fauna of that region was Dana. Stimpson also belongs to the earlier part of that period; his work on the Crustacea and Echinodermata of the Pacific shores of North America, published in 1857, was the first special treatise on the forms of that locality. In connection with the work of the later part of the past fifty years, the names of Stuxberg, Lockington, and Harford form one group as contemporaneous workers (1875-76), those of Schiødt and Meinert, and Budde-Lund, another group (1883-85), while the publications of Dr. Hansen and Dr. Benedict represent the latest (1898) work on the isopods of that coast.

The number of species already described is 75, and 22 are added in the present work. These species represent 44 genera and 16 families, as shown in the following table:

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41. <i>Bathyggyge</i>	869
94. <i>grandis</i> Hansen.....	869
42. <i>Cryptone</i>	869
95. <i>elongata</i> Hansen.....	869
43. <i>Parargeia</i>	869
96. <i>ornata</i> Hansen.....	869
44. <i>Ione</i>	869
97. <i>cornuta</i> Spence Bate.....	869

The author has used Dr. Benedict's keys for the genera *Synidotea* and *Arcturus*, and is indebted to Professor Sars for many suggestions obtained from his excellent work on the Crustacea of Norway. In many places his synopses of the families and genera have been used in entirety. Other authors have been most helpful; Hansen on the *Cirolanidae*; Schiødtte and Meinert on the *Cymothoidae*; Budde-Lund on the *Oniscidae*, and others, to whose works specific references are made.

The present paper is based on material contained in the U.S. National Museum.

ANALYTICAL KEY TO TRIBES, OR SUPERFAMILIES OF PACIFIC COAST ISOPODA.¹

- a. Legs of first pair cheliform. Uropoda terminal. Pleopoda, when distinctly developed, exclusively natatory..... I. CHELIFERA (p. 819).
- a'. Legs of first pair not cheliform.
 - b. Uropoda lateral.
 - c. Uropoda forming together with the terminal segment of the metasome a caudal fan. Pleopoda for the most part natatory.... II. FLABELLIFERA (p. 820).
 - c'. Uropoda valvelike, inflexed, arching over the pleopoda, which to a great extent are branchial..... III. VALVIFERA (p. 842).
 - b'. Uropoda terminal.
 - c. Free forms.
 - d. Pleopoda exclusively branchial, generally covered by a thin opercular plate (the modified first pair)..... IV. ASELOTA (p. 856).
 - d'. Pleopoda fitted for air-breathing..... V. ONISCOIDEA (p. 860).
 - c'. Parasitic forms..... VI. EPICARIDEA (p. 867).

I. CHELIFERA.

Family I. TANAIDÆ.

Body scarcely attenuated behind. Mandibles without palp. Coxal plates inconspicuous. Superior antennæ with one multiarticulate flagellum. Anterior maxillæ with only a single masticatory lobe; posterior ones quite rudimentary. Second pair of legs ambulatory in character. Epignath of maxillipeds narrow, falciform.

1. TANAIS Audouin and Milne-Edwards.

Antennæ short, subequal. Pleon five-jointed; fourth joint short; fifth joint terminated by a pair of single-branched filamentary uropoda. Only three pairs of pleopoda. Palp of anterior maxillæ biarticulate. Eyes well developed. Superior antennæ three-articulate, with small terminal flagellum.

ANALYTICAL KEY TO THE SPECIES OF TANAIS.

- a. Inferior antennæ scarcely half the length of superior antennæ. Pereiopoda having the first three joints short and broad, affixed to sides of pereion like plates of mail..... 1. *Tanais loricatus* Spence Bate.
- a'. Inferior and superior antennæ of nearly equal length. Pereiopoda with joints not dilated, slender..... 2. *Tanais alascensis*, new species.

1. TANAIS LORICATUS Spence Bate.

Tanais loricatus SPENCE BATE, Lord's Naturalist in British Columbia, II (1866), p. 282.

Habitat.—Esquimault Harbor, British Columbia.

2. TANAIS ALASCENSIS, new species.

Body three and a half times longer than broad.

Head large, narrowed anteriorly. Frontal margin almost straight.

¹Sars's analytic key has been used with slight modifications. Sars's "An Account of the Crustacea of Norway," II, Isopoda (1896), Pts. I, II, p. 3.

First pair of antennae short, stout, consisting of four joints, the first joint being the longest. Second pair of antennae more slender, a little longer, consisting of four joints, the first joint being longest, and a rudimentary flagellum. Eyes small and pedunculated.

The first segment of the thorax is confluent with the head. The second, third, fourth, and fifth segments increase slightly in length; the fifth and sixth are about equal; the seventh is not quite so long as the preceding one.

The abdomen is composed of five segments, the first three of which are subequal; the fourth is short, about half as long as any of the others and also narrower; the terminal segment is as long as the two preceding ones together, and is rounded posteriorly, with a slight median notch. The segments of the abdomen decrease in width gradually from the first to the terminal segment. The terminal filaments are seven-jointed and single-branched, and are furnished at their extremities with a few long hairs.

The first pair of legs are stout and chelate; the propodus is produced into a strong immovable finger, irregular in shape, having its central portion raised and truncate on its upper surface, which is distinctly serrate. The dactylus is likewise serrate on its inner surface. The other legs are slender, with a gradual increase in stoutness.

Color brown, marked in some specimens with a darker brown, and having oval patches of the darker color on the head.

Kyska Harbor, Alaska; Mr. W. H. Dall collector; depth, 6 to 8 fathoms.

Type.—No. 22563, U.S.N.M.

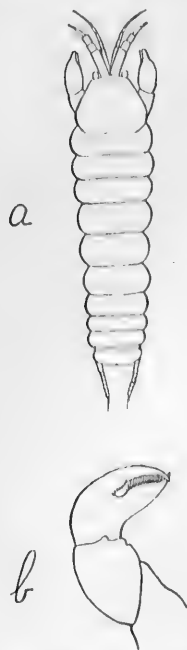


FIG. 1. *TANAIS ALASCENSIS*, NEW SPECIES.
X 8. *a*, DORSAL VIEW;
b, LAST TWO JOINTS
OF LEG OF THE FIRST
PAIR.

II. FLABELLIFERA.

ANALYTICAL KEY TO THE FAMILIES OF FLABELLIFERA.

- a*. Pleon consisting of six segments.
 - b*. Uropoda with one of the branches almost obsolete or rudimentary—not lamelliform Family II. LIMNORHIDE (p. 821).
 - b'*. Uropoda with both branches developed; mostly lamelliform.
 - a'*. Maxillipeds with the palp free, the margins of the last two joints more or less setose, never furnished with hooks.

¹The four points following *b'* are taken from Hansen's analytic key of the Ciro-lanidae (Vidensk. Selsk. Skr., 6th ser., natur. og math. Afd. V, 1890, p. 317), as translated by Stebbing, Hist. of Crust., 1893, pp. 340, 341.

d. Mandibles with the rather broad, more or less tridentate, cutting edges meeting squarely behind the large upper lip; the secondary plate and peculiar equivalent for the molar well developed. First maxillæ having the plate of the first joint armed with three spines, that of the third with many. Second maxillæ of moderate size, the three free plates very setose. Maxillipeds with the palp rather broad, very setose.

Family III. CIROLANIDÆ (p. 822).

d'. Mandibles with the distal part produced into a long prominent process, the pair much overlapping; the secondary plate and molar evanescent. First maxillæ having the plate of the first joint unarmed, of the third carrying one very long spine. Second maxillæ small and feeble, the free plates almost rudimentary, with few setæ. Maxillipeds with the palp narrowed, not very setose..... Family IV. CORALLANIDÆ (p. 825).

e'. Maxillipeds with the palp embracing the cone formed by the distal parts of the mouth organs, the inner upper margin and apex never setose, the apex and sometimes the inner upper margin at least in the males and females without eggs, being furnished with outward curved hooks.

d. Mandibles with the secondary plate very often visible; palp with no inflated joint. Maxillipeds commonly seven-jointed, sometimes four-jointed, the last joint in the latter case rather short, obtuse. Antennæ¹ long, unequal, with well-defined peduncle and flagellum.... Family V. AEGIDÆ (p. 825).

d'. Mandibles with no secondary plate; the palp in adults with first joint or both first and second joints inflated. Maxillipeds always four-jointed, last joint rather long and narrow, subacute. Antennæ¹ much reduced without clear distinction between peduncle and flagellum.

Family VI. CYMOTHOIDÆ (p. 828).

a'. Pleon consisting of less than six segments.

b. Pleon with two segments. Uropoda with one branch fixed, immovable.

Family VII. SPHEROMIDÆ (p. 831).

b'. Pleon with four segments. Uropoda with both branches movable.

Family VIII. SEROLIDÆ (p. 842).

Family II. LIMNORIIDÆ.

2. LIMNORIA Leach.

3. LIMNORIA LIGNORUM (Rathke).

Cymothoa lignorum RATHKE, Skrift. af Naturh. Selsk., V, 1799, p. 101, pl. 3, fig. 14 (White).

Limnoria tenebrans LEACH, Ed. Encycl., VII, 1813, p. 433 (Am. ed., p. 273); Trans. Linn. Soc., XI, 1815, p. 371; Diet. Sci. Nat., XII, 1818, p. 353.—DESMAREST, Consid. Crust., 1825, p. 312.—LATREILLE, Règne Anim., IV, 1829, p. 135.—EDWARDS, Annot. de Lamarek, V, 1838, p. 276; Hist. Nat. des Crust., III, 1840, p. 145; Règne Anim., Crust., 1849, p. 197, pl. 67, fig. 5.—GOULD, Invert. Mass., 1840, pp. 338-354.—VERRILL, Proc. Am. Assoc., 1873 (1874), p. 367.

Limnoria lignorum WHITE, Pop. Hist. Brit. Crust., 1857, p. 227, pl. 12, fig. 5.—BATE, Rep. Brit. Assoc., 1860 (1861), p. 225.—BATE and WESTWOOD, Brit. Sess. Crust., II, 1868, p. 351.—NORMAN, Rep. Brit. Assoc., 1868 (1869), p. 288.—VERRILL, Am. Journ. Sci., 3d ser., VII, 1874, pp. 133, 135; Proc. Am. Assoc., 1873 (1874), p. 371; Report U. S. Commissioner of Fish and Fisheries, 1874, Pt. 1, p. 379 (85).—HARGER, Report U. S. Commissioner of Fish and Fisheries, 1874, Pt. 1, p. 571 (277), pl. VI, fig. 25; Proc. U. S. Nat. Mus., II, 1879, p. 161.—STEBBING, Trans. Devon. Assoc., 1874, p. 8; Ann. Mag. Nat. Hist., 4th ser., XVII, 1876, p. 79.—SMITH, Proc. U. S. Nat. Mus., II, 1879 (1880), p. 232, fig. 2.

¹ Inserted by author.

Limnoria uncinata HELLER, Verh. k. k. Zool. Bot. Ges. Wien, XVI, 1866, p. 734.

Limnoria lignorum HARGER, Report U. S. Commissioner of Fish and Fisheries, 1878, Pt. 4, pp. 373, 376. (See Harger for further synonymy.)

Limnoria californica HEWSTON, Proc. Cal. Acad. Sci., V, 1874, p. 24 (*nomen nudum*).

Habitat.—Pacific Ocean; Bering Island. Also found on East coast of North America from Florida to Halifax, on the coast of Great Britain, and in the North Sea. Specimens from San Diego, California, collected by Mr. Henry Hemphill and labeled "*Limnoria californica* Hewston" are in the National Museum.

Family III. CIROLANIDÆ.

ANALYTICAL KEY TO THE GENERA OF CIROLANIDÆ.¹

- a. Peduncle of second antennæ five-jointed. Plate of second joint of maxillipeds furnished with hooks. First and second pleopods alike, with at least inner branch submembranaceous. Uropoda with inner angle of peduncle produced. 3. *Cirolana*.
- a'. Peduncle of second antennæ four-jointed. Plate of second joint of maxillipeds without hooks. Pleopoda with both branches submembranaceous. Uropoda with inner angle of peduncle very little produced. Superior antennæ with first joint of peduncle quite short, and extended straight in front at a right angle to remaining part of the antenna 4. *Eurydice*.

3. CIROLANA Leach.

ANALYTICAL KEY TO SPECIES OF CIROLANA.

- a. Head without median process. First pair of antennæ reach apex of peduncle of second pair of antennæ. Terminal abdominal segment subtriangular, armed on its posterior margin with twenty-six spines. Both branches of the uropoda rounded posteriorly and armed with spines. 4. *Cirolana harfordi* (Lockington).
- a'. Head with long, straight median projection. First pair of antennæ reach the posterior margin of the third thoracic segment. Terminal abdominal segment rounded and crenulate on its posterior margin and fringed with long hairs. Inner branch of the uropoda obliquely truncate posteriorly. 5. *Cirolana linguifrons*, new species.

4. 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.

Habitat.—Victoria, British Columbia; California: Santa Rosa Island, San Diego, Catalina Harbor, Pacific Grove, Monterey Bay; Lower California, specimens lighter in color.

Miers² remarks upon having examined specimens of *Æga harfordi*, sent by Mr. Lockington to the British Museum and designated *Idotea*

¹ The characters in this key on the Cirolanidæ are taken from Stebbing, "History of Crustacea," (1893), p. 342.

² Miers, Journ. Linn. Soc. London, XVI, 1883, p. 19.

harfordi in a manuscript note of the author. He considers that the specimens belong to the genus *Cirolana*, or a closely allied type, without further identifying them. Hansen¹ also states that, according to Miers, *Æga harfordi* is probably a *Cirolana*. He had not seen Lockington's description, but followed Miers regarding the systematic position of the species.

Specimens of *Æga harfordi* were sent by Mr. S. J. Holmes to the National Museum from the California Academy of Sciences, which prove to be identical with *Cirolana californica* Hansen.

5. CIROLANA LINGUIFRONS, new species.

Color, yellow, marked with scattered black dots. Body elongate-ovate, about five times longer than broad, greatly convex.

Head with the frontal margin produced in a long, straight process, rounded anteriorly and somewhat dilated. Eyes large, distinct. First pair of antennæ with joints of the peduncle large; flagellum of fifteen short joints extends to the posterior margin of the third thoracic segment. Second pair of antennæ, with a flagellum of thirteen long joints, extend to the posterior margin of the fifth thoracic segment.

The first three segments of the thorax are short; the other four segments are long. The epimera of the second, third, and fourth segments are not produced at the apex; those of the fifth, sixth, and seventh but slightly produced.

All the abdominal segments conspicuous, the first five being of equal length. The terminal segment is rounded posteriorly, faintly crenulate and fringed with long hairs. The base of this segment is raised above the other portion and has a well-defined edge with two points extending backward, one on either side of the median line. The uropoda extend beyond the tip of the abdomen; the inner branch is obliquely truncate; the outer branch is more rounded; both branches are fringed with long hairs.

The prehensile legs are short; the gressorial legs are long and slender. The legs increase gradually in length from the first to the seventh pair.

Two specimens, from Monterey Bay, California, collected by Mr. Heath from sandy shore at mean tide.

Type.—No. 22564, U.S.N.M.

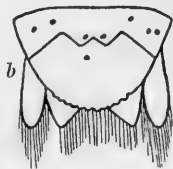


FIG. 2.—*CIROLANA LINGUIFRONS*. $\times 13\frac{1}{2}$. *a*, HEAD; *b*, TERMINAL SEGMENT.

¹Hansen, Vidensk. Selsk. Skr., 6th ser., natur. og math. Afd. V, 1890, pp. 338, 339; for synonymy see p. 357.

4. EURYDICE Leach.

6. EURYDICE CAUDATA, new species.

Body elongate and narrow. In male, abdomen is equal in length to thorax; in female, it is shorter. Surface of body smooth.

Head widely rounded in front; its anterior margin narrowly thickened. Eyes large and round and situated at a distance of one-third the width of the head apart. First pair of antennae extend to the posterior margin of the head; flagellum contains five articles, the first of which is very long and those following quite short. The second pair of antennae extend as far as the posterior margin of the fourth segment of the abdomen; the flagellum consists of twenty-five long, slender joints. In the female, the second pair of antennae are much shorter, reaching only to the posterior margin of the last thoracic segment; the flagellum contains about twenty joints.

The thoracic segments are subequal. The epimera are narrow, and those of the last three or four segments acutely pointed.

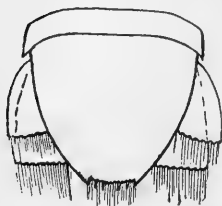


FIG. 3.—EURYDICE CAUDATA;
LAST TWO ABDOMINAL SEG-
MENTS. GREATLY ENLARGED.

All the abdominal segments are visible in a dorsal view. The terminal segment is rounded at the sides and truncate at its extremity, the lateral angles being produced in a short triangular process, between which the posterior margin is distinctly denticulate, and bears four spines, which are about twice as long as the lateral teeth. The uropoda are short, not reaching the extremity of the terminal segment, are truncate and crenulate on their posterior margins. The uropoda, as well as the terminal, segment are fringed with short hairs.

The legs are long and slender and armed with many spines.

Color, light brown marked with black spots.

Individuals of this species were collected at Isthmus Cove, Catalina Island, California, by the U. S. Fish Commission steamer *Albatross*.

Type.—No. 22565, U.S.N.M.

This species resembles *E. grimaldii* Dollfus¹ more closely than it does any other species of the genus. It differs in the following characters:

1. The greater number of joints in the flagellum of the first pair of antennae. In our species there are five joints, while in *E. grimaldii* the flagellum is uniarticulate.

2. In the fewer number of joints in the flagellum of the second pair of antennae. In our species there are only twenty-five, while in *E. grimaldii* the flagellum contains thirty-two articles.

3. In the presence of four spines on the posterior margin of the

¹Bull. Soc. Zool. France, XIII, 1888, pp. 35, 36; Sur Quelques Crustacés Isopodes du Littoral des Açores, A. Dollfus.

terminal segment. In *E. grimaldii* the posterior margin is denticulate. In our species it is denticulate, and also bears four spines.

Family IV. CORALLANIDÆ.

5. CORALLANA Dana.

7. CORALLANA TRUNCATA, new species.

Body elongate, about three and a half times longer than wide; color, yellow.

Head with a small median point. Eyes large, situated but a little distance apart. First pair of antennæ, with a flagellum of about nine articles, extend to the antero-lateral angle of the first thoracic segment. Second pair of antennæ broken in specimen.

First segment of the thorax is as long as the head, and about one and a half times longer than any of the other segments. Epimera of the second and third segments narrow; those of the remaining segments very broad.

The first abdominal segment is almost entirely covered by the last thoracic segment. The second, third, and fourth segments are tuberculated on their posterior margins. The fifth segment is also tuberculated, the tubercles on either side of the median line of tubercles being larger and more conspicuous. At the base of the terminal segment are four tubercles, the two center ones being the larger. The terminal segment is subtriangular with truncate apex. The posterior margin is armed with spines. The inner branch of the uropoda is truncate posteriorly, and armed with spines; it is about twice as broad as the outer branch, which is lanceolate in shape.

There is but one specimen, from Catalina Island, California; collected by Dr. J. G. Cooper.

Type.—No. 22566, U.S.N.M.

Family V. ÆGIDÆ.

ANALYTICAL KEY TO GENERA OF ÆGIDÆ.

- a. Body rather compact. Superior antennæ short, with first two peduncular joints more or less expanded. Epistome large, linguiform, projecting between the bases of inferior antennæ. Maxillipeds with palp composed of five joints. Anterior pairs of legs with propodus simple, cylindrical, not expanded, dactylus abruptly curved in middle. Front separating the whole or a great part of the first article of the first pair of antennæ. Flagellum of first pair of antennæ composed of many articles. Abdomen compact.....6. *Æga*.



FIG. 4.—CORALLANA TRUNCATA. 134.
a, HEAD; b, ABDOMEN AND LAST THORACIC SEGMENT.

a'. Body more depressed than in *Æga*. Superior antennæ short, with basal joints not expanded. Epistome very small and narrow. Maxillipeds with palp composed of only two joints. Anterior pair of legs with propodus more or less expanded, dactylus forming a very large and evenly curved hook. Front covering more or less the peduncle of the first pair of antennæ. Flagellum of first pair of antennæ composed of four to six articles. Abdomen relaxed. . . 7. *Rocinela*.

6. *ÆGA* Leach.

ANALYTICAL KEY TO SPECIES OF *ÆGA*.

a. Eyes very small; second joint of first pair of antennæ without process at its apex; terminal abdominal segment triangular, with rounded apex; inner branch of uropoda with apex faintly arcuate obliquely.

8. *Æga microphthalma* Dana.

a'. Eyes almost contiguous; second joint of first pair of antennæ with a process at its apex nearly as long as following joint; terminal abdominal segment with its apex arcuate-truncate; inner branch of uropoda subtruncate.

9. *Æga lecontii* (Dana).

8. *ÆGA* MICROPHTHALMA Dana.

Æga microphthalma DANA, Proc. Acad. Nat. Sci. Phila., VII, 1854, p. 176.—STIMPSON, Journ. Bos. Soc. Nat. Hist., VI, 1857, p. 68.

Habitat.—Monterey, California.

9. *ÆGA* LECONTII (Dana).

Ægacylla lecontii DANA, Proc. Acad. Nat. Sci. Phila., VII, 1854, p. 177.—STIMPSON, Journ. Bos. Soc. Nat. Hist., VI, 1857, p. 69.

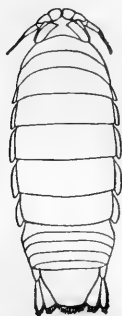
Habitat.—California.

Body elongate, oval; surface smooth; color yellow, with a few brown dots; eyes reddish brown.

Head with anterior margin bisinuated, the median point separating the basal joints of the first pair of antennæ and extending one-third the length of these joints. Eyes large, oval, very close together at upper inner angle. First pair of antennæ with basal joints very large, dilated; second joint of peduncle dilated, and with a process at its apex extending nearly the length of the third joint; third joint very narrow, about one-third the width of two preceding joints; flagellum, composed of seven joints, extends the length of the peduncle of second pair of antennæ. Second pair of antennæ, with a flagellum of twelve joints, extend almost to the posterior margin of the first thoracic segment.

The last four thoracic segments are each a little longer than any of the first three. The epimera are narrow, with rounded post lateral angles.

FIG. 5.—*ÆGA* LECONTII (DANA).
× 2.



The five abdominal segments are of equal length. The terminal segment is subtriangular with truncate extremity; its posterior margin is crenulate and fringed with hairs. The uropoda exceed slightly the length of the abdomen. The inner branch

is about twice as wide as the outer branch; is obliquely truncate, and crenulate. The outer branch is narrow, rounded posteriorly, and smooth. Both branches are fringed with hairs.

The legs are long and slender. Five spines are present on the merus of the prehensile legs. The gressorial legs are but slightly spinulose.

Two specimens examined were collected at Monterey Bay, California, by Mr. Heath.

The description of this species of *Æga* by Dana as *Ægacylla lecontii* was from a young specimen.¹ The individual sent us is thought to be the adult form, and differs from Dana's description² of the young individual in the crenulated posterior margin of the terminal segments, in the truncated inner branch of the uropoda, and in the addition of two joints to the length of the flagellum of the second pair of antennæ.

7. ROCINELA Leach.

ANALYTICAL KEY TO SPECIES OF ROCINELA.

- a. Flagellum of second pair of antennæ with fourteen to sixteen joints.
 - b. Propodus of prehensile legs with two to four spines.
 - c. First thoracic segment with antero-lateral angles produced hornlike at sides of head. Frontal margin of head produced. Spots wanting on fourth and fifth abdominal segments and base of terminal segment.
 - 10. *Rocinela cornuta* Richardson.
 - c'. First thoracic segment normal. Frontal margin of head not produced. Spots present on fourth and fifth abdominal segments and base of terminal segment.
 - 11. *Rocinela belliceps* (Stimpson).
 - b'. Propodus of prehensile legs with five or six spines.
 - 12. *Rocinela laticauda* Hansen.
- a'. Flagellum of second pair of antennæ with ten to eleven joints.
 - b. Tubercles developed on all the segments of the body.
 - 13. *Rocinela tuberculosa* Richardson.
 - b'. No tubercles developed on body. Terminal segment of body ornamented with a very wide crescentiform band, from whose posterior border three large hastiform stripes project backwards.
 - 14. *Rocinela aries* Schiødt and Meinert.

10. ROCINELA CORNUTA Richardson.

Rocinela cornuta RICHARDSON, Proc. Am. Phil. Soc., XXXVII, 1898, p. 12, figs. 1, 2.

Habitat.—Off Shumagin Bank, Alaska.

11. ROCINELA BELLICEPS (Stimpson).

Æga belliceps STIMPSON, Proc. Acad. Nat. Sci. Phila., XVI, 1864, p. 155.

Æga alaskensis LOCKINGTON, Proc. Cal. Acad. Sci., VII, 1877, Pt. 1, p. 46.

Rocinela alascensis RICHARDSON, Proc. Am. Phil. Soc., XXXVII, 1898, p. 11.

¹Schiødt and Meinert regard *Ægacylla* Dana as synonymous with *Æga*, and remark that Dana's specimen, by which the genus *Ægacylla* was instituted was a young *Æga*. See Naturhistorisk Tidsskrift, XII, 1879-80, p. 334. See also Lütken, Vid. Medd. Naturh. For., 1860, p. 180.

²There are no specimens of the young in the National Museum.

Habitat.—Cortes Bank, California, to Alaska and Bering Sea.

12. *ROCINELA LATICAUDA* Hansen.

Rocinela laticauda HANSEN, Bull. Mus. Comp. Zool., XXXI, 1897, No. 5, pp. 108, 109.—RICHARDSON, Proc. Am. Phil. Soc., XXXVII, 1898, pp. 14, 15, figs. 5, 6.

Habitat.—Off Acapulco; near Tres Marias Islands; off Mazatlan; off San Luis Obispo Bay, California; off Esteros Bay, California; Puget Sound, Washington; Unimak Island, Alaska.

13. *ROCINELA TUBERCULOSA* Richardson.

Rocinela tuberculosa RICHARDSON, Proc. Am. Phil. Soc., XXXVII, 1898, p. 16, fig. 10.

Habitat.—Southern part of Gulf of California.

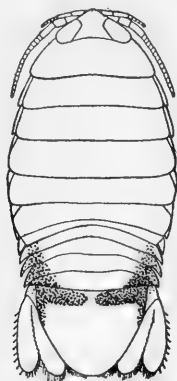


FIG. 6.—*ROCINELA BELLICEPS* (STIMPSON). $\times 2\frac{1}{2}$.

14. *ROCINELA ARIES* Schiedte and Meinert.

Rocinela aries SCHIEDTE and MEINERT, Naturhistorisk Tidsskrift, XII, 1879–80, pp. 401–403, pl. XIII, figs. 7, 8.

Habitat.—Mazatlan; Lower California; Panama Bay.

Family VI. CYMOTHOIDÆ.

ANALYTICAL KEY TO THE GENERA OF CYMOTHOIDÆ.

a. Head deeply immersed or set in the first thoracic segment, whose antero-lateral angles project forward.

b. Abdomen deeply immersed.

First pair of antennæ more often dilated, rarely compressed. First four or five segments of body long, subequal in length, except the first, which is a little longer; last two or three segments abruptly shorter, very often decreasing gradually in length. Terminal segment of abdomen subtriangular or semicircular, often bilobed. Body oblong 8. *Meinertia*.

b'. Abdomen scarcely immersed.

First pair of antennæ very much compressed. Segments of thorax either equal in length or the first segment abruptly longer than the others and the last segment abruptly shorter than the others. Terminal segment of the abdomen varying in size and form. Body sub-oval, more or less contorted. 9. *Livoneca*.

a'. Head not at all immersed.

b. Body relaxed. Posterior angles of first segment of body prominent or produced, very often acute; posterior angles of the following segments increasing gradually in length, the first of these very often scarcely prominent, the posterior ones very often produced, abruptly longer than the first. Epimera of the first segments very often involuted, and extending beyond the posterior angle of the segment; posterior ones produced, acute. Sides of the first five segments of abdomen more or less profoundly incised. 11. *Nerocila*.

b'. Body compact. Posterior angles of first segment of body scarcely prominent, occasionally produced, those of following five segments scarcely or not at all prominent; those of seventh segment produced. Epimera of first segments very often almost reaching, or not reaching by a short distance, the posterior angle of the segment. Sides of the first segments of the abdomen, whole or obscurely emarginated, of the posterior ones gradually more profoundly emarginated or incised. 11. *Anilocra*.

8. MEINERTIA Stebbing.¹

15. MEINERTIA GAUDICHAUDII (Milne-Edwards).

Cymothoa gaudichaudii MILNE-EDWARDS, Hist. Nat. Crust., III, 1840, p. 271.

Ceratothoa rapax HELLER, Reise Novara Crust., XII, p. 146, fig. 17.

Ceratothoa gaudichaudii SCHIÖDTE and MEINERT, Naturhistorisk Tidsskrift, XIII, 1881-83, pp. 335-340, pl. XIII, figs. 11-15.

Habitat.—Mazatlan.

9. LIVONECA Leach.

ANALYTICAL KEY TO SPECIES OF LIVONECA.

a. Terminal segment obscurely carinated, and sides enfolded. Caudal appendages destitute of accessory lamellæ. 16. *Livoneca californica* Schiödt and Meinert.

a'. Terminal segment not carinated, sides not enfolded. Caudal appendages furnished with accessory lamellæ.

b. Inner branch of uropoda a little longer and wider than outer branch. Terminal segment sublinguate. Abdomen deeply set in thorax.

17. *Livoneca vulgaris* Stimpson.

b'. Inner branch of uropoda a little longer and much narrower than outer branch. Terminal segment semicircular. Abdomen less deeply inserted in thorax.

18. *Livoneca panamensis* Schiödt and Meinert.

16. LIVONECA CALIFORNICA Schiödt and Meinert.

Livoneca californica SCHIÖDTE and MEINERT, Naturhistorisk Tidsskrift, XIV, 1883-84, pp. 372-374, pl. XVI, figs. 1, 2.

Habitat.—Shores of California, near San Francisco.

¹ Hist. of Crust., 1893, p. 345.

17. *LIVONECA VULGARIS* Stimpson.

Livoneca vulgaris STIMPSON, Journ. Bos. Soc. Nat. Hist., XXII, 1857, p. 68, pl. XXII, fig. 9.—SCHIEDTE and MEINERT, Naturhistorisk Tidsskrift, XIV, 1883-84, pp. 344-349, pl. XIV, figs. 1, 2.

Habitat.—Shores of California, near San Francisco, to Santa Margarita Island, Lower California.

18. *LIVONECA PANAMENSIS* Schiedte and Meinert.

Livoneca panemensis SCHIEDTE and MEINERT, Naturhistorisk Tidsskrift, XIV, 1883-84, pp. 349-353, pl. XIII, figs. 11, 12.

Habitat.—Mazatlan; west shores of Central America; Panama.

10. *NEROCILA* Leach.19. *NEROCILA CALIFORNICA* Schiedte and Meinert.

Nerocila californica SCHIEDTE and MEINERT, Naturhistorisk Tidsskrift, XIII, 1881-83, pp. 72-76, pl. v, figs. 12, 13; pl. vi, figs. 1, 2.

Habitat.—San Diego, California; Panama Bay.

11. *ANILOCRA* Leach.20. *ANILOCRA OCCIDENTALIS*, new species.

Body two and one-half times longer than broad.

Head large, broader than long, one-half as broad as the first thoracic segment, produced in front in a short, blunt process, whose anterior edge is roundly truncate. Eyes large, situated at a distance equal to almost half the width of the head apart. The first pair of antennae are composed of eight joints and extend to the middle of the first thoracic segment. The second pair of antennae are composed of nine joints and extend to the posterior angle of the first thoracic segment; they are more slender than the first pair of antennae.

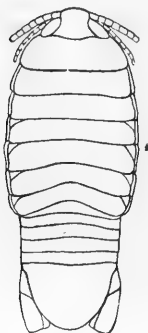


FIG. 7.—*ANILOCRA OCCIDENTALIS*. $\times 4$.

The first thoracic segment is trisinuated on its anterior margin, and is one and a half times longer than the second thoracic segment. The other segments are subequal. The sixth and seventh segments are somewhat narrower than the fifth, and the seventh is a little narrower than the sixth. All the epimera are long and narrow and more or less rounded posteriorly; they extend fully to the posterior angle of their corresponding segments, a character not found in any other species of the genus.

The first abdominal segment is partly covered at the sides by the last thoracic segment. The first five segments are about equal in length and width. The terminal segment is slightly wider than long, equal in length to the other abdominal segments taken together, is impressed at the base, and posteriorly rounded. The uropoda are

longer than the last abdominal segment. Both branches are similar in shape and size; they are oarlike, with truncate rounded extremities.

The legs increase slightly in length. The basis of all the legs is carinated on the inferior margin.

Color a light brown, marked with numerous black dots over the whole surface of the body, with the exception of the posterior half of the last abdominal segment and the inner branch of the uropoda, which are a light clear yellow without spots. The outer branch of the uropoda, which is almost black, contrasts in a marked degree with the light inner branch. In the caudal segment the change from the darker to the lighter half is graduated, making the contrast less marked.

Two individuals of this species were taken; one by the U. S. Fish Commission steamer *Albatross*, station 3138, at a depth of 19 fathoms, and one by Dr. D. S. Jordan, both at Monterey Bay, California. One was imperfect.

Type.—No. 22567, U.S.N.M. Monterey Bay. Depth, 19 fathoms.

When compared with *A. laevis* Miers¹ from Peru this species differs in the shape of the anterior portion of the head, which in *A. laevis* is narrowed and rounded, while in *A. occidentalis* it is truncate; in the greater length of the first thoracic segment and the equality in length of the succeeding segments in *A. occidentalis*, while in *A. laevis* the sixth segment is the longest, the others being of nearly equal length; in the length of the epimera, which in *A. occidentalis* attain the posterior margin of the corresponding segments, while with *A. laevis* they are all very small and somewhat spiniform in the fifth to the seventh segments; in the greater breadth posteriorly of the terminal segment of the body in *A. laevis*, and in the shape and length of the uropoda in the two species, the two branches being of unequal length, lamellate in shape (the inner one the longer), and both shorter than the last segment of the body in *A. laevis*, while in *A. californica* they are equal in length, similar in shape, oarlike, and longer than the terminal segment.

Family VII. SPHÆROMIDÆ.

ANALYTICAL KEY TO THE GENERA OF SPHÆROMIDÆ.

- a. Both exterior and interior branches of uropoda projecting.
 - b. Terminal segment of the abdomen excavated at its extremity...12. *Dynamene*.
 - b'. Terminal segment of abdomen entire.
 - c. Margins of head not produced; antennæ conspicuous; legs normal; mandibles with five-jointed palp 13. *Spharoma*.
 - c'. Anterior and lateral margins of head produced, concealing antennæ; propodus of first and second pairs of legs dilated, with reflexed dactylus; mandibles with three-jointed palp 14. *Tecticeps*.
- a'. Only exterior branch of uropoda projecting; penultimate abdominal segment in male generally produced in spine; terminal segment excavated with median tooth..... 15. *Cilicæa*.

¹ Proc. Zool. Soc. London, 1877, p. 672, pl. LXVIII, fig. 6.

12. DYNAMENE Leach.

ANALYTICAL KEY TO THE SPECIES OF DYNAMENE.

- a. Frontal margin of head produced in a quadrangular process; first two joints of first pair of antennæ dilated..... 21. *Dynamene dilatata*, new species.
- a'. Frontal margin of head not produced; joints of first pair of antennæ not dilated.
- b. Abdomen tuberculated. Neither branch of uropoda reaching extremity of abdomen 22. *Dynamene tuberculosa*, new species.
- b'. Abdomen not tuberculated. Inner branch of uropoda reaching extremity of abdomen.
- c. Ultimate segment of abdomen ridged. Branches of uropoda of equal length. Sinus at extremity of abdomen funnel shaped. 23. *Dynamene benedicti*, new species.
- c'. Ultimate segment of abdomen smooth. Outer branch of uropoda but little more than half as long as inner branch. Sinus at extremity of abdomen small 24. *Dynamene glabra*, new species.

It has been suggested by several authors¹ that *Dynamene* may prove to be the female of *Nasa*, but until facts can be produced to substantiate this assumption, it is necessary to retain the genus *Dynamene*.

21. DYNAMENE DILATATA, new species.

Body oval; surface very granular; color yellow.

Head rugose, with its anterior margin produced in a quadrangular process, having a small median projection, rounded antero-lateral angles and a thickened edge. First pair of antennæ extend to the posterior margin of the head, first two joints flattened and enlarged; first joint oblong, second joint triangular, and half as long as preceding joint; third joint small, as long as second, but half as wide; flagellum six-jointed. Second pair of antennæ are but little longer than first pair and do not reach the posterior margin of the first thoracic segment.

The thoracic segments are of equal length. The epimera are square or oblong, with straight lateral margins.

The penultimate abdominal segment is short, and crossed with suture lines. The terminal segment is triangular with a small rounded notch at the apex. There are three longitudinal ridges on the segment, one in the median line, and one on either side of it. The uropoda

are short, not reaching the extremity of the abdomen, and regularly rounded.

The legs are slender; the first two pairs are covered with long hairs,

FIG. 8.—DYNAMENE DILATATA.
a, HEAD AND FIRST THORACIC SEGMENT. $\times 13\frac{1}{2}$. b, DORSAL VIEW. $\times 10\frac{3}{4}$.



¹ Hesse, Ann. Sci. Nat., 5th ser., XVII, pp. 5, 6; Stebbing, Hist. of Crust., 1893, p. 361; Bate and Westwood, British Sessile-Eyed Crust., II, p. 432.

and extend in an anterior direction, the other five pairs extend in a posterior direction.

The type and only specimen was collected by Mr. Heath at Monterey Bay, California, at the surface. No. 22568, U.S.N.M.

22. DYNAMENE TUBERCULOSA, new species.

Body oblong-ovate; color, light yellow, almost white; surface of abdomen tuberculated.

Head large, much broader than long, with a wide anterior margin, broadly curving on either side of a small median point. Eyes small, and situated at the extreme post-lateral angle of the head. The first pair of antennæ, composed of eight articles, reach beyond the middle of the first thoracic segment. The second pair of antennæ, composed of twelve articles, extend to the posterior angle of the first thoracic segment.

The first segment of the thorax is one and a half times longer than any of the other segments, which are about equal in length. The epimera, which are distinctly marked, and roundly produced at their posterior angles, are much broader than long.

The first abdominal segment is transversely crossed by three suture lines, indicated at the sides of the segment. Three small tubercles are situated in a transverse line on the posterior margin of this segment. The terminal segment is subtriangular in shape with a broad funnel-like excavation at its extremity, formed by the infolding of the lateral edges. The anterior part of the terminal segment is very convex, upon which elevation are situated three large tubercles in a transverse row, the center one being in the median line. At the base of the terminal excavation is also a small tubercle. Both branches of the uropoda are similarly shaped, being of the same width throughout their entire length and rounded posteriorly. The outer branch is somewhat shorter than the inner branch; neither reach the extremity of the abdomen.

Individuals were found at Gualala, California, on *Haliotis rufescens*, by Dr. R. E. C. Stearns; also, one specimen at Catalina Harbor, California, and one at Popoff Island, Aleutian Islands, at low water, by Mr. W. H. Dall.

Type.—No. 22569, U.S.N.M. Popoff Island, Aleutian Islands.

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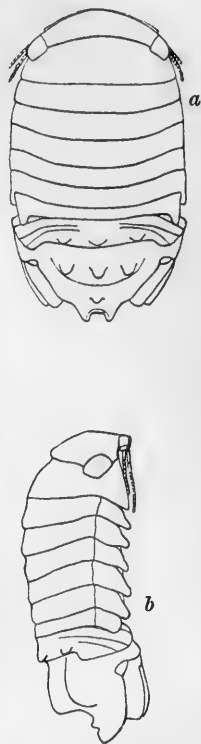


FIG. 9.—DYNAMENE TUBERCULOSA. $\times 8$. *a*, DORSAL VIEW; *b*, LATERAL VIEW.

23. DYNAMENE BENEDICTI, new species.

Body oblong, oval; surface minutely granular; color, dark gray.

Head with small median point. Eyes situated post-laterally. First pair of antennæ extend to the middle of the first thoracic segment; first joint of peduncle longest; second and third joints about equal in length; flagellum contains six joints. Second pair of antennæ extend to the posterior margin of the second thoracic segment; flagellum contains about eleven joints.

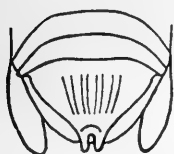


FIG. 10.—DYNAMENE BENEDICTI. $\times 13\frac{1}{2}$.
LAST THORACIC SEGMENT AND ABDOMEN.

The thoracic segments are of equal length. The epimera are square with rounded posterior angles.

The penultimate abdominal segment is crossed by suture lines, indicative of coalesced segments. The terminal segment is triangular, terminating posteriorly in two teeth separated by a narrow, rounded, funnel-shaped sinus. This segment is very convex, and bears two longitudinal ridges on either side of the median line. The uropoda do not exceed in length the extremity of the terminal segment. Both branches are rounded posteriorly and are similar in shape and size.

The type was collected by Mr. Heath at Monterey Bay, California, at the surface. No. 22570, U.S.N.M.

24. DYNAMENE GLABRA, new species.

Body oval; surface smooth.

Head small; eyes situated post-laterally. First pair of antennæ extend to the eye; first joint oblong; second joint short, half as long as first; flagellum contains six articles. Second pair of antennæ extend to the posterior margin of the first thoracic segment; flagellum contains about ten articles.

Thoracic segments are subequal; the first is a little longer than any of the others.

The penultimate abdominal segment consists of several coalesced segments, as indicated by the suture lines. The terminal segment is triangular, with a small median excavation at its extremity. The lower part of this segment is quite flat, the slope being gradual from the convex upper part or base of segment to the extremity. The inner branch of the uropoda is large and rounded posteriorly; the outer branch is small, though similar in shape, and is much shorter than the inner branch.



FIG. 11.—DYNAMENE GLABRA. $\times 13\frac{1}{2}$.
ABDOMEN AND LAST TWO THORACIC SEGMENTS.

A number of specimens were collected by Mr. Heath at Monterey Bay, California at the surface.

Type.—No. 22571, U.S.N.M.

13. SPHÆROMA Latreille.

ANALYTICAL KEY TO THE SPECIES OF SPHÆROMA.

- a. Body widening gradually from head backwards. Thorax transversely ridged and provided with three longitudinal rows of small tubercles. Branches of the uropoda very large, expanded 25. *Spharoma amplicauda* Stimpson.
- a'. Body not increasing in width. Surface of thorax smooth. Branches of the uropoda not expanded.
- b. Extremity of abdomen produced in a rhomboid process. 26. *Spharoma rhomburum*, new species.
- b'. Extremity of abdomen not produced.
- c. Surface of abdomen tubercular 27. *Spharoma octoncum*, new species.
- c'. Surface of abdomen smooth 28. *Spharoma oregonensis* Dana.

25. SPHÆROMA AMPLICAUDA Stimpson.

Spharoma amplicauda STIMPSON, Proc. Bos. Soc. Nat. Hist., VI, 1857, p. 89.

Habitat.—Tomales Bay, California.

Stebbing¹ suggests that a new genus near *Cycloidura* may be required for this species.

26. SPHÆROMA RHOMBURUM, new species.

Surface of body punctate; color, whitish yellow.

Head small. First pair of antennæ reach almost to the posterior margin of the first thoracic segment. Second pair of antennæ extend quite to the posterior margin of the first thoracic segment. Eyes situated post-laterally.

Thoracic segments equal in length. Epimera broad and short, extending downwards, forming an angle with the segments.

First abdominal segment as long as any of the thoracic segments, crossed by suture lines and surmounted by two tubercles, close together, one on either side of the median line. Terminal segment with its extremity produced in a process rhomboid in shape, and with sides infolded, forming a kind of funnel-like opening when seen from beneath. At the base of this segment are two tubercles, which are continuous with two longitudinal ridges in the center of the segment. These ridges unite near the extremity, and continue as one median ridge. The uropoda are shorter than the terminal segment; the outer branch is more lanceolate in shape; both are of equal length.

Two specimens were taken at Monterey Bay, California, by Mr. Heath.

Type.—No. 22573, U.S.N.M.

This species is near *S. egregium* Chilton² from Akaroa, but differs in



FIG. 12. — SPHÆROMA RHOMBURUM. $\times 13\frac{1}{2}$. ABDOMEN.

¹ Hist. Crust., 1893, p. 364.

² Trans. New Zealand Inst., XXIV, 1891, p. 269.

the presence of two tubercles on the first abdominal segment, in the presence of two tubercles and two longitudinal ridges uniting in a single ridge on the terminal segment, and in the equality in length of the two branches of the uropoda.

27. SPHÆROMA OCTONCUM, new species.

Body with all the thoracic segments, except the first, marked with four conspicuous brown spots, two on either side of the median line, and with two spots on the first abdominal segment, one on either side of the median line.

Head small. First pair of antennæ reach almost to the posterior margin of the first thoracic segments. Second pair extend fully to the posterior margin of the first segment.

Thoracic segments subequal. Epimera broad and extending downward, forming an angle with the segments.

First abdominal segment with two low tubercles close together, situated one on either side of the median line; terminal segment triangular, with apex narrowly rounded and sides slightly infolded, forming a small opening when seen from below. Six low tubercles are situated on this segment, two in longitudinal series on either side of the median line—the lower ones being a little farther apart than the upper ones—and one on either side of the series. The uropoda do not reach the extremity of the abdomen by some little distance. The outer branch is the shorter and is broadly rounded posteriorly. The inner branch is more pointed at the extremity.

Five individuals of this species were sent by Mr. Heath from Monterey Bay, California.

Type.—No. 22574, U.S.N.M.

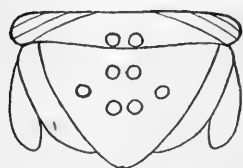


FIG. 13.—SPHÆROMA OCTONCUM. $\times 13\frac{1}{2}$. ABDOMEN.

28. SPHÆROMA OREGONENSIS Dana.

Sphæroma oregonensis DANA, Proc. Acad. Nat. Sci. Phila., VII, p. 177; U. S. Expl. Exp. Crust., II, p. 778, pl. LII, fig. 4.—STIMPSON, Journ. Bos. Soc. Nat. Hist., VI, 1857, p. 69.

Sphæroma olivacea LOCKINGTON, Proc. Cal. Acad. Sci., VII, 1877, Pt. 1, p. 45.

Habitat.—Pacific Grove to Alaska.

14. TECTICEPS Richardson.

ANALYTICAL KEY TO THE SPECIES OF TECTICEPS.

- a. Terminal segment of abdomen pointed. Outer branch of uropoda much longer than inner branch. First pair of antennæ reach the posterior angle of the first thoracic segment. Second pair reach the middle of the second thoracic segment. Sixth and seventh pair of legs show a marked disproportion in the length of the propodus.....29. *Tecticeps alascensis* Richardson.

a'. Terminal segment of abdomen widely rounded. Outer branch of the uropoda not longer than inner branch. First pair of antennæ reach the posterior angle of the third thoracic segment. Second pair of antennæ reach the middle of the fourth thoracic segment. Sixth and seventh pairs of legs show only a gradual increase in length.30. *Tecticeps convexus*, new species.

29. **TECTICEPS ALASCENSIS** Richardson.

Tecticeps alascensis RICHARDSON, Proc. Biol. Soc. Washington, XI, 1897, pp. 181-183.

Habitat.—Alaska; Kamchatka.

30. **TECTICEPS CONVEXUS**, new species.

Body oval, somewhat flattened. Surface smooth; color light yellow with markings of brown.

Head with the anterior margin much broader than the posterior margin, produced in front but not wholly concealing the basal joints of the first pair of antennæ, and somewhat raised, forming two small convex elevations. The antero-lateral margin is likewise produced forming an acute angular projection, which extends in a lateral direction beyond the post-lateral margin of the head. The eyes are dorsally situated in a median transverse line. The first pair of antennæ, with a flagellum of sixteen articles, extend to the posterior angle of the third thoracic segment. The second pair of antennæ, with a flagellum of thirteen articles, extend to the middle of the fourth thoracic segment, and exceed by one joint the length of the first pair of antennæ. Both pairs of antennæ are disposed to lie concealed under the broad epimeral plates of the thoracic segments.

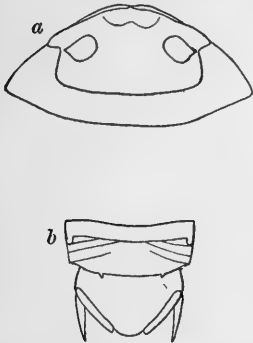


FIG. 15.—*TECTICEPS CONVEXUS*.
a, HEAD. $\times 5\frac{1}{2}$. *b*, ABDOMEN
AND LAST THORACIC SEGMENT.
 $\times 2\frac{1}{2}$.

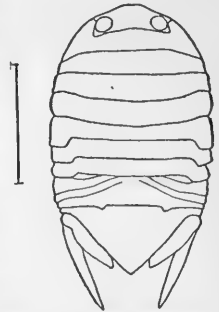


FIG. 14.—*TECTICEPS ALASCENSIS* RICHARDSON.
 $\times 2\frac{1}{2}$.

The thoracic segments are subequal in length. The first segment has its antero-lateral angles produced around the anterior portion of the head, forming a broad plate at the side of the segment. The epimera are almost twice as broad as long; those of the fifth segment extend downward, with the anterior margin straight, making the length and breadth about equal, and forming almost square epimera; in the epimera of the sixth and seventh segments, the anterior margins are in the same direction as the posterior margins, which extend downward.

The first segment of the abdomen has three suture lines, and its posterior margin is produced in two small points, one on either side of the median line, about equidistant from it and the lateral margin of the

segment. The terminal segment is widely rounded posteriorly. The inner branch of the uropoda is of nearly equal width throughout its length and is rounded at its extremity; the outer branch is slender and sharply pointed. Both branches are of nearly equal length and neither extend beyond the tip of the abdomen.

The first pair of legs have the propodus dilated and the dactylus reflexible. The propodus is large and oval in shape. In the legs of the second pair the propodus is irregular in shape, sometimes dilated with reflexible dactylus, and sometimes simple. The legs of the other five pairs are similar in structure, ambulatory, and show a gradual increase in length.

A number of individuals were found at Monterey Bay, California, and sent to the U. S. National Museum by Mr. Heath, who gives the following notes of their habits:

They were taken by the Chinese fishermen from a sandy sea bottom about 30 feet below the surface (according to the Chinese statement). These are rapid swimmers and the moment they are disturbed they roll into a ball and project the exopodite of the last free segment. This is undoubtedly for protection. I have not had time to accurately examine the position nor character of this appendage, but its sharp swordlike nature is readily recognized.

Type.—No. 22572, U.S.N.M.

This species differs from *T. alascensis* in having longer antennæ and antennulæ; in having a rounded terminal segment, which in that species is very pointed; in having the outer branch of the uropods as short as the inner, which in that species is much longer; in having only a gradual increase in the length of the legs, which in that species show such marked disproportions in the propodus of the sixth and seventh pairs; and in the position of the eyes, which in this species are situated in the median transverse line of the head, while in *T. alascensis* they are placed in the posterior half of the head.

13. CILICÆA Leach.

ANALYTICAL KEY TO THE SPECIES OF CILICÆA.

- a. Surface of body smooth.
 - b. Terminal segment with three sinuses, one above another, the two upper openings heart-shaped. Terminal segment as broad as long. Outer branch of the uropoda armed with four spines, broad and flat at upper end, and tapering to the extremity, which does not reach beyond the tip of the abdomen.
 - 31. *Cilicæa cordata*, new species.
 - b'. Terminal segment with a large sinus, in which are placed six sharp teeth. Terminal segment nearly twice as broad as long. Outer branch of the uropoda smooth, slender, cylindrical, and reaching much beyond the tip of the abdomen 32. *Cilicæa caudata gilliana*, new subspecies.
- a'. Surface of body densely granulated. Terminal segment with a quadrangular excavation, in the center of which is a long tooth.
 - 33. *Cilicæa granulosa*, new species.

The position of the three following species is somewhat doubtful, since they lack the spine on the penultimate abdominal segment, which

is characteristic of the genus *Cilicæa*. It has been noted by Stebbing,¹ by Miers,² and by Haswell³ that with many species of *Cilicæa*, as well as with some of the other genera of the Sphaeromidae, the spine is present and developed in the males but wanting in the females. As our three new species agree with the generic characters of *Cilicæa* except in the presence of the spine, we consider them for the present new and undescribed species of *Cilicæa*.

31. *CILICÆA CORDATA*, new species.

Body attenuated in front; color a faint yellow, profusely marked with a delicate pink tint.

Head with the anterior margin thickened, and slightly produced in front. Prominent median point triangularly shaped. Frontal margin broadly lobed on either side of median point. Eye situated at post-lateral angle of head. First pair of antennæ reach beyond the posterior margin of head; first joint of peduncle oblong; second joint very short; flagellum contains about nine articles. The second pair of antennæ extend to the posterior angle of the third thoracic segment; the flagellum contains about fifteen articles.

The thoracic segments are about equal in length, with the exception of the first, which is a little longer than any of the others. The epimera are very broad and drawn out to an apex, which is rounded. They are scarcely visible in a dorsal view, as they project downward laterally, forming an angle with the segments. The last thoracic segment is furnished with low tubercles on its posterior margin.

On the first abdominal segment are five double tubercles. The terminal segment of the body has three sinuses, one above another, the two upper openings being heart-shaped. Six teeth are grouped in a series of two each, and are placed in such regularity as to give the appearance of a triple sinus. At the base of the upper sinus is a large rounded tubercle, peaked at the top. Three double tubercles are also situated at the base of the abdomen. The inner branch of the uropoda is fixed and immovable; it is broad and pointed

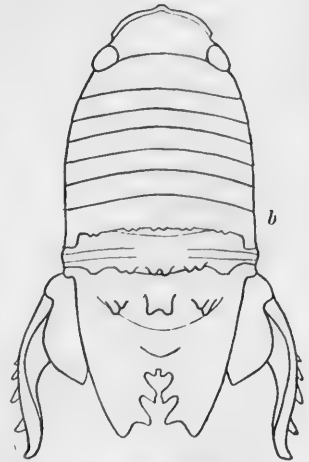


FIG. 16.—*CILICÆA CORDATA*. $\times 8$.
a, HEAD AND FIRST THORACIC SEGMENT; b, DORSAL VIEW.

¹ Hist. Crust., 1893, p. 364.

² Zool. Coll. Alert, 1884, p. 308.

³ Proc. Linn. Soc. New South Wales, VI, p. 183.

at its extremity and extends two thirds the length of the terminal segment. The outer branch is long and slender, broad and flattened above, more rounded and tapering at the extremity, somewhat incurved, and extends a little beyond the end of the abdomen. Its outer edge is crenulate and its under surface armed with four spines.

The legs are long and slender, all ambulatory, and with dactylus biunguiculate.

Two specimens were collected at Popoff Island (Aleutian Islands) by Mr. W. H. Dall at low water.

Type.—No. 22575, U.S.N.M., Popoff Island.

Another individual was found at Catalina Island, California, by Dr. J. G. Cooper. In this specimen the sixth thoracic segment is also tuberculated. One specimen was found by Mr. Heath at Monterey Bay on the pink coralline at low tide, and is shaded with a delicate pink. In this specimen, on the seventh thoracic segment and the penultimate abdominal segment, the tubercles on either side of the median line of tubercles are single instead of double.

32. *CILICÆA CAUDATA GILLIANA*, new subspecies.

Body slightly attenuated in front. Color, light brown with markings of black.

Head with anterior margin thickened and slightly produced. Large median point triangularly shaped, on either side of which the frontal margin of the head is broadly lobed. Eye situated at the posterior angle of the head. First pair of antennae reach beyond the posterior margin of the head; first joint of peduncle is oblong; second joint, very small; flagellum contains eight joints. The second pair of antennae are broken in the specimens examined.

The thoracic segments are about equal in length, with short but very broad epimera, which extend downward laterally, forming an angle with the segments. The last segment is ridged with very low tubercles on its posterior margin.

The first abdominal segment has two suture lines, indicative of coalesced segments, and bears five double tubercles. The terminal segment has a large sinus in which are situated six sharp teeth. At the base of the sinus is a large tubercle. Three double tubercles

FIG. 17. *CILICÆA*
CAUDATA GILLI-
ANA. — H.

are also found at the base of the terminal segment. The inner branch of the uropoda is affixed to the sides of the abdomen and extends two-thirds of its length; it is triangularly pointed at its extremity. The outer branch is long and slender, almost cylindrical in shape, smooth, somewhat incurved, and extends much beyond the tip of the terminal segment.

The legs, all ambulatory, are slender with dactylus uniunguiculate.

Specimens were dredged off Catalina Island, California.

Type.—No. 22576, U.S.N.M.

These specimens differ from *Cilicæa caudata* (Say),¹ in the presence of six distinct teeth within the sinus of the terminal segment, while in that species there are but four; in the greater development of the spine at the base of the sinus, and in the median double tubercle at the base of the terminal segment.

33. *CILICÆA GRANULOSA*, new species.

Surface of body densely granulated; granules large and close together.

Head with anterior margin thickened, and produced in a small median point, on either side of which the margin is lobed. Eyes situated post-laterally. First pair of antennæ extend to the posterior margin of the first thoracic segment; first joint of peduncle, oblong; second joint, short. Second pair of antennæ extend to the posterior margin of the third thoracic segment.

The first thoracic segment is longer than any of the following segments. The epimera are twice as broad as long.

The first abdominal segment is short and bears indications of three coalesced segments. There are three transverse elevations on this segment which are densely covered with granules. The terminal segment bears three transverse elevations at the base, the median one terminating in a spine. On its posterior margin is a quadrangular excavation, with a long median tooth, bearing a spine at its extremity. At the base of the tooth is a small elevation. On either side of the terminal excavation, a short distance up the lateral margin, is a small spine. The fixed inner branch of the uropoda is small and short; the outer branch is long, blunt at the extremity, somewhat incurved, and reaches, when open, much beyond the terminal segment. The margins of the terminal segment, and the edges of the outer branch of the uropoda, are pubescent.

The legs are all simple, ambulatory.

One specimen from Cerros Island, Lower California, was collected by Mr. A. W. Anthony at a depth of 20 fathoms.

Type.—No. 22649, U.S.N.M.

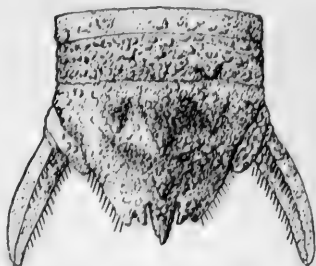


FIG. 18.—*CILICÆA GRANULOSA*. $\times 8$.
LAST THORACIC SEGMENT AND ABDOMEN.

¹*CILICÆA CAUDATA* (Say).

Nasa caudata SAY, Journ. Phil. Acad., I, p. 482.—MILNE-EDWARDS, Hist. Nat. des Crustacés, III, p. 219.

Cymodocea caudata IVES, Proc. Acad. Nat. Sci. Phila., 1891, p. 188, pl. VI, figs. 11-14.

Family VIII. SEROLIDÆ.

16. SEROLIS Leach.

34. SEROLIS CARINATA Lockington.

Serolis carinata LOCKINGTON, Proc. Cal. Acad. Sci., VII, 1877, Pt. 1, p. 36

Habitat.—San Diego, California.

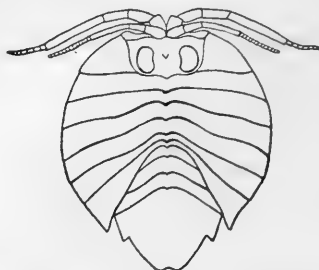


FIG. 19.—SEROLIS CARINATA LOCKINGTON. $\times 8$.

III. VALVIFERA.

ANALYTICAL KEY TO THE FAMILIES OF VALVIFERA.

- a*. Body more or less broad, depressed. Legs usually nearly alike, but first three pairs sometimes with propodus dilated and dactylus reflexed.

Family IX. IDOTEIDÆ (p. 842).

- a'*. Body narrow, scarcely depressed. Four anterior pairs of legs unlike three posterior pairs, and not ambulatory, nor strictly prehensile, directed forward, slender, ciliated, with terminal joint minute; last three pairs are stouter, ambulatory, with terminal joint bifid. Family X. ARCTURIDÆ (p. 853).

Family IX. IDOTEIDÆ.

ANALYTICAL KEY TO THE GENERA OF IDOTEIDÆ.¹

- a*. Sides of head emarginate or cleft and laterally produced beyond eyes, which are situated upon its dorsal surface. Three anterior pairs of legs, with penultimate joint or propodus dilated and forming, with reflexible dactylus, a prehensile hand. 17. *Glyptonotus*.
- a'*. Sides of head in a dorsal view entire and not laterally produced. Eyes lateral. Legs all ambulatory; three anterior pairs with penultimate joint not or not much dilated.
- b*. Flagellum of second pair of antennæ well developed and multiarticulate.
- c*. Palpus of maxillipeds four-jointed. Epimera of all the segments well developed and evident in a dorsal view. Abdomen² consisting of three³ segments with lateral sutures, indicative of another partially coalescent segment. 18. *Idotea*.

¹ See Miers on the Idoteidæ, Journ. Linn. Soc. London, XVI, 1883, pp. 9, 19, 20.

² Including terminal segment.

³ Dollfus, Feuille des Jeunes Naturalistes, 3d ser., 1895, p. 4; Sars, Crust. of Norway, 1897, Pts. 3, 4, p. 79.

- c'. Palpus of maxillipeds not four-jointed. Abdomen consisting of one segment, uniarticulate.
- d. Maxillipeds with a three-jointed palp. All the epimera coalesced and perfectly united with the segments 19. *Synidotea*.
- d'. Maxillipeds with a two-jointed palp. Epimera of second, third, and fourth segments coalesced and perfectly united with the segments; those of the fifth, sixth, and seventh segments distinct and well developed. 20. *Colidotea*, new genus.
- b'. Flagellum of second pair of antennæ with joints all consolidated and forming a single piece, or with flagellum composed of only two or three joints.
- c. Body smooth, linear. Epimera of all the thoracic segments distinct and visible; those of the second, third, and fourth segments short and narrow; those of the fifth, sixth, and seventh segments large and broad. Palp of maxillipeds two-jointed 21. *Cleantis*.
- c'. Body smooth, ovate. Epimera of second, third, fourth, and fifth thoracic segments coalesced with segments; those of sixth and seventh segments distinct and visible. Palp of maxillipeds three-jointed. Joints of flagellum all consolidated and forming a single piece. 22. *Eusymmerus*, new genus.

17. GLYPTONOTUS Eights.

ANALYTICAL KEY TO THE SPECIES OF GLYPTONOTUS.¹

- a. Joints of the peduncle of antennæ not dilated; flagellum eight to fourteen jointed. Antero-lateral cervical lobes prominent....35. *Glyptonotus entomon* (Linnaeus).
- a'. Joints and peduncle of antennæ greatly dilated; flagellum seven to eight jointed. Antero-lateral cervical lobes not prominent...36. *Glyptonotus sabini* (Krøyer).

35. GLYPTONOTUS ENTOMON (Linnaeus).

Oniscus entomon LINNÆUS, Syst. Nat., 12th ed., II, 1766, p. 1060.—PALLAS, Spicil. Zool., IX, 1772, p. 61, pl. v, figs. 1-6.

(?) *Entomon pyramidale* KLEIN, Rém. 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 BOSCH, Hist. Nat. des Crust., II, 1802, p. 178.—LATHEILLE, 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, Neue 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, 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, Sutherland's Voy. Baffin's Bay, etc., Appendix, 1852, p. cccvii.

Idotea 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 further synonymy.)

Habitat.—Circumpolar; West coast of North America to Pacific Grove, California.

¹ This key is taken from Miers, Journ. Linn. Soc. London, XVI (1883), p. 11.

36. GLYPTONOTUS SABINI (Krøyer).

Idotea sabini KRØYER, Nat. Tidsskrift., 2d ser., II, 1847, p. 401; Atlas of Crust. in Gaimard's Voy. en Scand., pl. xxvii, fig. 1.—REINHARDT, Fortegnelse over Grønland's Kredsdyr, 1857, p. 34.—LÜTKEN, List of Crust. of Greenland in Arctic Manual, 1875, p. 149.—SARS, Arch. f. Math. og Naturvidensk., II, 1877, p. 350.

Chiridothea megalura G. O. SARS, Archiv. f. Math. og Naturvidenskab., IV, 1880, p. 432.

Glyptonotus sabini MIERS, Journ. Linn. Soc., London, XVI, 1883, pp. 15, 16, pl. 1, figs. 3-5. (See Miers for further synonymy.)

Habitat.—Circumpolar; west coast North America (Miers).

18. IDOTEA Fabricius.

ANALYTICAL KEY TO THE SPECIES OF IDOTEA.¹

- a. Terminal segment emarginate at its extremity 37. *Idotea resecata* Stimpson.
- a'. Terminal segment not emarginate at its extremity.
 - b. Body slender, linear, filiform.
 - c. Terminal segment truncate at apex 38. *Idotea gracillima* Dana.
 - c'. Terminal segment acute at its extremity.
 - d. Postero-lateral angles of terminal segment prominent and separated by a tooth from subtriangular middle portion, which bears a small tooth at the middle. 39. *Idotea urotoma* Stimpson.
 - d'. Postero-lateral angles not separated by a tooth from middle portion.
 - 40. *Idotea rectilineata* Lockington.
 - b'. Body oblong-ovate.
 - c. Terminal segment regularly rounded, with small median point.
 - 41. *Idotea vosnesenskii* Brandt.
 - c'. Terminal segment triangulate posteriorly with subparallel sides.
 - d. Epimera of second, third, and fourth segments short, not reaching the post-lateral angles of their respective segments.
 - 42. *Idotea ochotensis* Brandt.
 - d'. Epimera of all the segments reaching the post-lateral angles of their respective segments.
 - e'. Sides of thorax arcuate 43. *Idotea stenops* Benedict.
 - e'. Sides of thorax more nearly parallel. 44. *Idotea whitei* Stimpson.

37. IDOTEA RESECATA Stimpson.

Idotea resecata STIMPSON, Bos. Journ. Nat. Hist., VI, 1857, p. 61, pl. xxii, fig. 7; Proc. Bos. Soc. Nat. Hist., 1859, p. 88.—MIERS, Journ. Linn. Soc. London, XVI, 1883, p. 45.

Habitat.—Straits Juan de Fuca, opposite Fort Townsend, Vancouver Island; Gulf of Georgia, Orcas Island; Pacific Grove, San Pedro, and Monterey Bay, California.

38. IDOTEA GRACILLIMA Dana.

Idotea gracillima DANA, Proc. Acad. Nat. Sci. Phila., VII, 1854, p. 175.—STIMPSON, Bos. Journ. Nat. Hist., VI, 1857, p. 505.—MIERS, Journ. Linn. Soc. London, XVI, 1883, p. 35.

Habitat.—California.

¹ See Miers, Journ. Linn. Soc. London, XVI, 1883, p. 43.

39. IDOTEA UROTOMA Stimpson.

Idotea urotoma STIMPSON, Proc. Acad. Nat. Sci. Phila., 1864, p. 155.—MIERS, Journ. Linn. Soc. London, XVI, 1883, p. 34.

Habitat.—Puget Sound.

40. IDOTEA RECTILINEATA Lockington.

Idotea rectilineata LOCKINGTON, Proc. Cal. Acad. Sci., VII, 1877, Pl. 1, p. 36.—MIERS, Journ. Linn. Soc. London, XVI, 1883, p. 34.

Habitat.—Along the Pacific coast from Humboldt County, California, to Ensenada, Lower California.

From an examination of specimens, this species, which Miers¹ says is scarcely to be distinguished from *I. ochotensis* Brandt, is seen to be specifically distinct. It differs from *I. ochotensis* in the proportions of the body, *I. rectilineata* being more slender—about five times as long as broad—while in *I. ochotensis* the length is only three and a half times greater than the width; in the relative length of the antennae to the body, and the proportions of the joints in the peduncle of the antennae, the antennae in *I. ochotensis* reaching only to the posterior margin of the third thoracic segment (in all the specimens examined) the joints of the peduncle being short and stout, while in *I. rectilineata* the antennae extend to the posterior margin of the fifth thoracic segment, the joints of the peduncle being long and slender; in the form of the anterior margin of the head, the excavation being deeper and wider in *I. rectilineata* than in *I. ochotensis*; in the shape of the first thoracic segment, which in *I. ochotensis* is produced laterally and has the antero-lateral angles truncate, while in *I. rectilineata* this segment is not produced and has rounded antero-lateral angles; in the size of the epimera, which are much more slender in *I. rectilineata* than in *I. ochotensis*; and in the shape of the terminal segment of the body, the posterior angle of which in *I. ochotensis* is more acute, the line from the lateral angle to the median angle being excavate, while in *I. rectilineata* this line is straight and the median angle obtuse.

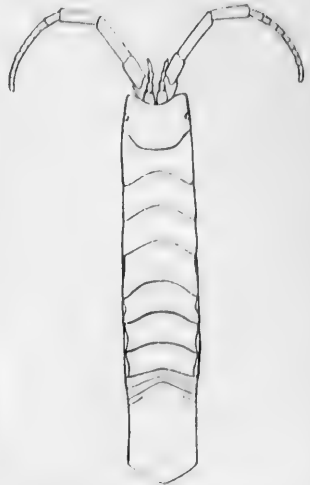


FIG. 20.—IDOTEA RECTILINEATA
LOCKINGTON. $\times 2$.

¹ Journ. Linn. Soc. London, XVI, 1883, p. 34.

41. *IDOTEA WOSNESENSKII* Brandt.

Idotea wosnesenskii BRANDT, Middendorf's Sibirische Reise, II, 1851, Crust., p. 146.—STIMPSON, Bos. Journ. Nat. Hist., VI, 1857, p. 504.—SPENCE BATE, Lord's Naturalist in British Columbia, II, 1866, p. 281.—MIERS, Journ. Linn. Soc. London, XVI, 1883, p. 40.

Idotea hirtipes DANA, Cr. U. S. Expl. Exp., Pt. II, 1853, p. 704, pl. XLVI, fig. 6.

Idotea oregonensis DANA, Proc. Acad. Nat. Sci. Phila., VII, 1854, p. 175.

Idotea media (DANA?) SPENCE BATE, Lord's Naturalist in British Columbia, II, 1866, p. 282.

Habitat.—Sea of Ochotsk and Kamchatka Sea; west coast of North America to Monterey Bay, California.

42. *IDOTEA OCHOTENSIS*¹ Brandt.

Idotea ochotensis BRANDT, Middendorf's Sibirische Reise, II, 1851, Crust., p. 145, pl. VI, fig. 33.—MIERS, Journ. Linn. Soc. London, 1883, XVI, p. 32, pl. I, figs. 8-10.

Habitat.—Awaatsch Bay, Sea of Ochotsk; northwest coast of North America to Vancouver Island (Miers).

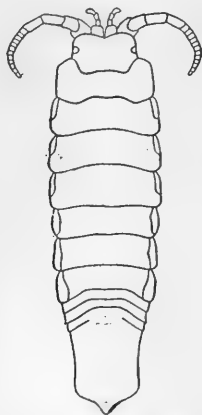


FIG. 21.—*IDOTEA OCHOTENSIS* BRANDT. $\times 2$.

43. *IDOTEA STENOPS* Benedict.

Idotea stenops BENEDICT, Proc. Biol. Soc. Washington, XII, 1898, pp. 54, 55.

Habitat.—Monterey, California.

44. *IDOTEA WHITEI* Stimpson.

Idotea whitei STIMPSON, Proc. Acad. Nat. Sci. Phila., 1864, p. 155.—MIERS, Journ. Linn. Soc. London, XVI, 1883, pp. 42, 43.

¹The following is quoted from Miers, Journ. Linn. Soc. London, XVI, 1883, p. 63: "Mr. Spence Bate (Lord's Naturalist in British Columbia, II, 1866, p. 282) refers without any description, specimens from Esquimaux Harbor, British Columbia, to *Idotea stricta* Dana; it is far more probable that they belong to *Idotea ochotensis*."

Habitat.—Puget Sound; Monterey Bay, California, collected by Mr. Heath.

A specimen from Monterey Bay, California, agrees with Miers's description of two males received from California, which he refers to this species. It is unlike *Idotea vosnesenskii* in the following points, and from an examination of a large number of individuals of *I. vosnesenskii*, in which these points remain constant, it seems to demonstrate the impossibility of uniting the two species.

1. "Form of epimera of second to fourth thoracic segments, which reach quite to the postero-lateral angles of these segments.

2. "Epimera of the second segment are broader anteriorly, and the terminal segment more resembles that of *I. ochotensis*, being more angulated and less rounded at the postero-lateral angles."¹

3. The absence of hairs on the legs.

The legs of *I. vosnesenskii* (the males) are thickly covered with hairs and very bushy in appearance.

4. The smooth margins of the epimera, which in *I. vosnesenskii* have thickened edges.

19. SYNIDOTEA Harger.

ANALYTICAL KEY TO THE SPECIES OF SYNIDOTEA.²

a. Abdomen emarginate or notched at its distal end.

b. Two spines or tubercles overhanging the frontal notch.

c. Spines united near the base 45. *Synidotea pallida* Benedict.

c'. Tubercles free at base 46. *Synidotea erosa* Benedict.

b'. No spines or tubercles overhanging frontal notch.

c. With a low ridge arising between the eyes, and interrupted on the median line.

d. Outlines of abdomen subparallel 47. *Synidotea nebulosa* Benedict.

d'. Outlines strongly arcuate 48. *Synidotea angulata* Benedict.

c'. Without a ridge between the eyes.

d. Outline of abdomen subtriangular.

e. Front not excavated 49. *Synidotea consolidata* (Stimpson).

e'. Front excavated 50. *Synidotea bicuspidata* (Owen).

d'. Outlines of abdomen rounded.

e. Length of abdomen equal to width at base.

51. *Synidotea laticauda* Benedict.

e'. Length of abdomen equal to one and one-half times width at base.

52. *Synidotea harfordi* Benedict.

a'. Abdomen pointed.

b. Undulations of body not tubercular or spiny.

c. Tubercle in front of eyes not margined 53. *Synidotea nodulosa* (Krøyer).

c'. Tubercle on the frontal margin and forming a part of it.

54. *Synidotea lewis* Benedict.

b'. Undulations of the body tubercular and spiny.

c. Four spines on the front of the head; body spinous.

55. *Synidotea muricata* (Harford).

c'. A wedge-shaped tubercle behind the frontal notch; body tubercular.

56. *Synidotea picta* Benedict.

¹ Miers, Journ. Linn. Soc. London, XVI, 1883, pp. 42, 43.

² Benedict, Proc. Acad. Nat. Sci. Phila. (1897), p. 391.

Mr. Adrian Dollfus in his paper on "Les Idoteidae des Côtes de France,"¹ has wrongly confounded *Synidotea* Harger with *Stenosoma* Leach. *Synidotea* can by no means be considered a synonym of *Stenosoma*, as anyone who is familiar with the two genera will undoubtedly admit. It differs from *Stenosoma* in the consolidation of the epimera with the segments. The epimera are firmly and perfectly united with the segments, and the only trace or indication of a separation is represented in the anterior segments by a slight and almost imperceptible notch in the posterior margins, halfway between the lateral margin and the median line of the body, and in the three posterior segments by a very faint line. In *Stenosoma* all the epimera are very distinct from the segments.

45. *SYNIDOTEA PALLIDA* Benedict.

Synidotea pallida BENEDICT, Proc. Acad. Nat. Sci. Phila., 1897, pp. 396, 397.

Habitat.—Chirikof Island, Alaska.

46. *SYNIDOTEA EROSA* Benedict.

Synidotea erosa BENEDICT, Proc. Acad. Nat. Sci. Phila., 1897, pp. 397-399.

Habitat.—Sannakh Island, Alaska.

47. *SYNIDOTEA NEBULOSA* Benedict.

Synidotea nebulosa BENEDICT, Proc. Acad. Nat. Sci. Phila., 1897, pp. 394, 395.

Habitat.—Unalaska; Kyska Harbor; Semidi Islands; Unimak Island; Bering Sea; Kamchatka.

48. *SYNIDOTEA ANGULATA* Benedict.

Synidotea angulata BENEDICT, Proc. Acad. Nat. Sci. Phila., 1897, pp. 395, 396.

Habitat.—Off Cape Johnson, Washington; off Destruction Island, Washington; off Cape Flattery, Washington.

49. *SYNIDOTEA CONSOLIDATA* (Stimpson).

Idotea consolidata STIMPSON, Proc. Cal. Acad. Sci., I, 1856, p. 89; Bos. Journ. Nat. Hist., VI, 1857, p. 503.

Edotia bicuspidata MIERS, Journ. Linn. Soc. London, XVI, 1883, p. 66.

Synidotea consolidata BENEDICT, Proc. Acad. Nat. Sci. Phila., 1897, p. 393.

Habitat.—Pacific Grove, California.

50. *SYNIDOTEA BICUSPIDA* (Owen).

Idotea bicuspidata OWEN, Crustacea of the Blossom, 1839, p. 92, pl. XXVII, fig. 6.

Idotea pulchra LOCKINGTON, Proc. Cal. Acad. Sci., VII, 1877, p. 44.

Idotea bicuspidata MIERS, Journ. Linn. Soc. London, XVI, 1883, p. 66.

Synidotea bicuspidata SARS, Crust. Norwegian North Atlantic Expedition, 1885, p. 116, pl. x, figs. 24-26.—BENEDICT, Proc. Acad. Nat. Sci. Phila., 1897, pp. 391, 392.

Habitat.—West coast of Alaska and Bering Sea.

¹ Feuille des Jeunes Naturalistes, 1895.

51. *SYNIDOTEA LATICAUDA* Benedict.

Synidotea laticauda BENEDICT, Proc. Acad. Nat. Sci. Phila., 1897, pp. 393, 394.

Habitat.—San Francisco Bay.

52. *SYNIDOTEA HARFORDI* Benedict.

Idotea marmorata HARFORD, Proc. Cal. Acad. Sci., VII, 1877, p. 117.

Synidotea harfordi BENEDICT, Proc. Acad. Sci. Phila., 1897, p. 402.

Habitat.—Magdalena Bay, Lower California.

53. *SYNIDOTEA NODULOSA* (Krøyer).

Idotea nodulosa KRØYER, Naturhist. Tidssk., II, 1846, p. 100.

Synidotea nodulosa HARGER, Report of U. S. Commissioner of Fish and Fisheries, 1878, Pt. 6, pp. 351, 352.—BENEDICT, Proc. Acad. Nat. Sci. Phila., 1897, pp. 398, 399.

Habitat.—Dixon Entrance, north of Queen Charlotte Islands, British Columbia.

54. *SYNIDOTEA LÆVIS* Benedict.

Synidotea laevis BENEDICT, Proc. Acad. Nat. Sci. Phila., 1897, pp. 399, 400.

Habitat.—Between Bristol Bay and Pribilof Islands, Alaska; Bering Sea.



FIG. 22.—MAXILLIPED OF *COLIDOTEA ROSTRATA* (BENEDICT).

55. *SYNIDOTEA MURICATA* (Harford).

Idotea muricata HARFORD, Proc. Cal. Acad. Sci., VII, 1877, Pt. 1, p. 117.

Synidotea muricata BENEDICT, Proc. Acad. Nat. Sci. Phila., 1897, p. 400.

Habitat.—Icy Cape.

56. *SYNIDOTEA PICTA* Benedict.

Synidotea picta BENEDICT, Proc. Acad. Nat. Sci. Phila., 1897, pp. 401, 402.

Habitat.—Alaska and Bering Straits.

20. *COLIDOTEA*,¹ new genus.57. *COLIDOTEA ROSTRATA* (Benedict).

Idotea rostrata BENEDICT, Proc. Biol. Soc. Washington, XII, 1898, pp. 53, 54.

Habitat.—San Pedro, California.

¹ See key on p. 843 for characters of genus.

21. CLEANTIS Dana.

ANALYTICAL KEY TO THE SPECIES OF CLEANTIS.

a. Flagellum consolidated and forming a single piece. Sides of abdomen not separated by an acute tooth from rounded posterior portion.

58. *Cleantis occidentalis*, new species.

a'. Flagellum composed of three joints. Sides of abdomen separated by an acute tooth from rounded posterior portion.....59. *Cleantis heathii*, new species.

58. CLEANTIS OCCIDENTALIS, new species.

Body narrow, elongate; surface smooth.

Head of same width as thoracic segments, and with a small, median anterior depression. Eyes lateral. First pair of antennae consisting of four joints, reaching the middle of the third joint of the second pair of antennae. Second pair of antennae contain six joints (five seen from a dorsal view), the last joint being the flagellum.

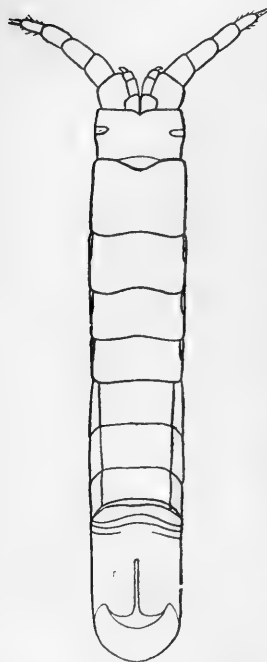


FIG. 23.—CLEANTIS OCCIDENTALIS.
X 10.

The thoracic segments show a gradual, though marked, decrease in length, the first one being the longest and somewhat excavate on its anterior margin. The epimera of the second, third, and fourth segments are short and narrow, reaching but half the length of the segments, while those of the last three segments are broad, with their posterior angles produced beyond the segments.

The abdomen is composed of four segments, three short ones and the terminal segment, which bears suture lines indicative of another coalesced segment. The terminal segment is rounded posteriorly. The anterior three-fourths of the segment is raised considerably above the posterior fourth, which is flat, and there



FIG. 24. — MAXILLIPED OF CLEANTIS OCCIDENTALIS.
GREATLY ENLARGED

is a groove in the median line on the posterior third of the anterior part of the segment.

The legs are similar to those of the type species of the genus. The three anterior pairs increase in length, the third pair being the longest, and all are directed anteriorly. The fourth pair are very short and fold across the body. The last three pairs increase in length, the seventh pair being the longest, and all these are directed posteriorly. The legs are compact and lie folded on the ventral side and can not be seen from a dorsal view.

There is but one specimen collected by the *Albatross* in 1888 at Magdalena Bay, Lower California; depth, 12 fathoms.

Type.—No. 22578, U.S.N.M.

This species, when compared with *Cleantis planicauda*¹ Benedict, from Pensacola, Florida, presents points of difference which are interesting and which can easily be recognized in the manuscript quoted below.

59. *CLEANTIS HEATHII*, new species.

Body slender, elongate; surface smooth.

Head with lateral margins straight; anterior margin slightly excavate. Eyes small, lateral. First pair of antennæ consist of four joints and are a little longer than half the width of the head. The second pair of antennæ are half as long as the body and are composed of nine

¹ *CLEANTIS PLANICAUDA* Benedict, new species.

Body linear, densely granulated, five times longer than broad. Feet folded beneath out of view from above. Body lined longitudinally, by six more or less broken black lines. The lines on the sides are more distinct than those above.

Head subquadrate, partially immersed in the first thoracic segment and rounded on the posterior margin; sides parallel, anterior margin emarginate; a deep depression or groove runs from the median notch to the center of the head. The eyes are situated near the antero-lateral angle; post-occipital lobe distinct; antennæ with six segments; first very short and nearly immobile; second very short and stout; the third segment is equal in length to the second, but not so stout; the fourth and fifth are of equal length and about one-third longer than the second and third segments. The terminal segment or flagellum is lighter in color, and is armed with short bristles. The length of the antennæ is equal to the length of the head and first two thoracic segments. The antennulæ extend to the middle of the third segment of the antennæ. The first segment is quadrate; the second subquadrate; the third is pear-shaped; the fourth segment is very small.

The segments of the thorax are nearly equal in length and breadth, the third and fourth being but little longer than the others. The epimera of the second, third, and fourth segments are very small and can not be seen from above. On the fifth, sixth, and seventh segments the epimera are large and project well behind the margin of the segment in the form of an acute angle.

The pleon is composed of four segments; the first three are very narrow; the terminal segment is elongated with subparallel sides. A marked character of the pleon is its obliquely truncated extremity. The oblique terminus is perfectly flat with a raised margin.

The feet of this species, as in the typical species described by Dana, are in two series. The first is composed of the first three pairs of feet, which are comparatively stout and increase in length to the third segment. The second series begins on the fourth segment with a pair of short feet, which fold transversely, the other pairs are successively longer and fold backwards. The feet of the second series are much more slender than those of the first. The dactyli of all are biungulate. The carpal and propodal joints are spinulose beneath.

The operculum is not traversed by an oblique line. The sides of the basal segment are subparallel. The terminal segment is about as broad as long.

Length, 15 mm.; width, 3 mm.

Type.—No. 22579, U.S.N.M.

joints, the three terminal ones forming the flagellum, which can not be distinguished from the peduncle.

Thoracic segments subequal, with narrow epimera, those of the second, third, and fourth segments reaching but half the length of the segments, the last three epimera extending to the extremity of the segments.

The abdomen is composed of three segments with suture lines indicative of another. The terminal segment is broadly rounded posteriorly, with small but acute lateral angles. The sides are almost parallel.

The first four pairs of legs are directed anteriorly; the last three extend in a posterior direction. There is no perceptible inequality in length. The dactyli are bifid.

Two specimens were sent by Mr. Heath from Monterey Bay, California.

Type.—No. 22577, U.S.N.M.

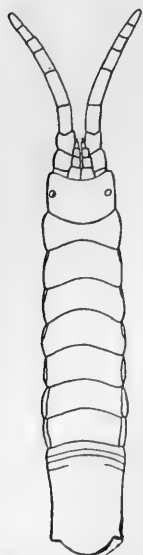


FIG. 25.—*CLEANTIS*
HEATHII. X 63.

22. *EUSYMMERUS*, new genus.

Body elliptical. Palp of maxillipeds three-jointed. Second pair of antennae with joints of flagellum all consolidated and forming a single piece. Eyes dorsally situated.

Lateral margins of thoracic segments expanded, edges straight and full. Epimera of second, third, fourth, and fifth segments coalesced and firmly united with segments, those of the sixth and seventh segments distinct and visible.

Abdomen composed of one segment with suture lines indicative of another partly coalesced segment.

60. *EUSYMMERUS ANTENNATUS*, new species.

Body elliptical, tapering toward the extremity; surface smooth.

Head three times broader than long, with the antero-lateral angles prominent. Anterior margin excavate. Lateral margins expanded. Eyes situated dorsally on the extreme lateral margin in the median transverse line. First pair of antennae four-jointed, short, extending only a little beyond the second joint of the second pair of antennae. Second pair of antennae are six-jointed, geniculate, the last or flagellar joint being somewhat clavate.

Thoracic segments with lateral margins expanded. Lateral edges straight, full. Epimera of second, third, fourth, and fifth segments coalesced and firmly united with the segments; epimera of sixth and seventh segments distinct and articulating with segments.

Abdomen of only one segment with suture lines indicative of another partly coalesced segment. Abdomen posteriorly rounded, tapering from the base to the extremity.

Legs slender, with dactyli biunguiculate.

Color of specimen brown. Lateral edges of thoracic segments colorless.



FIG. 26.—EUSYMMERUS ANTENNATUS. $\times 8$.



FIG. 27.—MAXILLIPED OF EUSYMMERUS ANTENNATUS.

One individual from off Abreojos Point, Lower California, station 2835, was collected by the U. S. Fish Commission steamer *Albatross*; depth, 48 fathoms.

Type.—No. 22580, U.S.N.M.

Family X. ARCTURIDÆ.

23. ARCTURUS Latreille.

Flagellum of second pair of antennæ more than four-jointed. Fourth segment of thorax not greatly longer than others. Marsupium of female composed of four pairs of plates. Posterior thoracic legs biunguiculate.

ANALYTICAL KEY TO THE SPECIES OF ARCTURUS.¹

- a*. End of abdomen notched, as seen from above.
 - b*. Body smooth and free from spines 61. *Arcturus beringanus* Benedict.
 - b'*. Body spiny.
 - c*. Head and six segments of thorax each with a pair of spines on the dorsum. Second and third articles of antennæ without spines.
 - 62. *Arcturus longispinis* Benedict.
 - c'*. Head and segments of thorax with not less than two pairs of spines to the segment.
 - d*. Head with one large median spine on anterior part of head in front of eyes.
 - 63. *Arcturus intermedius*, new species.
 - d'*. Head with three spines on anterior part of head in front of eyes.
 - 64. *Arcturus murchisoni* Benedict.
 - a'*. End of abdomen without notch 65. *Arcturus glaber* Benedict.

¹ Dr. Benedict's key is used in part for the genus *Arcturus*. Proc. Biol. Soc. Washington, XII (1898), pp. 42, 43.

61. ARCTURUS BERINGANUS Benedict.

Arcturus beringanus BENEDICT, Proc. Biol. Soc. Washington, XII, 1898, pp. 46, 47.

Habitat.—Alaska; Bering Sea.

62. ARCTURUS LONGISPINIS Benedict.

Arcturus longispinis BENEDICT, Proc. Biol. Soc. Washington, XII, 1898, pp. 44, 45.

Habitat.—Aleutian Islands.

63. ARCTURUS INTERMEDIUS, new species.

Head, with a deep excavation on its anterior margin, the antero-lateral angles being produced in a double process, the inner one rounded, the outer one acutely pointed. Near the anterior margin in the median line

is one large spine. Just back of the eyes and between them are two long spines. The lateral margins of the head are produced in two small angulations with a rounded sinus between, posterior to the double antero-lateral process. On the post-lateral margin on either side of the head is a small spine.

The first pair of antennæ are small and short, not reaching to the end of the second joint of the second pair of antennæ. The first joint of the second pair of antennæ is visible and unarmed; the second joint is armed with three spines; the third joint is unarmed, and is about twice as long as the second joint; the fourth and fifth joints are about equal in length and are each about twice

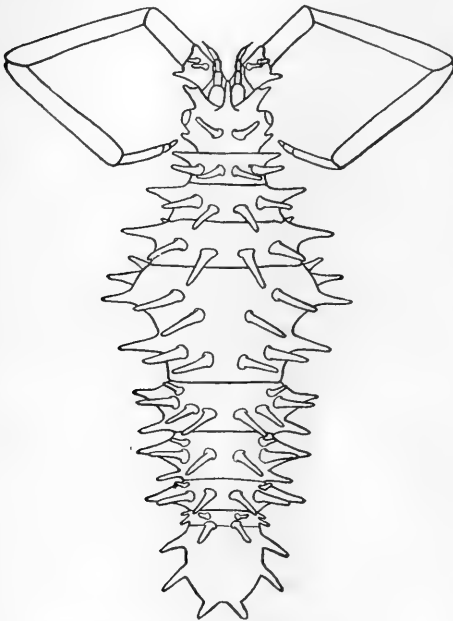


FIG. 28.—ARCTURUS INTERMEDIUS. $\times 10$.

as long as the third; the flagellum contains three joints.

The first, second, and third thoracic segments have a transverse row of six large spines, three on either side of the median longitudinal line, the two center ones being the longest, although all are very long. The fourth segment is twice as long as any of the other segments, and has a transverse constriction on the posterior half of the segment. On the anterior portion are six spines, three on either side of the median line, the four outer ones being in a straight line, the inner two below this line. On the posterior portion are six spines also, three on either side

of the median line. The fifth thoracic segment has twelve spines, six on either side of the median line. The sixth segment has ten spines, five on either side. The seventh and last segment has eight spines, four on either side.

The abdomen is composed of two segments. The first is short, with twelve spines, six on either side of the median line, the four inner ones being arranged in two longitudinal series, the two upper ones being small, the two lower ones very long. The terminal segment has the upper surface smooth. This segment terminates in two long divergent spines. There is a single spine on the lateral margin on either side halfway down the segment. The three anterior pairs of legs have each two spines on the coxal joint and one spine on the basis. The body increases in width from the first to the fourth segment, and then decreases in width from the fourth to the terminal segment.

One specimen from Kyska Harbor, Aleutian Islands, 10 fathoms, collected by Mr. W. H. Dall.

Type.—No. 22581, U.S.N.M.

Our species differs from *A. murdochi* in the absence of spines on the third joint of the second pair of antennæ; in the greater length of this joint in relation to the preceding joint; in the greater length of the two following joints; in the presence of a single spine on the anterior part of the head, while in *A. murdochi* there are three, and of two spines on the posterior part, while in *A. murdochi* there are four; in the absence of two small spines just below the constriction in the fourth segment; in the absence of the row of spines on the terminal segment of the body; and in the presence of two spines on the coxal joint and one on the basal joint of the legs, while in *A. murdochi* there is but one spine on the basal joint.

This species is also distinguished from *A. hystrix* in the presence of a single median spine on the anterior part of the head, while in *A. hystrix* there are two, one on either side of the median line and widely separated; in the presence of two spines on the posterior part of the head, while in *A. hystrix* there are four; in the absence of the double row of spines on the terminal segment of the body; and in the absence of the spine at the articulation of the third joint of the second pair of antennæ.

64. ARCTURUS MURDOCHI Benedict.

Arcturus murdochi BENEDICT, Proc. Biol. Soc. Washington, XII, 1898, pp. 49, 50.

Habitat.—Point Franklin, Alaska.

65. ARCTURUS GLABER¹ Benedict.

Arcturus glabrus BENEDICT, Proc. Biol. Soc. Washington, XII, 1898, p. 46.

Habitat.—Bering Sea.

¹ *Glabrus* by error.

IV. ASELLOTA.

ANALYTICAL KEY TO THE FAMILIES OF ASELLOTA.¹

- a.* Lateral parts of cephalon scarcely expanded. Eyes, when present, small, lateral. Peduncle of inferior antennæ without small accessory appendage outside of third joint. Legs ambulatory, except first pair, which are distinctly subcheliform; legs with dactylus generally uniungiculate. First pair of pleopoda in female very small, not operculiform. Outer lamella of second pair very large and incrustated, so as to form, together with corresponding lamellæ of other side, a sort of operculum, covering the two succeeding pairs.

Family XI. ASELLIDÆ (p. 856).

- a'.* Lateral parts of cephalon usually lamellarly expanded. Eyes, when present, usually subdorsal. Peduncle of inferior antennæ generally with small accessory appendage outside of third joint. Legs subequal in length with dactylus generally bi- or triungiculate; first pair sometimes prehensile. First pair of pleopoda in female transformed into a single, large opercular plate. Outer lamellæ of two succeeding pairs narrow and confluent with basal part.

Family XII. JANIRIDÆ (p. 856).

Family XI. ASELLIDÆ.

24. ASELLUS Geoffroy.

Dactyli of last six pairs of periopoda uniungiculate. Lateral margins of segments produced. Eyes distinct, lateral. Mandibles strong, with a three-jointed palp. Head without rostrum.

66. ASELLUS TOMALENSIS Harford.

Asellus tomalensis HARFORD, Proc. Cal. Acad. Sci., VII, 1877, Pt. 1, pp. 54, 55.

Habitat.—Tomales Bay, California.

Family XII. JANIRIDÆ.

ANALYTICAL KEY TO THE GENERA OF JANIRIDÆ.

- a*'.² Eyes dorsal. Antennæ of first pair well developed, with multiarticulate flagellum. Antennæ of second pair long, with multiarticulate flagellum, peduncular joints not dilated. Mandibles with a three-jointed palp, and with cutting part separated from molar part by a deep incision.
- b.* Head without any true rostrum. First pair of antennæ extremely small with flagellum rudimentary. Second pair of antennæ of moderate length, without any distinctly squamiform appendage. First pair of legs not prehensile. Uropoda extremely small, branches very short, nodiform.. 25. *Jara*.
- b'*. Head with prominent rostral projection, or with a comparatively small rostrum, or without rostrum. First pair of antennæ well developed; flagellum multiarticulate. Second pair of antennæ very much elongated with a well-marked scalelike appendage outside of third joint. First pair of legs prehensile, carpus large, subfusiform, and edged inside with spines; propodus narrow, linear, and very movably articulated to carpus, so as to admit of being bent in against it. Uropoda largely developed, with branches slightly unequal.

¹ Sars, Crust. of Norway, II, 1897, Pts. 5, 6, pp. 95, 98.

² Idem, Pts. 5, 6, pp. 98-100, 103, 104.

- c. Head with lateral parts produced to very prominent acute lappets. Segments of thorax with lateral parts lacinate and produced. Caudal segment forming on each side, at the end, a triangular expansion..... 26. *Ianthe*.
- c'. Head with lateral parts not produced into lappets. Segments of thorax with lateral parts not produced, not lacinate. Caudal segment rounded, not expanded laterally 27. *Janira*.
- a'. Eyes lateral. Antennæ of the first pair small with flagellum obsolete. Antennæ of the second pair short, with peduncular joints dilated, rudimentary flagellum, containing five articles, and equal in length to the width of the head. Mandibles with a three-jointed palp, and with cutting part composed of five teeth 28. *Jaropsis*.

25. JÆRA Leach.

67. JÆRA WAKISHIANA Spence Bate.

Jæra wakishiana SPENCE BATE, Lord's Naturalist in British Columbia, II, 1866, p. 282.—C. BOVALLIUS, Bihang till K. Sv. Vet. Akad. Handl., II, 1886, No. 15, p. 49.

Habitat.—Esquimault Harbor, British Columbia.

26. IANTHE Bovallius.

ANALYTICAL KEY TO THE SPECIES OF IANTHE.

- a. Head with prominent rostrum; lateral margins incised and produced into two angulations. Second and third thoracic segments with epimeral lobes double. Terminal segment of body with lateral angulations and central portion acute. 68. *Ianthe triangulata*, new species.
- a'. Head without rostrum; lateral margins entire and produced into one anterior angulation. Second and third thoracic segments with epimeral lobes single. Terminal segment of body with lateral angulations and central portion blunt and rounded..... 69. *Ianthe erostrata*, new species.

68. IANTHE TRIANGULATA, new species.

Surface of body smooth; color yellow, marked with black dots.

Head with rostrum in front equal to one-half the length of head. Anterior margin lobate, between the rostrum and the lateral angulations. The side of the head is produced in two angulations, the upper one extending in an oblique direction and not reaching beyond the anterior margin of the head. The first pair of antennæ are not as long as the width of the head. The second pair of antennæ are longer than the body.

The lateral margins of the first segment are produced into two angulations; those of the second and third into two, with the epimera produced into two-lobed angulations; those of the fourth into two lobes, the small epimeral lobe or angulation between; and those of the fifth, sixth, and seventh into one large upper lobe, and one small lower lobe.

The terminal segment is produced backward at the sides into two sharply pointed angulations, with a broad triangulate central lobe between, to which the uropoda are attached. The uropoda are longer

than the terminal segment, the outer branch somewhat shorter than the inner one, and both fringed with hairs.

First pair of legs prehensile; remaining pairs simple.

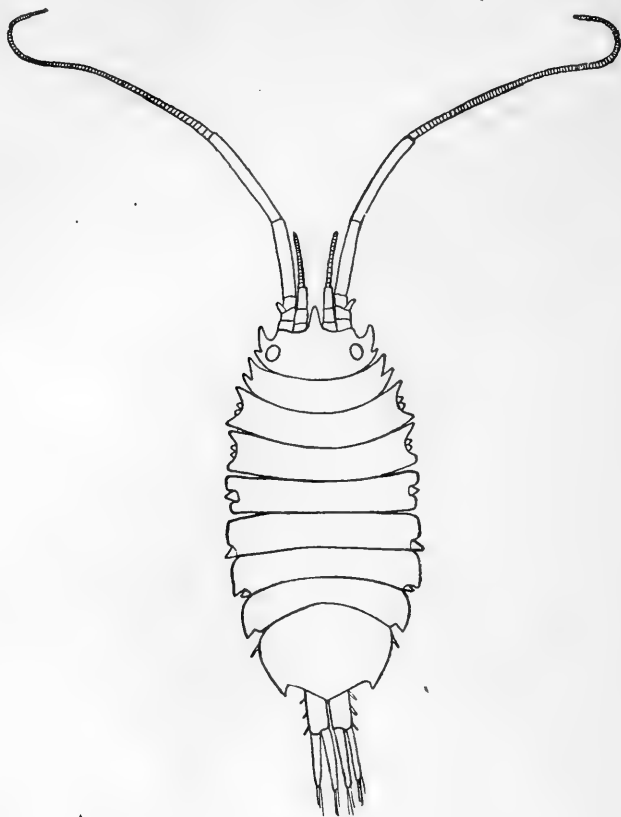


FIG. 29.—*IANTHE TRIANGULATA*. $\times 13\frac{1}{2}$.

Two specimens were collected by Mr. Heath at Monterey Bay, California.

Type.—No. 22582, U.S.N.M.

69. *IANTHE EROSTRATA*, new species.

Head two and a half times broader than long, with prominent antero-lateral angulations. Lateral margins produced, entire. In place of the rostrum, which marks all the other known species of this genus, there is a small median point. The eyes are dorsally situated a short distance from the lateral edges. The first pair of antennæ are short, not equal to the width of the head. The second pair are broken in the specimen examined.

The first thoracic segment is produced laterally in two angulations. The second, third, and fourth segments are each produced in two angu-

lations, with a small epimeral lobe in between. The fifth, sixth, and seventh segments have each a large anterior lobe and a small posterior epimeral lobe.

The terminal segment has two bluntly triangular angulations, one on either side of a bluntly triangular central portion. The uropoda are about as long as the caudal segment, are styliform, with branches nearly equal. The first pair of legs are prehensile. The others are simple, biunguiculate. One specimen was collected at Chichagof Harbor, Attu (Aleutian Islands), by Mr. W. H. Dall.

Type.—No. 22610, U.S.N.M.

27. *JANIRA* Leach.

70. *JANIRA OCCIDENTALIS* Walker.

Janira occidentalis WALKER, Trans. Liverpool Biol. Soc., XII, 1898, pp. 280, 281, pl. xv, figs. 7-10.

Habitat.—Puget Sound, Washington.

28. *JÆROPSIS* Koehler.

71. *JÆROPSIS LOBATA*, new species.

Surface of body smooth.

Color very peculiar and striking. The head is brown. The first thoracic segment is perfectly white, without any markings. The second, third, and fourth segments are brown. The fifth and sixth are white. The seventh thoracic segment and the caudal segment are brown. This peculiar marking gives the body a striped appearance.

Head large; front produced into a prominent triangular process, with rounded apex, very broad at the base, occupying half the anterior margin of the head. The antero-lateral angles of the head are produced in acute angles on either side to a distance equal to half the length of the frontal process. The eyes, which are small, are situated on the extreme lateral margins of the head. The first pair of antennæ are extremely small, equal in length to less than half the width of the head; flagellum obsolete. The second pair of antennæ are also extremely short, equal in length to the width of the head, with rudimentary flagellum, composed of about five joints, and with peduncular joints dilated. Mandibles have the cutting part composed of five teeth; palp, three-jointed.

The thoracic segments are subequal in length, with lateral edges produced, but not laciniate, and separated from each other by lateral incisions.

Caudal segment regularly rounded, with two small incisions at the place where the uropoda are attached, between which is a rounded lobe. Uropoda are extremely small, short, nodiform.

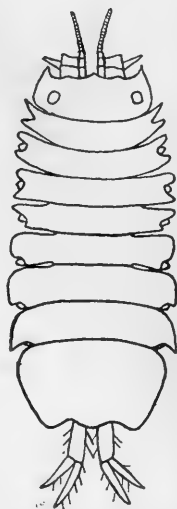


FIG. 30.—*JANIRA OCCIDENTALIS*.
TRATA. $\times 13\frac{1}{2}$.

Legs simple, similar in structure, with biunguiculate dactyli.

Two specimens from Monterey Bay, California, were sent by Mr. Heath.

Type.—No. 22583, U.S.N.M.

This species is very close to *Jæropsis brevicornis*, but differs in the following points: the coloring of the body, which in *J. brevicornis* is

perfectly transparent and colorless, with the exception of the head, which is marked with a large brown spot, while in our species the head is dark, as are also the entire second, third, fourth, and seventh thoracic seg-



FIG. 31.—MAXILLIPED AND MANDIBLE OF JÆROPSIS LOBATA.

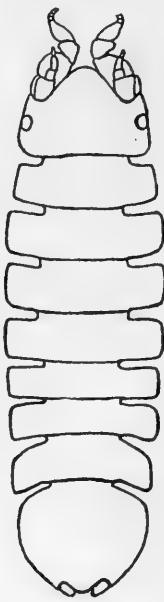


FIG. 32.—JÆROPSIS LOBATA. $\times 20$.



FIG. 33.—ANTENNÆ OF JÆROPSIS LOBATA.

ments and the terminal abdominal segment, the other segments being colorless; in the shape of the terminal segment, which is perfectly rounded in *J. brevicornis* and fringed with hairs, while in our species there are two posterior incisions for the reception of the uropoda, and an absence of hairs; in the larger median lobe on the anterior margin of the head; in the acuteness of the antero-lateral angles of the head, which are rounded in *J. brevicornis*; in the more angular post-lateral angles of the head, and in the more angular antero- and post-lateral angles of the thoracic segments. Other differences are noticed from a comparison of both pairs of antennæ.

V. ONISCOIDEA.

ANALYTICAL KEY TO THE FAMILIES OF ONISCOIDEA.

- a. Flagellum of outer antennæ not multiarticulate. Buccal mass not very prominent below. First maxillæ have two plumose setæ on the inner plate. Mandibles with molar expansion obsolete, without any triturating surface, it being replaced by brushlike recurved setæ. Maxillipeds with terminal part three-

- articulate; epignath large, flanking the basal part. Sexual appendage of male simple, and generally connected with inner rami of first pair of pleopoda. Uropoda, with inner branch smaller than outer, and attached far in front of it.
- b. External antennæ generally long, close together, with antennal openings large. Body scarcely able to be contracted into a ball. Head less manifestly immersed in first thoracic segment. Lateral parts of the head separated by a vertical marginal and inframarginal line. Clypeus arched. Legs generally long. Uropoda produced, reaching beyond the terminal segment of the abdomen and the post-terminal segment. Terminal segment narrower than preceding ones and conically produced at end..... Family XIII. ONISCIDÆ (p. 861).
- b'. External antennæ generally short, with antennal openings small. Body able to be contracted into a ball. Head immersed in first thoracic segment. Lateral parts of the head undifferentiated. Clypeus perpendicular. Legs generally short. Uropoda short, not reaching beyond the epimera of the terminal segment of the abdomen or the post-terminal segment. Terminal segment short and broad Family XIV. ARMADILLIDIDÆ (p. 865).
- a'. Flagellum of outer antennæ multiarticulate. Buccal mass prominent. First maxillæ have three plumose setæ on the inner plate. Mandibles with molar expansion large and broad, exhibiting a finely fluted triturating surface. Maxillipeds with terminal part distinctly five-articulate; epignath short. External sexual appendages in male double. Inner ramus of first pair of pleopoda of a similar structure in both sexes. Uropoda with both branches styliform..... Family XV. LIGIDÆ (p. 865).

Family XIII. ONISCIDÆ.

ANALYTICAL KEY TO THE GENERA OF ONISCIDÆ.

- a. Flagellum of external antennæ biarticulate. External opercular ramus of the first, second, and rarely of the third or all the pairs of the abdominal appendages furnished with trachea.
- b. Lateral lobes of the head large; frontal lobe more or less projecting. Eyes subdorsal. First two abdominal segments generally very short; three following ones large, with large epimera. Terminal segment not reaching beyond the epimera of preceding segment. Uropoda somewhat even; longer in male than in female..... 29. *Porcellio*.
- b'. Lateral lobes of head small, hardly projecting; frontal lobe obsolete. Eyes lateral. First two abdominal segments scarcely shorter than those following. Epimera of all the segments small. Terminal segment extending beyond the epimera of preceding segment. Uropoda subequal in both sexes.
30. *Metoponorthus*.
- a'. Flagellum of external antennæ triarticulate. External opercular ramus of abdominal appendages containing no special respiratory organ.
- b. Front of head produced at the middle and at the sides in tubercles; lateral tubercles hornlike. Epimera of abdominal segments moderate or small.
31. *Alloniscus*.
- b'. Front of head not produced; with lateral lobes. Epimera of abdominal segments large 32. *Lyprobius*.

29. PORCELLIO Latreille.

ANALYTICAL KEY TO THE SPECIES OF PORCELLIO.

- a. Surface of body smooth.
- b. Frontal median lobe of head rounded, a little produced. Articles of the flagellum of external antennæ equal in length. Last segment of the abdomen with its extremity widely rounded..... 72. *Porcellio formosus* Stuxbërg.

- b'. Frontal median lobe of head more acnte, minute. First article of the flagellum of external antennæ equal in length to the other or a little longer. Last segment of the abdomen with its extremity acnte... 73. *Porcellio lavis* Latreille.
- a'. Surface of body closely and roughly granulated.... 74. *Porcellio scaber* Latreille.

72. PORCELLIO FORMOSUS Stuxberg.

Porcellio formosus STUXBERG, Øfversigt af Vetensk. Akad. Forhandl., 1875, No. 2, p. 57.—BUDDE-LUND, Crust. Isop. Terrestria, 1883, p. 141.

Habitat.—San Francisco and San Pedro, California.

73. PORCELLIO LÆVIS Latreille.

- Porcellio lavis* LATREILLE, Hist. Crust. Ins., VII, p. 46; Gen. Crust., I, p. 71.—LEACH, Edinb. Encycl., VII, p. 406; Transact., XI, p. 375.
- Oniscus lavis* LAMARCK, Hist. nat. an. s. vert., V, p. 154; 2d ed., V, p. 261.
- (?) *Porcellio lavis* RISSO, Crust. Nice, p. 156; Hist. Nat., pp. 119, 163.—DESMAREST, Consid., p. 321.
- (?) *Porcellio degeerii* AUDOUIN and SAVIGNY, Descript. de l'Égypte, p. 289, pl. XIII, fig. 5.
- Porcellio cucereus* BRANDT, Bull. Soc. Imp. d. Moscou, VI, 1833, p. 177.—MILNE-EDWARDS, Hist. Nat. des Crust., III, p. 168.
- Porcellio syriacus* BRANDT, Bull. Soc. Imp. d. Moscou, VI, 1833, p. 178.—MILNE-EDWARDS, Hist. Nat. des Crust., III, p. 170.
- Porcellio musculus* BRANDT, Bull. Soc. Imp. d. Moscou, VI, 1833.
- Porcellio cinerascens* BRANDT, Bull. Soc. Imp. d. Moscou, VI, 1833, p. 178.
- Porcellio dubius* BRANDT, Bull. Soc. Imp. d. Moscou, VI, 1833, p. 178.—MILNE-EDWARDS, Hist. Nat. des Crust., III, p. 170.
- Porcellio poeyi* GUÉRIN, Comptes Rendus, 1837, p. 132.
- Porcellio lavis* MILNE-EDWARDS, Hist. Nat. des Crust., III, p. 169; Règne an. Planch, p. 71, bis, fig. 2.
- Porcellio urbicus* KOCH, Deutsch. Crust., p. 36.
- Porcellio degeerii* BRANDT, Wagner Reise Alg., III, 1836, p. 278.
- Porcellio oratus* ZADDACH, Synops., p. 13.
- Porcellio flavipes* KOCH, Berichtig, etc., p. 206, pl. 8, fig. 97.
- Porcellio degeerii* LUCAS, Expl. d'Alg., I, pp. 69, 139.
- Porcellio lavis* LEREBoullet, Mém. de la Soc. de Strasbourg, IV, p. 45, pl. I, fig. 7; pl. III, figs. 55-60.
- Porcellio poeyi* GUÉRIN, Ramon de la Sagra, Crust., p. 67.—SAUSSURE, Mém., p. 61, pl. v, fig. 34.
- Porcellio cubensis* SAUSSURE, Mém., p. 61, pl. v, fig. 35.
- Porcellio sumichrasti* SAUSSURE, Mém., p. 62, pl. v, fig. 36.
- Porcellio cotilla* SAUSSURE, Mém., p. 62, pl. v, fig. 37.
- Porcellio mexicanus* SAUSSURE, Mém., p. 63, pl. v, figs. 39, 40.
- Porcellio aztecus* SAUSSURE, Mém., p. 63, pl. v, fig. 38.
- Porcellio interruptus* HELLER, Verh. Zool. Bot. Ges. Wien, XI, p. 495; Novara Exp., p. 136, pl. 12, fig. 6 (vix adult).
- Porcellio lavis* PLATEAU, Crust. Isop., p. 10.—BUDDE-LUND, Nat. Tidsskrift., 3d ser., VII, p. 236.
- Porcellio aztecus* MIERS, Proc. Zool. Soc. London, 1877, p. 669.
- Porcellio lavis* ULJANIN, Crust. Turkest., p. 17, pl. 4, figs. 1-10.—BUDDE-LUND,¹ Crust. Isop. Terrestria, 1885, pp. 138-141.—HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, p. 124.

¹ See Budde-Lund for further synonymy.

Habitat.—Distribution world-wide; Colfax, California (Cook and Jaquay); Monterey, California; Unalaska.

74. PORCELLIO SCABER Latreille.

Oniscus asellus LINNÆUS, Fn. Su., p. 2058; Syst. Nat., I, p. 1061; in part.

Porcellio scaber LATREILLE, Hist. Crust. Ins., VII, p. 45; Gen. Crust, I, p. 70.—LEACH, Edinb. Encycl., VII, p. 406.

Oniscus granulatus LAMARCK, Hist. Nat. des animaux sans vertèbres, V, p. 154; 2d ed., V., p. 261.

Porcellio scaber RISSO, Crust. de Nice, p. 155; Hist. Crust., p. 119.

Porcellio nigra SAY, Journ. Phil. Acad., I, p. 432.

Porcellio granulatus BRÉBISSE, Mém. Soc. Calv., 1825, p. 261.

Porcellio scaber DESMAREST, Consid. Crust., p. 321.—BRANDT and RATZBURG, Med. Zool., II., p. 77, pl. 12, figs. 1-4 and A-B.—BRANDT, Consp., p. 14 (Bull. Soc. Imp. d. Naturalistes de Moscou, VI, 1833).

Porcellio brandtii MILNE-EDWARDS, Hist. Nat. des Crust., III, p. 168.

Porcellio granulatus MILNE-EDWARDS, Hist. Nat. des Crust., III, p. 169, pl. 32, fig. 21.

Porcellio scaber MILNE-EDWARDS, Cuvier Rg. An., 1849, pl. 71-71 bis.

Porcellio nigra GOULD, Rep. Crust., p. 337.

Porcellio scaber KOCH, Deutschlands Crust., p. 34.

Porcellio dubius KOCH, Deutschlands Crust., p. 34.

Porcellio asper KOCH, Berichtig, p. 207, pl. 8, fig. 98.

Porcellio scaber LEREBoullet, Mém. Strasb., IV, p. 34, pl. 1, figs. 4, 5; pl. 2, figs. 43-47.

Porcellio gemmulatus DANA, Crust. U. S. Expl. Exp., 1853, p. 725, pl. 47, fig. 7.—STIMPSON, Journ. Bos. Soc. Nat. Hist., VI, p. 66.

Philoscia tubercululata STIMPSON, Proc. Cal. Acad. Sci., I, p. 89.

Porcellio scaber SILL, Crust. Sieb., 1861, p. 3.—BATE and WESTWOOD, Brit. Crust., II, p. 475.

Porcellio paulenses HELLER, Novara Exp., p. 136, pl. 12, fig. 5.

Porcellio scaber PLATEAU, Bull. Acad. r. Belgique, 2d ser., XXIX, 1870, No. 2, p. 8.—E. BRANDT, Horæ Soc. Ent. Rossi, VIII, p. 167.—BUDDE-LUND, Nat. Tidsskrift., 3d ser., VII, p. 238; Prospectus, p. 3; Bos, Crust. Hedrioph. Nederl., pp. 38, 91.—BUDDE-LUND, Crust. Isop. Terrestria, 1885, pp. 129-131.¹

Habitat.—Distribution world-wide; San Francisco, California; San Pedro, California; Puget Sound.

Budde-Lund suggests that *Porcellio gemmulatus* Dana differs in no wise from *Porcellio scaber*.²

30. METOPONORTHUS Budde-Lund.

75. METOPONORTHUS PRUINOSUS Budde-Lund.³

Metoponorthus pruinosis BUDDE-LUND, Crust. Isop. Terrestria, 1885, pp. 169, 170.

Porcellio maculicornis KOCH, Deutschlands Crustaceen, 1840, p. 34.—STUXBERG, Øfersigt af Vetensk. Akad. Forhandl., 1875, No. 2, p. 55.

Habitat.—California.

¹ See Budde-Lund for further synonymy.

² Crust. Isop. Terrestria, 1885, p. 131.

³ See Budde-Lund for further synonymy.

31. ALLONISCUS Dana.

ANALYTICAL KEY TO THE SPECIES OF ALLONISCUS.

- a. Surface of body very densely granulated. Margins of epimera serrated.
76. *Alloniscus mirabilis* Stuxberg.
- a'. Surface of body punctate.
b. Lateral processes of the head large, prominent.
77. *Alloniscus cornutus* Budde-Lund.
- b'. Lateral processes of the head small, scarcely prominent.
78. *Alloniscus perconvexus* Dana.

76. ALLONISCUS MIRABILIS (Stuxberg).

Rhinoryctes mirabilis STUXBERG, Øfversigt af Vetensk. Akad. Forhandl., 1875, No. 2, p. 51.

Alloniscus mirabilis BUDDE-LUND, Crust. Isop. Terrestria, 1885, p. 229.

Habitat.—California.

77. ALLONISCUS CORNUTUS Budde-Lund.

Alloniscus cornutus BUDDE-LUND, Crust. Isop. Terrestria, 1885, pp. 228, 229.

Habitat.—California.

78. ALLONISCUS PERCONVEXUS Dana.

Alloniscus perconvexus DANA, Proc. Acad. Nat. Sci. Phila., VII, p. 176.—STIMPSON, Journ. Bos. Soc. Nat. Hist., VI, p. 66.—BUDDE-LUND, Crust. Isop. Terrestria, 1885, p. 225.

(?) *Alloniscus maculosus* HARFORD, Proc. Cal. Acad. Sci., Pt. 1, VII, 1877, p. 54.

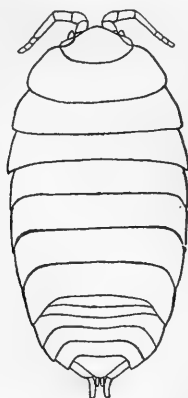


FIG. 34. — ALLONISCUS PERCONVEXUS DANA. × 8.

Habitat.—California; Pacific Grove: Santa Barbara; Monterey Bay, collected by Mr. Heath; Tillamook Head, Oregon.

32. LYPROBIUS Budde-Lund.

79. LYPROBIUS PUSILLUS Budde-Lund.

Lyprobius pusillus BUDDE-LUND, Crust. Isop. Terrestria, 1885, p. 230.

Habitat.—California.

Family XIV. ARMADILLIDIDÆ.

33. CUBARIS Brandt.

Outer branch of the uropoda small or minute, rather smooth. Terminal segment not shorter than uropoda. Terminal segment posteriorly truncate. Clypeus very short, with the superior margin entire, lobated at the sides. Terminal abdominal segment subtetragonal. External branch of the uropoda inserted in the middle of the internal lateral margin of the basal joint.

ANALYTICAL KEY TO THE SPECIES OF CUBARIS.¹

- a. Last abdominal segment longer than broad. 80. *Cubaris californica* (Budde-Lund).
 a'. Last abdominal segment a little transverse, with median constriction. Antennæ minutely roughened 81. *Cubaris affinis* (Dana).

80. CUBARIS CALIFORNICA (Budde-Lund).

Armadillo speciosus STUXBERG, Øfversigt af Vetensk. Akad. Forhandl., 1875, No. 2, p. 62.

Armadillo californica BUDDE-LUND, Crust. Isop. Terrestria., 1885, p. 40.

Habitat.—California: San Francisco and San Pedro.

Budde-Lund² remarks that perhaps this species does not differ from *Cubaris affinis* (Dana).

81. CUBARIS AFFINIS (Dana).

Spherillo affinis DANA, Proc. Acad. Nat. Sci. Phila., VII, 1854, p. 176.—STIMPSON, Journ. Bos. Soc. Nat. Hist., VI, 1857, p. 65.

Armadillo affinis BUDDE-LUND, Crust. Isop. Terrestria, 1885, p. 39.

Habitat.—California.

Family XV. LIGIIDÆ.

ANALYTICAL KEY TO THE GENERA OF LIGIIDÆ.

- a. Uropoda equal in length, styliform, often filiform. Interior mala of the mandibles with numerous pencils of hairs. Last segment of body broad, with distinct epimeral plates. Maxillipeds with palp four to five jointed; epignath rounded 34. *Ligia*.
 a'. Uropoda unequal in length.
 b. Extremity of uropods furnished with two long apical bristles. Interior mala of right mandible with three pencils of hairs, of left mandible with five pencils of hairs. Last segment of body small and without any epimeral plates. Maxillipeds with a five-jointed palp; epignath narrow, linguiform.. 35. *Ligidium*.
 b'. Extremity of uropods not furnished with two long apical bristles.

36. *Styloniscus*.

¹ *Cubaris* is oldest synonym of preoccupied *Armadillo* (Stebbing, Hist. of Crust., 1893, p. 433).

² Crust. Isop. Terrestria, 1885, p. 40.

34. *LIGIA* Fabricius.ANALYTICAL KEY TO THE SPECIES OF *LIGIA*.

a. External antennæ shorter than the body.

b. Caudal stylets about equal to half the length of body.

82. *Ligia occidentalis* Dana.

b'. Caudal stylets about equal to one-fifth the length of body.

83. *Ligia pallasii* Brandt.

a'. External antennæ longer than body, or equal to length of body. Caudal stylets about equal to two-thirds length of body..... 84. *Ligia exotica* Roux.

82. *LIGIA OCCIDENTALIS* Dana.

Ligia occidentalis DANA, U. S. Expl. Exp. Crust., II, p. 7¹², pl. XLIX, fig. 7; Proc. Acad. Nat. Sci. Phila., VII, p. 176.—STIMPSON, Bos. Journ. Nat. Hist., VI, 1857, p. 66.—HARFORD, Proc. Cal. Acad. Sci., VII, 1877, p. 116.—BUDDE-LUND, Crust. Isop. Terrestria, 1885, p. 264.

Habitat.—California: San Francisco Bay; San Diego; Sacramento River; Monterey Bay; Lower California.

83. *LIGIA PALLASII* Brandt.

Ligia pallasii BRANDT, Bull. Soc. Impér. des Natur. de Moscou, VI, 1833, p. 172.

Ligia dilatata STIMPSON, Bos. Journ. Nat. Hist., 1857, p. 67, 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., 1877, p. 671 (see footnote).

Ligia pallasii BUDDE-LUND, Crust. Isop. Terrestria, 1885, pp. 261, 262.

Habitat.—Unalaska; Sitka; Tanager, Aleutian Islands; Victoria, Vancouver Island; Puget Sound; California.

84. *LIGIA EXOTICA* Roux.

Ligia exotica ROUX, Crust. Médit., p. 3, pl. XIII, fig. 9.

Ligia grandis PERTY, Spix. H. Martius, p. 212, pl. XL, fig. 13.

Ligia gaudichaudii MILNE-EDWARDS, Hist. Nat. des Crust., III, p. 157.

Ligia baudiniana MILNE-EDWARDS, Hist. Nat. des Crust., III, p. 155.

Ligia (Italica) coriacea KOCH, Deutschl. Crust., p. 36; Berichtig., p. 211.

Ligia gaudichaudii DANA, Expl. Exp., p. 741, pl. XLIX, figs. 6a-h.—NICOLET, Gay, Hist. Chile, III, p. 265.

Ligia baudiniana MIERS, Proc. Zool. Soc., 1877, p. 670.

Ligia exotica BUDDE-LUND, Crust. Isop. Terrestria, 1885, pp. 266-268.

Habitat.—Widely distributed; California; Topolobampo, Mexico (Mr. Edward Palmer).

35. *LIGIDIUM* Brandt.ANALYTICAL KEY TO THE SPECIES OF *LIGIDIUM*.

a. Inner process of the basal article of the uropoda three times shorter than the terminal external branch; internal terminal branch reaching the apex of the external branch; the two terminal hairs equal in length to the external branch.

85. *Ligidium hypnorum* (Cuvier).

a'. Inner process of the basal article of the uropoda four times shorter than the terminal external branch; internal terminal branch long, extending much beyond the apex of the external branch, being a sixth part longer; the two terminal hairs short, equal in length to half the external branch.

86. *Ligidium tenue* Budde-Lund.

85. *LIGIDIUM HYPNORUM* (Cuvier).

Oniscus hypnorum CUVIER, Journ. d'hist. nat. II, p. 19, pl. 26.

Ligidium hypnorum BUDDE-LUND, Naturhistorisk Tidsskrift, 3d ser., VII, 1870, p.

225.—STUXBERG, Øfversigt af Vetensk. Akad. Forhandl., 1875, No. 2, p. 48.

Habitat.—California (Stuxberg).

86. *LIGIDIUM TENUE* Budde-Lund.

Ligidium tenue BUDDE-LUND, Crust. Isop. Terrestria, 1885, p. 258.

Habitat.—Sitka Island.

86. *STYLONISCUS* Dana.87. *STYLONISCUS GRACILIS* Dana.

Styloniscus gracilis DANA, Proc. Acad. Nat. Sci. Phila., VII, 1854-55, p. 176.—

STIMPSON, Journ. Bos. Soc. Nat. Hist., VI, 1857, p. 66.—BUDDE-LUND,

Crust. Isop. Terrestria, 1885, p. 271.

Habitat.—California.

VI. EPICARIDEA.

Family XVI. BOPYRIDÆ.¹

Body of female primarily disciform, variously modified subsequently by retrogressive metamorphosis; distinctly segmented; more or less asymmetrical, twisted now to right, now to left; dorsal face flattened; head deeply sunk in thorax and carrying in front two pairs of rudimentary antennæ; eyes, when present, dorsal. Maxillipeds lamellar, biarticulate, obtecting the oral area below, and more frequently exhibiting a small terminal joint, and, at base, two curved lanceolate appendages. Legs, seven pairs, sometimes obsolete on one side, and all of same structure, short, prehensile; coxal plates obsolete or distinctly defined. Incubatory plates, five pairs, more or less arching over the ventral face of the thorax; first pair, as a rule, concealed by second and divided by a transversal fold into two segments. Abdomen more or less distinctly segmented; pleopoda, forming simple or double lamellæ, all of the same structure, rarely obsolete. Uropoda, when present, simple lanceolate. Male elongate, very small, symmetrical; segments of thorax distinct, those of abdomen sometimes distinct, sometimes confluent. Mouth parts simple, conic; posterior antennæ with flagellum four-articulate; legs of uniform structure; uropoda with inner branch shorter than outer. Parasitic on decapodous crustacea.²

¹ Sars, Crustacea of Norway, II, 1898, pp. 195, 196, pls XI, XII.

² Bopyridæ parasitic on *Crangon crangon* (Linnaeus), *Nectocrangon* lar (Owen), *Nectocrangon alaskensis* Kingsley, and other shrimps, have been reserved for more detailed study.

This family has not been sufficiently worked up to offer as yet any systematic arrangement of the genera.¹

37. ARGEIA Dana.

ANALYTICAL KEY TO THE SPECIES OF ARGEIA.

- a.* Head transverse. All the thoracic branchial appendages present. All the abdominal appendages present..... 88. *Argeia pugettensis* Dana.
a'. Head bilobate. Thoracic branchial appendages apparently absent in some of anterior segments. Last three pairs of abdominal appendages wanting.
 89. *Argeia depauperata* Stimpson.

88. ARGEIA PUGETTENSIS Dana.

Argeia pugettensis DANA, U. S. Expl. Exp. Crust., II, p. 804, pl. LIII, fig. 7.—
 STIMPSON, Bos. Journ. Nat. Hist., VI, 1857, p. 71.

Habitat.—Puget Sound on *Crangon munita*.

89. ARGEIA DEPAUPERATA Stimpson.

Argeia depauperata STIMPSON, Bos. Journ. Nat. Hist., VI, 1857, p. 71.

Habitat.—San Francisco Bay on *Crangon franciscorum*.

38. PHYLLODURUS Stimpson.

90. PHYLLODURUS ABDOMINALIS Stimpson.

Phyllodurus abdominalis STIMPSON, Bos. Journ. Nat. Hist., VI, 1857, p. 71.—LOCK-
 INGTON, Proc. Cal. Acad. Sci., VII, 1876, Pt. 1, p. 57.

Habitat.—Puget Sound; Tomales Bay, California; “on the common *Upogebia*.”

39. BOPYROIDES Stimpson.

91. BOPYROIDES ACUTIMARGINATUS Stimpson.

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

Habitat.—Puget Sound, on *Spirontocaris brevirostris*.

40. PSEUDIONE Kossmann.

ANALYTICAL KEY TO THE SPECIES OF PSEUDIONE.

- a.* Antennæ five-jointed. First pair of maxillæ absent. In male, eyes present; maxillæ wanting; last segment of abdomen cordate in form, being narrow anteriorly and having its hinder margin notched.
 92. *Pseudione giardi* Calman.
a'. Antennæ four-jointed. Maxillæ normal, present. In male, eyes wanting; maxillæ normal, present; last segment of abdomen triangular and entire.
 93. *Pseudione galacanthæ* Hansen.

¹ See Hansen, Bull. Mus. Comp. Zool., Harvard College, XXXI (1897), p. 112.

92. PSEUDIONE GIARDI Calman.

Pseudione giardi CALMAN, Ann. N. Y. Acad. Sci., XI, 1898, No. 13, pp. 274–281, pl. XXXIV, fig. 5.

Habitat.—Puget Sound, on *Pagurus ochotensia* (Brandt).

93. PSEUDIONE GALACANTHÆ Hansen.

Pseudione galacanthæ HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 118–120, pl. v, fig. 22i.

Habitat.—Gulf of California, in branchial cavity of *Galacantha diomedæ* var. *parvispina* Faxon.

41. BATHYGYGE Hansen.

94. BATHYGYGE GRANDIS Hansen.

Bathygge grandis HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 122, 124, pl. vi, figs. 2, 2e.

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

42. CRYPTIONE Hansen.

95. 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, 1g.

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

43. PARARGEIA Hansen.

96. PARARGEIA ORNATA Hansen.

Parargeia ornata HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 120–122, pl. vi, figs. 1, 1i.

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

44. IONE Latreille.

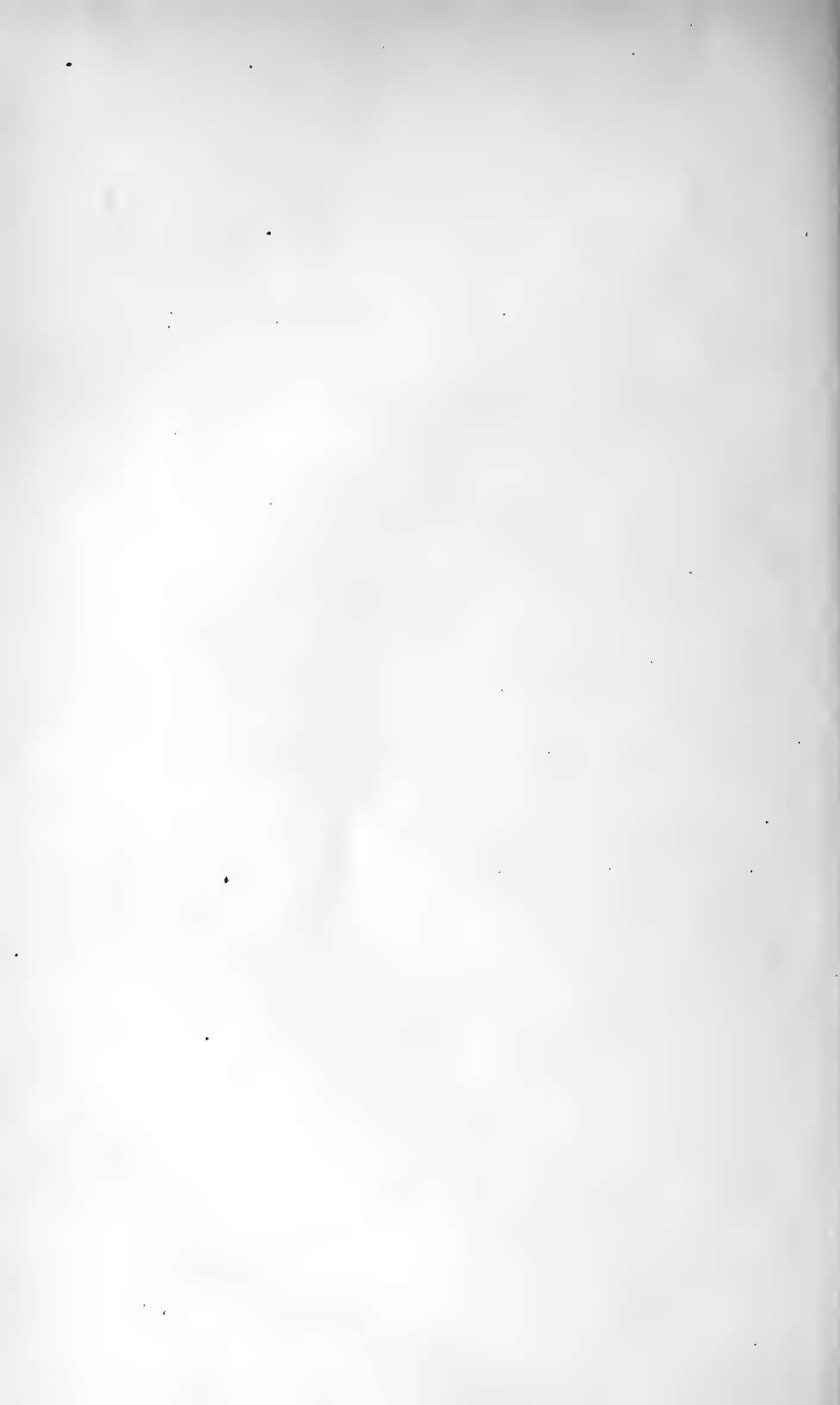
97. IONE CORNUTA Spence Bate.

Ione cornuta SPENCE BATE, Lord's Naturalist in British Columbia, II, 1866, p. 282.

Ione thoracica HELLER, Carcinolog. Beitrag z. Fauna der Adriat. Meeres, Verhand. Zool. Bot. Gessellsch. Wien, XV, pp. 979–984, pl. 17.

Ione cornuta BATE and WESTWOOD, Brit. Sessile-Eyed Crust., II, p. 253.—GIARD and BONNIER, Contributions à l'étude des Bopyriens, 1887.

Habitat.—Esquimault Harbor, British Columbia, in branchia of *Calianassa longimana*; Vancouver Island.



DESCRIPTION OF A NEW SPECIES OF SUBTERRANEAN ISOPOD.

By W. P. HAY, M. S.,
Central High School, Washington, D. C.

Forty or fifty specimens of an interesting and apparently undescribed Isopod were obtained from an old well in Irvington, Marion County, Indiana. They were evidently strictly aquatic. The pump in the well drew water from the bottom, and the animals could be obtained only by vigorous work. After capture they lived for some hours in a jar of water, crawling about on the bottom, very much after the manner of *Asellus*. While in the water the pleopods could be seen to be gently moved up and down with a fanlike motion. Several of the females carried eggs, six or eight of which were sufficient to fill the brood pouch.

The nearest relatives of this species are *Haplophthalmus mengii* (Zaddach) and *H. danicus* Budde-Lund, both of which are inhabitants of moist situations, such as decaying leaves and wood, in various localities in Europe. It is also closely related to *Scyphacella* (*Haplophthalmus*?) *arenicola* S. I. Smith, which has been found burrowing in the sand in a number of localities along the Atlantic coast of North America.

HAPLOPHTHALMUS PUTEUS, new species.

Male.—Body elliptical, length about three times the breadth, dorsal surface strongly convex, covered with longitudinal rows of low tubercles and scattered setae. Segments of the pereon about equal in length, the posterior pleural angle of all, except the first, more or less produced backwards. Pleurae of third, fourth, and fifth segments of the pleon thin and directed backwards and outwards. Terminal segment of abdomen notched behind and with the postero-lateral margins concave. Uropods exserted, short, outer ramus longer than inner; both rami setose. Front margin of head very slightly produced. Antennae longer than the greatest breadth of the body; first and second segments of medium length, third short, fourth and fifth long, flagellum short, pinniform, composed of three very small, closely articulated segments. Antennae geniculate between segments four and five. Antennules minute, composed of three segments, entirely concealed by the front of the head, sensory filaments five. Eyes small, simple. Upper lip regularly rounded in front and with a median triangular patch of

setæ. Mandibles large and powerful, bearing on the inner surface a broad, ridged molar tubercle; on the anterior surface, one or two delicate, branched sensory styles. The cutting portion of the mandibles is different; that on the left, consists of two portions, an outer with four heavy teeth and an inner with three much smaller teeth; the other mandible has but one row of three or four large teeth which, when closed, fit in the space between the two rows of teeth of the mandible first described. The first maxilla has both branches erect, the outer bearing five or six acute curved teeth, the inner three delicate plumose flagelliform processes. The second maxilla consists of two strap-shaped lamellæ closely applied to one another and bearing setæ at their ends. The maxilliped is a broad, flattened plate, with straight inner and rounded outer margins, and bearing at the tip two obscurely segmented, setose processes. The pereopods are similar in general to one another, differing only in the arrangement and strength of the spines.

The first and second pairs of pleopods are two-segmented, slender, and styliform. The second pair appear to be the sexual organs, while the first are to some degree rudimentary.

The third pleopod is flattened and somewhat operculiform.

The fourth and fifth pleopods are broad, flat, thin, and lie flat upon one another and the last segment of the pleon. They and the preceding are the branchial appendages of the animal.

The uropods have been already described.

Color, white; eyes, black; intestine showing through the shell as a grayish line.

Female.—Similar in general characters to the male, but with the following differences: Body not more than two and one-half times as long as wide. First and second pleopods absent. Pereopods with flattened plates, forming a brood or egg chamber.

Length, 3 to 4 mm.

Type.—No. 22586, U.S.N.M.

· EXPLANATION OF PLATE LXXXVI.

Fig. 1. Dorsal view of a male specimen.

2. Mandible of right side, seen from in front.

3. Mandible of left side (tip only), to show double row of cutting teeth and ridges on molar tubercle.

4. First maxilla.

5. First maxilliped.

6. Upper lip.

7. Antenna (second antenna).

8. Antennule (first antenna).

9. First pereopod.

10. First pleopod.

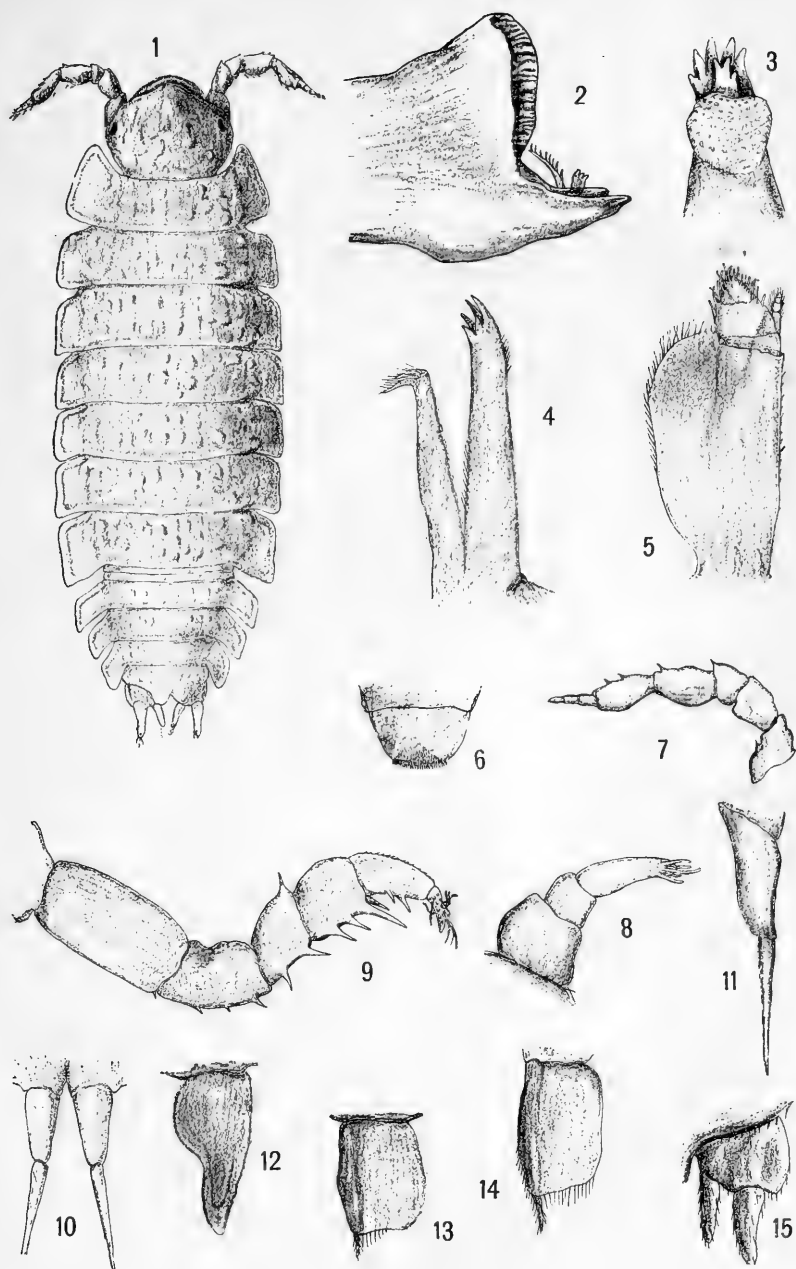
11. Second pleopod.

12. Third pleopod.

13. Fourth pleopod.

14. Fifth pleopod.

15. Uropod (right side).



HAPLOPHTHALMUS PUTEUS W. P. HAY, NEW SPECIES.

FOR EXPLANATION OF PLATE SEE PAGE 872.



SYNOPSIS OF THE RECENT AND TERTIARY LEPTONACEA OF NORTH AMERICA AND THE WEST INDIES.

By WILLIAM H. DALL,
Curator, Division of Mollusks.

Having been engaged in reviewing the Tertiary species of this group it was found necessary to investigate the standing of the genera and higher groups, both recent and fossil, as the synonymy was found in great confusion. The full details of this work will appear in Transactions¹ of the Wagner Institute of Science, Philadelphia, but it seemed desirable to give a synopsis of the American species, with the revised synonymy, for the use of students who might not have access to the larger paleontological work. No doubt more thorough exploration of our Southern coasts and the Antilles will add largely to the present list, which nevertheless adds several genera and some 20 recent species to those heretofore known from our fauna.

The *Leptonacea* form a very interesting and puzzling group. Their characters combine features, characteristic in other Teleodonts of immaturity, with such as are more probably due to environmental modifications. Without being in themselves prototypes they exhibit features which we may readily suppose might have been characteristic of prototypic Teleodonts. Groups which are really starting points for numerous subsequently developed genera, are usually notable for their tendency to vary and interchange characters. In the present case perhaps the very general habit of commensalism, or parasitism, has produced degeneration accompanied by a revival of atavistic primary characters. The fact that authors, struck by similarity of dental features to those of immature specimens of genera of widely different origin, have too hastily referred species of *Leptonacea* to such families as the Mactridæ or Cyrenidæ is significant in this connection.

It must be confessed at the outset that our knowledge of the anatomy of recent *Leptonacea* is lamentably deficient. We have to assume (which is never safe) that forms with similar dentition are generally

¹ Volume III, Pt. 5.

similar in other points of structure, except where we know to the contrary. We find, moreover, that the dentition is frequently indistinctly developed, or somewhat amorphous, rendering it difficult to make out the homologies of the different parts of the hinge. It is certainly unsafe to assume, as Bernard has sometimes done, that the position of a dental lamina is sufficient to settle its homology. The dynamic reactions of the teeth upon each other are, I am confident, of the utmost importance in the development of the hinge. As in the vertebrate skeleton, pressure and friction in localized areas will produce directly a response in facets and buttresses. In fact, to the eye trained to take such matters into account, every hinge shows more or less evidence of the mutability of hinge structure and its responses to stress, as well as to inherited tendencies of form. In no group are these more obvious than in the *Leptonacea*.

The prototypic hinge of the group, or that which with slight modifications will exhibit any of the various types of hinge-structure found in the group, is very simple and has been figured by Bernard in his illustrations of a minute form which he has named *Pachykellya*. His invaluable researches upon the early features of the hinge have shown that among the *Teleodesmacea* the so-called laterals and cardinals are dissevered parts of originally single laminae sharply bent at the proximal, or umbonal, end and having somewhat the form of a figure seven (7). In *Pachykellya* the hinge is composed of an internal resilium not obviously separated from the ligament and inclined obliquely backward as in many nepionic Teleodonts. On each side of this in each valve is a pair of the \searrow -shaped lamellae, of which most have developed more or less distinctly the proximal or cardinal "hook." The lower ones are less engaged in the various stresses to which the laminae are subjected in use, and hence, as might be expected, the hook is less evident or even undeveloped.

From this type of hinge all the others can be developed by trifling modifications. The laminae may be long or short; when the outer limb is short we have a Λ -shaped tooth; if the angle proceeds to that stage of development when its continuity is lost we may have a hinge like that of *Cyamiomactra*; the severed hook may be modified by pressure to a petaloid shape, which again by degeneration may be reduced to two obscure minute conical projections, as in some species of *Galeomma*. Any part or the whole of the hinge may become obsolete; the resilium and ligament may separate or continue in connection; the latter frequently becomes external and often obsolete, though traces of it almost always exist.

The arrangement of the groups must, in our present state of knowledge, be provisional.

No linear arrangement will show the exact interrelations of the different genera, and yet we are confined to a linear arrangement.

The present tentative scheme is based on our present insufficient

information, and, where only shell characters are known, chiefly on those of the hinge. It is difficult at present to say what should be done with *Montacuta*. According to the literature it has Lucinoid gills and Thyasiroid hepatic digitations, while the shell is obviously Leptonoid. The anatomical combinations that the other groups would exhibit are at present unknown in many cases. It may be for the present most convenient to place the *Montacutas* and *Aligenas* at the end of the list with an unassigned value, as they certainly seem to lead up to the *Thyasiridae* in spite of the differences of the gills.

It does not seem practicable to associate *Sportella*, *Anisodonta*, and other genera, in which the soft parts are permanently retained within the shell, with forms like *Galeomma*, in which they are exerted, covering a large part of the valves. The only data we have on *Anisodonta* (*quadrata*) would indicate that the mantle edges are largely united, the gills as in *Thyasira* (*Cryptodon*), but united behind the foot, and, contrary to the rule in the *Leptonacea*, the incurrent orifice, though not developed into a siphon, is complete and posterior. Yet the shell characters merge so gradually into those of typical *Anisodonta*, and these into those of *Sportella*, that one feels that they can hardly be widely separated without more definite information. The interchanges of characters and the multiplicity of forms separated by apparently trifling details of structure make this group one of the most perplexing I have ever tried to review.

The following scheme is provisionally adopted.

The name of the typical species follows the date of the genus. The series begins with the most specialized forms.

Family CHLAMYDOCONCHIDÆ.

Chlamydoconcha Dall, 1884. *C. orcutti* Dall.

Family GALEOMMATIDÆ.

Ephippodonta Tate, 1889. *E. macdougalli* Tate.

Galeomma Turton, 1825. *G. turtoni* Sowerby.

Sections: *Amphilepida* Dall, 1899. *G. polita* Deshayes.

Paralepida Dall, 1899. *G. formosa* Deshayes.

Libratula Pease, 1865. *L. plana* Pease.

Solecardia Conrad, 1849. *S. eburnea* Conrad.

Subgenera: *Scintilla* Deshayes, 1855. *S. philippinensis* Deshayes.

Spaniorinus Dall, 1899. *S. cossmanni* Dall.

Scintillorbis Dall, 1899. *S. crispata* Fischer.

Vasconiella Dall, 1899. *Vasconia jeffreysiana* Fischer.

Family SPORTELLIDÆ.

Sportella Deshayes, 1858. *Psammobia dubia* Deshayes.

? Section: *Fabella* Conrad, 1863. *F. constricta* Conrad.

Anisodonta Deshayes, 1858. *A. complanata* Deshayes.

Sections: *Fulcrella* Cossmann, 1886. *Poromya paradoxa* Deshayes.

? *Basterotia* Mayer, 1870. *Corbula quadrata* Hinds.

Hindsiella Stoliczka, 1871. *Modiola arcuata* DeFrance.

FAMILY LEPTONIDÆ.

Entovalva Voeltzkow, 1890. *E. mirabilis* Voeltzkow.

Lepton Turton, 1822. *Solen squamosus* Montagu.

Subgenera: *Neolepton* Monterosato, 1875. *L. sulcatulum* Jeffreys.

Lutetina Vélain, 1876. *L. antarctica* Vélain.

Epilepton Dall, 1899. *Lepton clarkiae* Clark.

Planikellia Cossmann, 1887. *Erycina radiolata* Lamarek.

Erycina (Lamarek, 1806) Récluz. *Erycina pellucida* Lamarek.

Subgenera: *Scacchia* Philippi, 1844. *Tellina elliptica* Scacchi.

Anomalokellia Cossmann, 1887. *A. catalaunensis* Cossmann

Pseudopythina Fischer, 1884. *P. macandrewi* Fischer.

Turquetia Vélain, 1876. *T. fragilis* Vélain.

Bornia Philippi, 1836. *Erycina corbuloides* Bivona.

Sections: *Ceratobornia* Dall, 1899. *Lepton longipes* Stimpson.

Pythina Hinds, 1844. *P. deshayesiana* Hinds.

Kellia Turton, 1822. *Mya suborbicularis* Montagu.

Sections: *Mancikellia* Dall, 1899. *Zoë pumila* Monterosato.

Kelliola Dall, 1899. *Kellia symmetros* Jeffreys.

Divarikellia Cossmann, 1887. *K. nitida* Caillat.

Thecodonta A. Adams, 1864. *T. sieboldii* Adams.

? Subgenera: *Serridens* Dall, 1899. *Pristiphora oblonga* Carpenter.

Dicranodesma Dall, 1899. *Mysella calvertensis* Glenn.

Mysella Angas, 1877. *M. anomala* Angas.

Subgenera: *Pythinella* Dall, 1899. *Montacuta cuneata* Verrill.

Sphenalia S. Wood, 1874. *Montacuta donacina* S. Wood.

Rockfortia Vélain, 1876. *R. australis* Vélain.

Pachykellya Bernard, 1897. *P. edwardsi* Bernard.

* * * * *

Laswa Leach, 1827. *Cardium rubrum* Montagu.

Myllita Orbigny, 1850. *M. deshayesii* Récluz.

Perrierina Bernard, 1897. *P. taxodonta* Bernard.

FAMILY KELLIELLIDÆ.

Kelliella Sars, 1870. *K. abyssicola* Sars.

Lutetia Deshayes, 1860. *L. parisiensis* Deshayes.

Alveinus Conrad, 1865. *A. parvus* Conrad.

Cyamimactra Bernard, 1897. *C. problematica* Bernard.

Turtonia Alder, 1848. *Venus minuta* Fabricius.

INCERTÆ SEDIS.

Cyamium Philippi, 1845. *C. antarcticum* Philippi.

Scioberetia Bernard, 1896. *S. australis* Bernard.

Montacuta Turton, 1822. *Ligula substriata* Montagu.

Aligena H. C. Lea, 1845. *Abra æquata* Conrad.

? Section: *Spaniodon* Reuss, 1867. *S. nitidus* Reuss.

Cycladella Carpenter, 1865. *C. papyracea* Carpenter.

Asbiornsenia Friele, 1886. *A. striata* Friele.¹

A.—SPECIES OF THE EAST COAST OF NORTH AMERICA.

Genus SOLECARDIA Conrad.

1. *Solecardia* (*Scintilla*) *mörchii* Dall, 1899; St. Thomas, West Indies.
Scintilla eburnea Mörch, 1876; not Conrad, 1849.

Genus SPORTELLA Deshayes.

2. *Sportella* (*Fabella*) *pilsbryi* Dall, 1899; 17 miles off Cape Hatteras, North Carolina, in 49 fathoms sand; U. S. Fish Commission.
3. *Sportella* (*Fabella*) *protexta* (Conrad) 1841; 17 miles off Cape Lookout, North Carolina, in 22 fathoms sand; U. S. Fish Commission.

This is *Amphidesma protexta* Conrad, 1841, + *Hiatella lancea* H. C. Lea, 1845, and *Saxicava fragilis* Holmes, 1859. It ranges from the Miocene to the present fauna.

Genus ANISODONTA Deshayes.

4. *Anisodonta* (*Basterotia*) *quadrata* (Hinds) 1844; coast of North Carolina to the West Indies.

Type of the genus *Eucharis* Récluz, 1850; not Latreille, 1804.

5. *Anisodonta* (*Fulcrella*) *elliptica* Récluz, 1850; North Carolina to Guadelupe Island, West Indies; Miocene?
6. *Anisodonta* (*Fulcrella*) *corbuloidea* Dall, 1899; North Carolina.

Genus LEPTON Turton.

7. *Lepton lepidum* (Say) 1826; Charleston Harbor, South Carolina.
Amphidesma lepidum of Say.
8. *Lepton placunoideum* Carpenter, 1857; "West Indies."

Genus ERYCINA Lamarck.

9. *Erycina linella* Dall, 1899; off Cape Lookout, North Carolina.
10. *Erycina emmonsii* Dall, 1899; coast of North Carolina.

¹ Referred by Friele to *Tellinida*, following Jeffreys's advice, but possibly related to *Montacuta*. I may add that the genus *Erycinella* Conrad, 1845, which from its name might be supposed to belong among the *Leptonacea*, probably should be classed among those *Carditida*, like *Carditella* Smith, which have an internal resilium.

11. *Erycina periscopiana* Dall, 1899; off Cape Lookout, North Carolina.
12. *Erycina fernandina* Dall, 1899; off Fernandina, Florida.

The shortness and strength of the laterals in this species recall those features in *Mysella*.

Genus BORNIA Philippi.

13. *Bornia barbadensis* Dall, 1899; Barbados; 100 fathoms.
14. *Bornia* (*Ceratobornia*) *longipes* Stimpson, 1855; coast of the Carolinas.

Genus KELLIA Turton.

15. *Kellia suborbicularis* (Montagu, 1804) Turton, 1822, var. *gouldii* Thomson, 1867; Salem, Massachusetts, to Long Island Sound.
16. *Kellia* (*Kelliola*) *symmetros* Jeffreys, 1876; Baffin Bay, in 1,750 fathoms; North Atlantic, 488 fathoms.

Genus MYSELLA Angas.

17. *Mysella planulata* Stimpson, 1851; Nova Scotia south to Corpus Christi, Texas.
= *Kellia rubra* Gould, 1841, ex parte, not Montagu; *Montacuta bidentata* Verrill and Bush, 1898, not Montagu, nec Gould; var. *fragilis* Verrill and Bush, 1898.
18. *Mysella planulata* var. *tenuis* Verrill and Bush, 1898; Massachusetts Bay south to North Carolina.

This variety is connected by numerous gradations with the type, in which the laminae are less stout.

19. *Mysella striatula* Verrill and Bush, 1898; coast of North Carolina in 5 to 50 fathoms.
20. *Mysella casta* Verrill and Bush, 1898; coast of North Carolina in 14 to 17 fathoms.
21. *Mysella ovata* Jeffreys (?); Vineyard Sound, Massachusetts, in 100 to 157 fathoms.
22. *Mysella triquetra* Verrill and Bush, 1898; off Cape Hatteras, North Carolina, in 43, and off Fernandina, Florida, in 294 fathoms.
23. *Mysella tumidula* Jeffreys var. *verrilli* Dall, 1899; off Delaware Bay in 843 to 1,091 fathoms.
24. *Mysella mölleri* Mörch, 1899; Novaia Zemlia, Spitsbergen, Norway, and Greenland.

Montacuta elevata Mörch, 1875, after Torell, not of Stimpson, 1851.

25. *Mysella barbadensis* Dall, 1899; Barbados, in 100 fathoms.
26. *Mysella* (*Pythinella*) *cuneata* Verrill and Bush, 1898; coast of North Carolina.

Genus MONTACUTA Turton.

27. *Montacuta dawsoni* Jeffreys, 1863; Europe from Norway to the Mediterranean; Spitsbergen; America from Disco, Greenland, to St. Johns, Newfoundland.

Perhaps Möller's *species indet.* No. 8, 1842.

28. *Montacuta floridana* Dall, 1899; Miocene, Pliocene; Recent, West Florida.
29. *Montacuta minuscula* Dall, 1899; off Cape Hatteras, North Carolina, in 124 fathoms.
30. *Montacuta limpida* Dall, 1899; Florida coast from Fernandina to Cape Florida, in 85 to 294 fathoms.
31. *Montacuta percompressa* Dall, 1899; Vineyard Sound, Massachusetts.

Montacuta ferruginosa Verrill, 1884, not of British authorities following Montagu.

Genus LASÆA Leach.

32. *Lasæa rubra* Montagu, 1804; Bermuda; European seas; California.

Genus TURTONIA Alder.

33. *Turtonia minuta* Fabricius, 1780; Greenland, Nova Scotia, New England coast (and south to South Carolina?).

Genus KELLIELLA Sars.

34. *Kelliella nitida* Verrill, 1885; off the coast between Delaware and Marthas Vineyard, in 1,525 to 2,033 fathoms.

Genus ALIGENA H. C. Lea.

35. *Aligena elevata* Stimpson, 1851; coast of southern New England from Chelsea beach, Massachusetts, to New Haven, Connecticut.

= *Montacuta bidentata* Gould, ex parte, 1841, not of Turton; *Montacuta elevata* Stimpson, 1851; *Kelliopsis elevata* Verrill and Bush, 1898.

B.—SPECIES OF THE WEST COAST OF NORTH AMERICA

Genus CHLAMYDOCONCHA Dall.

1. *Chlamydoconcha orcutti* Dall, 1884; San Diego, California.

Genus SOLECARDIA Conrad.

2. *Solecardia eburnea* Conrad, 1849; Cape St. Lucas to Panama.
This is *Scintilla cumingi* Deshayes, 1855.

Genus SPORTELLA Deshayes.

3. *Sportella californica* Dall, 1899; Monterey, California.
4. *Sportella stearnsii* Dall, 1899; Gulf of California.

Genus LEPTON Turton.

5. *Lepton meröeum* Carpenter, 1864; San Diego, California.
6. *Lepton umbonatum* Carpenter, 1857; Mazatlan, Mexico.

Genus ERYCINA Lamarck.

7. ? *Erycina subquadrata* Carpenter, 1857; Mazatlan.

Described as a *Montacuta*, but, according to a camera lucida drawing of the type by Carpenter, has the hinge of *Erycina*.

8. *Erycina (Pseudopythina) rugifera* Carpenter, 1864; Puget Sound.

Described as *Pythina*. Lives attached to the abdomen of *Gebia pugetensis* Dana, a burrowing crustacean. *Lepton rude* Whiteaves, is synonymous.

9. *Erycina (Pseudopythina) compressa* Dall, 1899; Nunivak Island, Bering Sea, and throughout the Aleutian region.

Genus BORNIA Philippi.

10. *Bornia pulchra* Philippi, 1848; "West America."

Described as *Kellia*. Probably a *Pythina*, but unfigured.

11. *Bornia* species indet. Carpenter, Maz. Cat. No. 688, 1857; Mazatlan.

Listed as *Lasca* species, but appears from a camera lucida sketch of the type to have the hinge of *Bornia*.

12. *Bornia retifera* Dall, 1899; off Santa Rosa Island, California, in 13 fathoms.

Dredged by the U. S. Fish Commission.

13. ? *Bornia dubia* Deshayes, 1855; Muerte Island, Guayaquil.

Described as *Erycina*, but perhaps a *Bornia*.

Genus KELLIA Turton.

14. *Kellia suborbicularis* (Montagu as *Mya*), 1804; Straits of Juan de Fuca south to Mazatlan; North Atlantic.

Has many synonyms: *Tellimya lactea* and *tenuis* Brown, 1827; *Bornia inflata* Philippi, 1844, and others have been cited in connection with it. The West American specimens seem identical with those of Europe.

15. *Kellia laperousii* Deshayes, 1839; from Bering Island and the Aleutians south along the coast to San Diego, California, and Panama.

The largest and finest of the genus and a typical *Kellia*; very variable; *Bornia laticola* Valenciennes, 1846; *Chironia laperousii* Deshayes; *Kellia rotundata* Carpenter, 1865 and *Kellia* var. *chironii* Carpenter, are synonymous.

16. ? *Kellia papyracea* Deshayes, 1855; West Colombia.

Described as *Erycina* and unfigured, but perhaps a *Kellia*.¹

? Genus SERRIDENS Dall.

Pristiphora Carpenter, 1865, not Blanchard, 1835.

17. *Serridens oblonga* Carpenter, 1865; San Pedro, California.

¹ *Kellia ventricosa* (C. B. Adams as *Amphidesma*) Carpenter, 1857, is a *Semele*.

Genus MYSELLA Angas.

Tellimya Carpenter, 1864, not Brown, 1827; *Montacuta* Verrill and Bush, 1898, not Turton, 1822.

18. *Mysella tumida* Carpenter, 1864; Alaska Peninsula and south to San Diego, California.

Described as *Tellimya*.

19. *Mysella planata* Dall, 1885; Bering Strait south to the Aleutians and east to the Shumagin Islands, Alaska.

20. *Mysella aleutica* Dall, 1899; Bering Sea, the Aleutians, and east to Sitka Bay, Alaska.

21. *Mysella pedroana* Dall, 1899; San Pedro, California.

22. *Mysella clementina* Carpenter, 1857; Mazatlan.

Described as *Lepton*.

23. *Mysella dionæa* Carpenter, 1857; Mazatlan.

Described as *Lepton*.

24. *Mysella obtusa* Carpenter, 1865; Mazatlan.

Described as *Montacuta*.

25. *Mysella chalconica* Carpenter, 1857; Mazatlan.

Described as *Montacuta*.

26. *Mysella elliptica* Carpenter, 1857; Mazatlan.

Described as *Montacuta*.

- 26a. ?*Mysella subquadrata* Carpenter, 1857; Mazatlan.

Described as *Montacuta*, said by Carpenter to be congeneric with the two preceding species, but his drawing of the hinge looks like *Erycina*.

27. *Mysella* (*Pythinella*) *sublævis* Carpenter, 1857; Mazatlan.

Described as *Pythina*.

Genus LASÆA Leach.

28. *Lasæa rubra* (Montagu), 1804; Puget Sound south to San Diego, California; North Atlantic, etc.

The West American specimens can not be distinguished from those of Europe. A variety, *subviridis* Carpenter, is pale greenish yellow. It is reported from Lower California.

29. *Lasæa oblonga* Carpenter, 1857; Mazatlan.

30. *Lasæa trigonalis* Carpenter, 1857; Mazatlan.

This and the preceding species need more thorough study.

Genus TURTONIA Alder.

31. *Turtonia minuta* Fabricius; Bering Sea to the Shumagins.

Precisely similar to European and New England specimens.

32. *Turtonia occidentalis* Dall, 1871; Plover Bay, Bering Strait, and northward, in 20 to 40 fathoms.

Larger, stouter, and shorter than the preceding.

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Genus CYCLADELLA Carpenter.

33. *Cycladella papyracea* Carpenter, 1865; Mazatlan.

The only known perfect specimen is inaccessible in the Hanley collection. The shell is possibly the nepionic young of *Cooperella* or *Clementia*.

C.—TERTIARY SPECIES OF THE UNITED STATES.

Genus SOLECARDIA Conrad.

Subgenus SPANIORINUS Dall.

1. *Solecardia clarkeana* Aldrich; Chickasawan.
2. *Solecardia alabamiensis* Cossmann; Claibornian.
3. *Solecardia oblonga* Conrad; Vicksburgian.
4. *Solecardia cossmanni* Dall; Miocene, Virginia.

Genus SPORTELLA Deshayes.

5. *Sportella oblonga* Aldrich, 1897; Chickasawan.
6. *Sportella gregorioi* Cossmann, 1894; Claibornian.
7. *Sportella alabamensis* Aldrich, 1897; Claibornian.
8. *Sportella obolus* Dall; Oligocene, Florida.
9. *Sportella unicarinata* Dall; Oligocene, Florida.
10. *Sportella lubrica* Dall; Oligocene, Florida.
11. *Sportella lioconcha* Dall; Oligocene, Florida.
12. *Sportella whitfieldi* Dall; Miocene, New Jersey and Maryland.
13. *Sportella constricta* Conrad, 1863; Miocene and Pliocene.
14. *Sportella protexta* Conrad, 1841; Miocene and Recent.
15. *Sportella petropolitana* Dall; Miocene, Virginia.
16. *Sportella compressa* H. C. Lea; Miocene, Pliocene.
17. *Sportella yorkensis* Dall; Miocene, Virginia.
18. *Sportella recessa* Glenn; Miocene, Maryland.
19. *Sportella pelex* Dall; Miocene, Virginia and Maryland.

Genus ANISODONTA Deshayes.

Section BASTEROTIA Mayer.

20. *Anisodonta bowdeniana* Dall; Oligocene, Jamaica.

Section FULORELLA Cossmann.

21. *Anisodonta elliptica* Récluz ?; Miocene to Recent.

Section ANISODONTA s. s.

22. *Anisodonta americana* Dall; Pliocene, Florida.

Genus HINDSIELLA Stoliczka.

23. *Hindsiella faba* O. Meyer, 1886; Claibornian.
24. *Hindsiella donacia* Dall; Claibornian.
25. *Hindsiella nephritica* Dall; Oligocene, Florida.
26. *Hindsiella carolinensis* Dall; Miocene, North Carolina.
27. *Hindsiella acuta* Dall; Miocene, North Carolina and Maryland.

Genus ERYCINA Lamarck.

28. *Erycina whitfieldi* O. Meyer, 1886; Claibornian.
29. *Erycina* (*whitfieldi* var.) *meyeri* Cossmann, 1894; Claibornian.
30. *Erycina plicatula* Dall; Claibornian.
31. *Erycina zitteli* O. Meyer, 1887; Jacksonian.
32. *Erycina undosa* Dall; Oligocene, Florida.
33. *Erycina chipolana* Dall; Oligocene, Florida.
34. *Erycina quadrata* Gabb, 1873; Oligocene, West Indies.
35. *Erycina fabulina* Dall; Oligocene, Florida.
36. *Erycina curticens* Dall; Oligocene, Florida.
37. *Erycina carolinensis* Dall; Miocene and Pliocene.
38. *Erycina americana* Dall; Miocene, Maryland.
39. *Erycina marylandica* Glenn; Miocene, Maryland.
40. *Erycina protracta* Dall; Pliocene, North Carolina.
41. *Erycina kurtzii* Dall, 1898; Pliocene, Florida.

Genus BORNIA Philippi.

42. *Bornia prima* Aldrich, 1897; Chickasawan.
43. *Bornia dalli* Cossmann, 1894; Claibornian.
44. *Bornia dodona* Dall; Oligocene, Florida.
45. *Bornia floridana* Dall; Oligocene, Florida.
46. *Bornia mactroides* Conrad, 1834; Miocene, Maryland.
47. *Bornia triangula* H. C. Lea (MS.); Miocene, Pliocene.
48. *Bornia rota* Dall; Miocene, North Carolina.
49. *Bornia lioica* Dall, 1898; Pliocene, Florida.
50. *Bornia mazyckii* Dall, 1898; Pliocene, Florida.

Genus KELLIA Turton.

51. *Kellia* species indet.; Miocene, Maryland.
52. *Kellia laperousei* Deshayes, 1839; Pleistocene, California.
53. *Kellia suborbicularis* Montagu, 1804; Pleistocene, California.

Genus THECODONTA A. Adams.

? Subgenus DICRANODESMA Dall.

54. *Thecodonta* (*Dicranodesma*) *calvertensis* Glenn; Miocene, Maryland.

Genus MYSELLA Angas.

55. *Mysella stantoni* Dall; Miocene, North Carolina.
56. *Mysella stimpsoni* Dall; Miocene, North Carolina.
57. *Mysella planulata* Stimpson, 1851; Pliocene and Recent.
58. *Mysella bowmani* Holmes; Pleistocene.

Genus ALVEINUS Conrad.

59. *Alveinus minutus* Conrad; Eocene.
60. *Alveinus rotundus* Dall; Chipola Oligocene, Florida.

Genus TURTONIA Alder.

61. *Turtonia minuta* (Fabricius), 1780; Pleistocene; Recent.

Genus MONTACUTA Turton.

62. *Montacuta claiborniana* Dall; Claibornian.
63. *Montacuta chipolana* Dall; Oligocene, Florida.
64. *Montacuta actinophora* Dall; Oligocene, Florida.
65. *Montacuta petropolitana* Dall; Miocene, Virginia.
66. *Montacuta sagrinata* Dall; Miocene, Virginia.
67. *Montacuta floridana* Dall; Pliocene; Recent.

Genus ALIGENA H. C. Lea.

68. *Aligena æquata* Conrad, 1843; Miocene, Pliocene.
69. *Aligena pustulosa* Dall, 1898; Oligocene, Florida.
70. *Aligena lineata* Dall; Oligocene, Florida.
71. *Aligena sharpei* O. Meyer, 1888; ? Miocene, Maryland.
72. *Aligena minor* Dall; Miocene, North Carolina.
73. *Aligena elevata* Stimpson, 1851; Pleistocene and Recent.

DESCRIPTIONS OF NEW SPECIES AND REMARKS ON OTHERS
IMPERFECTLY KNOWN.

[The letter and number before the remarks refer to the preceding lists.]

SOLECARDIA MÖRCHII Dall.

Scintilla eburnea MÖRCH, Journ. de Conchyl., XXIV, 1876, p. 373.

A. 1. Though described from the Swift collection, now the property of the Academy of Natural Sciences, Philadelphia, it seems not to exist there at present. It is unfigured. Mörch says that it is nearest to "*S. lactea* Deshayes," but the only *S. lactea* in the literature is of Sowerby, and this is probably what is meant.

SOLECARDIA EBURNEA Conrad.

Solecardia eburnea CONRAD, Proc. Acad. Nat. Sci., Phila., IV, 1849, p. 155; Journ. Acad. Nat. Sci., 2d ser., I, 1850, p. 278, pl. XXXIX, fig. 1.

B. 2. Specimens of this species were compared by Carpenter with the type of *Scintilla cumingi* in the British Museum and proved conspecific.

SPORTELLA PILSBRYI Dall.

Sportella (*Fabella*) *pilsbryi*, new species.

(Plate LXXXVIII, fig. 9.)

A. 2. Shell small, compressed, elongate-ovate, inequilateral, the anterior part much the longest; anterior dorsal margin nearly straight, base evenly arcuate, ends rounded; external ligament on a well-marked nymph, pit for the resilium rather small; teeth in the left valve normal,

small, and delicate; adductor scars high up, the anterior narrow and longer, the posterior larger and rounded; exterior with a very thin, pale straw-colored epidermis, and faint incremental sculpture, the surface apparently smooth but under the microscope minutely sagriate. Lon. 8, alt. 5, diam. 2.5 mm.

A single left valve was dredged as stated.

SPORTELLA CALIFORNICA Dall.

Sportella californica, new species.

(Plate LXXXVIII, fig. 5.)

B. 3. Shell small, compressed, rude, with a yellowish epidermis; slightly arcuate, dorsal margin evenly arched, base concavely arcuate; inequilateral, the anterior part longer, rounded, the posterior end more blunt; teeth normal, the larger right cardinal nearly parallel with the dorsal margin, the ligamentary nymph obscure, the attachment for the resilium thickened and projecting; scar of the mantle wide and somewhat irregular, the anterior adductor scar not well distinguished from it. Lon. 6, alt. 4.2, diam. 1.5 mm.

A single rather worn right valve was collected on the beach at Monterey, California, by Dall in 1866.

SPORTELLA STEARNSII Dall.

Sportella stearnsii, new species.

(Plate LXXXVII, figs. 9, 12.)

B. 4. Shell of moderate size for the genus, inequilateral, not very convex, white, with an almost imperceptible yellowish epidermis; anterior dorsal margin nearly straight, the base parallel with it, the ends bluntly rounded; surface nearly smooth, with faint incremental lines and microscopic sagriation; teeth normal, strong, the posterior cardinal prominent, vertical; ligament strong, external, on a nymph; resilium well developed, its area of attachment thickened; posterior adductor scar rounded, unusually large. Lon. 13.5, alt. 10, diam. 5 mm.

One well-preserved specimen from the Gulf of California, exact locality unknown, is contained in the Stearns collection.

ANISODONTA CORBULOIDEA Dall.

Anisodonta corbuloidea, new species.

(Plate LXXXVIII, fig. 2.)

A. 6. Shell small, glassy white, rather compressed, very inequilateral, anterior side short, comprising about the anterior fourth of the shell, bluntly rounded; beaks distinct, dorsal margin nearly parallel with the base; posterior end obliquely rounded-truncate to a point near the base from which an obscure ridge extends to the beaks; nymph for the

ligament distinct, small; anterior tooth prominent, arcuate, posterior low, small, oblique; surface microscopically sagriate and with faint incremental lines. Lon. 6.5, alt. 3.75, diam. 2.5 mm.

Fresh valves were dredged in 18 to 22 fathoms, sand, off Cape Fear and Cape Lookout, North Carolina, bottom temperature 78° F., by the U. S. Fish Commission.

ERYCINA LINELLA Dall.

Erycina linella, new species.

(Plate LXXXVIII, fig. 7.)

A. 9. Shell transparent, glassy, small, extremely thin, compressed; beak very low, anterior end somewhat shorter, rounded, posterior dorsal margin and end continuously arched, base evenly convexly arcuate; surface polished, microscopically sagriate, but otherwise smooth; anterior right dental lamella long, narrow, with a short hook nearly parallel; pit for the resilium shallow, posterior lamella longer than the anterior, but only raised distally; adductor scars long and narrow, hardly differentiated from the rather wide pallial line. Lon. 4.6, alt. 3.6, diam. 1.5 mm.

One right valve was dredged in 31 fathoms, sand, bottom temperature 74° F., by the U. S. Fish Commission.

ERYCINA EMMONSI Dall.

Erycina emmonsi, new species.

(Plate LXXXVIII, fig. 1.)

A. 10. Shell small, compressed, elongate, white or translucent, nearly equilateral, the anterior side slightly longer; dorsal and ventral margins nearly parallel, the anterior end bluntly rounded, the posterior end narrower and more oblique above, rounded near the base; surface concentrically and somewhat irregularly sculptured by the incremental lines, more or less polished; beak inconspicuous, dental lamellæ low, elongate, the "hook" small but distinct; adductor scars high up and rather narrow; pallial scar linear, rather distant from the margin. Lon. 9, alt. 5, diam. 3 mm.

Off Frying Pan Shoals in 12 fathoms, Dr. Rush; off Cape Lookout, North Carolina, in 22-31 fathoms, sand, U. S. Fish Commission.

This species appears to be the recent representative of the Miocene *E. kurtzii* Dall, but is a more delicate shell and without the sharp radial sculpture of that species.

ERYCINA PERISCOPIANA Dall.

Erycina periscopiana, new species.

(Plate LXXXVIII, fig. 3.)

A. 11. Shell small, pellucid, subquadrate, with the ends bluntly rounded and the dorsal and ventral margins nearly parallel; beaks

low, valves compressed, very inequilateral, the beaks being nearly at the posterior fifth of the shell; left anterior lamina very long, rather elevated, with a very small hook, posterior lamina short, nearly obsolete, with an elongated resiliary pit below it; adductor scars small, high up, the anterior narrower, the posterior rounder;¹ pallial scar linear; surface polished, smooth, or marked only by incremental lines and very obscure occasional radial striulations. Lon. 5, alt. 2.8, diam. 1 mm.

A single left valve was dredged in 22 fathoms off Cape Lookout, North Carolina, on sandy bottom, with a temperature of 78.2° F., by the U. S. Fish Commission.

ERYCINA FERNANDINA Dall.

Erycina ? *fernandina*, new species.

(Plate LXXXVIII, fig. 6.)

A. 12. Shell small, ovate, pellucid white, sometimes with irregular radial opaque white narrow streaks; moderately convex, with a very thin, pale straw-colored epidermis; very inequilateral, the posterior side short; beaks distinct, the prodissoconch often conspicuous; surface polished, sculptured only with faint incremental lines and obscure, irregular microscopic radial striæ; right valve with the anterior and posterior lamellæ short and strong, with a marked sulcus above each of them, the anterior with a conspicuous hook; resilium well developed, but short; adductor scars small, narrow, pallial scar linear. Lon. 3.75, alt. 2.8, diam. 1.5 mm.

Dredged off Fernandina, Florida, in 294 fathoms, coral sand, by the U. S. Fish Commission, bottom temperature 46° F. The strong laminae and the deep sulci above them give this species, when casually observed, the look of a *Mysella*.

ERYCINA (PSEUDOPYTHINA) RUGIFERA Carpenter.

Pythina rugifera CARPENTER, Suppl. Rept. Brit. Assoc., 1863 (1864), pp. 602, 643; Proc. Acad. Nat. Sci., Phila., 1865, p. 57.

Lepton rude (DALL manuscript) WHITEAVES, Rept. Progr. Geol. Surv. Canada, 1878-79 (1880), p. 198 B, fig. 2.

B. 8. This differs from the type of *Pseudopythina* in having an obscurer remnant of the cardinal hook in the shape of a small subumbonal conical tooth, and less obvious radial striation, but is otherwise very similar. In both there is a well-marked calcareous coating to the ventral surface of the resilium. The arcuate form is undoubtedly correlated with its peculiar *situs*. (See Plate LXXXVII, fig. 4.)

¹ In all these forms, whether the shorter end be anterior or posterior, its adductor scar will be more rounded and often larger than the scar at the longer end of the shell, a result brought about in all probability by the dynamics of the situation.

ERYCINA (PSEUDOPYTHINA) COMPRESSA Dall.

Erycina (*Pseudopythina*) *compressa*, new species.

(Plate LXXXVII, figs. 1, 8.)

B. 9. Shell large, subquadrate, thin, moderately compressed, white, covered with a conspicuous, thin, wrinkled, partly glossy periostracum; nearly equilateral, the posterior end slightly broader, both ends rounded, the basal margin nearly straight; beaks inconspicuous, surface with strong, irregular incremental lines, but no radial sculpture; pallial scar rather wide and irregular, merging into the subequal, rather narrow adductor scars; resilium large, wide, and long, more or less calcareous ventrally, left valve with one obscure cardinal tooth, right valve with the tooth better developed; the right dorsal valve margins overlap those of the left valve a little, but there are no distinct lamellæ. Lon. 18, alt. 13, diam. 6 mm.

Dredged on muddy bottom in from 4 to 28 fathoms in the eastern part of Bering Sea, south of Nunivak Island, the eastern Aleutians, and southward to Sitka, Alaska, by Mr. W. H. Dall.

This is easily discriminated from the other species by its flattened and normal form. As it has always been found free in the dredge it is probably not a commensal species.

BORNIA BARBADENSIS Dall.

Bornia barbadensis, new species.

A. 13. Shell rather large for the group, evenly ovate, moderately convex, polished, white, covered with a brilliant yellowish periostracum, inequilateral, the anterior end shorter; dorsal margins convexly arcuate; ends rounded, the posterior end obliquely, and produced near the base which is evenly convexly arcuate; beaks low, distinct; teeth normal, adductor scars small and high up, margins entire. Lon. 15, alt. 12, diam. 5 mm.

A dead and somewhat dilapidated valve was dredged in 100 fathoms at Barbados, but is clearly distinct from any of the other East American species.

BORNIA (CERATOBORNIA) LONGIPES Stimpson.

A. 14. This was described as *Lepton* but the shell is a typical *Bornia*.¹ The soft parts resemble those of *Montacuta percompressa* Dall, as figured by Verrill under the name of *ferruginosa* Montagu,² except that there are one posterior and two anterior cirrhi arising from the

¹ Proc. Boston Soc. Nat. Hist., V, February, 1855, p. 111.

² Trans. Conn. Acad. Sci., VI, 1884, p. 225, pl. xxx, fig. 13.

dorsal side of the animal and as long as its shell, while the foot is pointed in front and produced into a cylindrical, extremely extensile "heel" behind. The byssal gland is situated at the extreme conical end of this organ, which can be moved about like a finger and emits when needed a single byssal thread. When fully extended it may reach twice the length of the shell. It will be seen at once on comparing Stimpson's figures (here first published) with Deshayes's figure of the type species of *Bornia*¹ that the two are quite different animals. For this reason I have separated Stimpson's species under the name of *Ceratobornia*. The produced hood of *Bornia* is apparently lacking. (See Plate LXXXVIII, figs. 10, 11, 13.)

BORNIA PULCHRA Philippi.

B. 10. *Kellia pulchra* PHILIPPI, Zeitschr. für Mal., V, 1848, p. 149

BORNIA RETIFERA Dall.

Bornia retifera, new species.

(Plate LXXXVII, fig. 2.)

B. 12. Shell thin, white, moderately convex, rounded, trigonal, nearly equilateral; beaks distinct, not high; surface polished, with faint incremental lines and minute close punctations whose interspaces give the effect of a fine netting; hinge normal, delicate; adductor scars rounded, high up; posterior basal margin very slightly crenulate. Lon. 12, alt. 9, diam. 4 mm.

One left valve dredged by the U. S. Fish Commission at station 2900, in 13 fathoms, off Santa Rosa Island, California.

The microscopic sculpture distinctly separates this from any other American species.

KELLIA (SUBORBICULARIS var.) GOULDII Thomson.

Montacuta gouldii THOMSON, Am. Journ. Conch., III, 1867, p. 33, pl. I, fig. 15.

A. 15. An examination of Thomson's types shows that his species is identical with the shell hitherto identified as *Kellia suborbicularis*, from southern New England. It is also probably *Lepton fabagella* Conrad,² but Conrad's unique type is lost, and his description and figures insufficient for positive identification. All the specimens of this form hitherto found on the New England coast are notably smaller and more delicate than adult British examples, and it may prove distinct. On the other hand Pacific coast specimens (B. 14), in size and all other features, agree well with the European shells.

¹ Fischer, Manual, p. 1026, fig. 772, where it is called *B. complanata* erroneously.

² Am. Mar. Conch., 1831.

KELLIA (KELLIOLA) SYMMETROS Jeffreys.

Kellia symmetros JEFFREYS, Ann. Mag. Nat. Hist., December, 1876, p. 491.

A. 16. From a careful microscopic examination of the type of this very minute species, I find the hinge was imperfectly observed, and hence incorrectly described by Dr. Jeffreys, a fact perhaps due to imperfection of his microscope. There is in each valve a single strong, short tooth in front of the beaks, that in the left valve is thinner, flatter, and fits over the more conical tooth of the right valve. Behind the beaks is a strong resilium without a lithodesma. The hinge plate is narrow and flat; in some lights the edge is so illuminated as to give the appearance of a lamina, which does not exist. This hinge recalls that of *Aligena*, and is quite different from that of the true *Kellias*, for which reason I have separated it as *Kelliola*.

MYSELLA PLANULATA Stimpson.

Kellia planulata STIMPSON, Shells of New England, 1851, p. 17.

A. 17. The shell figured by Gould¹ was named *planulata* by Stimpson. Gould's description included not only this species, but *Turtonia minuta*, which, as Gould afterwards recognized, he took to be the young of the larger shell which he figured. Subsequently the *planulata* was incorrectly identified with the British *Tellimya bidentata* of authors. The two shells are quite distinct, as the examination of a very large number of *Mysella bidentata* has convinced me. The European shell is constantly smaller, more convex, more inequilateral, more quadrate, and more elongate. It also has smaller dental lamellæ than the average American specimens. I have not found any adult specimens which could be called intermediate, and I have therefore restored Stimpson's name. The variety *fragilis* Verrill and Bush has feebler teeth than the form which they call variety *tenuis*, but differences of this kind are frequent among these little shells, and too much value should not be ascribed to them. Exactly parallel differences occur in all those species of *Mysella* of which I have been able to examine a large series of specimens.

MYSELLA OVATA Jeffreys.

Montacuta ovata (? Jeffreys's species) VERRILL and BUSH, Proc. U. S. Nat. Mus., XX, 1898, p. 781, pl. XCII, figs. 9, 10.

A. 21. The specimens so identified are incrustated with such a heavy coat of iron oxide as to have become pathologically modified. They resemble many of Jeffreys's specimens in this, and may really be identical, but it would be more satisfactory to be able to prove it by normal individuals.

MYSELLA (TUMIDULA var.) VERRILLI Dall.

Montacuta tumidula VERRILL and BUSH, Proc. U. S. Nat. Mus., XX, 1898, p. 781, pl. XCII, fig. 6; pl. XCIV, figs. 1, 2.

¹Inv. Mass., 1841, pl. II, fig. 33.

A. 23. This, upon careful comparison, proves not to be quite the same as *Montacuta tumidula* Jeffreys.¹ An examination of types of both authors shows that the American shell is more produced and patulous in front and more attenuated and abruptly truncate behind, as well as somewhat more inflated. A European series from nine localities shows some individual variation, but all in a direction away from rather than toward the American type.

MYSELLA MÖLLERI (Hölboll) Mörch.

(Plate LXXXVIII, fig. 14.)

Unnamed bivalve No. 7, Möller, Index Moll. Grönl., p. 24, 1842.

Montacuta elevata MÖRCH, Arctic Man., p. 131, 1875, not of Stimpson, 1851.

Montacuta mölleri "Hölboll," MÖRCH, Arctic Man., p. 131, 1875; Rink's Greenland, p. 441, 1877; (name only).

Montacuta ferruginosa var. *grönlandica* MÖRCH, Forteg. Grönl., Blodd., p. 19, No. 164, 1857; fide Posselt, Consp. Faunæ Grönl., Moll., p. 75, 1898.

Montacuta mölleri POSSELT, Conspectus Faunæ Grönl., Moll., p. 74, 1898; in Meddel. om Grönl., XXXIII, 1898.

A. 24. Shell rather large for the group, ovate, white, covered by a profuse wrinkled yellow-brown papery periostracum; valves only moderately convex, inequilateral, the anterior part longer and more fully rounded, base convexly arcuate; beaks low, often eroded; teeth of moderate size, the anterior about three times as long as the other in the right valve; pallial scar rather wide and uneven, not sharply distinguished from the adductor scars; resilium short, stout, ventrally calcareous. Lon. 6.4, alt. 4.8, diam. 3 mm.

From specimens kindly sent by Jensen, who edited Posselt's posthumous Conspectus, I am able to identify this species with the shell called *Montacuta mölleri* after Hölboll's manuscript by Mörch. The identification can only take date from 1898, as all the previous references were absolutely without any means of identification. Posselt furnishes the link which connects the name with Möller's unnamed diagnosis. It seems curious that Mörch should have listed this species under two distinct specific names, but specimens sent by him to Jeffreys show this to have been the case.

Specimens from Greenland were identified as *Montacuta elevata* Stimpson, by Torell and Mörch, and are now in the Jeffreys collection. There is also one unnamed from the collection made by Möller and Hölboll in Greenland. It is perhaps the shell to which Hölboll's manuscript name of *impura* applies, but I was not able to find any type so named in the Copenhagen collection. It somewhat resembles the fresh, brown specimens of *M. planulata* Stimpson, but is much larger, with more unequal laminae and a coarse, dirty-looking epidermis over a smooth surface.

¹ Brit. Conch., V, 1869, p. 177, pl. 100, fig. 5.

MYSELLA BARBADENSIS Dall.

Mysella barbadensis, new species.

(Plate LXXXVII, fig. 3.)

A. 25. Shell small, white, thin, inflated, inequilateral, ovate, with distinct beaks, rounded at both ends, with a convexly arcuate basal margin, the short posterior end somewhat attenuated; surface apparently smooth, but not polished, magnification shows a fine, even concentric striation; pallial scar linear, adductor scars small, obscure. Lon. 4, alt. 2.9, diam. 1.8 mm.

This species recalls *M. tumidula*, but is rather longer, less inflated, more equilateral, and has a different surface. A single left valve was obtained.

MYSELLA (PYTHINELLA) CUNEATA Verrill and Bush.

Montacuta cuneata VERRILL and BUSH, Proc. U. S. Nat. Mus., XX, 1898, p. 782, pl. XCI, fig. 4; pl. XCIII, fig. 5.

A. 26. This species presents the concavely arcuate form which I believe to be correlated with commensalism, and the group of species thus distinguished in *Mysella*, for which I have proposed the name *Pythinella*, has the same relations to the typical *Mysella* as *Pythina* has to *Bornia*, *Pseudopythina* to *Erycina*, and *Hindsella* to its associated genera.

MYSELLA TUMIDA Carpenter.

Tellimya tumida CARPENTER, Suppl. Rept. Brit. Assoc. for 1863 (1864), pp. 88, 97, 129; Proc. Acad. Nat. Sci., Phila., 1865, p. 58.

B. 18. It has not hitherto been figured and I have given (Plate LXXXVII, fig. 7) a camera lucida outline from the type specimen for comparison with the other west coast species. It is especially characterized by its solid and tumid valves, rounded triangular form, and strong hinge. Lon. 3.8, alt. 3.2, diam. 2 mm.

MYSELLA PLANATA Dall.

Tellimya planata DALL, in Krause, Beitr. Moll. fauna des Beringsmeers, Arch. f. Naturg., LI, 1885, Pt. 1, p. 34, pl. III, figs. 6 a-d.

B. 19. Dr. Krause's figures are not all equally characteristic, and I give, therefore, a magnified camera lucida sketch (Plate LXXXVIII, fig. 12) from one of his specimens which shows the hinge and outline rather better. Lon. 5.3, alt. 4, diam. 2 mm.

MYSELLA ALEUTICA Dall.

Mysella aleutica, new species.

(Plate LXXXVII, fig. 6.)

B. 20. Shell small, solid, ovate, white, smooth, covered with a polished straw-colored epidermis with usually three or four concentric darker

colored zones; beaks distinct, often eroded, ends and base rounded, valves moderately convex, teeth strong in the right valve, anterior adductor scar narrow and rather irregular, elongated, posterior rounded, pallial scar linear. Lon. 4.3, alt. 3.3, diam. 2 mm.

Resembles *M. tumida* Carpenter, but is more ovate and with less prominent beaks and smaller resilium.

MYSELLA PEDROANA Dall.

Mysella pedroana, new species.

(Plate LXXXVIII, fig. 4.)

B. 21. Shell large, thin, rounded, rather compressed, white, with a concentrically rugose pale-brownish epidermis (to which, in the type, adheres a good deal of blackish oxide of iron); beaks inconspicuous; surface with coarse, concentric, incremental lines; inequilateral; the posterior side short, dorsal margins merging roundly into the distal and they into the basal margin, which last is nearly straight; hinge feeble; the right anterior lamella elongated and very slender, the posterior one shorter and stouter, the resilium subumbonal and very small; adductor scars small, the pallial scar linear. Lon. 9, alt. 7.3, diam. 3 mm.

This is an unusually large and fragile species, of which a single shell was found on the beach at San Pedro.

MONTACUTA FLORIDANA Dall.

Montacuta floridana, new species.

(Plate LXXXVII, fig. 10.)

A. 28. Shell subovate, inequilateral, posterior end much the shorter, white, inflated; beaks low, polished; sculpture of concentric lines growing gradually stronger downward and forward until on the lower anterior third they form low, stout, evenly distributed, concentrically striated lamellæ, remaining feebler on the rest of the shell; base nearly straight, dorsal margin convexly arcuated, ends evenly rounded; hinge with a prominent slender cardinal in each valve, the lamellæ obsolete; sockets of the resilium thickened and raised above the inner surface of the valve. Lon. 16, alt. 10, diam. 9.5 mm.

This is probably the largest species of the genus, if, indeed, it should not prove eventually distinct from the typical forms upon which the genus rests. The anterior lamellæ are entirely absent and there is no radial sculpture visible without a lens. A few faint striations on the anterior slope are feebly reflected on the inner surface of the anterior margin.

The recent specimens of this species were first collected on the beaches of west Florida, near the Manatee River, by Charles T. Simpson.

MONTACUTA MINUSCULA Dall.

Montacuta minuscula, new species.

(Plate LXXXVIII, fig. 8.)

A. 29. Shell small, very thin, white, brilliantly polished; inequilateral, with the posterior end shorter, rounded, the anterior wider and obtusely pointed; the dorsal margin before the beaks convexly arcuate; lamellæ obsolete in the left valve; valves with the beaks low, the surface with faint incremental sculpture; adductor scars elongate, narrow, the anterior not well distinguishable from the pallial line. Lon. 2.7, alt. 1.7, diam. 1.1 mm.

A single left valve was dredged by the U. S. Fish Commission, 36 miles south $\frac{1}{2}$ west from Cape Hatteras in 124 fathoms, sand, bottom temperature 61°.

MONTACUTA LIMPIDA Dall.

Montacuta limpida, new species.

(Plate LXXXVII, figs. 5, 11.)

A. 30. Shell small, thin, white, inflated, uniformly ovate; beaks small, low, but very distinct; surface concentrically minutely striate, the striæ stronger at regular intervals, no radial sculpture; the margin forms an uninterrupted oval; the right anterior lamella is present but feeble and its hook or cardinal though visible is somewhat obsolete; the adductor scars are narrow, the pallial scar linear. Lon. 3, alt. 2.5, diam. 1.8 mm.

An apparently young right valve was obtained in 294 fathoms, coral sand, off Fernandina, Florida, bottom temperature 46.3° F.; an adult valve supposed to be conspecific and which has been selected as the type came from a depth of 85 fathoms, 5 miles off Cape Florida, in the Gulf of Mexico. The younger valve has a length of 1.6 mm.; is slightly more pointed behind; has the dental hook proportionately more prominent, and the pallial line wider and less distinguished from the adductor scars.

MONTACUTA PERCOMPRESSA Dall.

Montacuta percompressa, new species.

A. 31. Shell small, thin, compressed, oblong-ovate, white, tinged with reddish brown near the umbones; inequilateral; the posterior side shorter, bluntly rounded; anterior side produced, narrower; beaks depressed; surface rather irregularly concentrically striated and sometimes feebly waved; lamellæ feeble, almost obsolete; adductor scars narrow, rather irregularly merging in the somewhat ragged pallial line. Lon. 3.7, alt. 2.9, diam. 1.4 mm.

This is *Montacuta ferruginosa* Verrill.¹

On comparison with authentic specimens of *M. ferruginosa* Montagu, they appeared to be discrepant. Subsequently a comparison was made with several hundred specimens from thirty-eight different European localities, from Norway to the Mediterranean. None was found to have the characteristics of the American shell. The true *M. ferruginosa* grows to a much larger size than any of the Woods Hole specimens, and a comparison of the latter with European shells of as nearly the same size as could be found, developed the following differences: The *M. ferruginosa* Montagu is longer and more slender, more inflated, its posterior end is proportionately longer and more pointed, the beaks more elevated and convex, the dental lamellæ more conspicuous, the adductor scars larger and more clean-cut.

I conclude, therefore, that the two forms are distinct and propose the name of *percompressa* for the flattish form from Woods Hole.

LASÆA RUBRA Montagu.

A. 32. It is remarkable that this little shell should be abundant at Bermuda, and even in southern California, and unknown on our Atlantic coast.

TURTONIA MINUTA Fabricius.

A. 33. In examining the muscular and pallial scars of a large number of American and European specimens I found that there was a certain amount of variation among them. However, none of them showed the extreme discrepancy in size of the pedal scar as figured by Professor Verrill,² and it would seem as if his specimen must have been abnormal and exceptional. I found the pedal scar large, but never attaining the size of the adductor near it. I also found the range of variation in Alaskan and British specimens quite sufficient to cover the differences which led Professor Verrill to suggest that the British and American shells might belong to distinct species.

ALIGENA ELEVATA Stimpson.

A. 35. The genus *Aligena* H. C. Lea, 1845, from an examination of his types, proves to have been based upon a species of which *Montacuta elevata* Stimpson is a recent representative. It occurs in the Tertiaries of both Europe and America. *Spaniodon* Reuss is probably, and *Laubrièreia* Cossmann certainly, congeneric, as is *Kelliopsis* Verrill and Bush.³

The species is *Montacuta bidentata* Gould, 1841, not of Montagu, 1804; *Montacuta elevata* Stimpson, 1851, not of Möreh, 1875; *Cyamium elevatum*

¹ Trans. Conn. Acad., VI, 1884, p. 225, pl. xxx, fig. 13; Proc. U. S. Nat. Mus., XX, 1898, p. 783, pl. xc, figs. 7, 8.

² Am. Journ. Sci., 3d ser., III, 1872, pl. VII, figs. 4, 4a.

³ Proc. U. S. Nat. Mus., XX, 1898, p. 784, pl. xciii, figs. 2-4; pl. xciv, figs. 7, 8.

H. and A. Adams, 1858, *Tellimya elevata*¹ Dall, 1889, and *Kelliopsis elevata* of Verrill and Bush, 1893.

FOSSIL LEPTONACEA.

C. 1—73. The descriptions and figures of the fossil species will appear in the Transactions of the Wagner Free Institute of Science, Philadelphia.² The full elucidation of the generic synonymy is also reserved for that work. The types of the fossil and recent new species are in the collection of the U. S. National Museum. Most of the fossils were collected by the parties of the U. S. Geological Survey.

EXPLANATION OF PLATES.

When not otherwise stated, the figures are from magnified camera lucida drawings, by Mr. W. H. Dall, from the types in the U. S. National Museum. The extreme length in millimeters of the specimen figured follows each name, together with the number of the specimen in the Museum Register.

PLATE LXXXVII.

Fig. 1. *Erycina (Pseudopythina) compressa* Dall; 18.0 mm. No. 107855, U.S.N.M. Ber-
ing Sea.

2. *Bornia retifera* Dall; 12.0 mm. No. 107856, U.S.N.M. The microscopic reticu-
lation is too fine to be represented on the scale of the figure.

3. *Mysella barbadensis* Dall; 4.0 mm. No. 95703, U.S.N.M. Barbados.

4. *Gebia pugetensis* Dana, with *Erycina (Pseudopythina) rugifera* Carpenter, at-
tached by its byssus to the abdomen of the crab behind the limbs. Nat-
ural size. Drawn from nature by Dr. J. C. McConnell. No. 15789,
U.S.N.M. Puget Sound.

5. *Montacuta limpida* Dall; adult type; 3.0 mm. No. 97155, U.S.N.M. Florida.

6. *Mysella aleutica* Dall; 4.3 mm. No. 108233, U.S.N.M. Kiska Harbor, Aleu-
tian Islands.

7. *Mysella tumida* Carpenter; type specimen; 3.8 mm. No. 5242, U.S.N.M. Cal-
ifornia.

8. Hinge of *Erycina (Pseudopythina) compressa* Dall; right valve, considerably
enlarged; *c*, cardinal tooth; *p*, prodissoconch; *rl*, resilium covered by the
large calcareous lithodesma; *l*, raised edge of the valve carrying the
linear external ligament.

9. *Sportella stearnsii* Dall; enlarged view of hinge, right valve, *c*, *c'*, cardinals;
l, nymph for the ligament; *p*, prodissoconch; *r*, excavation and ridge
which carry the resilium.

10. *Montacuta floridana* Dall; interior of right valve; 16.0 mm. No. 64456,
U.S.N.M. West Florida.

11. *Montacuta limpida* Dall; young shell; 1.6 mm. No. 107867, U.S.N.M. Florida.

12. *Sportella stearnsii* Dall; 13.5 mm. No. 73071, U.S.N.M. Gulf of California.

PLATE LXXXVIII.

Fig. 1. *Erycina emmonsii* Dall; 7.0 mm. No. 92638, U.S.N.M. North Carolina.

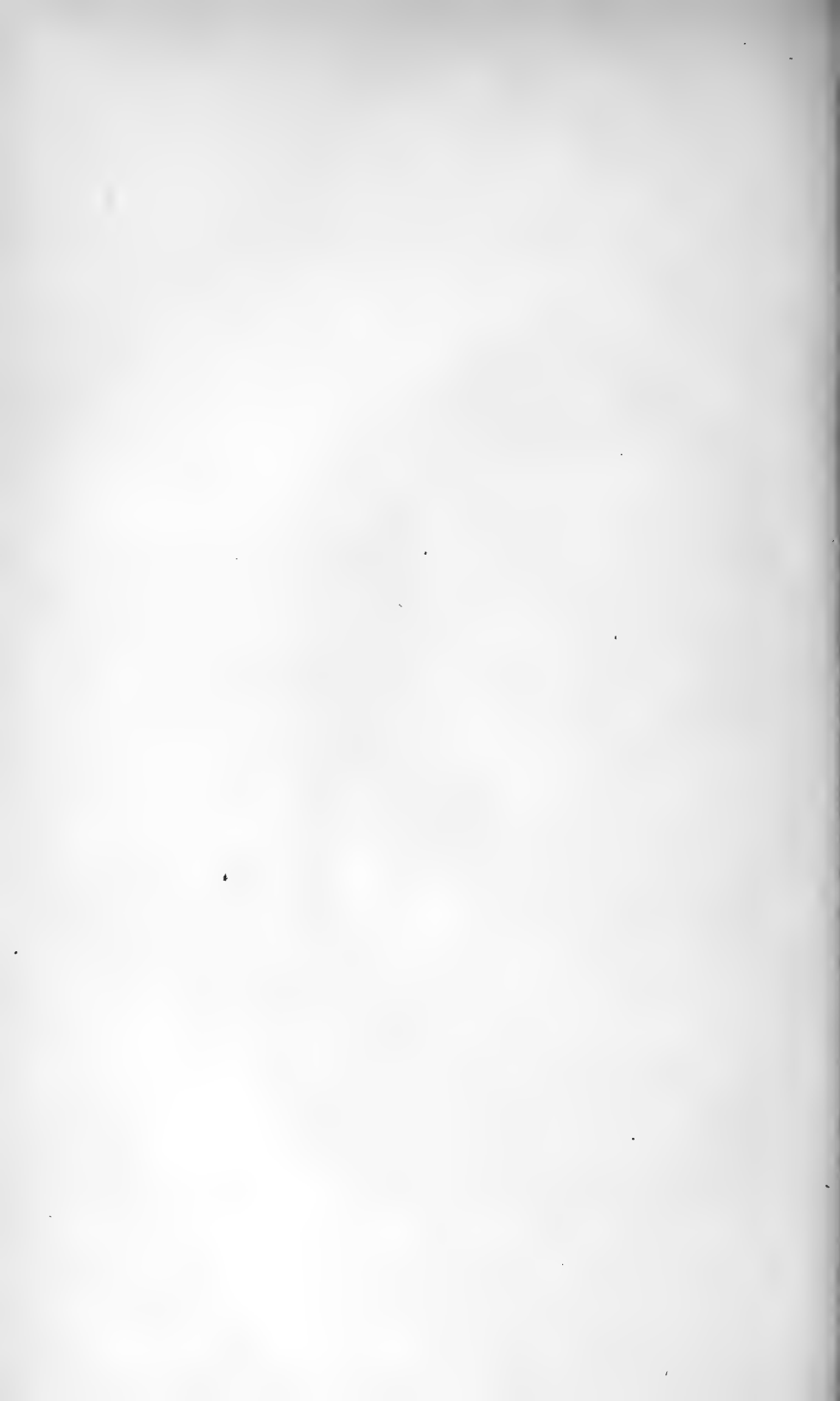
2. *Anisodonta (Fulcrella) corbuloides* Dall; 6.5 mm. No. 92303, U.S.N.M. North
Carolina.

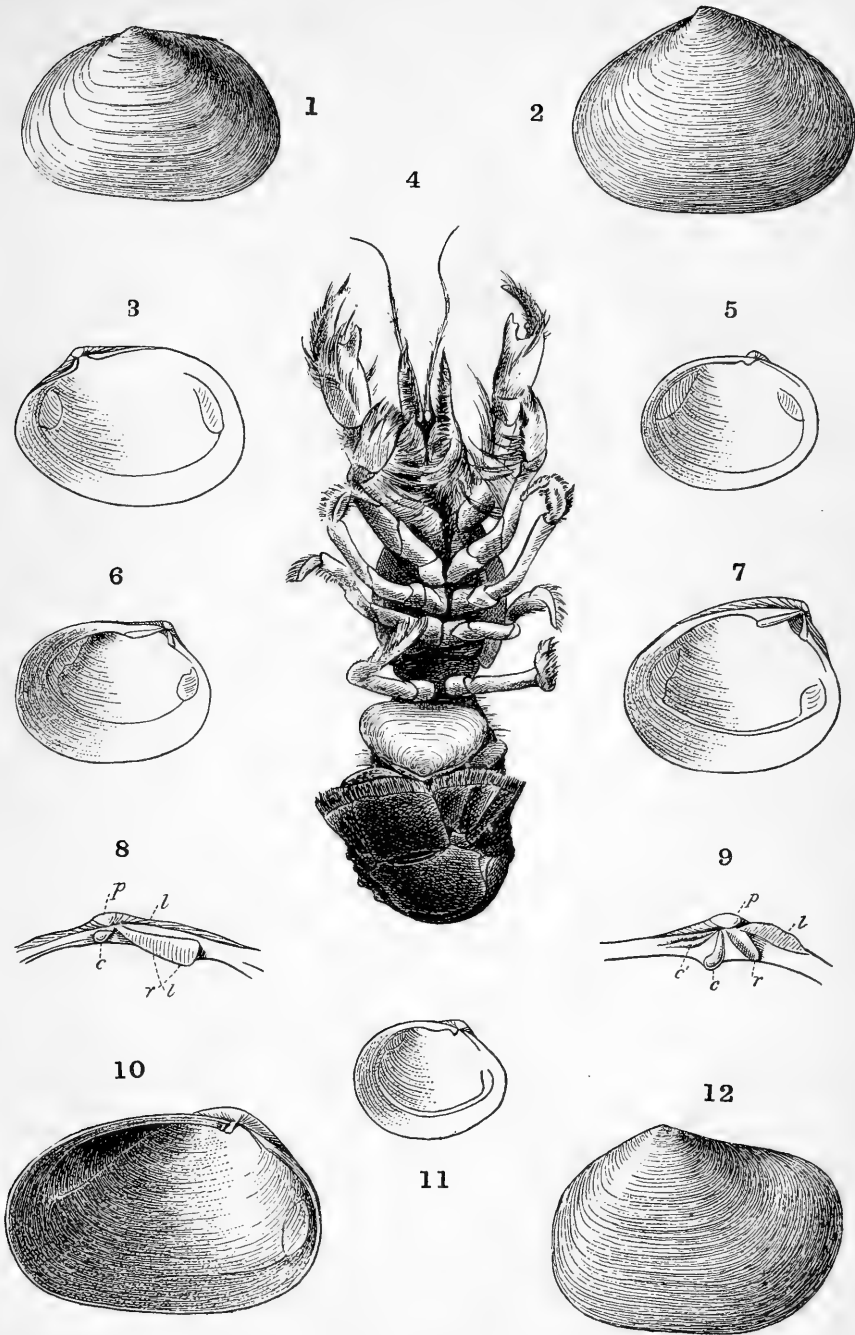
¹ Bull. No. 37, U. S. Nat. Mus., 1889, p. 50.

² Volume III, Pt. 5.

Fig. 3. *Erycina periscopiana* Dall; left valve; 5.0 mm. No. 92227, U.S.N.M. North Carolina.

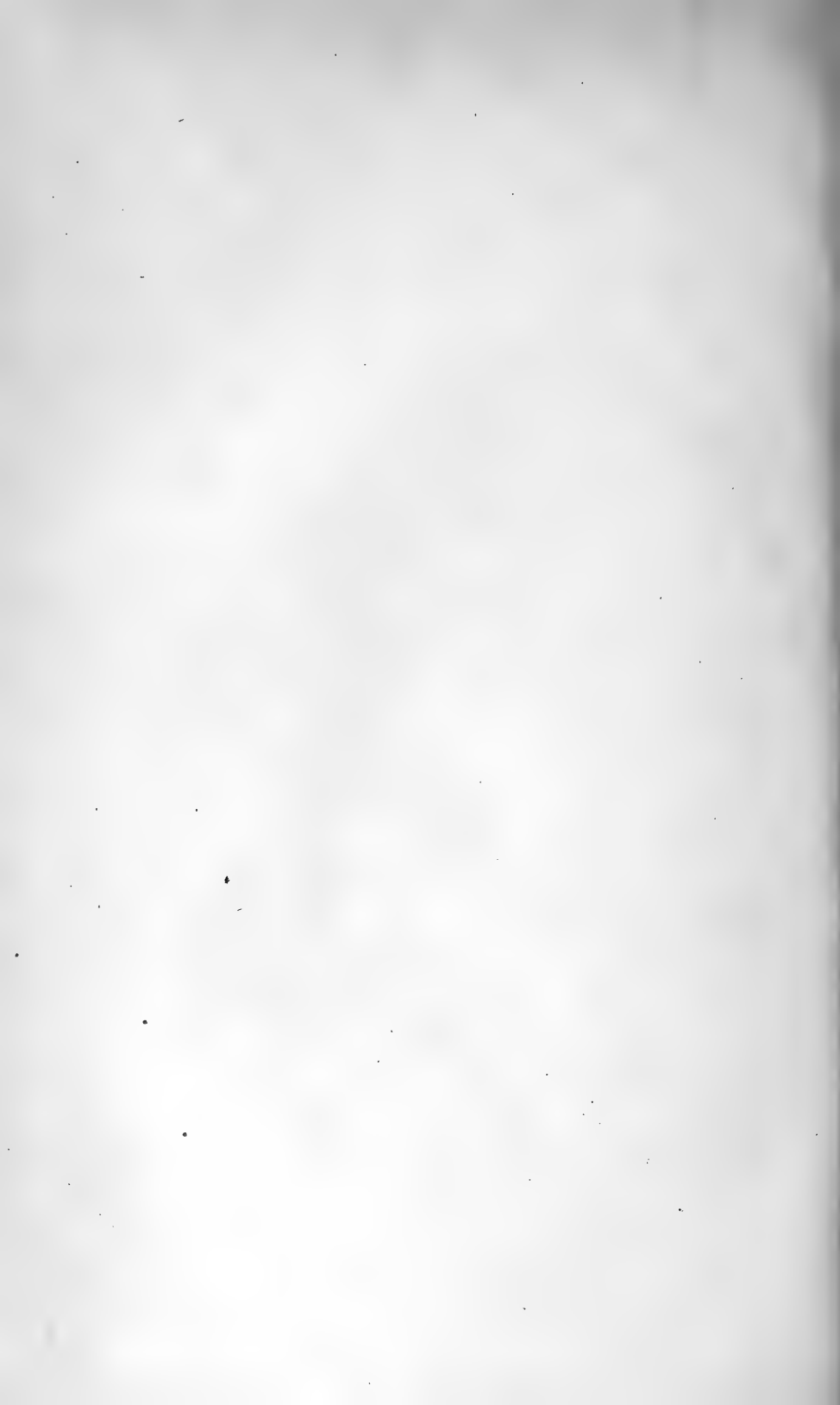
4. *Mysella pedroana* Dall; 9.0 mm. No. 127565, U.S.N.M. California. The subumbonal projection between the laminae is the resilium.
5. *Sportella californica* Dall; 6.0 mm. No. 108231, U.S.N.M. The drawing represents the right valve and the posterior projection of the hinge plate carries the resilium.
6. *Erycina fernandina* Dall; 3.75 mm. No. 108230, U.S.N.M. Deep water off Florida. The dark spot to the right of the cardinal tooth is the resilium.
7. *Erycina linella* Dall; 4.6 mm. No. 107863, U.S.N.M. North Carolina.
8. *Montacuta minuscula* Dall; 2.7 mm. No. 92628, U.S.N.M. North Carolina.
9. *Sportella pilsbryi* Dall; 8.0 mm. No. 107864, U.S.N.M. Left valve. North Carolina.
10. *Bornia* (*Ceratobornia*) *longipes* Stimpson; about one and a half times natural size. From an unpublished drawing by Stimpson, representing the animal crawling, the right side facing the observer. South Carolina. Shell is No. 107812 U.S.N.M.
11. The same, representing the animal suspended by its byssal thread, the heel of the foot elongated. Drawn by Stimpson.
12. *Mysella planata* Dall; 5.3 mm. No. 108234, U.S.N.M. Aleutian Islands. The dark spot between the laminae is the resilium.
13. *Bornia* (*Ceratobornia*) *longipes* Stimpson; the posterior extremity, or heel, of the foot emitting the byssal thread. Much enlarged. From a drawing by Stimpson.
14. *Mysella mölleri* Mörch; 6.4 mm. No. 108232, U.S.N.M. From a specimen in the Jeffreys collection, named *Montacuta elevata* by Mörch, and collected by Torell in Greenland.

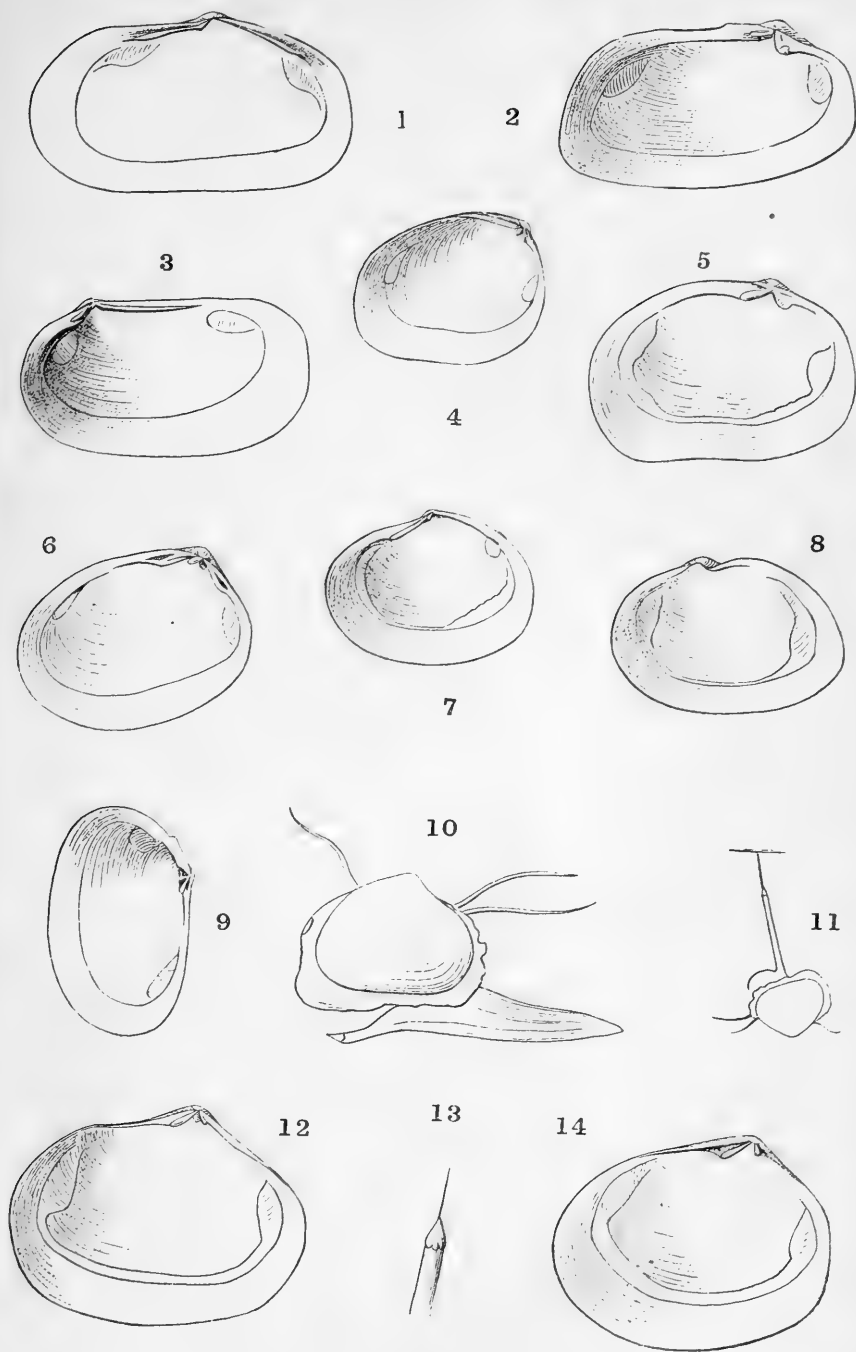




LEPTONACEA OF NORTH AMERICA.

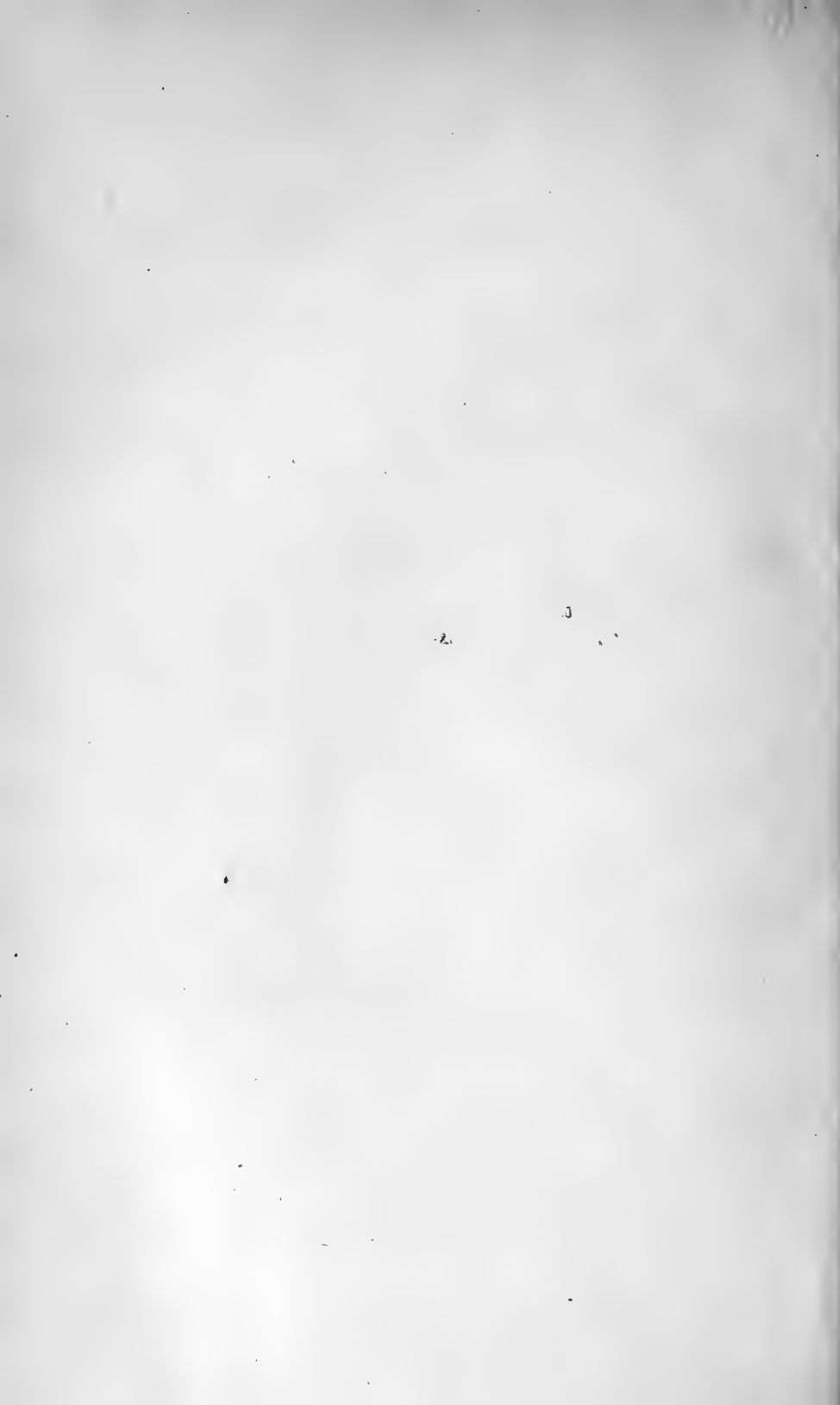
FOR EXPLANATION OF PLATE SEE PAGE 896.





LEPTONACEA OF NORTH AMERICA.

FOR EXPLANATION OF PLATE SEE PAGES 896, 897.



DESCRIPTION OF A NEW GENUS AND SPECIES OF DISCOGLOSSOID TOAD FROM NORTH AMERICA.

By LEONHARD STEJNEGER,
Curator, Division of Reptiles and Batrachians.

The discovery of a discoglossoid genus of batrachia in America is almost as noteworthy an event among the *Salientia* as the appearance of the blind proteoid salamander, *Typhlomolge*, among the *Urodeles* a few years ago.

The salientian suborder Costata, embracing the single family *Discoglossidae*, to which the new genus belongs, has been credited with a most extraordinary geographic distribution. Until now it was composed of four genera, three of which are confined to the southwestern corner of the palaearctic region, except a single species at the southeastern end of the same region. The fourth genus, composed of a single species, represents, alone, the batrachia in New Zealand. None of the seven species known to form this suborder consequently had been found in the Western Hemisphere at all, and none has thus far been taken in tropical Africa, Australia, or Asia, with the above exception.

The addition of a typical costate genus to the fauna of North America is therefore not only an interesting novelty in itself, but it emphasizes the fact that we have as yet much to learn about the geographical distribution of the vertebrates even in regions which have been fairly well explored.

The suborder Costata, as the name implies, is trenchantly separated from all other tailless batrachians by the possession of ribs. Concomitant with this important character is the presence of transverse processes at the base of the urostyle.

ASCAPHUS,¹ new genus.

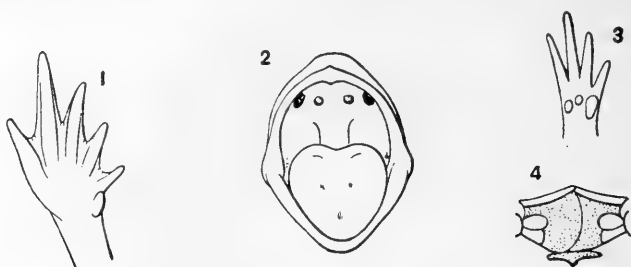
Tympanum and Eustachian tubes not visible (probably absent); pupil elliptical, vertical; diapophyses of sacral vertebra moderately dilated; tongue free behind; second rib with a posterior process; sternum a narrow transverse band of cartilage; urostyle articulated to a single condyle; vomerine teeth in two small groups between choanæ; parotoid gland well developed.

¹ From α , without; *σκάφος*, spade.

Type.—*Ascaphus truei* Stejneger.

Upper jaw toothed; shoulder girdle of the arciferous type; precoracoid but slightly curved; coracoid short; epicoracoid cartilage very broad; apparently no omosternum; sternum a narrow transverse cartilage with a short posterior median process; tongue thick, broadly pear-shaped, slightly emarginate and free behind, adherent in front; urostyle with two basal transverse processes directed obliquely backward, the articular surface quite flat; outer metatarsals separated by web; fingers free; toes slightly webbed; no subarticular tubercles; tips of digits obtusely pointed; inner metatarsal tubercle slight.

The type specimen being thus far unique, I have not ventured to dissect it further than to make clear the above features, and even a few of these are somewhat uncertain—for instance, the extent of the



ASCAPHUS TRUEI.

FIG. 1.—UNDERSIDE OF RIGHT HIND FOOT. FIG. 2.—OPEN MOUTH. FIG. 3.—UNDERSIDE OF RIGHT FORE FOOT. FIG. 4.—PECTORAL ARCH.

Enlarged $1\frac{1}{2}$ times.

degeneration of the auditory tract. The exact shape of the sternum is also a little doubtful, inasmuch as it had been considerably damaged by the collector cutting the abdomen open to admit alcohol to the intestines, but it seems almost certain that there are no posteriorly diverging lateral styles as in the other genera. The precise outline of the pupil is difficult to determine, but it appears to be vertically elliptical; what shape it might assume by greater contraction is quite uncertain.

If the shape of the sternum really is as it appears to be in the only specimen at hand, this genus differs considerably from the four known genera, but in most other respects *Ascaphus* agrees with one or more of them, the chief exception being the position of the vomerine teeth, which in all the others are behind the level of the choanæ, while in our new genus they are located entirely between them.

ASCAPHUS TRUEI,¹ new species.

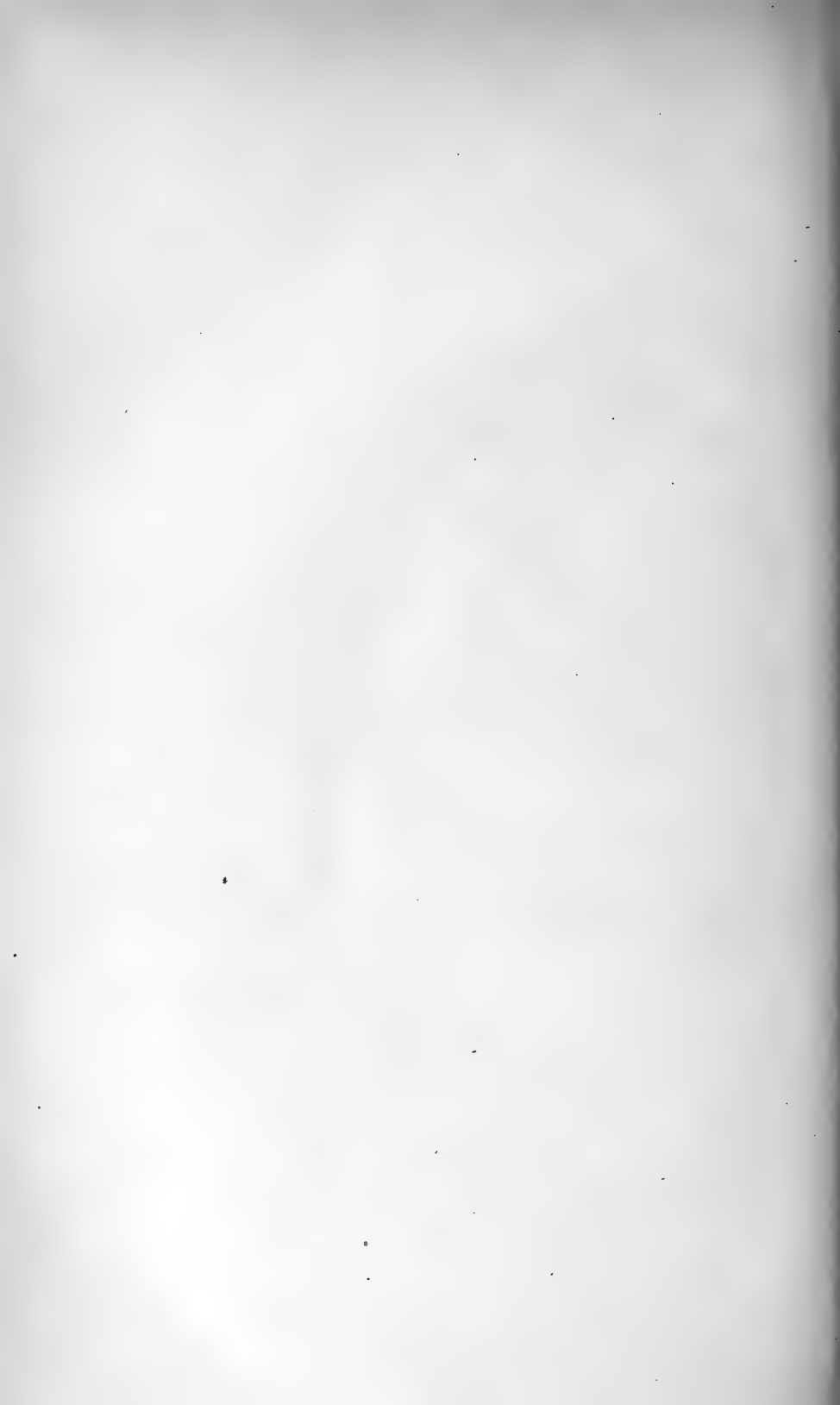
Type.—No. 25979, U.S.N.M.; Humptulips, Washington; August 19, 1897; collector, Cloud Rutter.

¹Named in honor of Dr. F. W. True, head curator of the Department of Biology, U. S. National Museum.

Description of type specimen.—Vomerine teeth in two small groups between the choanæ; tongue large, pear-shaped, thick, adherent in front, free in the posterior third; head flat, slightly broader than long; snout obtusely pointed, high, abruptly descending, with well-marked canthus rostralis, longer than diameter of orbit; nostril considerably nearer the orbit than the tip of the snout; eye moderate; interorbital space about as broad as upper eyelid, much less than distance between nostrils; no tympanum; fingers long, slender, obtusely pointed, free, first shortest, third longest, second and fourth equal; no subarticular tubercles; three convex palmar tubercles, the inner largest; hind limbs rather long, the tibio-tarsal articulation reaching the center of the eye; tibia longer than femur, the heels overlapping when legs are bent at right angles to body; toes rather slender, except outer, which is wide and flat; webs very short, barely reaching beyond the metatarsals, but edging the toes for some distance; no subarticular tubercles; a moderately sized inner metatarsal tubercle, somewhat longer than one-half the length of inner toe; no tarsal fold. Skin above granular, yet shiny, wrinkled, and irregularly warty on the lower back, and with similar pustules on the limbs; below smoother, wrinkled, and pustuled on the posterior aspect of the femurs near the vent; a well-marked elongate parotic gland extending from posterior angle of eye toward the shoulder; a large elongate gland on side of body. Color above, dull reddish brown, with a few indistinct blackish markings on the back; a dusky band across the middle of upper eyelids and interorbital space; the whole top of the head in front of this band pale reddish gray, which color at the end of the snout descends on the middle line to the lip as a narrow projection; on each side of this light streak the vertical portion of the tip of the snout is covered by a large black spot which extends backward as a narrow band through the nostrils and the eye and forming the lower border of the parotoid gland; below the insertion of the fore limb a blackish spot irregularly bordered by whitish; some irregular blackish and whitish spots on the posterior aspect of the arm; a blackish cross band, interrupted in the middle, at lower end of forearm; an ill-defined, dusky band, more or less irregularly edged with whitish along outer aspect of femur and tibia, and continued on under side of foot; posterior aspect of femur near vent dusky with whitish pimples; tips of digits whitish; under side whitish, more or less clouded with brownish, especially across the chest.

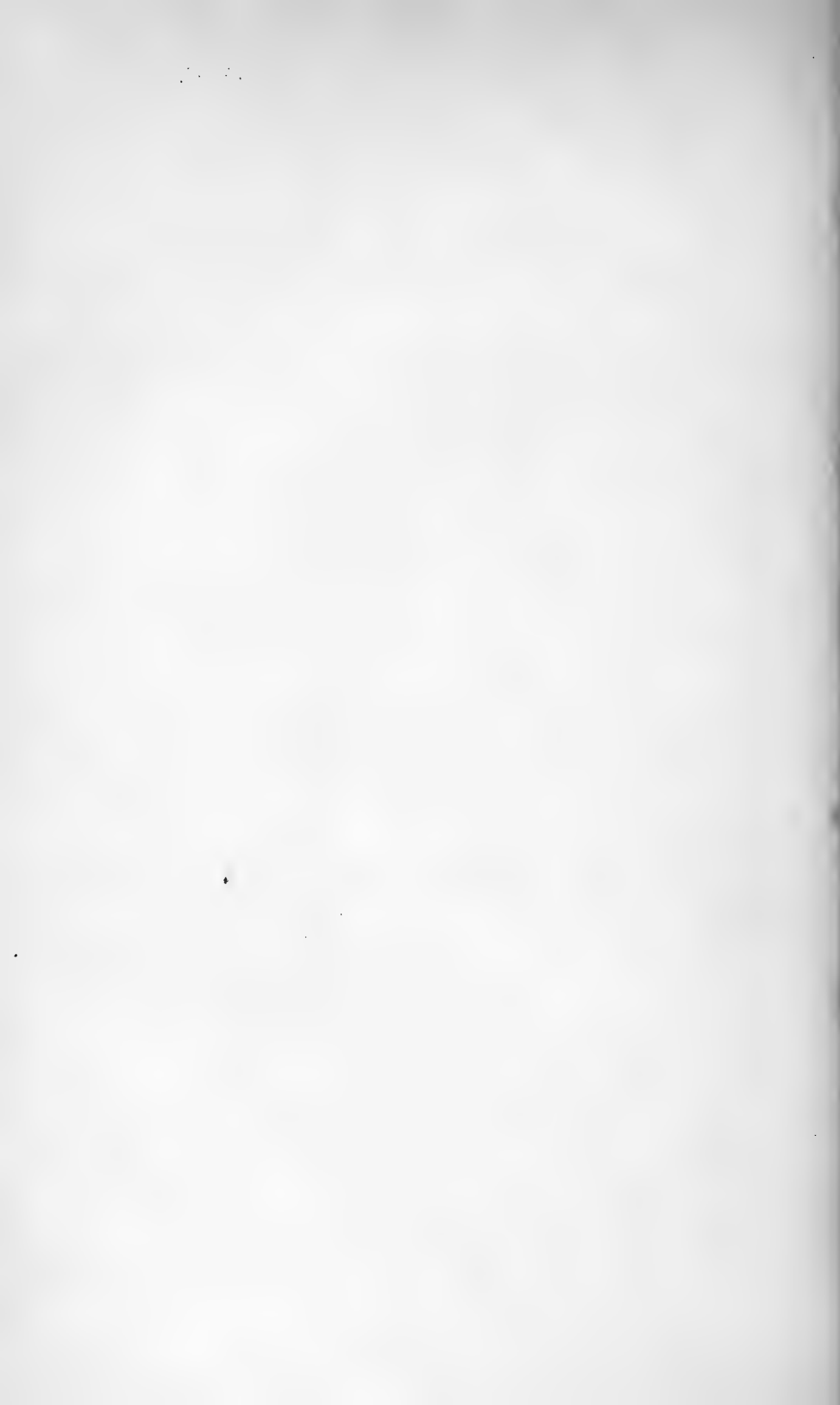
Dimensions.—Snout to vent, 40 mm.; width of head, 15 mm.; diameter of eye, 4 mm.; interorbital width, 3 mm.; eye to nostril, 3 mm.; eye to tip of snout, 6.5 mm.; fore limb, 25 mm.; hind limb, 59 mm.

Only a single specimen of this remarkable animal was collected by Mr. Cloud Rutter, at Humptulips, in the extreme western portion of the State of Washington, August 19, 1897. Mr. Rutter was at the time engaged in investigations for the U. S. Commission of Fish and Fisheries.





ASCAPHUS TRUEI, NEW SPECIES.



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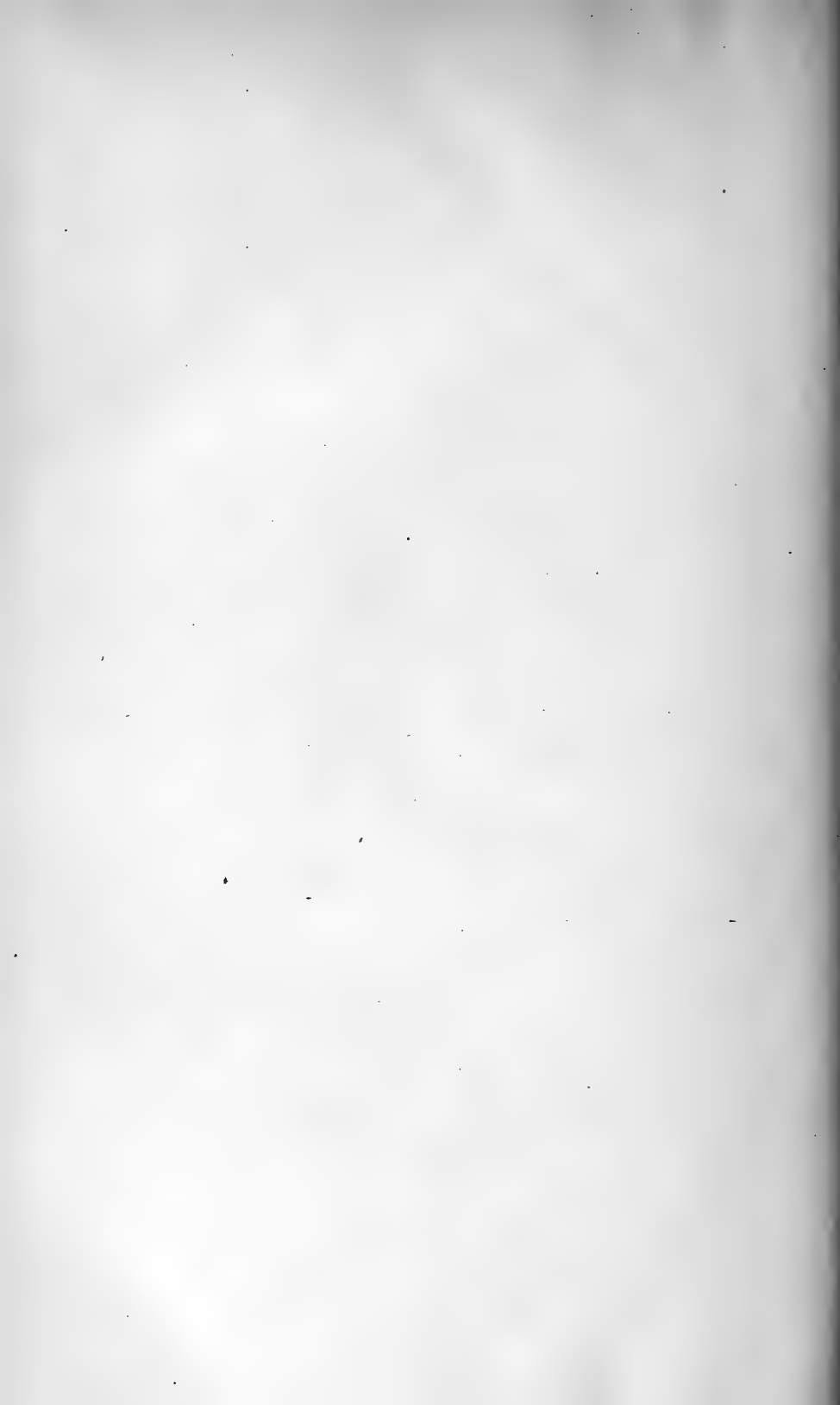
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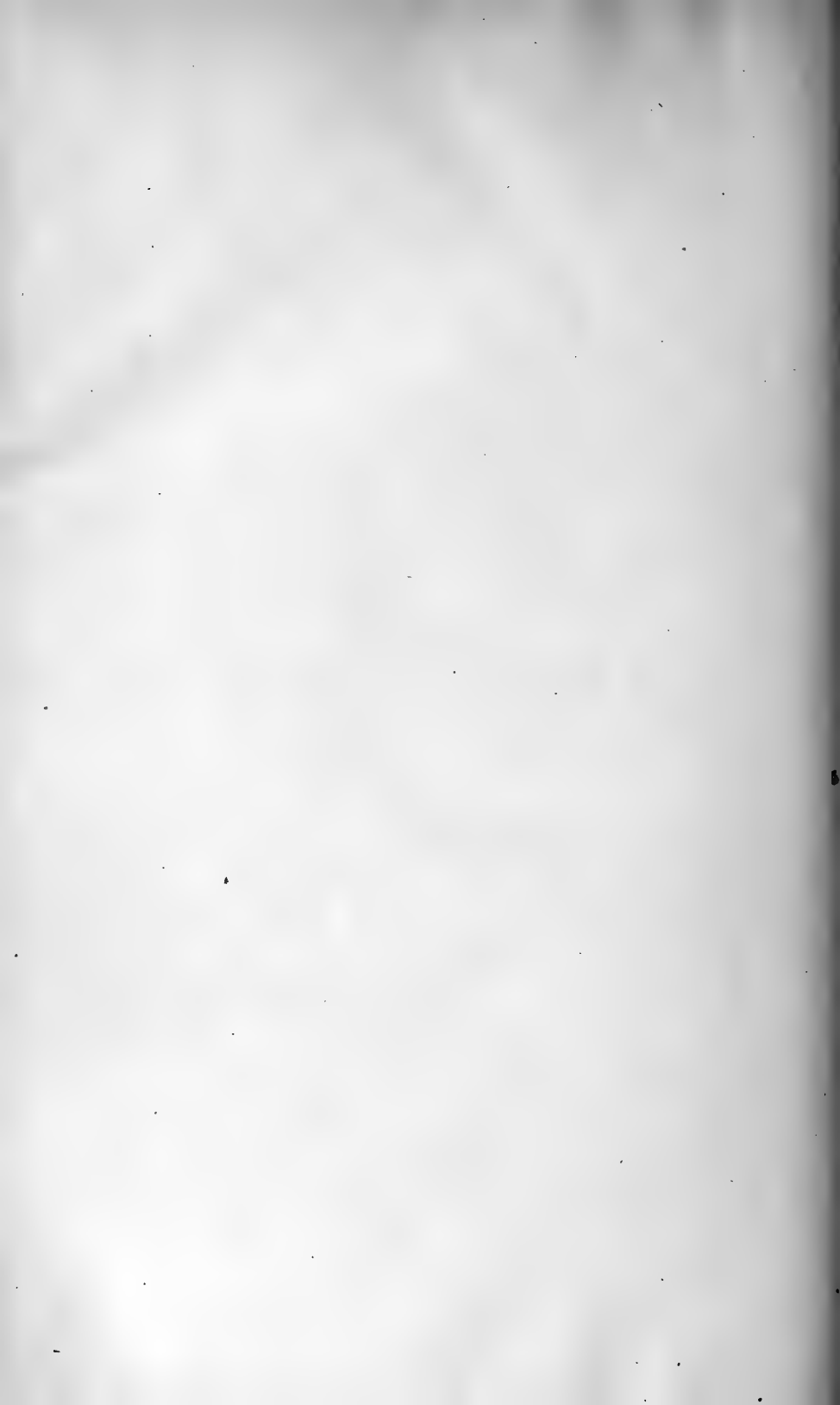
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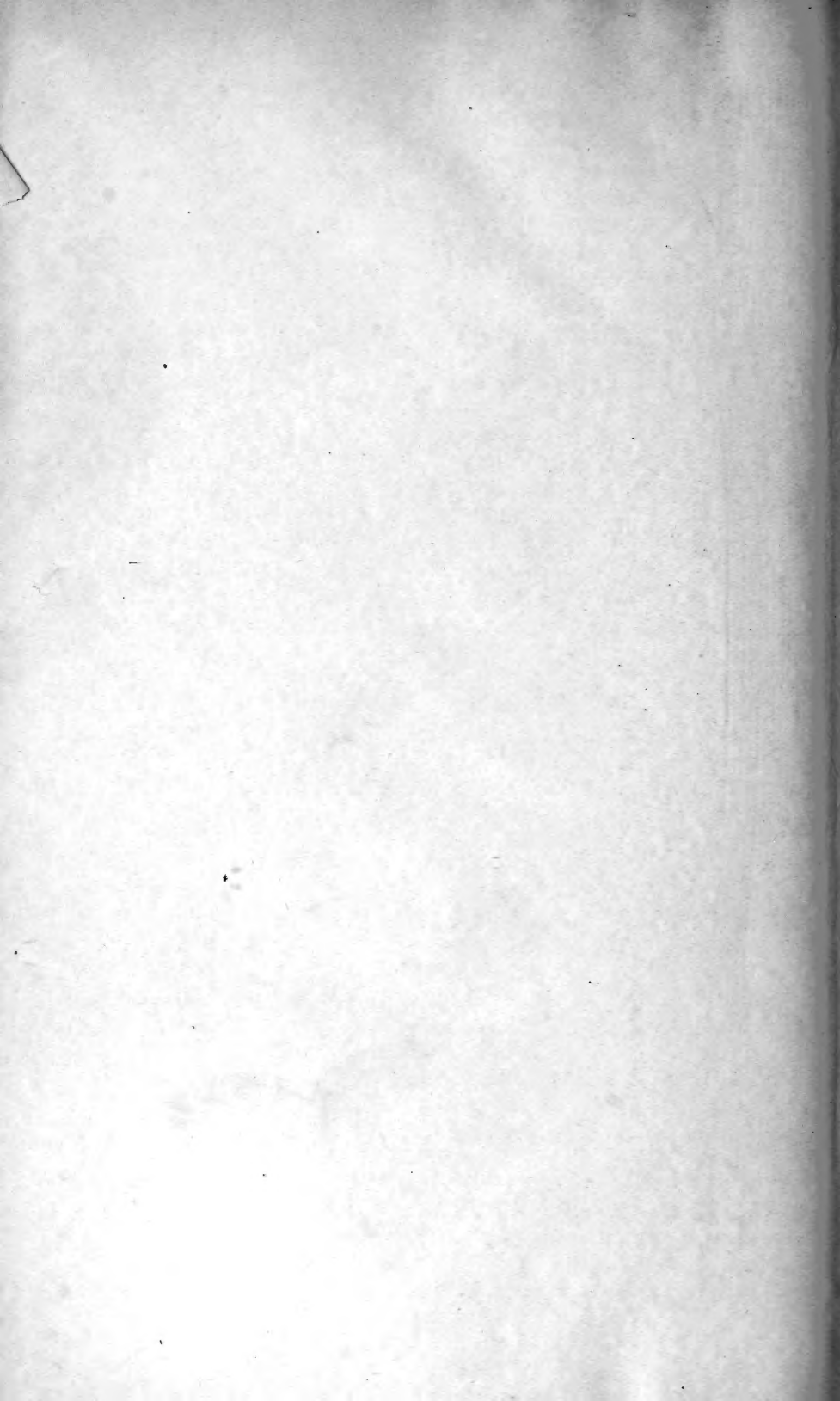
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